

# N8480 Series Thermocouple Power Sensors

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# Introduction

The Keysight Technologies, Inc. N8480 Series thermocouple power sensors are amongst the most accurate and reliable sensors, plus they include EEPROM, and extended frequency and power ranges.

## Accurate, repeatable measurements

Here's how: Excellent linearity (1% approximately) and noise specifications. The sensors' low SWR further enhances accuracy by minimizing mismatch uncertainty. These sensors also come with dual-range power for greater sensitivity to fluctuating signals. With high accuracy and stability, the N8480 helps you test confidently, faster.

## Calibration-easy testing

During test, calibrating your sensor is an essential step. Minimizing the time this step takes is essential. The N8480 sensor eliminates cumbersome keying-in of the calibration factor (CF), eliminates manual input errors, and saves you time and effort. CF, linearity, and temperature corrections are all stored in the sensors' EEPROM—auto-downloaded on calibration. The N8480 Series streamlines the calibration procedure making overall testing faster and more efficient.

## One sensor, WIDEST range

Pick an N8480 sensor—any one—and you'll see how its wide dynamic range equips you for various applications: metrology labs, radar, mobile radio, TDMA, GSM, W-CDMA, and WiMAX™, among others.

With up to 55 dBm wide dynamic range, the N8480 Series offers you the widest thermocouple sensor power range in the industry.

## System integration can be difficult, but not with the N8480

The N8480 Series sensors are backward compatible with the Keysight leading range of power meters, including the P-Series, EPM-P Series, and EPM Series. All that's needed is a simple firmware upgrade that's downloadable for free from the Website.

All SCPI codes used on the E-Series sensors are re-usable on the N8480, including most of the codes used on the 8480 Series. When migrating code from the 8480 Series, Option CFT<sup>1</sup> will allow SCPI codes to behave much like they do on the 8480 Series.

## Features

- High accuracy with excellent linearity and noise specifications
- Wide dynamic range in a single sensor
- Auto-download of calibration factor and corrections from EEPROM
- Option CFT provides full-code compatibility between sensors and the 8480 Series (excluding the N8488A)
- Broad compatibility with existing power meters: P-Series (N1911A/12A), EPM-P Series (E4416A/17A), and EPM Series (N1913A/14A, E4418B/19B)

1. Option CFT is not available for the N8488A power sensor.

## Compatible Power Meters

To get your existing power meters up-and-running in supporting the N8480 Series, just download their firmware upgrades online at [www.keysight.com](http://www.keysight.com) > Technical Support > Drivers & Software > Firmware Update

| Power meter               | Model number | Compatible firmware revision |
|---------------------------|--------------|------------------------------|
| EPM Series power meters   | E4418B       | A1.09.01 and above           |
|                           | E4419B       | A2.09.01 and above           |
|                           | N1913A       | A.01.00 and above            |
|                           | N1914A       | A.01.00 and above            |
| EPM-P Series power meters | E4416A       | A1.05.01 and above           |
|                           | E4417A       | A2.05.01 and above           |
| P-Series power meters     | N1911A       | A.05.02 and above            |
|                           | N1912A       | A.05.02 and above            |

## Specification Definitions

There are two types of product specifications:

- Warranted specifications
- Characteristic specifications

### Warranted specifications

Warranted specifications are covered by the product warranty and apply over 0 to 55°C, unless otherwise noted. Warranted specifications include measurement uncertainty calculated with 95% confidence.

### Characteristic specifications

Characteristic specifications are not warranted. They describe product performance that is useful in the application of the power sensors by giving typical, but non-warranted performance parameters. These characteristics are shown in *italics* or denoted as “typical,” “nominal” or “approximate.”

Characteristic information is representative of the product. In many cases, it may also be supplemental to a warranted specification.

Characteristic specifications are not verified on all power sensors. The types of characteristic specifications can be placed in two groups:

- The first group of characteristic types describes ‘attributes’ common to all products of a given model or option. Examples of characteristics that describe attributes are product weight and 50-Ω input Type-N connector. In these examples, product weight is an approximate value and a 50-Ω input is nominal. These two terms are most widely used when describing a product’s attributes.
- The second group of characteristic types describes ‘statistically’ the aggregate performance of the population of products. These characteristics describe the expected behavior of the population of products. They do not guarantee the performance of any individual product. No measurement uncertainty value is accounted for in the specification. These specifications are referred to as typical.

