DATA SHEET

E4416A/E4417A EPM-P Series Power Meters and E-Series E9320 Peak and Average Power Sensors

EPM-P Power Meter Specifications

Specifications describe the instrument's warranted performance and apply after a 30 minute warm-up. These specifications are valid over its operating and environmental range unless otherwise stated and after performing a zero and calibration procedure.

Supplemental characteristics are intended to provide additional information; useful in applying the instrument by giving typical (expected), but not warranted performance parameters. These characteristics are shown in *italics* or labeled as 'typical', 'nominal' or 'approximate'.

Measurement uncertainties information can be found in, *Fundamentals of RF and Microwave Power Measurements, Application Note,* literature number 5965-6630E.

Compatibility, the EPM-P series power meters operate with the E-series E9320 family of power sensors for peak, average and time-gated power measurements. The EPM-P series also operates with the existing 8480 and N8480 series, E-series CW and the E9300 range of power sensors for average power measurements. For specifications pertaining to the 8480 and E-series CW and E9300 power sensors, please refer to the *EPM Series Power Meters, E-Series and 8480 Series Power Sensors, Technical Specification,* literature number 5965-6382E. For specifications pertaining to the N8480 series power sensors, please refer to the *N8480 Series Thermocouple Power Sensors, Technical Specification,* literature number 5989-9333EN.

Measurement modes, the EPM-P series power meters have two measurement modes:

- Normal mode (default mode using E9320 sensors) for peak, average and time-related measurements, and
- Average only mode. This mode is primarily for average power measurements on low-level signals, when using E9320 sensors, and is the mode used with 8480 and N8480 series sensors, E-series CW sensors and E-series E9300 sensors.

Frequency range: 9 kHz to 110 GHz, sensor dependent

Power range: –70 to +44 dBm, sensor dependent

Single Sensor Dynamic Range

E-series E9320 peak and average power sensors	70 dB maximum (normal mode)
	85 dB maximum (average only mode)
E-series CW power sensors	90 dB
E-series E9300 average power sensors	80 dB maximum
8480 series sensors	50 dB maximum
N8480 series sensors	55 dB maximum
Display units	
Absolute	Watts or dBm
Relative	Percent or dB
Display resolution	Selectable resolution of 1.0, 0.1, 0.01, 0.001 dB in logarithmic mode, or 1 to 4 significant digits in linear mode
Offset range	± 100 dB in 0.001 dB increments, to compensate for external loss or gain
Video bandwidth	5 MHz (set by meter and is sensor dependent)

Note that the video bandwidth represents the ability of the power sensor and meter to follow the power envelope of the input signal. The power envelope of the input signal is, in some cases, determined by the signal's modulation bandwidth, and hence video bandwidth is sometimes referred to as modulation bandwidth.

Video bandwidth/dynamic range optimization

The power measurement system, comprising the sensor and meter, has its maximum video bandwidth defined by the E9320 sensor. To optimize the system's dynamic range for peak power measurements, the video bandwidth in the meter can be set to High, Medium and Low, as detailed in the following table. The filter video bandwidths stated in the table are not the 3 dB bandwidths as the video bandwidths are corrected for optimal flatness. Refer to Figures 6 to 8 for information on the sensor's peak flatness response. A filter OFF mode is also provided.

Table 1. Video bandwidth versus peak power dynamic range.

Sensor model	Video bandwidth/Max peak power dynamic range			
	OFF	High	Medium	Low
E9321A E9325A	300 kHz/–40 dBm to +20 dBm	300 kHz/–42 dBm to +20 dBm	100 kHz/–43 dBm to +20 dBm	30 kHz/–45 dBm to +20 dBm
E9322A E9326A	1.5 MHz/–37 dBm to +20 dBm	1.5 MHz/–38 dBm to +20 dBm	300 kHz/–39 dBm to +20 dBm	100 kHz/–39 dBm to +20 dBm
E9323A E9327A	5 MHz/–32 dBm to +20 dBm	5 MHz/–32 dBm to +20 dBm	1.5 MHz/–34 dBm to +20 dBm	300 kHz/–36 dBm to +20 dBm

Accuracy

Instrumentation

Please add the corresponding power sensor linearity percentage; see Tables 6a and 6b for the E9320 sensors.

Average only mode		
Absolute	Logarithmic	± 0.02 dB
	Linear	± 0.5%
Relative	Logarithmic	± 0.04 dB
	Linear	± 1.0%

Normal mode	Calibration temperature [1] ± 5 °C	Temperature 0 to 55 °C
Absolute accuracy (log)	± 0.04 dB	± 0.08 dB
Absolute accuracy (linear)	± 0.8%	± 1.7%
Relative accuracy (log)	± 0.08 dB	± 0.16 dB
Relative accuracy (linear)	± 1.6%	± 3.4%
Time base accuracy	0.01%	

1 mW power reference

Power output	1.00 mW (0.0 dBm). Factory set to ± 0.5% traceable to the National Physical Laboratories (NPL), UK [2]
Accuracy	For two years ± 0.5% (23 ± 3 °C)
	± 0.6% (25 ± 10 °C)
	± 0.9% (0 to 55 °C)
Frequency	50 MHz nominal
SWR	1.06 maximum (1.08 maximum for Option E41xA-003)
Connector type	Type N (f), 50 ohms

1 Power meter is within ± 5 °C of its calibration temperature.
2 National metrology institutes of member states of the Metre Convention, such as the National Institute of Standards and Technology in the USA, are signatories to the ComitÈ International des Poids et Mesures Mutual Recognition Arrangement. Further information is available from the Bureau International des Poids et Mesures, at http://www.bipm.fr/

Table 2. Measurement speed for different sensor types.

