E-series E9300 Average Power Sensor Specifications

The E-series E9300 wide dynamic range, average power sensors are designed for use with the EPM family of power meters. These specifications are valid ONLY after proper calibration of the power meter and apply for CW signals unless otherwise stated.

Specifications apply over the temperature range 0 °C to 55 °C unless otherwise stated, and specifications quoted over the temperature range 25 °C ±10 °C, conform to the standard environmental test conditions as defined in TIA/EIA/ IS-97-A and TIA/EIA/IS-98-A [1].

The E-series E9300 power sensors have two independent measurement paths (high and low power paths):

High Power Path: -10 to +20 dBm ("A" suffix sensors), +20 to +44 dBm ("B" suffix sensors) and 0 to +30 dBm ("H" suffix sensors).

Low Power Path: -60 to -10 dBm ("A" suffix sensors), -30 to +20 dBm ("B" suffix sensors) and -50 to 0 dBm ("H" suffix sensors).

Some specifications are detailed for an individual measurement path.

Wide Dynamic Range (-60 to +20 dBm) Sensors

Table 9

Model	Frequency Range	Maximum SWR (25 °C ± 10 °C)	Maximum SWR (0 – 55 °C)	Maximum Power	Connector Type
E9300A	10 MHz - 18.0 GHz	10 MHz to 30 MHz: 1.15 30 MHz to 2 GHz: 1.13 2 GHz to 14 GHz: 1.19 14 GHz to 16 GHz: 1.22 16 GHz to 18 GHz: 1.26	10 MHz to 30 MHz: 1.21 30 MHz to 2 GHz: 1.15 2 GHz to 14 GHz: 1.20 14 GHz to 16 GHz: 1.23 16 GHz to 18 GHz: 1.27	+25 dBm average; +33 dBm peak (< 10 usec)	Type- N (m)
E9301A	10 MHz - 6.0 GHz	10 MHz to 30 MHz: 1.15 30 MHz to 2 GHz: 1.13 2 GHz to 6 GHz: 1.19	10 MHz to 30 MHz: 1.21 30 MHz to 2 GHz: 1.15 2 GHz to 6 GHz: 1.20	+25 dBm average; +33 dBm peak (< 10 usec)	Type- N (m)
E9304A	9 kHz - 6.0 GHz	9 kHz to 2 GHz: 1.13 2 GHz to 6 GHz: 1.19	9 kHz to 2 GHz: 1.15 2 GHz to 6 GHz: 1.20	+25 dBm average; +33 dBm peak (< 10 usec)	Type- N (m)

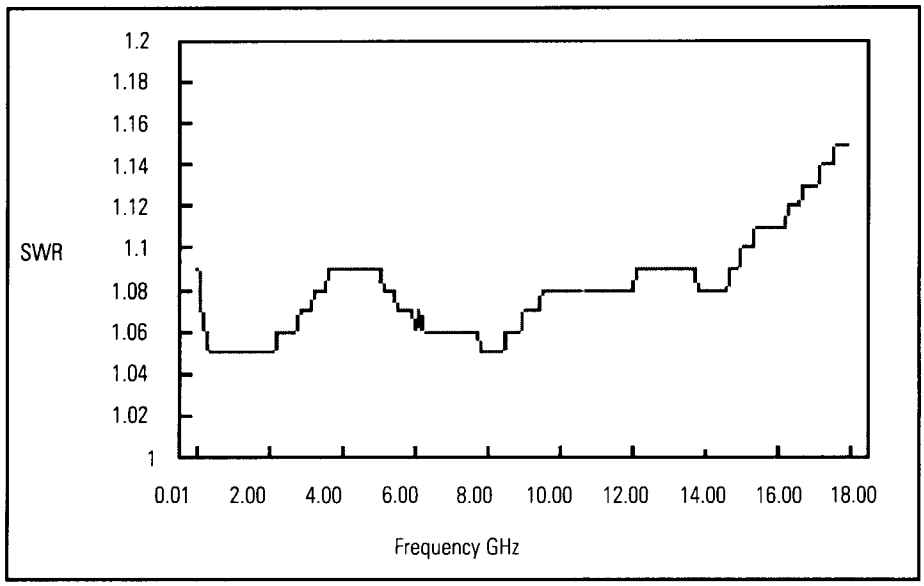
Wide Dynamic Range (-30 to +44 dBm) Sensors