## Conditions

The power meter and power sensor meet their specifications when:

- Stored for a minimum of two hours at a stable temperature within the operating temperature range and turned on for at least 30 minutes
- The power meter and power sensor are within their recommended calibration periods
- Used in accordance to the information provided in the power meter's user's guide

## Performance Characteristics

Specifications stated hereon refer to all N8480 Series power sensors, unless otherwise stated. The term "standard" refers to all N8480 Series sensors except Option CFT.

### Frequency and dynamic power range

| Sensor option | Sensor model       | Frequency range                       | Dynamic power range |                |
|---------------|--------------------|---------------------------------------|---------------------|----------------|
| Standard      | N8481A             | 10 MHz to 18 GHz                      | -35 to +20 dBm      |                |
|               | N8482A             | 100 kHz to 6 GHz                      |                     |                |
|               | N8485A             | 10 MHz to 26.5 GHz                    |                     |                |
|               | N8485A - Option 33 | 10 MHz to 33 GHz                      |                     |                |
|               | N8487A             | 50 MHz to 50 GHz                      |                     |                |
|               | N8488A             | 10 MHz to 67 GHz,<br>67 GHz to 70 GHz |                     |                |
|               | N8486AR            | 26.5 to 40 GHz                        |                     |                |
|               | N8486AQ            | 33 to 50 GHz                          |                     |                |
|               | N8481B             | 10 MHz to 18 GHz                      |                     | -5 to +44 dBm  |
|               | N8482B             | 100 kHz to 6 GHz                      |                     |                |
| Option CFT    | N8481A             | 10 MHz to 18 GHz                      | -30 to +20 dBm      |                |
|               | N8482A             | 100 kHz to 6 GHz                      |                     |                |
|               | N8485A             | 10 MHz to 26.5 GHz                    |                     |                |
|               | N8485A - Option 33 | 10 MHz to 33 GHz                      |                     |                |
|               | N8487A             | 50 MHz to 50 GHz                      |                     |                |
|               | N8486AR            | 26.5 to 40 GHz                        |                     |                |
|               | N8486AQ            | 33 to 50 GHz                          |                     |                |
|               | N8481B             | 10 MHz to 18 GHz                      |                     | 0 to +44 dBm   |
|               | N8482B             | 100 kHz to 6 GHz                      |                     |                |
|               | N8481H             | 10 MHz to 18 GHz                      |                     | -10 to +35 dBm |
| N8482H        | 100 kHz to 6 GHz   |                                       |                     |                |

## Damage level

| Sensor model | Damage level (average power) | Damage level (peak power) |
|--------------|------------------------------|---------------------------|
| N8481A       | +25 dBm                      | 15 W/2 $\mu$ s            |
| N8482A       |                              |                           |
| N8485A       |                              |                           |
| N8487A       |                              |                           |
| N8488A       |                              |                           |
| N8486AR      |                              |                           |
| N8486AQ      |                              |                           |
| N8481B       | +49 dBm                      | 500 W/1 $\mu$ s           |
| N8482B       |                              |                           |
| N8481H       | +40 dBm                      | 100 W/1 $\mu$ s           |
| N8482H       |                              |                           |

