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.

The E-Series E9300 power sensors have two independent measurement paths (high and low power paths) as shown in Table 7.

Table 7. E9300 Series two-path specification

	"A" suffix sensors	"B" suffix sensors	"H" suffix sensors
High power path	–10 to +20 dBm	+20 to +44 dBm	0 to +30 dBm
Low power path	–60 to –10 dBm	–30 to +20 dBm	–50 to 0 dBm

Table 8. E9300 Series sensors specification

Model	Frequency range	Maximum SWR (25 °C ± 10 °C)	Maximum SWR (0 to 55 °C)	Maximum power	Connector type
–60 dBm to +20 dBm wide dynamic range sensors					
E9300A	10 MHz to 18 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 (320 mW) average; +33 dBm peak (2 W) (< 10 µsec)	Type-N (m)
E9301A	10 MHz to 6 GHz	10 MHz to 30 GHz: 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 (320 mW) average; +33 dBm peak (2 W) (< 10 µsec)	Type-N (m)
E9304A	9 kHz to 6 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 (320 mW) average; +33 dBm peak (2 W) (< 10 µsec)	Type-N (m)
–30 dBm to +44 dBm wide dynamic range sensors					
E9300B	10 MHz to 18 GHz	10 MHz to 8 GHz: 1.12 8 GHz to 12.4 GHz: 1.17 12.4 GHz to 18 GHz: 1.24	10 MHz to 8 GHz: 1.14 8 GHz to 12.4 GHz: 1.18 12.4 GHz to 18 GHz: 1.25	0 to 35 °C: 30 W avg 35 to 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 to 6 GHz	10 MHz to 6 GHz: 1.12	10 MHz to 6 GHz: 1.14	0 to 35 °C: 30 W avg 35 to 55 °C: 25 W avg < 6 GHz: 500 W pk > 6 GHz: 125 W pk 500 W.µS per pulse	Type-N (m)
–50 dBm to +30 dBm wide dynamic range sensors					
E9300H	10 MHz to 18 GHz	10 MHz to 8 GHz: 1.15 8 GHz to 12.4 GHz: 1.25 12.4 GHz to 18 GHz: 1.28	10 MHz to 8 GHz: 1.17 8 GHz to 12.4 GHz: 1.26 12.4 GHz to 18 GHz: 1.29	3.16 W avg 100 W pk 100 W.µS per pulse	Type-N (m)
E9301H	10 MHz to 6 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)

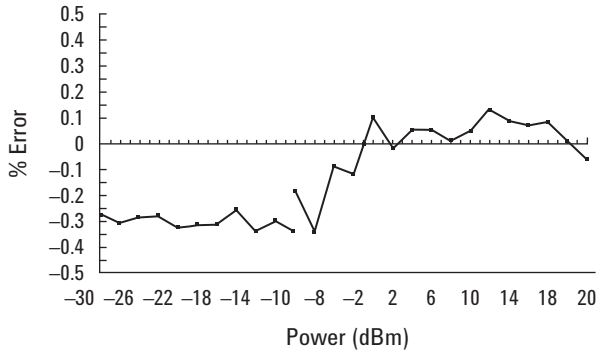
E-Series E9300 Average Power Sensor Specifications *(continued)*

Power linearity*

Table 9. E9300 Series power linearity (after zero and cal at ambient environmental conditions) sensor

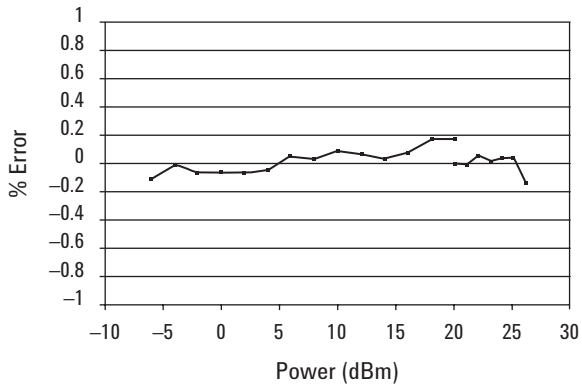
Sensor	Power	Linearity (25 °C ±10 °C)	Linearity (0 °C to 55 °C)
E9300A, E9301A, E9304A	–60 to –10 dBm	±3.0%	±3.5%
	–10 to 0 dBm	±2.5%	±3.0%
	0 to +20 dBm	±2.0%	±2.5%
E9300B, E9301B	–30 to +20 dBm	±3.5%	±4.0%
	+20 to +30 dBm	±3.0%	±3.5%
	+30 to +44 dBm	±2.5%	±3.0%
E9300H, E9301H	–50 to 0 dBm	±4.0%	±5.0%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

* After zero and calibration at ambient environmental conditions



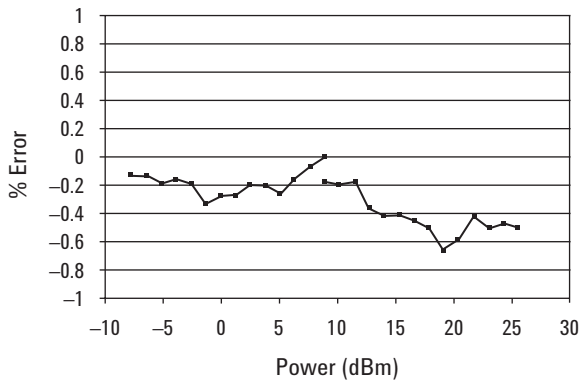
Typical E9300A/01A/04A power linearity at 25 °C, after zero and calibration, with associated measurement uncertainty