Model	Frequency Range	Maximum SWR (25 °C ± 10 °C)	Maximum SWR (0 – 55 °C)	Maximum Power	Connector Type
E9300B	10 MHz – 18.0 GHz	10 MHz to 8 GHz: 1.12 8 to 12.4 GHz: 1.17 12.4 to 18 GHz: 1.24	10 MHz to 8 GHz: 1.14 8 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.25	0 – 35°C: 30 W avg 35 – 55°C: 25 W avg <6 GHz: 500 W pk >6 GHz: 125 W pk 500 W-µS per pulse	Type-N (m)
E9301B	10 MHz – 6.0 GHz	10 MHz to 6 GHz: 1.12	10 MHz to 6 GHz: 1.14	0 – 35°C: 30 W avg 35 – 55°C: 25 W avg <6 GHz: 500 W pk 500 W-µS per pulse	Type-N (m)

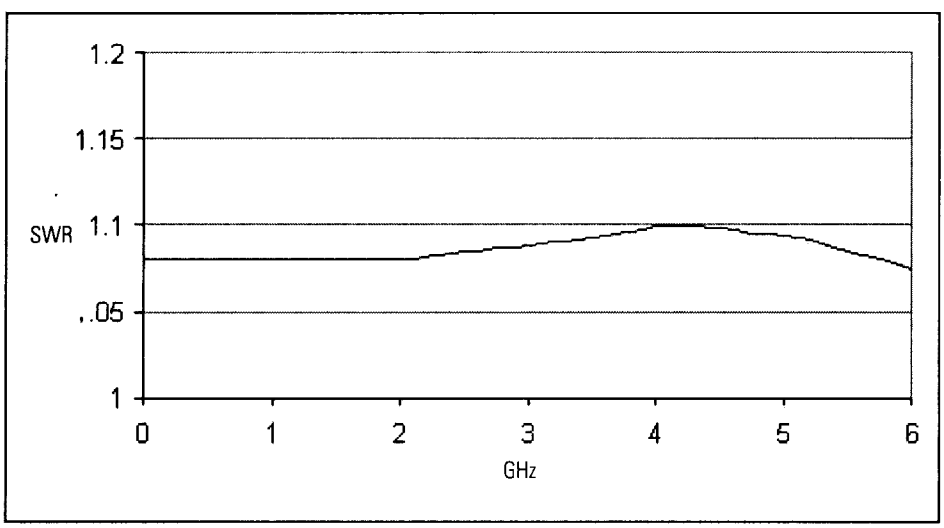
Wide Dynamic Range (-50 to +30 dBm) Sensors

Model	Frequency Range	Maximum SWR (25 °C ± 10 °C)	Maximum SWR (0 – 55 °C)	Maximum Power	Connector Type
E9300H	10 MHz – 18.0 GHz	10 MHz to 8 GHz: 1.15 8 to 12.4 GHz: 1.25 12.4 to 18 GHz: 1.28	10 MHz to 8 GHz: 1.17 8 to 12.4 GHz: 1.26 12.4 to 18 GHz: 1.29	3.16 W avg 100 W pk 100 W-µS per pulse	Type-N (m)
E9301H	10 MHz – 6.0 GHz	10 MHz to 6 GHz: 1.15	10 MHz to 6 GHz: 1.17	3.16 W avg 100 W pk 100 W-µS per pulse	Type-N (m)

