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User's Guide

HP EPM E4418A (EPM-441A)

Power Meter



HP Part no. E4418-90000
April 22, 1997





5

— Specifications





Specifications
Introduction

Introduction

This chapter details the power meter's specifications and supplemental characteristics.

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

Supplemental characteristics, which are shown in italics, are intended to provide information useful in applying the power meter by giving typical, but nonwarranted performance parameters. These characteristics are shown in italics or denoted as "typical", "nominal" or "approximate".

For information on measurement uncertainty calculations, refer to HP Application Note 64-1A, "Fundamentals of RF and Microwave Power Measurements", Literature Number 5965-6630.



Power Meter Specifications

Meter

Frequency Range

100 kHz to 50 GHz and 75 GHz to 110 GHz, power sensor dependent

Power Range

-70 dBm to +44 dBm (100 pW to 25 W), power sensor dependent

Power Sensors

Compatible with all HP 8480 series power sensors and HP ECP-series power sensors.

Single Sensor Dynamic Range

90 dB maximum (HP ECP-series power sensors)
50 dB maximum (HP 8480 series power sensors)

Display Units

Absolute: Watts or dBm

Relative: Percent or dB

Display Resolution

Selectable resolution of:

1.0, 0.1, 0.01 and 0.001 dB in logarithmic mode, or
1, 2, 3 and 4 significant digits in linear mode

Default Resolution

0.01 dB in logarithmic mode
3 digits in linear mode

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Accuracy

Instrumentation

Absolute: ± 0.02 dB (Logarithmic) or $\pm 0.5\%$ (Linear). (Refer to the power sensor linearity specification in your power sensor manual to assess overall system accuracy.)

Relative: ± 0.04 dB (Logarithmic) or $\pm 1.0\%$ (Linear). (Refer to the power sensor linearity specification in your power sensor manual to assess overall system accuracy.)

Zero Set (digital settability of zero): Power sensor dependent (refer to Table 5-1). For HP ECP-series power sensors, this specification applies when zeroing is performed with the sensor input disconnected from the POWER REF.

Table 5-1: Zero Set Specifications

Power Sensor	Zero Set
HP 8481A	± 50 nW
HP 8481B	± 50 μ W
HP 8481D	± 20 pW
HP 8481H	± 5 μ W
HP 8482A	± 50 nW
HP 8482B	± 50 μ W
HP 8482H	± 5 μ W
HP 8483A	± 50 nW
HP 8485A	± 50 nW
HP 8485D	± 20 pW
HP R8486A	± 50 nW
HP R8486D	± 30 pW
HP Q8486A	± 50 nW
HP Q8486D	± 30 pW
HP W8486A	± 200 nW
HP 8487A	± 50 nW
HP 8487D	± 20 pW
HP ECP-E18A	± 50 pW
HP ECP-E26A	± 50 pW



Power Reference

Power Output

1.00 mW (0.0 dBm). Factory set to $\pm 0.7\%$ traceable to the US National Institute of Standards and Technology.

Accuracy

$\pm 1.2\%$ worst case ($\pm 0.9\%$ rss) for one year.





Specifications
Power Meter Supplemental Characteristics

Power Meter Supplemental Characteristics

Power Reference

Frequency

50 MHz nominal

SWR

1.05 maximum

Connector

Type N (f), 50 Ω

Measurement Speed

Over the HP-IB, three measurement speed modes are available as shown, along with the typical maximum measurement speed for each mode:

- **Normal:** 20 readings/second
- **x2:** 40 readings/second
- **Fast:** 200 readings/second, for HP ECP-series power sensors only

Maximum measurement speed is obtained using binary output in free run trigger mode.





Zero Drift of Sensors

Power sensor dependent (refer to Table 5-3).

Measurement Noise

Power sensor dependent (refer to Table 5-2 and Table 5-3).