## Performance Characteristics (continued)

### Maximum SWR<sup>1</sup>

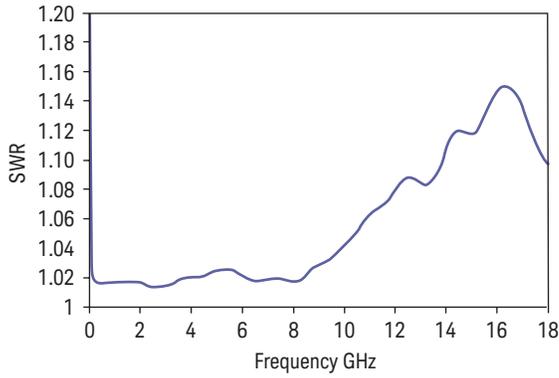
| Sensor model | Frequency band              | Maximum SWR |           |
|--------------|-----------------------------|-------------|-----------|
|              |                             | 25 ±10°C    | 0 to 55°C |
| N8481A       | 10 to 30 MHz                | 1.37        | 1.57      |
|              | 30 to 50 MHz                | 1.14        | 1.16      |
|              | 50 MHz to 2 GHz             | 1.08        | 1.11      |
|              | 2 to 12.4 GHz               | 1.16        | 1.16      |
|              | 12.4 to 18 GHz              | 1.23        | 1.25      |
| N8482A       | 100 to 300 kHz              | 1.54        | 1.57      |
|              | 300 kHz to 1 MHz            | 1.17        | 1.17      |
|              | 1 MHz to 2 GHz              | 1.06        | 1.06      |
|              | 2 to 6 GHz                  | 1.07        | 1.08      |
| N8485A       | 10 to 50 MHz                | 1.33        | 1.53      |
|              | 50 to 100 MHz               | 1.08        | 1.11      |
|              | 100 MHz to 2 GHz            | 1.05        | 1.07      |
|              | 2 to 12.4 GHz               | 1.14        | 1.14      |
|              | 12.4 to 18 GHz              | 1.19        | 1.20      |
|              | 18 to 26.5 GHz              | 1.26        | 1.28      |
|              | 26.5 to 33 GHz <sup>2</sup> | 1.32        | 1.36      |
| N8487A       | 50 to 100 MHz               | 1.08        | 1.10      |
|              | 100 MHz to 2 GHz            | 1.05        | 1.07      |
|              | 2 to 12.4 GHz               | 1.10        | 1.10      |
|              | 12.4 to 18 GHz              | 1.16        | 1.16      |
|              | 18 to 26.5 GHz              | 1.22        | 1.22      |
|              | 26.5 to 40 GHz              | 1.30        | 1.30      |
|              | 40 to 50 GHz                | 1.34        | 1.33      |
| N8488A       | 10 to 100 MHz               | 1.08        | 1.08      |
|              | 100 MHz to 2.4 GHz          | 1.08        | 1.08      |
|              | 2.4 to 12.4 GHz             | 1.10        | 1.10      |
|              | 12.4 to 18 GHz              | 1.12        | 1.14      |
|              | 18 to 26.5 GHz              | 1.21        | 1.23      |
|              | 26.5 to 40 GHz              | 1.30        | 1.31      |
|              | 40 to 67 GHz                | 1.46        | 1.47      |
|              | 67 to 70 GHz                | 1.48        | 1.50      |
| N8486AR      | 50 MHz <sup>3</sup>         | 1.17        | 1.20      |
|              | 26.5 to 40 GHz              | 1.40        | 1.40      |
| N8486AQ      | 50 MHz <sup>3</sup>         | 1.17        | 1.20      |
|              | 33 to 50 GHz                | 1.50        | 1.50      |
| N8481B       | 10 MHz to 2 GHz             | 1.09        | 1.10      |
|              | 2 to 12.4 GHz               | 1.14        | 1.18      |
|              | 12.4 to 18 GHz              | 1.23        | 1.28      |
| N8482B       | 100 kHz to 2 GHz            | 1.08        | 1.10      |
|              | 2 to 6 GHz                  | 1.16        | 1.18      |
| N8481H       | 10 MHz to 8 GHz             | 1.16        | 1.16      |
|              | 8 to 12.4 GHz               | 1.22        | 1.22      |
|              | 12.4 to 18 GHz              | 1.32        | 1.41      |
| N8482H       | 100 kHz to 6 GHz            | 1.13        | 1.14      |

1. For overlapping frequency points, refer to the lower SWR specification.

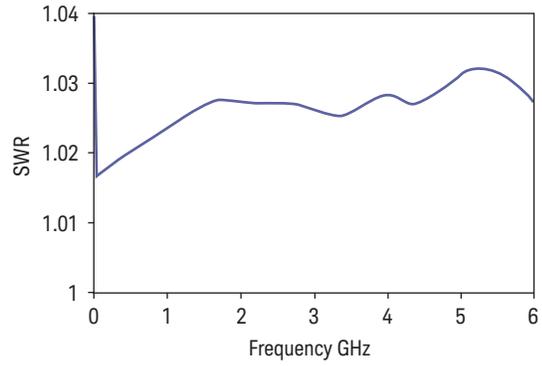
2. Only applicable for N8485A Option 033.