Sensor type		Measurement speed (readings/second)		
		Normal	x 2	Fast [1, 2]
E-Series E9320 peak and average sensors	Average only mode	*20*	*40*	*400*
	Normal mode [3]	*20*	*40*	*1000*
E-Series CW and E9300 average power sensors		*20*	*40*	*400*
8480 and N8480 Series sensor		*20*	*40*	*NA*

Channel functions	A, B, A/B, B/A, A-B, B-A and Relative
Storage registers	10 instrument states can be saved via the Save/Recall menu
Predefined setups	For common wireless standards (GSM900, EDGE, NADC, iDEN, *Bluetooth*®, IS-95 CDMA, W-CDMA and cdma2000®), predefined setups are provided

Trigger

Sources	Internal, External TTL, GPIB, RS232/422
Time resolution	50 ns
Delay range	± 1.0 s
Delay resolution	50 ns for delays < ± 50 ms; otherwise 200 ns
Hold-off – Range – Resolution	 1 µs to 400 ms 1% of selected value (minimum of 100 ns)

Internal Trigger

Range	–20 to +20 dBm
Level accuracy	± 0.5 dB
Resolution	0.1 dB
Latency	500 ns ± 100 ns

Latency is defined as the delay between the applied RF crossing the trigger level and the meter switching into the triggered state.

External trigger range	High > 2.0 V, Low < 0.8 V; BNC connector; rising or falling edge triggered; input impedance > 1 kW
Trigger out	Output provides TTL compatible levels (high > 2.4 V, low < 0.4 V) and uses a BNC connector

1 Fast speed is not available for 8480 and N8480 series sensors.
2 Maximum measurement speed is obtained by using binary output in free run trigger.
3 For E9320 sensors, maximum speed is achieved using binary output in free run acquisition.

Sampling Characteristics

Sampling rate	20 Msamples/second
Sampling technique	Continuous sampling

Rear Panel Inputs/Outputs

Recorder output(s)	Analog 0 to 1 V, 1 kW output impedance, BNC connector. Two outputs are available on E4417A (channels A and B).	
Remote input/output		
– TTL output	Used to signal when measurement has exceeded a defined limit	
– TTL input	Initiates zero and calibration cycle	
Connector type	RJ-45 series shielded modular jack assembly	
– TTL output	High = 4.8 V max; Low = 0.2 V max.	
– TTL input	High = 3.5 V min, 5 V max; Low = 1 V max, –0.3 V min	
RS-232/422 interface	Serial interface for communication with an external controller. Male plug 9-pin D-subminiature connector.	
Trigger in	Accepts a TTL signal for initiating measurements, BNC connector	
Trigger out	Outputs a TTL signal for synchronizing with external equipment, BNC connector	
Ground	Binding post accepts 4 mm plug or bare wire connection	
Line power	Input voltage range	85 to 264 Vac, automatic selection
	Input frequency range	47 to 440 Hz
	Power requirement	Approximately 50 VA (14 Watts)

Remote Programming

Interface	GPIB interface operates to IEEE 488.2 and IEC-625. RS-232 and RS-422 serial interfaces supplied as standard
Command language	SCPI standard interface commands
GPIB compatibility	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DC1, DT1, C0.

Environmental Specifications

Operating environment	
Temperature	0 to 55 °C
Maximum humidity	95% at 40 °C, (non-condensing)
Maximum altitude	3,000 meters (9,840 feet)

Storage conditions	
Storage temperature	–20 to +70 °C
Non-operating maximum humidity	90% at 65 °C (non-condensing)
Non-operating maximum altitude	15,420 meters (50,000 feet)

Regulatory Information

Electromagnetic compatibility

This product conforms with the protection requirements of European Council Directive 89/336/ EEC for Electromagnetic Compatibility (EMC). The conformity assessment requirements have been met using the technical Construction file route to compliance, using EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992. In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

Product safety

This product conforms to the requirements of European Council Directive 73/23/EEC, and meets the following safety standards:

- IEC/ EN 61010-1
- IEC 825-1 (1993) / EN 60825-1 (1994) Canada / CSA C22.2 No. 1010.1-93

Physical Specifications

Dimensions	The following dimensions exclude front and rear panel protrusions: 212.6 mm W x 88.5 mm H x 348.3 mm D (8.5 in x 3.5 in x 13.7 in)	
Weight		
– Net	E4416A	4.0 kg (8.8 lbs) approximate
	E4417A	4.1 kg (9.0 lbs) approximate
– Shipping	E4416A	7.9 kg (17.4 lbs) approximate
	E4417A	8.0 kg (17.6 lbs) approximate