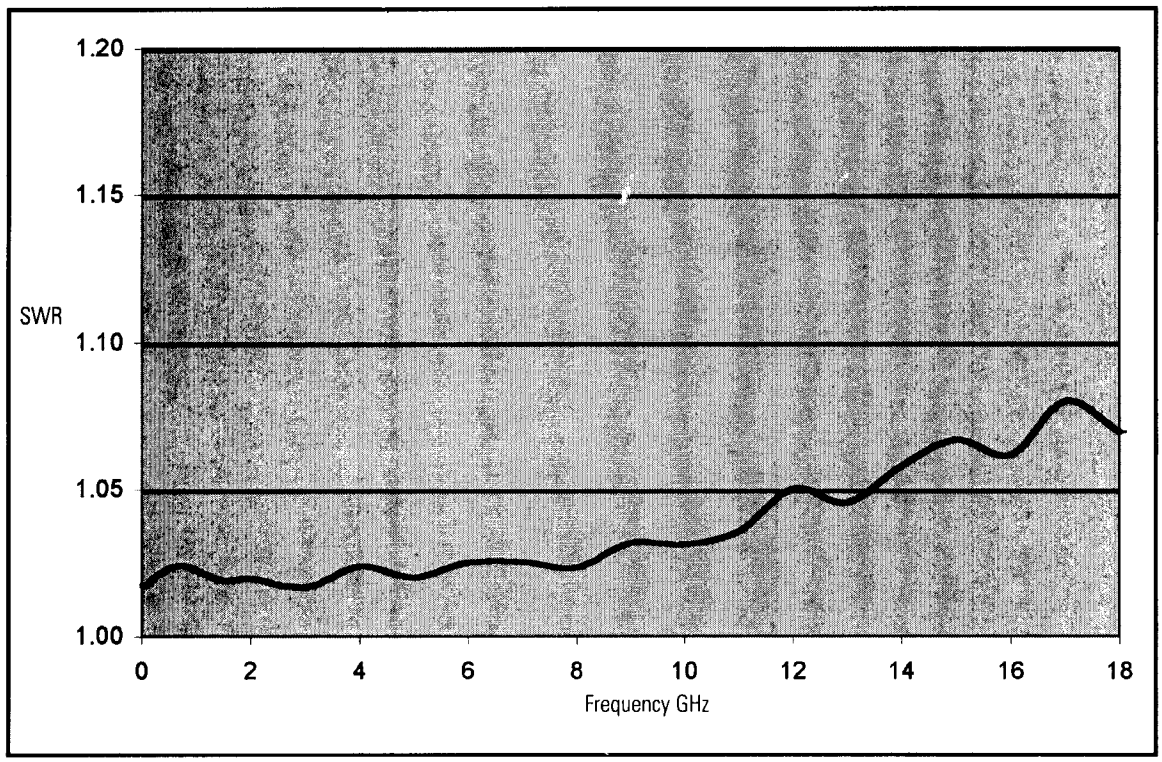
Typical SWR, 10 MHz to 18 GHz, (25 °C ± 10 °C) for E9300A and E9301A sensors