3. SWR for 50 MHz calibration port. Type-N (m) coaxial connector is used in the 50 MHz calibration.

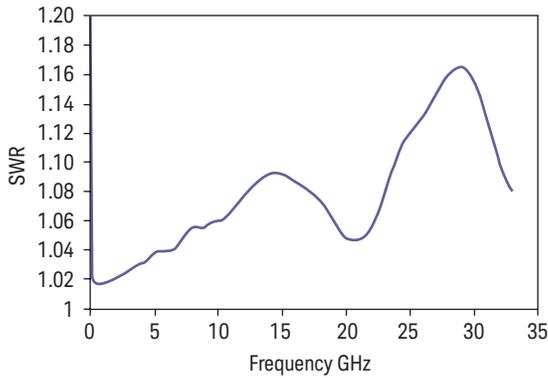
## Performance Characteristics (continued)



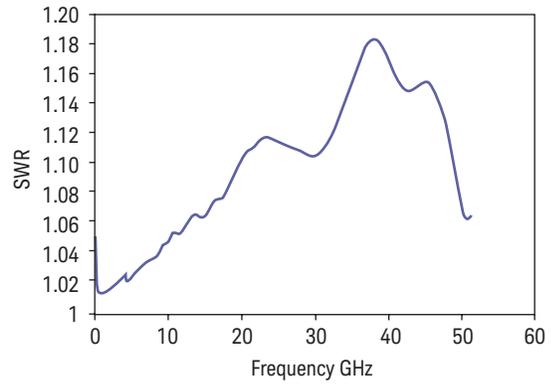
Typical SWR, 10 MHz to 18 GHz ( $25 \pm 10^\circ\text{C}$ ) for N8481A sensor



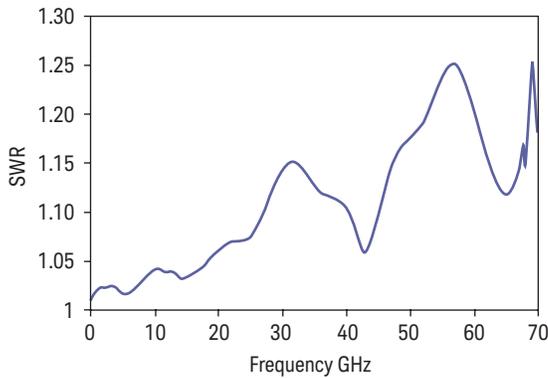
Typical SWR, 100 kHz to 6 GHz ( $25 \pm 10^\circ\text{C}$ ) for N8482A sensor



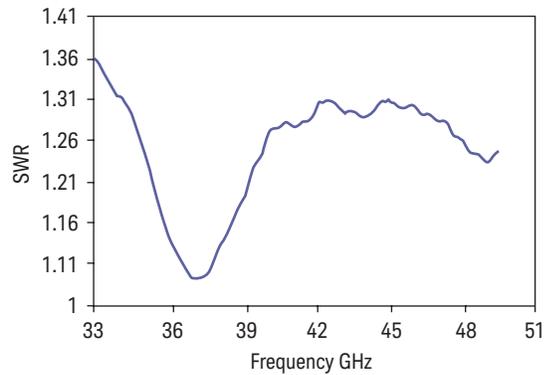
Typical SWR, 10 MHz to 26.5 GHz ( $25 \pm 10^\circ\text{C}$ ) for N8485A sensor



Typical SWR, 50 MHz to 50 GHz ( $25 \pm 10^\circ\text{C}$ ) for N8487A power sensor

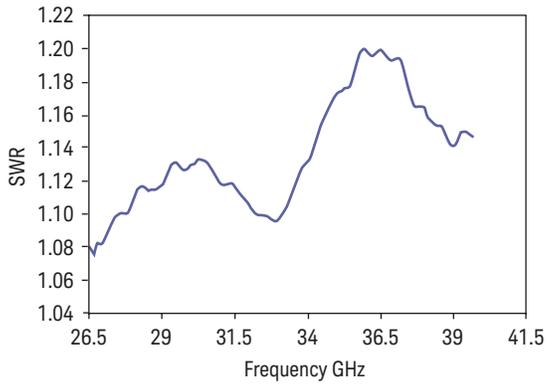


Typical SWR, 10 MHz to 70 GHz ( $25 \pm 10^\circ\text{C}$ ) for N8488A power sensor