Ordering Information

Standard-shipped accessories

Power sensor cable	
E9288A	1.5 meter (5 ft). One per E4416A, two per E4417A
Power cord	One 2.4 meter (7.5 ft) cable. Power plug matches destination requirements.
Manuals	Product CD-ROM (contains English and localized User's Guide and Programming Guide)

Power Meter Options

Connectors	
E441xA-002	Parallel rear panel sensor input connector(s) and front panel reference calibrator connector
E441xA-003	Parallel rear panel sensor input connector(s) and rear panel reference calibrator connector
Calibration documentation	
E441xA-A6J	NSI/ NCSL Z540-1-1994 compliant calibration test data including measurement uncertainties
E441xA-1A7	ISO/ IEC 17025:2005 compliant calibration test data including measurement uncertainties
Documentation	
E441xA-0BF	Hard copy English language Programming Guide
E441xA-0BK	Hard copy English language User’s Guide and Programming Guide
E441xA-0B3	Hard copy English language Service Manual
E441xA-ABD	Hard copy German localization User’s Guide and Programming Guide
E441xA-ABE	Hard copy Spanish localization User’s Guide and Programming Guide
E441xA-ABF	Hard copy French localization User’s Guide and Programming Guide
E441xA-ABJ	Hard copy Japanese localization User’s Guide and Programming Guide
E441xA-ABZ	Hard copy Italian localization User’s Guide and Programming Guide
E4416A-CD1	Documentation Optical Disk (consists of documentation CD-ROM and Keysight Instruments Control DVD)
Power sensor cables	
E441xA-004	E441xA-004
For operation with the E9320 power sensors	
E9288A	E9288A
E9288B	E9288B
E9288C	E9288C
Note: The E9288A, B, and C sensor cables will also operate with 8480, N8480 and E-series power sensors.	

For operation with 8480, N8480, E-series CW and E9300 power sensors	
11730A	Power sensor and SNS noise source cable, length 5 ft (1.5 m)
11730B	Power sensor and SNS noise source cable, length 10 ft (3 m)
11730C	Power sensor and SNS noise source cable, length 20 ft (6.1 m)
11730D	Power sensor cable, length 50 ft (15.2 m)
11730E	Power sensor cable, length 100 ft (30.5 m)
11730F	Power sensor cable, length 200 ft (61.0 m)
Other sensor cable lengths can be supplied on request	

Accessories	
E441xA-908	Rack mount kit (one instrument)
E441xA-909	Rack mount kit (two instruments)
34131A	Transit case for half-rack 2U high instruments
34141A	Yellow soft carry/operating case
34161A	Accessory pouch

Service Options

Calibration [1]	
R-50C-011-3	R-50C-011-3 Keysight Calibration Upfront Plan 3-year coverage
R-50C-011-5	R-50C-011-5 Keysight Calibration Upfront Plan 5-year coverage

E-Series E9320 Power Sensor Specifications

The E9320 peak and average power sensors are designed for use with the EPM-P series power meters. The E9320 sensors have two measurement modes:

Normal mode	Default mode for E9320 sensors for peak, average and time-related measurements
Average only mode	Designed primarily for average power measurements on low-level signals. This mode is the only mode used with 8480 and N8480 series sensors, E-series CW sensors and E-series E9300 sensors.

The following specifications are valid after zero and calibration of the power meter.

Note: E9320 power sensors MUST be used with an E9288A, B or C cable.

1 Options not available in all countries.

Table 3. Sensor specification.

Sensor model	Video bandwidth	Frequency range	Power range		Maximum power	Connector type
			Average only mode	Normal mode [1]		
E9321A E9325A	300 kHz	50 MHz to 6 GHz 50 MHz to 18 GHz	–65 dBm to +20 dBm	–50 dBm to +20 dBm	+23 dBm average; +30 dBm peak (< 10 µsec duration)	Type N (m)
E9322A E9326A	1.5 MHz	50 MHz to 6 GHz 50 MHz to 18 GHz	–60 dBm to +20 dBm	–45 dBm to +20 dBm		
E9323A E9327A	5 MHz	50 MHz to 6 GHz 50 MHz to 18 GHz	–60 dBm to +20 dBm	–40 dBm to +20 dBm		

The E9320 power sensors have two measurement ranges (lower and upper) as detailed in Table 4.

Table 4. Lower and upper measurement ranges.

	E9321A/E9325A		E9322A/E9326A		E9323A/E9327A	
	Normal	Average only	Normal	Average only	Normal	Average only
Lower range (min. power)	–50 dBm	–65 dBm	–45 dBm	–60 dBm	–40 dBm	–60 dBm
Lower range (max. power)	+0.5 dBm	–17.5 dBm [1]	–5 dBm	–13.5 dBm [2]	–5 dBm	–10.5 dBm [2]
Lower to upper auto range point						
Upper to lower auto range point	–9.5 dBm	–18.5 dBm	–15 dBm	–14.5 dBm	–15 dBm	–11.5 dBm
Upper range (min. power)	–35 dBm	–50 dBm	–35 dBm	–45 dBm	–30 dBm	–35 dBm
Upper range (max. power)	+20 dBm	+20 dBm [1]	+20 dBm	+20 dBm [2]	+20 dBm	+20 dBm [2]

1 For average power measurements, free run acquisition.
2 Applies to CW and constant amplitude signals only above –20 dBm.

