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 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 15. E9300 Series two-path specification

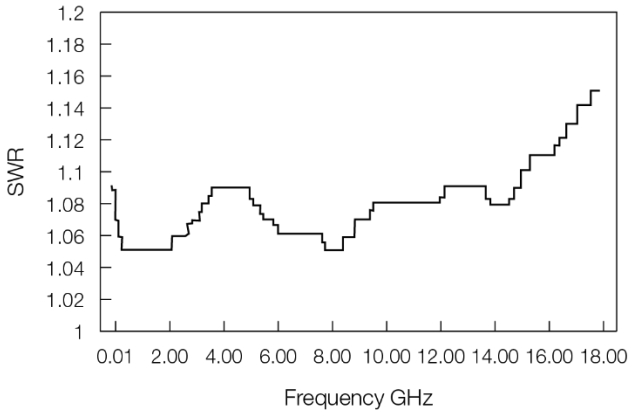
	"A" suffix sensors	"B" suffix sensors	"H" suffix sensors
High power path	–10 to +20 dBm	+20 to +44 dBm	0 to +30 dBm
Low power path	–60 to –10 dBm	–30 to +20 dBm	–50 to 0 dBm

Table 16. E9300 Series sensors specification

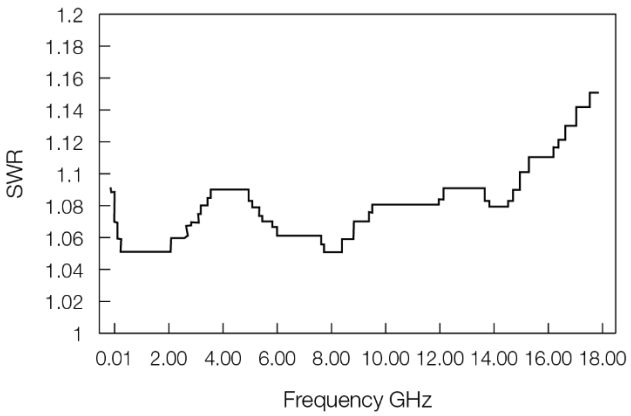
Model	Frequency range	Maximum SWR (25 °C ± 10 °C)	Maximum SWR (0 to 55 °C)	Maximum power	Connector type
–60 to +20 dBm wide dynamic range sensors					
E9300A	10 MHz to 18 GHz	10 to < 30 MHz: 1.15	10 to < 30 MHz: 1.21	+25 dBm (320 mW) average	Type-N (m)
		30 MHz to < 2 GHz: 1.13	30 MHz to < 2 GHz: 1.15	+33 dBm peak (2 W) (< 10 µsec)	
		2 to < 14 GHz: 1.19	2 to < 14 GHz: 1.20		
		14 to < 16 GHz: 1.22	14 to < 16 GHz: 1.23		
		16 to 18 GHz: 1.26	16 to 18 GHz: 1.27		
E9301A	10 MHz to 6 GHz	10 to < 30 MHz: 1.15	10 to < 30 MHz: 1.21	+25 dBm (320 mW) average	Type-N (m)
		30 MHz to < 2 GHz: 1.13	30 MHz to < 2 GHz: 1.15	+33 dBm peak (2 W) (< 10 µsec)	
		2 to 6 GHz: 1.19	2 to 6 GHz: 1.20		
E9304A	9 kHz to 6 GHz	9 KHz to < 2 GHz: 1.13	9 KHz to < 2 GHz: 1.15	+25 dBm (320 mW) average	Type-N (m)
		2 to 6 GHz: 1.19	2 to 6 GHz: 1.20	+33 dBm peak (2 W) (< 10 µsec)	
–30 to +44 dBm wide dynamic range sensors					
E9300B	10 MHz to 18 GHz	10 MHz to < 8 GHz: 1.12	10 MHz to < 8 GHz: 1.14	0 to 35 °C: 30 W avg	Type-N (m)
		8 to < 12.4 GHz: 1.17	8 to < 12.4 GHz: 1.18	35 to 55 °C: 25 W avg	
		12.4 to 18 GHz: 1.24	12.4 to 18 GHz: 1.25	< 6 GHz: 500 W pk	
				> 6 GHz: 125 W pk	
				500 W. µS per pulse	
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	Type-N (m)
				35 to 55 °C: 25 W avg	
				< 6 GHz: 500 W pk	
				> 6 GHz: 125 W pk	
				500 W.µS per pulse	