Averaging effects on measurement noise. Averaging over 1 to 1024 readings is available for reducing noise. Table 5-3 provides the measurement noise for a particular power sensor with the number of averages set to 16 for normal mode and 32 for x2 mode. Use the “Noise Multiplier” for the appropriate mode (normal or x2) and number of averages to determine the total measurement noise value.

For example, for an HP 8481D power sensor in normal mode with the number of averages set to 4, the measurement noise is equal to:

$$(<45 \text{ pW} \times 2.75) = <124 \text{ pW}$$

Table 5-2: Noise Multiplier

Number of Averages	1	2	4	8	16	32	64	128	256	512	1024
Noise Multiplier (Normal Mode)	5.5	3.89	2.75	1.94	1.0	0.85	0.61	0.49	0.34	0.24	0.17
Noise Multiplier (x2 mode)	6.5	4.6	3.25	2.3	1.18	1.0	0.72	0.57	0.41	0.29	0.2



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Power Meter Supplemental Characteristics

Table 5-3: Power Sensor Specifications

Power Sensor	<i>Zero Drift</i>¹	<i>Measurement Noise</i>²
HP 8481A	$<\pm 10 \text{ nW}$	$<110 \text{ nW}$
HP 8481B	$<\pm 10 \mu\text{W}$	$<110 \mu\text{W}$
HP 8481D	$<\pm 4 \text{ pW}$	$<45 \text{ pW}$
HP 8481H	$<\pm 1 \mu\text{W}$	$<10 \mu\text{W}$
HP 8482A	$<\pm 10 \text{ nW}$	$<110 \text{ nW}$
HP 8482B	$<\pm 10 \mu\text{W}$	$<110 \mu\text{W}$
HP 8482H	$<\pm 1 \mu\text{W}$	$<10 \mu\text{W}$
HP 8483A	$<\pm 10 \text{ nW}$	$<110 \text{ nW}$
HP 8485A	$<\pm 10 \text{ nW}$	$<110 \text{ nW}$
HP 8485D	$<\pm 4 \text{ pW}$	$<45 \text{ pW}$
HP R8486A	$<\pm 10 \text{ nW}$	$<110 \text{ nW}$
HP R8486D	$<\pm 6 \text{ pW}$	$<65 \text{ pW}$
HP Q8486A	$<\pm 10 \text{ nW}$	$<110 \text{ nW}$
HP Q8486D	$<\pm 6 \text{ pW}$	$<65 \text{ pW}$
HP W8486A	$<\pm 40 \text{ nW}$	$<450 \text{ nW}$
HP 8487A	$<\pm 10 \text{ nW}$	$<110 \text{ nW}$
HP 8487D	$<\pm 4 \text{ pW}$	$<45 \text{ pW}$
HP ECP-E18A	$<\pm 15 \text{ pW}$	$<70 \text{ pW}$
HP ECP-E26A	$<\pm 15 \text{ pW}$	$<70 \text{ pW}$

1. Within 1 hour after zero set, at a constant temperature, after a 24 hour warm-up of the power meter.

2. The number of averages at 16 (for normal mode) and 32 (for x2 mode), at a constant temperature, measured over a 1 minute interval and 2 standard deviations. For HP ECP-series power sensors the measurement noise is measured within the low range. Refer to the relevant power sensor manual for further information.



Settling Time

0 to 99% settled readings over the HP-IB.