Table 5. Power sensor maximum SWR.

Sensor model	Maximum SWR (≦ 0 dBm)	
E9321A, E9325A	50 MHz to 2 GHz	1.12
	>2 GHz to 10 GHz	1.16
	>10 GHz to 16 GHz	1.23
	>16 GHz to 18 GHz	1.28
E9322A, E9326A	50 MHz to 2 GHz	1.12
	>2 GHz to 12 GHz	1.18
	>12 GHz to 16 GHz	1.21
	>16 GHz to 18 GHz	1.27
E9323A, E9327A	50 MHz to 2 GHz	1.14
	>2 GHz to 16 GHz	1.22
	>16 GHz to 18 GHz	1.26

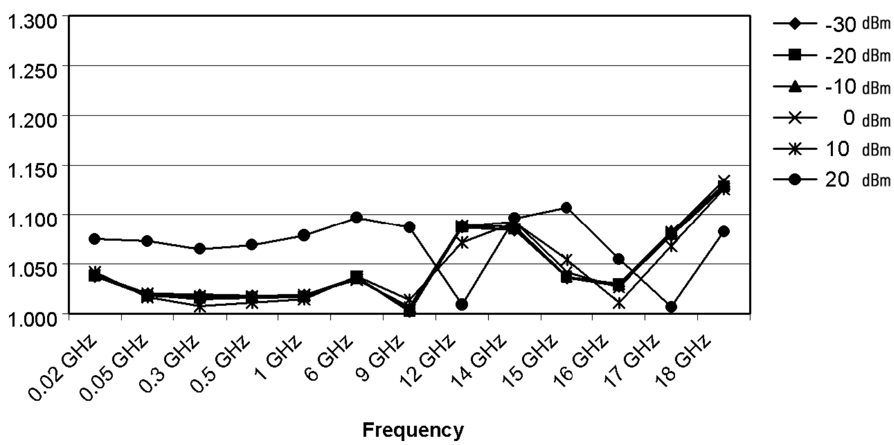

Figure 1. Typical SWR for the E9321A and E9325A sensors at various power levels.

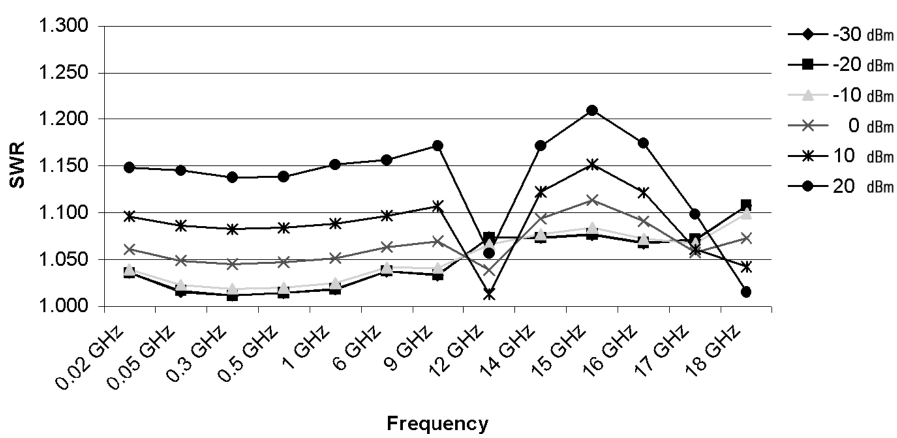

Figure 2. Typical SWR for the E9322A and E9326A sensors at various power levels.

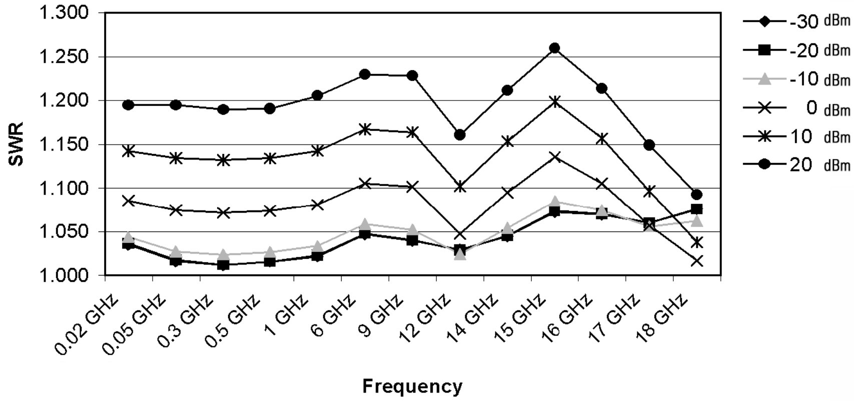

Figure 3. Typical SWR for the E9323A and E9327A sensors at various power levels.