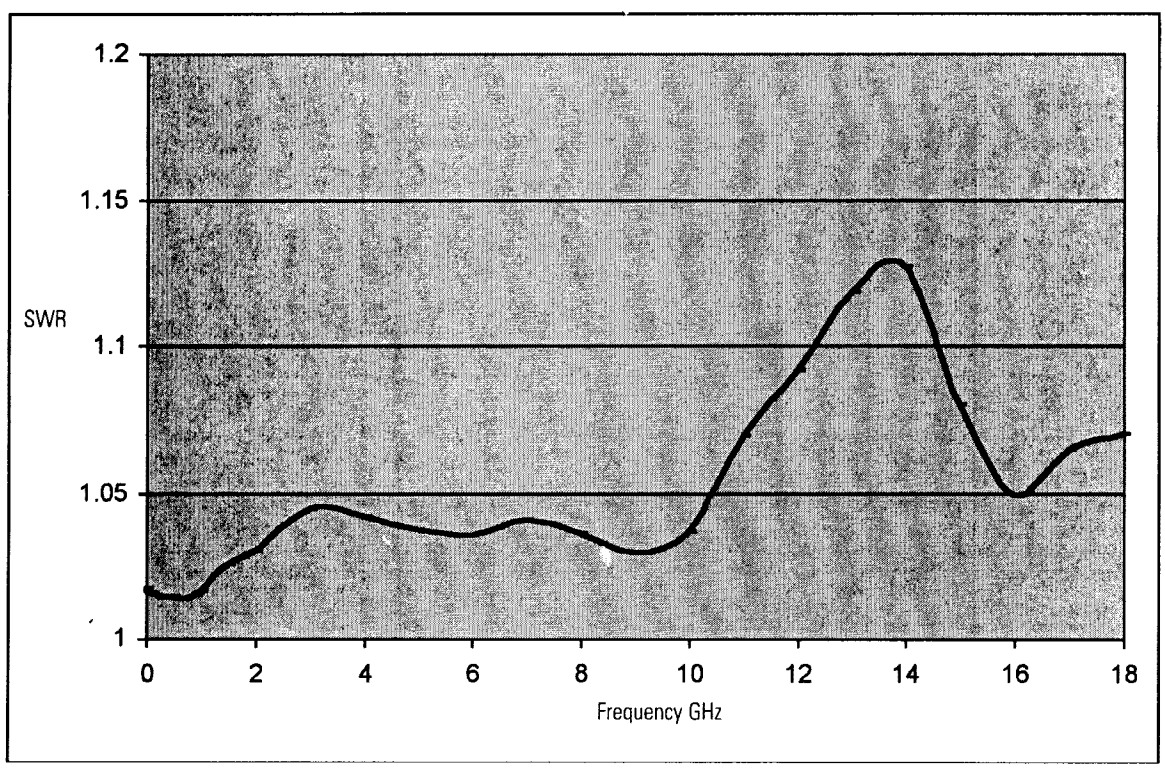
Typical SWR, 9kHz to 6 GHz, (25 °C ± 10 °C) for E9304A sensors