–50 to +30 dBm wide dynamic range sensors					
E9300H	10 MHz to 18 GHz	10 MHz to < 8 GHz: 1.15	10 MHz to < 8 GHz: 1.17	3.16 W avg	Type-N (m)
		8 to < 12.4 GHz: 1.25	8 to < 12.4 GHz: 1.26	100 W pk	
		12.4 to 18GHz: 1.28	12.4 to 18GHz: 1.29	100 W.µS per pulse	
E9301H	10 MHz to 6 GHz	10 MHz to < 6 GHz: 1.15	10 MHz to < 6 GHz: 1.17	3.16 W avg	Type-N (m)
				100 W pk	
				100 W.µS per pulse	

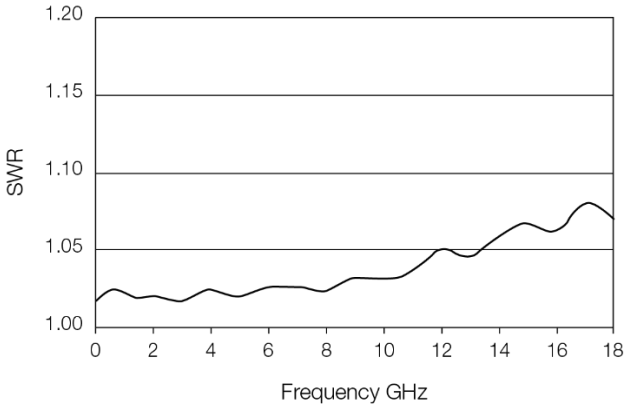
E-Series E9300 Average Power Sensor Specifications (Continued)



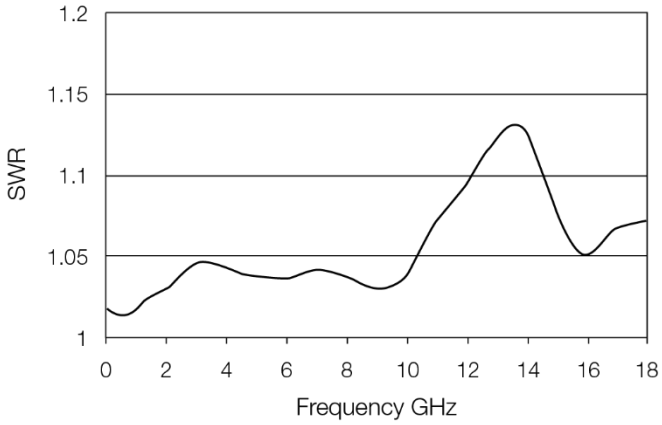
Typical SWR, 10 MHz to 18 GHz (25 °C ± 10 °C) for E9300A and E9301A sensor.



Typical SWR, 9 kHz 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 Sensor Specifications (Continued)

Power linearity [17]

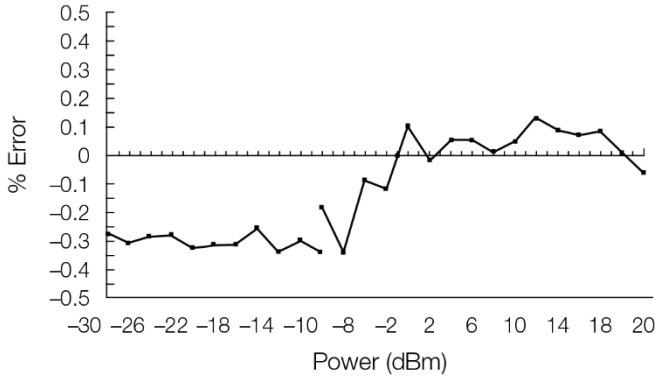
Table 17. E9300 Series power linearity (after zero and cal at ambient environmental conditions) sensor

Sensor	Power	Linearity (25 ± 10 °C)	Linearity (0 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%

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

Table 18.

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%

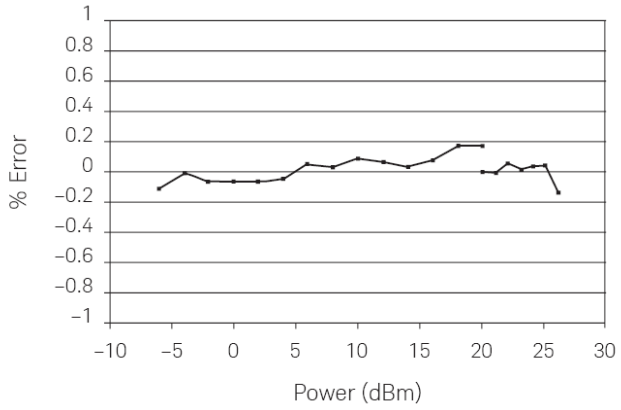


17. After zero and calibration at ambient environmental conditions.

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

Table 19.