Sensor Linearity

Table 6a. Power sensor linearity, normal mode (upper and lower range).

Sensor model	Temperature (25 ± 10 °C)	Temperature (0 to 55 °C)
E9321A and E9325A	± 4.2%	± 5.0%
E9322A and E9326A	± 4.2%	± 5.0%
E9323A and E9327A	± 4.2%	± 5.0%

Table 6b. Power sensor linearity, average only mode (upper and lower range).

Sensor model	Temperature (25 ± 10 °C)	Temperature (0 to 55 °C)
E9321A and E9325A	± 3.7%	± 4.5%
E9322A and E9326A	± 3.7%	± 4.5%
E9323A and E9327A	± 3.7%	± 5.0 %

If the sensor temperature changes after calibration, and the meter and sensor is not re-calibrated, then the following additional linearity errors should be added to the linearity figures in Tables 6a and 6b.

Table 6c. Additional linearity error (normal and average only modes).

Sensor model	Temperature (25 ± 10 °C)	Temperature (0 to 55 °C)
E9321A and E9325A	± 1.0%	± 1.0%
E9322A and E9326A	± 1.0%	± 1.0%
E9323A and E9327A	± 1.0%	± 1.0%

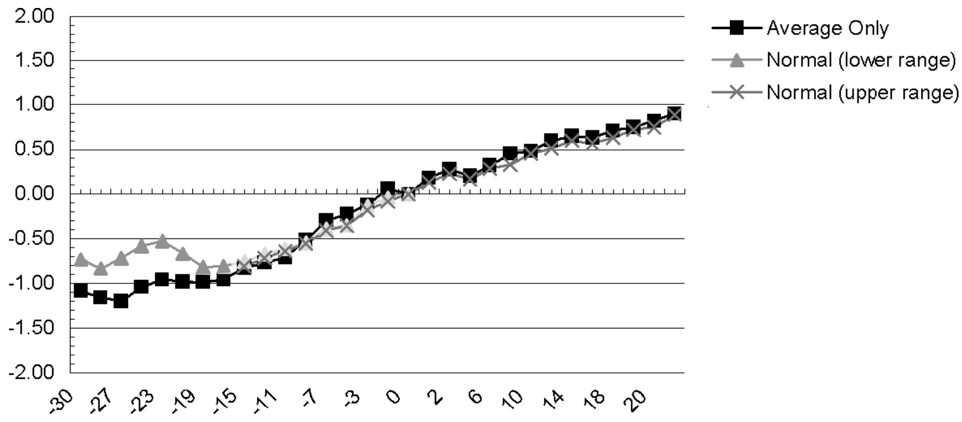

Figure 4. Typical power linearity at 25 °C for the E9323A and E9327A 5 MHz bandwidth sensors, after zero and calibration, with associated measurement uncertainty.

Power range	–30 to –20 dBm	–20 to –10 dBm	–10 to 0 dBm	0 to +10 dBm	+10 to +20 dBm
Measurement uncertainty	0.9%	0.8%	0.65%	0.55%	0.45%

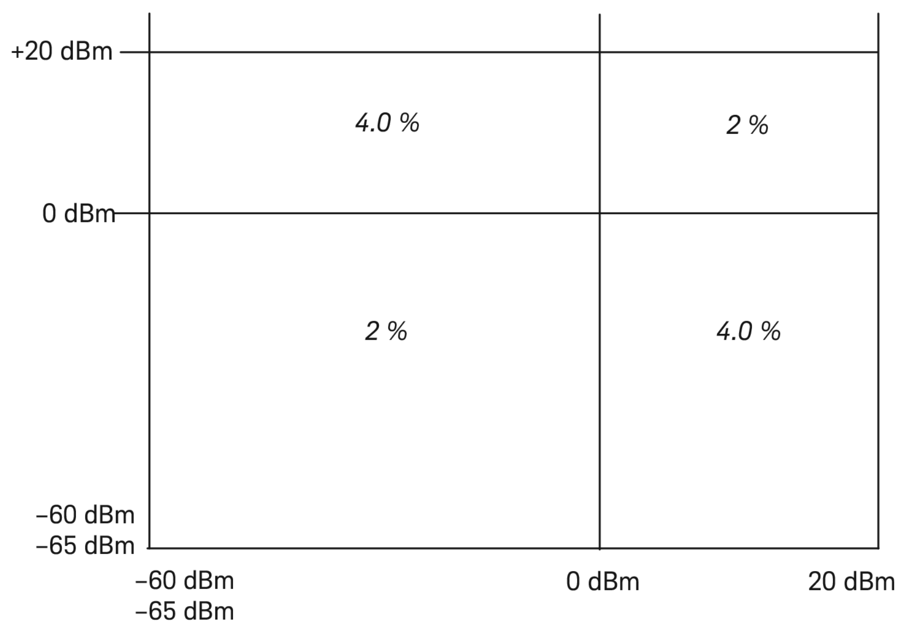

Figure 5. Relative mode power measurement linearity with an EPM-P series power meter, at 25 °C (typical).