Typical SWR, 10 MHz to 18 GHz, (25 °C ± 10 °C) for E9300B and E9301B sensors



Typical SWR, 10 MHz to 18 GHz, (25 °C ± 10 °C) for E9300H and E9301H sensors



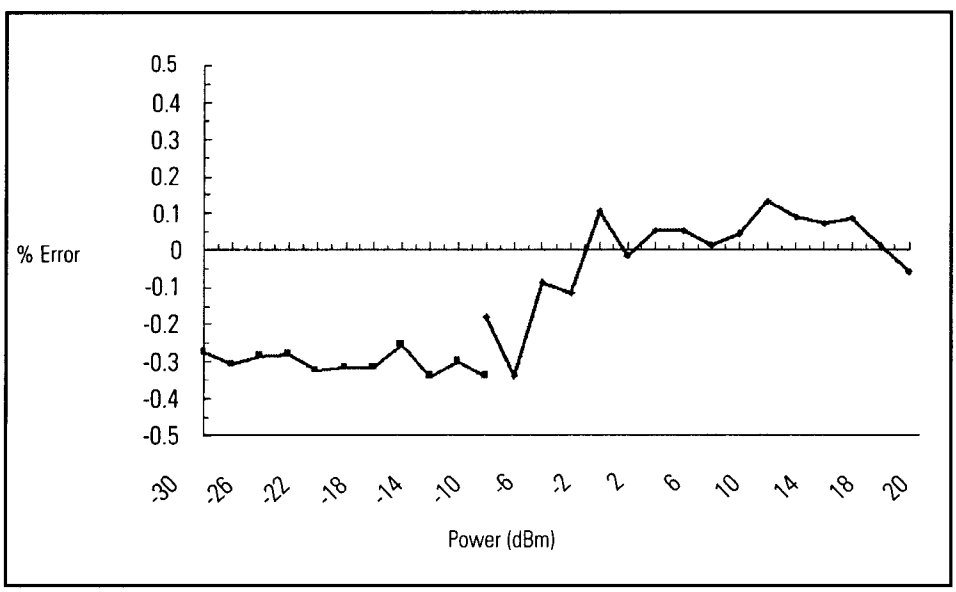
E-Series E9300 Average Power Sensors

Power Linearity (after zero and cal at ambient environmental conditions)

Table 10

Sensor	Power	Linearity (25 °C ± 10 °C)	Linearity (0 – 55 °C)
E9300A, E9301A E9304A	-60 to –10 dBm	±3.0%	±3.5%
	-10 to 0 dBm	±2.5%	±3.0%
	0 to +20 dBm	±2.0%	±2.5%
E9300B, E9301B	-30 to +20 dBm	±3.5%	±4.0%
	+20 to +30 dBm	±3.0%	±3.5%
	+30 to +44 dBm	±2.5%	±3.0%
E9300H, E9301H	-50 to 0 dBm	±4.0%	±5.0%
	0 to +10 dBm	±3.5%	±4.0%
	+10 to +30 dBm	±3.0%	±3.5%

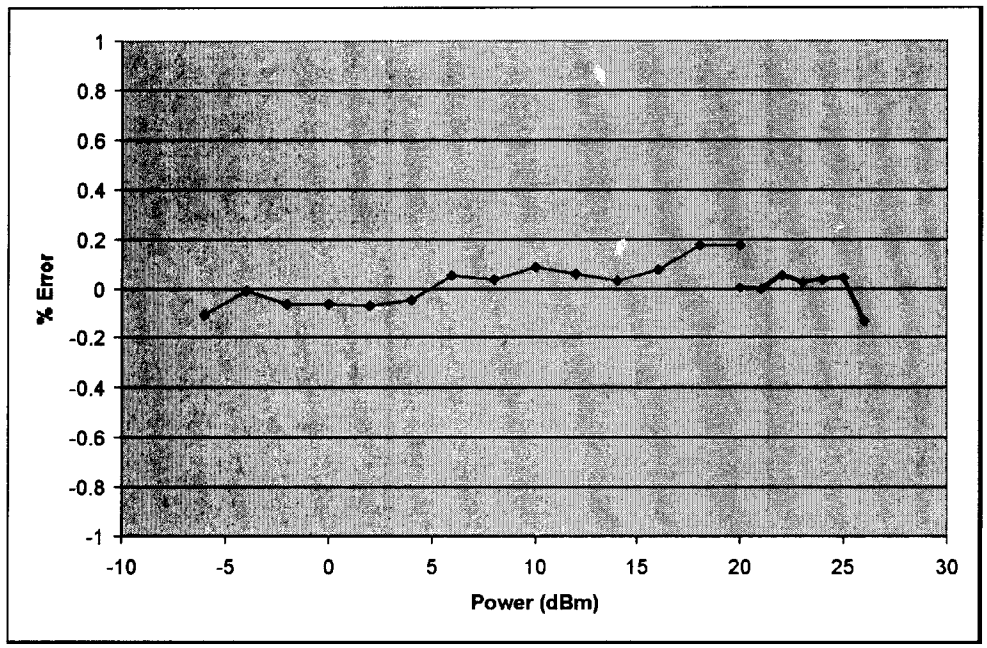
Typical E9300A/01A/04A Power Linearity at 25 °C, after zero and calibration, with associated Measurement Uncertainty