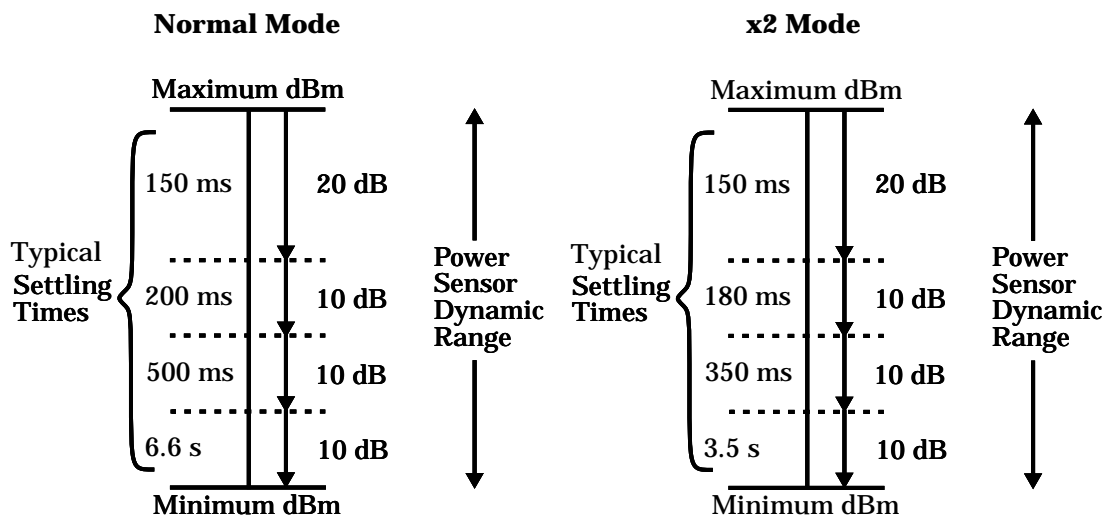
For HP 8480 series power sensors

Manual filter, 10 dB decreasing power step:

Table 5-4: Settling Time

Number of Averages	1	2	4	8	16	32	64	128	256	512	1024
Settling Time (s) <i>(Normal Mode)</i>	0.15	0.2	0.3	0.5	1.1	1.9	3.4	6.6	13	27	57
Response Time (s) <i>(x2 mode)</i>	0.15	0.18	0.22	0.35	0.55	1.1	1.9	3.5	6.9	14.5	33

Auto filter, default resolution, 10 dB decreasing power step, normal and x2 speed modes:



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For HP ECP-series power sensors

In FAST mode, within the range -50 dBm to +17 dBm, for a 10 dB decreasing power step, the settling time is 10 ms¹.

¹*When a decreasing power step crosses the power sensor's auto-range switch point, add 25 ms. Refer to the relevant power sensor manual for further information.*

For HP ECP-series power sensors in normal and x2 speed modes, manual filter, 10 dB decreasing power step:

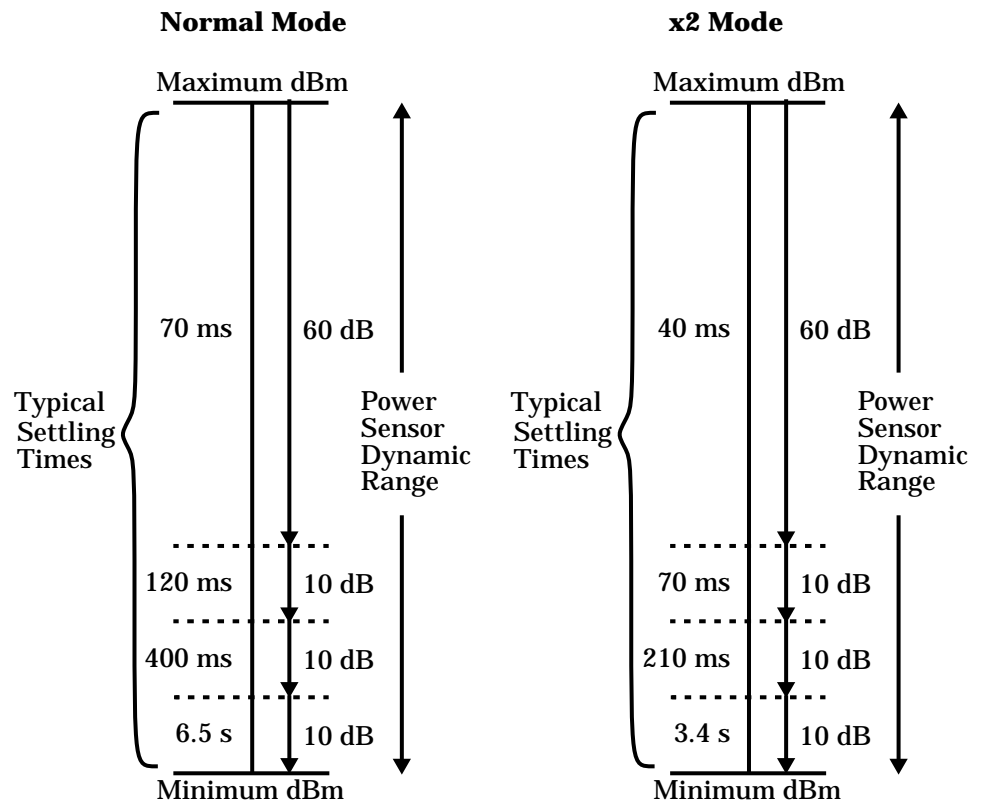
Table 5-5: Settling Time

Number of Averages	1	2	4	8	16	32	64	128	256	512	1024
<i>Settling Time (s) (Normal Mode)</i>	<i>0.07</i>	<i>0.12</i>	<i>0.21</i>	<i>0.4</i>	<i>1</i>	<i>1.8</i>	<i>3.3</i>	<i>6.5</i>	<i>13</i>	<i>27</i>	<i>57</i>
<i>Response Time (s) (x2 mode)</i>	<i>0.04</i>	<i>0.07</i>	<i>0.12</i>	<i>0.21</i>	<i>0.4</i>	<i>1</i>	<i>1.8</i>	<i>3.4</i>	<i>6.8</i>	<i>14.2</i>	<i>32</i>



Specifications
Power Meter Supplemental Characteristics

Auto filter, default resolution, 10 dB decreasing power step, normal and x2 speed modes:





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Power Meter Supplemental Characteristics

Power Sensor Specifications

Definitions

Zero Set

In any power measurement, the power meter must initially be set to zero with no power applied to the power sensor. Zero setting is accomplished within the power meter by digitally correcting for residual offsets.

Zero Drift

This parameter is also called long term stability and is the change in the power meter indication over a long time (usually one hour) for a constant input power at a constant temperature, after a defined warm-up interval.

Measurement Noise

This parameter is also known as short term stability and is specified as the change in the power meter indication over a short time interval (usually one minute) for a constant input power at a constant temperature.



General Characteristics

Rear Panel Connectors

Recorder Output

Analog 0-1 Volt, 1 k Ω output impedance, BNC connector

HP-IB

Allows communication with an external controller.

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 63 Hz
- **Power Requirement:** approximately 50 VA (14 Watts)



Specifications
Environmental Characteristics

Environmental Characteristics

General Conditions

Complies with the requirements of the EMC Directive 89/336/EEC. This includes Generic Immunity Standard EN 50082-1: 1992 and Radiated Interference Standard EN 55011:1991/CISPR11:1990, Group 1 - Class A.

Operating Environment

Temperature

0°C 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)

Location

For use indoors.

Storage Conditions

Storage Temperature

-20°C to +70°C

Non-Operating Maximum Humidity

90% at 65°C (non-condensing)

Non-Operating Maximum Altitude

15,240 meters (50,000 feet)





General

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

4.0 Kg (8.8 lb)

Shipping

7.9 Kg (17.4 lb)

Safety

Conforms to the following Product Specifications:

- EN61010-1: 1993/IEC 1010-1:1990+A1/CSA C22.2 No. 1010-1:1993
- EN60825-1: 1994/IEC 825-1: 1993 Class 1
- Low Voltage Directive 72/23/EEC

Remote Programming

Interface

HP-IB interface operates to IEEE 488.2.

Command Language

SCPI standard interface commands. HP 437B code compatible.

HP-IB Compatibility

SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DC1, DT1, C0





Specifications
General

Non-Volatile Memory

Battery

Lithium Polycarbon Monofluoride, approximate lifetime 5 years at 25°C.