Figure 5 shows the typical uncertainty in making a relative power measurement, using the same power meter channel and the same power sensor to obtain the reference and the measured values. It also assumes that negligible change in frequency and mismatch error occurs when transitioning from the power level used as the reference to the power level measured.

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. Figures 6, 7 and 8 refer to the relative error in peak-to-average measurement as the tone separation is varied. The measurements were performed at –10 dBm average power using an E9288A sensor cable (1.5 m).

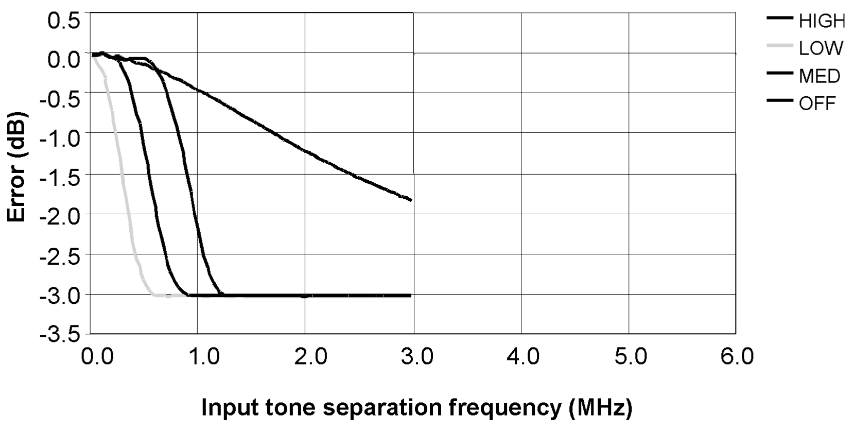

Figure 6. E9321A and E9325A Error in peak-to-average measurements for a two-tone input (high, medium, low and off filters).

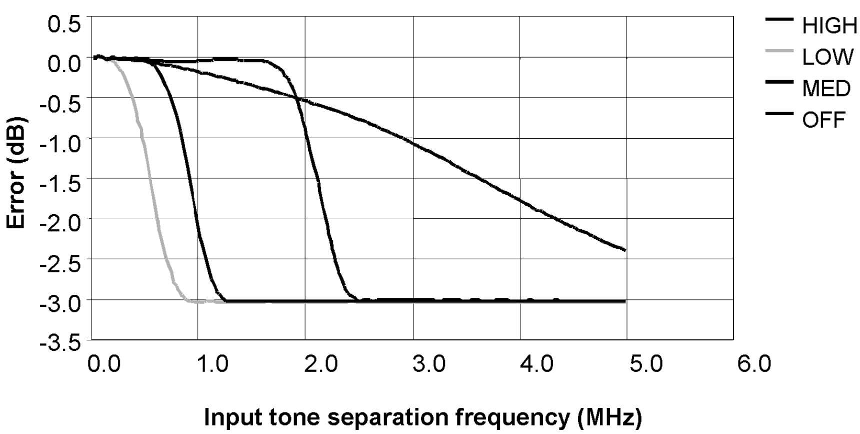

Figure 7. E9322A and E9326A error in peak-to-average measurements for a two-tone input (high, medium, low and off filters).

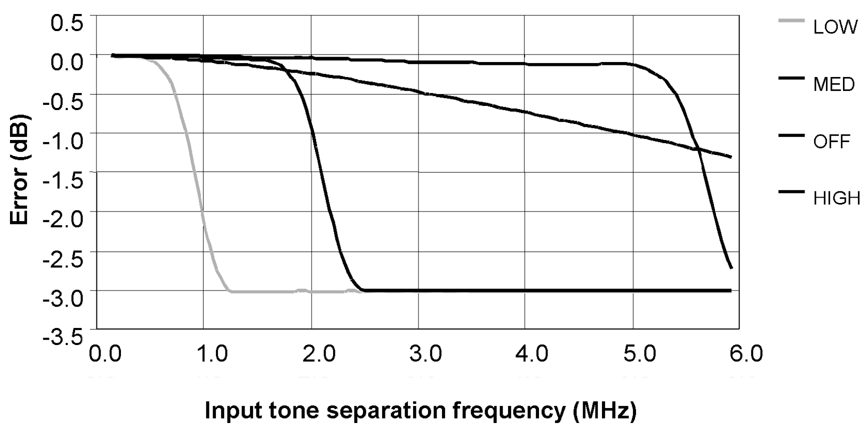

Figure 8. E9323A and E9327A error in peak-to-average measurements for a two-tone input (high, medium, low and off filters).

Calibration Factor (CF) and Reflection Coefficient (Rho)

Calibration Factor and Reflection Coefficient data are provided at frequency intervals on a data sheet included with the power sensor. This data is unique to each sensor. If you have more than one sensor, match the serial number on the data sheet with the serial number of the power sensor you are using. The CF corrects for the frequency response of the sensor. The EPM-P series power meter automatically reads the CF data stored in the sensor and uses it to make corrections.