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



Typical E9300B/01B power linearity at 25 °C, after zero and calibration, with associated measurement uncertainty

Power range	Measurement uncertainty
–6 to 0 dBm	± 0.65%
0 to +10 dBm	± 0.55%
+10 to +20 dBm	± 0.45%
+20 to +26 dBm	± 0.31%



Typical E9300H/01H power linearity at 25 °C, after zero and calibration, with associated measurement uncertainty

Power range	Measurement uncertainty
–26 to –20 dBm	± 0.9%
–20 to –10 dBm	± 0.8%
–10 to 0 dBm	± 0.65%
0 to +10 dBm	± 0.55%
+10 to +20 dBm	± 0.45%
+20 to +26 dBm	± 0.31%

E-Series E9300 Average Power Sensor Specifications *(continued)*

Effects of change in temperature on linearity

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 9.

For small changes in temperature:

The typical maximum additional power linearity error due to small temperature change after calibration is ±0.15%/°C (valid after zeroing the sensor).

For large changes in temperature:

Refer to Table 10.

Table 10. Typical maximum additional power linearity error due to temperature change (valid after zeroing the sensor)

Sensor	Power	Additional power linearity error (25 °C ± 10 °C)	Additional power linearity error (0 °C to 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%

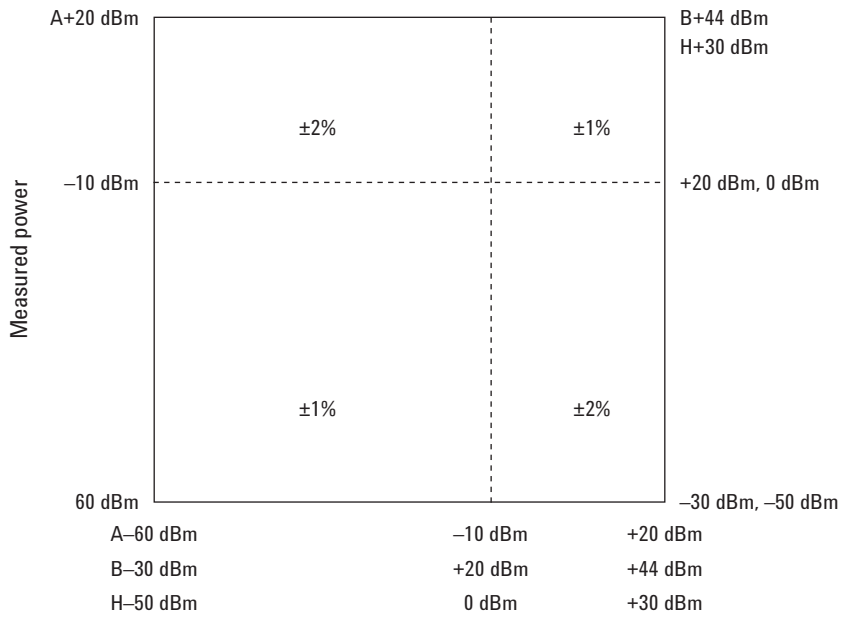


Figure 2. Relative mode power measurement linearity with an EPM Series power meter, at 25 °C ±10 °C (typical)

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 Sensor Specifications *(continued)*

Switch point data

The E9300 power sensors have two paths as shown in Table 7. 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 11. E9300 Series sensor switch point specification

E9300 sensor suffix	Conditions[1]	Zero set	Zero drift[2]	Measurement noise[3]
A	Lower power path (15% to 75% RH)	500 pW	150 pW	700 pW
	Lower 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	3000 nW	500 nW
B	Lower power path (15% to 75% RH)	500 nW	150 nW	700 nW
	Lower 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	3000 mW	500 µW
H	Lower power path (15% to 75% RH)	5 nW	1.5 nW	7 nW
	Lower power path (75% to 95% RH)	5 nW	40 µW	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 mW	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.

E-Series E9300 Average Power Sensor Specifications *(continued)*

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 certificate of calibration (CoC) 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 12a and 12b. 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.

Table 12a. Calibration factor uncertainties (low power path)

Frequency	Uncertainty (%) (25 °C ±10 °C)	Uncertainty (%) (0 °C to 55 °C)
10 MHz to 30 MHz	± 1.8%	±2.2%
30 MHz to 500 MHz (E9304A: 9 kHz to 500 MHz)	±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%

Table 12b. Calibration factor uncertainties (high power path)

Frequency	Uncertainty (%) (25 °C ±10 °C)	Uncertainty (%) (0 °C to 55 °C)
10 MHz to 30 MHz	± 2.1%	±4.0%
30 MHz to 500 MHz (E9304A: 9 kHz to 500 MHz)	±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%