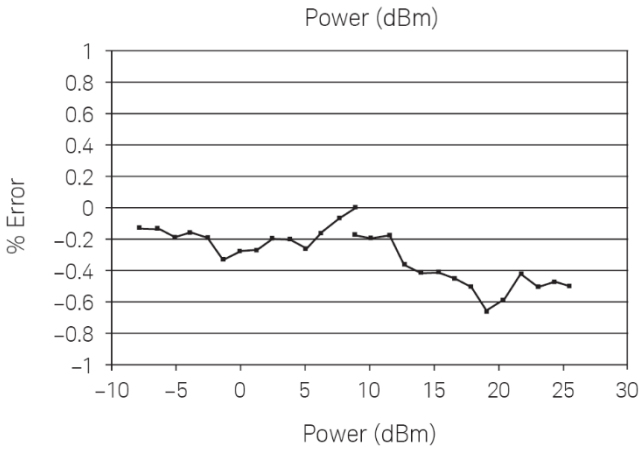
Power range	Measurement uncertainty
–6 to 0 dBm	± 0.65%
0 to +10 dBm	± 0.55%
+10 to +20 dBm	± 0.45%
+20 to +26 dBm	± 0.31%



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

Table 20.

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%



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.

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).

Table 21. 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 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 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.

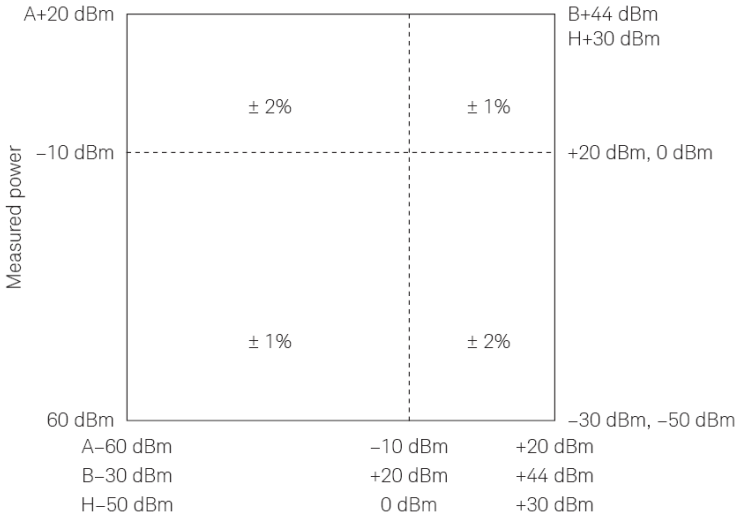


Figure 2. Relative mode power measurement linearity with an EPM Series power meter, at 25 °C ± 10 °C (typical).

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:

- Typical = ± 0.5% (= ± 0.02 dB)

Switching point hysteresis:

- 0.5 dB typical

Table 22. E9300 Series sensor switch point specification

E9300 sensor suffix	Conditions [18]	Zero set	Zero drift [19]	Measurement noise [20]
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*

18. RH is the abbreviation for relative humidity.
19. Within 1 hour after zero set, at a constant temperature, after a 24-hour warm-up of the power meter with power sensor connected.
20. 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.

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.

Table 23. Calibration factor uncertainties (low power path)

Frequency	Uncertainty [21] (%) (25 °C ± 10 °C)	Uncertainty [21] (%) (0 to 55 °C)
10 to < 30 MHz	± 1.8%	± 2.2%
30 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 to < 6 GHz	± 1.7%	± 2.0%
6 to < 14 GHz	± 1.8%	± 2.0%
14 to < 18 GHz	± 2.0 %	± 2.2%

21. The characterized calibration factor should not deviate between periodic calibrations by more than the specified maximum uncertainty in table 12a or 12b. Compliance is confirmed by the deviation being less than or equal to square root (2) times the specified maximum uncertainty.

Table 24. Calibration factor uncertainties (high power path).

Frequency	Uncertainty [21] (%) (25 °C ± 10 °C)	Uncertainty [21] (%) (0 to 55 °C)
10 to < 30 MHz	± 2.1%	± 4.0%
30 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 to < 6 GHz	± 1.8%	± 2.1%
6 to < 14 GHz	± 1.9%	± 2.3%
14 to < 18 GHz	± 2.2 %	± 3.3%