For power levels greater than 0 dBm, add to the calibration factor uncertainty specification:

- ± 0.1%/dB (for E9321A and E9325A sensors),
- ± 0.15%/dB (for E9322A and E9326A sensors) and
- ± 0.2%/dB (for E9323A and E9327A sensors)

Reflection Coefficient (Rho) relates to the SWR according to the formula:

- SWR = (1 + Rho)/(1 – Rho)

Maximum relative uncertainties of the CF data are listed in Table 7. The uncertainty analysis for the calibration of the sensors was done in accordance with the ISO Guide. The uncertainty data, reported on the calibration certificate, is the expanded uncertainty with a 95% confidence level and a coverage factor of 2.

Table 7. Calibration factor relative uncertainty at 0.1 mW (–10 dBm).

Frequency	Uncertainty (%) (25 ± 10 °C)[1]	Uncertainty (%) (0 to 55 °C)[1]
50 MHz	Reference	Reference
100 MHz	1.8	2.0
300 MHz	1.8	2.0
500 MHz	1.8	2.0
800 MHz	1.8	2.0
1.0 GHz	2.1	2.3
1.2 GHz	2.1	2.3
1.5 GHz	2.1	2.3
2.0 GHz	2.1	2.3
3.0 GHz	2.1	2.3
4.0 GHz	2.1	2.3
5.0 GHz	2.1	2.3
6.0 GHz	2.1	2.3
7.0 GHz	2.3	2.5
8.0 GHz	2.3	2.5
9.0 GHz	2.3	2.5
10.0 GHz	2.3	2.5
11.0 GHz	2.3	2.5
12.0 GHz	2.3	2.5
12.4 GHz	2.3	2.5
13.0 GHz	2.3	2.5
14.0 GHz	2.5	2.8
15.0 GHz	2.5	2.8
16.0 GHz	2.5	2.8
17.0 GHz	2.5	2.8
18.0 GHz	2.5	2.8

[1] The characterized calibration factor should not deviate between periodic calibrations by more than the specified maximum uncertainty in the table. Compliance is confirmed by the relative deviation ($\frac{|CF_1 - CF_2|}{CF_1} * 100$) being less than or equal to √2 times the specified maximum uncertainty. $\sqrt{2} * Umax$ with a reference calibration factor of 100%.

Zero Set

This specification applies to a ZERO performed when the sensor input is not connected to the POWER REF.

Table 8. Zero set.

Sensor model	Zero set (normal mode)	Zero set (average only mode)
E9321A, E9325A	5 nW	0.17 nW
E9322A, E9326A	19 nW	0.5 nW
E9323A, E9327A	60 nW	0.6 nW

Zero Drift and Measurement Noise

Table 9. Zero drift and measurement noise.

Zero drift [1]			Measurement noise [2]		
Sensor model	Normal mode	Average only mode	Normal mode [3]	Normal mode [4]	Average only mode
E9321A, E9325A	*< 5 nW*	*< 60 pW*	*< 6 nW*	*< 75 nW*	*< 165 pW*
E9322A, E9326A	*< 5 nW*	*< 100 pW*	*< 12 nW*	*< 180 nW*	*< 330 pW*
E9323A, E9327A	*< 40 nW*	*< 100 pW*	*< 25 nW*	*< 550 nW*	*< 400 pW*

Effect of averaging on noise: Averaging over 1 to 1024 readings is available for reducing noise. Table 9 provides the measurement noise for a particular sensor. Use the noise multipliers in Table 10, for the appropriate speed (normal or x 2) or measurement mode (normal or average only) and the number of averages, to determine the total measurement noise value.

In addition, for x 2 speed (in normal mode) the total measurement noise should be multiplied by 1.2, and for fast speed (in normal mode), the multiplier is 3.4.

Note that in fast speed, no additional averaging is implemented.

1 Within 1 hour after zero set, at a constant temperature, after a 24-hour warm-up of the power meter.
2 Measured over a one-minute interval, at a constant temperature, two standard deviations, with averaging set to 1 (for normal mode), 16 (for average only mode, normal speed) and 32 (for average only mode, x 2 speed).
3 In free run acquisition mode.
4 Noise per sample, video bandwidth set to OFF with no averaging (i.e. averaging set to 1) - see the note "Effect of Video Bandwidth Setting" and Table 11.

Table 10. Noise multipliers.

Mode	Number of averages	1	2	4	8	16	32	64	128	256	512	1024
Average-only	Noise multiplier (normal speed)	*5.5*	*3.89*	*2.75*	*1.94*	*1.0*	*0.85*	*0.61*	*0.49*	*0.34*	*0.24*	*0.17*
	Noise multiplier (x 2 speed)	*6.5*	*4.6*	*3.25*	*2.3*	*1.63*	*1.0*	*0.72*	*0.57*	*0.41*	*0.29*	*0.2*
Normal	Noise multiplier (normal speed; free run acquisition)	*1.0*	*0.94*	*0.88*	*0.82*	*0.76*	*0.70*	*0.64*	*0.58*	*0.52*	*0.46*	*0.40*

Example

E9321A power sensor, number of averages = 4, free run acquisition, normal mode, x 2 speed.
Measurement noise calculation: (< 6 nW x 0.88 x 1.2) = < 6.34 nW

Effect of video bandwidth setting

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

Table 11. Effect of video bandwidth on noise per sample.