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%

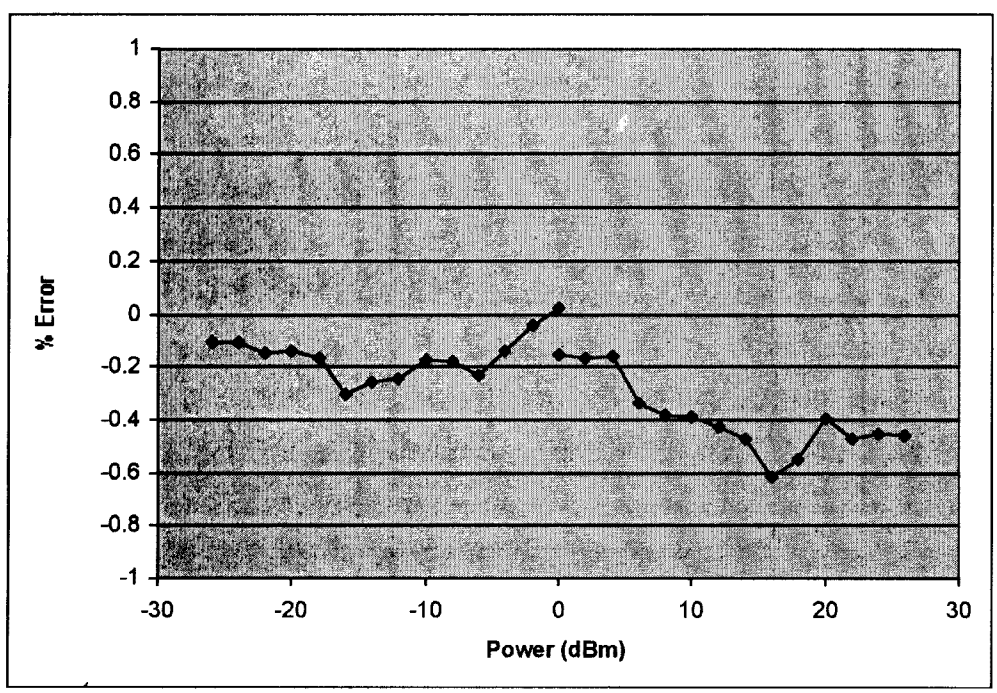
E-Series E9300 Average Power Sensors

Typical E9300B/01B Power Linearity at 25 °C, after zero and calibration, with associated Measurement Uncertainty



Power Range	-6 to 0 dBm	0 to +10 dBm	+10 to +20 dBm	+20 to +26 dBm
Measurement Uncertainty	± 0.65%	± 0.55%	± 0.45%	± 0.31%

Typical E9300H/01H Power Linearity at 25 °C, after zero and calibration, with associated Measurement Uncertainty



Power Range	-26 to -20 dBm	-20 to –10 dBm	-10 to 0 dBm	0 to +10 dBm	+10 to +20 dBm	+20 to +26 dBm
Measurement Uncertainty	± 0.9%	± 0.8%	± 0.65%	± 0.55%	± 0.45%	± 0.31%

Note: If the temperature changes after calibration and you choose not to re-calibrate the sensor, the following additional Power Linearity error should be added to the linearity specs in Table 10:
The typical maximum additional Power Linearity error due to temperature change after calibration, for small changes in temperature, is ±0.15%/ °C (valid after zeroing the sensor).

For large changes in temperature, refer to Table 11.

Typical maximum additional Power Linearity error due to temperature change after calibration at 25 °C for any change in temperature (valid after zeroing the sensor)

Table 11

Sensor	Power	Additional Power Linearity error (25 °C ± 10 °C)	Additional Power Linearity error (0 – 55 °C)
E9300A, E9301A E9304A	-60 to –10 dBm	±1.5%	±2.0%
	-10 to 0 dBm	±1.5%	±2.5%
	0 to +20 dBm	±1.5%	±2.0%
E9300B, E9301B	-30 to +20 dBm	±1.5%	±2.0%
	+20 to +30 dBm	±1.5%	±2.5%
	+30 to +44 dBm	±1.5%	±2.0%
E9300H, E9301H	-50 to 0 dBm	±1.5%	±2.0%
	0 to +10 dBm	±1.5%	±2.5%
	+10 to 30 dBm	±1.5%	±2.0%