Sensor	Noise multipliers		
	Low	Medium	High
E9321A, E9325A	*0.32*	*0.50*	*0.63*
E9322A, E9326A	*0.50*	*0.63*	*0.80*
E9323A, E9327A	*0.40*	*0.63*	*1.0*

Example

E9322A power sensor, triggered acquisition, video bandwidth = High. Noise per sample calculation:
(< 180 nW x 0.80) = < 144 nW

Effect of time-gating on measurement noise

The measurement noise will depend on the time gate length, over which measurements are made. Effectively 20 averages are carried out every 1 us of gate length.

Settling Times

Average-only mode

In normal and x 2 speed, manual filter, 10 dB decreasing power step refer to Table 12.

Table 12. Settling time (average only mode).

Number of average	1	2	4	8	16	32	64	128	256	512	1024
Settling time(s) normal	*0.08*	*0.13*	*0.24*	*0.45*	*1.1*	*1.9*	*3.5*	*6.7*	*14*	*27*	*57*
Settling time(s) x 2	*0.07*	*0.09*	*0.15*	*0.24*	*0.45*	*1.1*	*1.9*	*3.5*	*6.7*	*14*	*27*

In fast speed, within the range –50 to +20 dBm, for a 10 dB decreasing power step, the settling time is 10 ms (for the E4416A) and 20 ms (for the E4417A).

When a power step crosses the power sensor's auto-range switch point, add 25 ms.

Normal mode

In normal, free run acquisition mode, within the range –20 to +20 dBm, for a 10 dB decreasing power step, the settling time is dominated by the measurement update rate and is listed in Table 13 for various filter settings.

Table 13. Settling time (normal mode).

Number of averages	1	2	4	8	16	32	64	128	256	512	1024
Settling time free run acquisition, normal speed (s)	*0.1*	*0.15*	*0.25*	*0.45*	*0.9*	*1.7*	*3.3*	*6.5*	*13.0*	*25.8*	*51.5*
Settling time free run acquisition, X2 speed (s)	*0.08*	*0.1*	*0.15*	*0.25*	*0.45*	*0.9*	*1.7*	*3.3*	*6.5*	*13.0*	*25.8*

In normal mode, measuring in continuous or single acquisition mode, the performance of rise times, fall times and 99% settled results are shown in Table 14. Rise time and fall time specifications are for a 0.0 dBm pulse, with the rise time and fall time measured between 10% to 90% points and upper range selected.

Table 14. Rise and fall times versus sensor bandwidth. [1]

Sensor mode, parameter	Video bandwidth setting			
	Low	Medium	High	Off
E9321A, rise time (< µs)	*2.6*	*1.5*	*0.9*	0.3
E9325A, fall time (< µs)	*2.7*	*1.5*	*0.9*	0.5
Settling time (rising) (< µs)	*5.1*	*5.1*	*4.5*	*0.6*
Settling time (falling) (< µs)	*5.1*	*5.1*	*4.5*	*0.9*
E9322A, rise time (< µs)	*1.5*	*0.9*	*0.4*	0.2
E9326A, fall time (< µs)	*1.5*	*0.9*	*0.4*	0.3
Settling time (rising) (< µs)	*5.3*	*4.5*	*3.5*	*0.5*
Settling time (falling) (< µs)	*5.3*	*4.5*	*3.5*	*0.9*
E9323A, rise time (< µs)	*0.9*	*0.4*	*0.2*	0.2
E9327A, fall time (< µs)	*0.9*	*0.4*	*0.2*	0.2
Settling time (rising) (< µs)	*4.5*	*3.5*	*1.5*	*0.4*
Settling time (falling) (< µs)	*4.5*	*3.5*	*2*	*0.4*

Overshoot in response to power steps with fast rise times, i.e. less than the sensor rise time, is < 10%. When a power step crosses the power sensor's auto-range switch point, add 10 µs.

1 Rise and fall time specifications are only valid when used with the E9288A sensor cable (1.5 meters).

Physical Specifications

Dimensions	150 mm L x 38 mm W x 30 mm H (5.9 in x 1.5 in x 1.2 in)
Weight	Net: 0.2 kg (0.45 lbs)
Shipping	0.55 kg (1.2 lbs)
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

E9321A	50 MHz to 6 GHz; 300 kHz BW
E9322A	50 MHz to 6 GHz; 1.5 MHz BW
E9323A	50 MHz to 6 GHz; 5 MHz BW
E9325A	50 MHz to 18 GHz; 300 kHz BW
E9326A	50 MHz to 18 GHz; 1.5 MHz BW
E9327A	50 MHz to 18 GHz; 5 MHz BW

Accessories Supplied

Operating and Service Guide (multi-language).

Power Sensor Options

E932xA-A6J	Supplies ANSI/NCSL Z540-1-1994 test data including measurement uncertainties
E932xA-1A7	Supplies ISO/ IEC 17025:2005 test data including measurement uncertainties
E932xA-0B1	Hard copy English language Operating and Service manual
E9321A-CD1	Documentation Optical Disk (consists of documentation CD-ROM and Keysight Instruments Control DVD)