Figure 2; Relative Mode Power Measurement Linearity with an EPM series power meter, at 25 °C ±10 °C (typical):

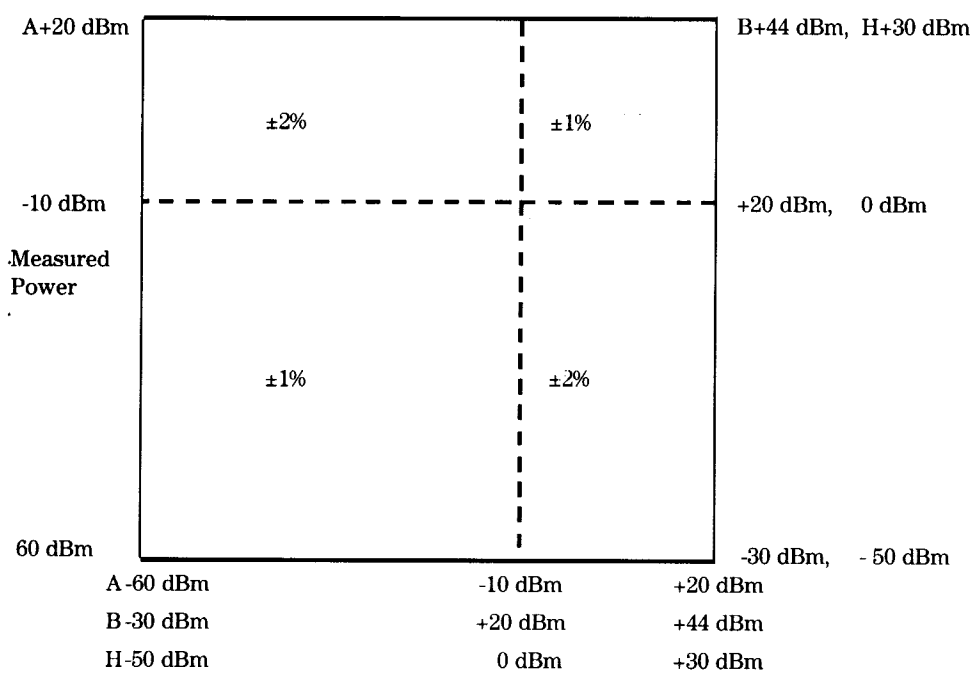


Figure 2 shows the typical uncertainty in making a relative power measurement, using the same power meter channel and same power sensor to obtain the reference and the measured values, and assumes that negligible change in frequency and mismatch error occur when transitioning from the power level used as the reference to the power level being measured.

E-Series E9300 Average Power Sensors

Switch Point Data:

The E9300 power sensors have two paths, a low power path covers: -60 to -10 dBm ("A" suffix sensors), -30 to +20 dBm ("B" suffix sensors), and -50 to 0 dBm ("H" suffix sensors). The high power path covers: -10 to +20 dBm ("A" suffix sensors), +20 to +44 dBm ("B" suffix sensors), and 0 to +30 dBm ("H" suffix sensors). The power meter automatically selects the proper power level path. To avoid unnecessary switching when the power level is near the switch point, Switching Point Hysteresis has been added.

E9300 "A" suffix sensors example: Hysteresis causes the low power path to remain selected until approximately -9.5 dBm as the power level is increased, above this power the high power path will be selected. The high power path will remain selected until approximately -10.5 dBm is reached as the signal level decreases, below this power the low power path will be selected.

Switching Point Linearity: *Typically ≤ ±0.5% (≤ ±0.02 dB)*
Switching Point Hysteresis: 0.5 dB typical

Table 12, E9300A, E9301A, and E9304A sensors Zero and Measurement Noise

Conditions [1]	Zero Set	Zero Drift (2)	Measurement Noise [3]
Low Power Path (15% to 75% RH)	500 pW	150 pW	700 pW
Low Power Path (75% to 95% RH)	500 pW	4,000 pW	700 pW
High Power Path (15% to 75% RH)	500 nW	150 nW	500 nW
High Power Path (75% to 95% RH)	500 nW	3 nW	500 nW

E9300B and E9301B sensors

Conditions [1]	Zero Set	Zero Drift (2)	Measurement Noise [3]
Low Power Path (15% to 75% RH)	500 nW	150 nW	700 nW
Low Power Path (75% to 95% RH)	500 nW	4 µW	700 nW
High Power Path (15% to 75% RH)	500 µW	150 µW	500 µW
High Power Path (75% to 95% RH)	500 µW	3 mW	500 µW

E9300H and E9301H sensors

Conditions [1]	Zero Set	Zero Drift (2)	Measurement Noise [3]
Low Power Path (15% to 75% RH)	5 nW	1.5 nW	7 nW
Low Power Path (75% to 95% RH)	5 nW	40 nW	7 nW
High Power Path (15% to 75% RH)	5 µW	1.5 µW	5 µW
High Power Path (75% to 95% RH)	5 µW	30 µW	5 µW

1. RH is the abbreviation for Relative Humidity.
2. Within 1 hour after zero set, at a constant temperature, after a 24-hour warm-up of the power meter with power sensor connected.
3. The number of averages at 16 for Normal mode and 32 for x2 mode, at a constant temperature, measured over a one minute interval and two standard deviations.

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 on the power sensor you are using. The CF corrects for the frequency response of the sensor. The EPM series power meter automatically reads the CF data stored in the sensor and uses it to make the corrections.

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

SWR =(1 + Rho)/(1 - Rho)

Maximum uncertainties of the CF data are listed in Tables 13A and 13B. As the E-series E9300 power sensors have two independent measurement paths (high and low power paths), there are two calibration factor uncertainty tables. 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.

Calibration Factor Uncertainties (Low Power Path)

Table 13A

Frequency	Uncertainty (%) (25 0C +10 0C)	Uncertainty (%) (0 to 55 0C)
10 MHz to 30 MHz	± 1.8 %	± 2.2 %
30 MHz to 500 MHz (E9304A: 9kHz to 500MHz)	± 1.6 %	± 2.0 %
500 MHz to 1.2 GHz	± 1.8 %	± 2.5 %
1.2 GHz to 6 GHz	± 1.7 %	± 2.0 %
6 GHz to 14 GHz	± 1.8 %	± 2.0 %
14 GHz to 18 GHz	± 2.0 %	± 2.2 %

Calibration Factor Uncertainties (High Power Path)

Table 13B

Frequency	Uncertainty (%) (25 0C +10 0C)	Uncertainty (%) (0 to 55 0C)
10 MHz to 30 MHz	± 2.1 %	± 4.0 %
30 MHz to 500 MHz (E9304A: 9kHz to 500MHz)	± 1.8 %	± 3.0 %
500 MHz to 1.2 GHz	± 2.3 %	± 4.0 %
1.2 GHz to 6 GHz	± 1.8 %	± 2.1 %
6 GHz to 14 GHz	±1.9 %	± 2.3 %
14 GHz to 18 GHz	± 2.2 %	± 3.3 %

General

Dimensions: Length 130 mm, Width 38 mm, Height 30 mm

Weight: 0.18 kg (0.4 lbs)

References:

[1] TIA is the Telecommunications Industry Association; EIA is the Electronic Industries Association.
TIA/EIA/IS-97-A is the Recommended Minimum Performance Standards for Base Stations Supporting Dual-Mode Wideband Spread Spectrum Cellular Mobile Stations.
TIA/EIA/IS-98-A is the Recommended Minimum Performance Standards for Dual-Mode Wideband Spread Spectrum Cellular Mobile Stations.