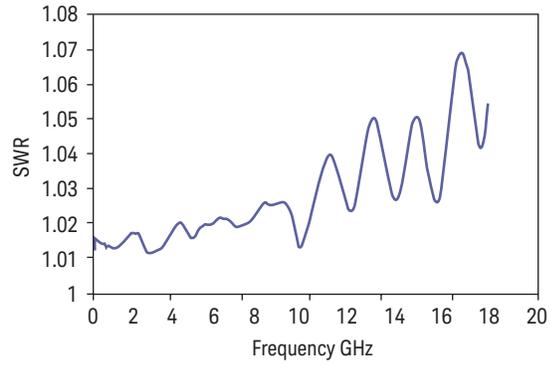


Typical SWR, 33 to 50 GHz ( $25 \pm 10^\circ\text{C}$ ) for N8486AQ power sensor

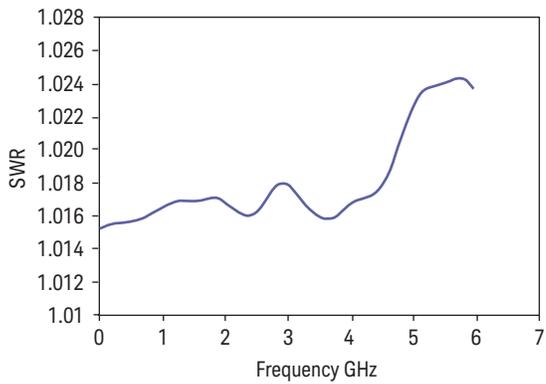
## Performance Characteristics (continued)



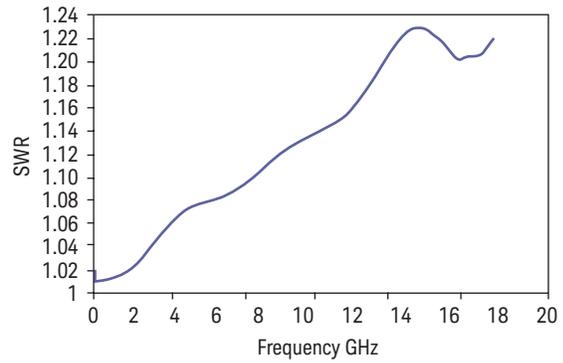
Typical SWR, 26.5 to 40 GHz (25 ±10°C) for N8486AR power sensor



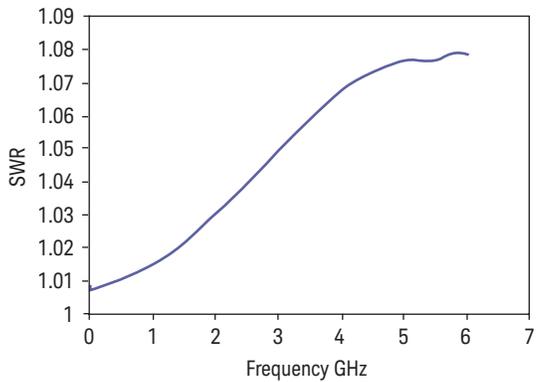
Typical SWR, 10 MHz to 18 GHz (25 ±10°C) for N8481B power sensor



Typical SWR, 100 kHz to 6 GHz (25 ±10°C) for N8482B power sensor



Typical SWR, 10 MHz to 18 GHz (25 ±10°C) for N8481H power sensor



Typical SWR, 100 kHz to 6 GHz (25 ±10°C) for N8482H power sensor

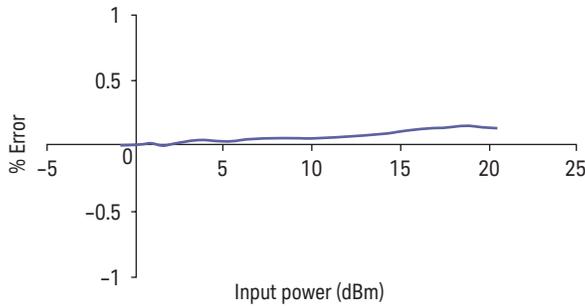
# Performance Characteristics (continued)

## Power linearity <sup>1</sup>

The N8480 Series power sensors' linearity is negligible except for the power range specified in the table below.

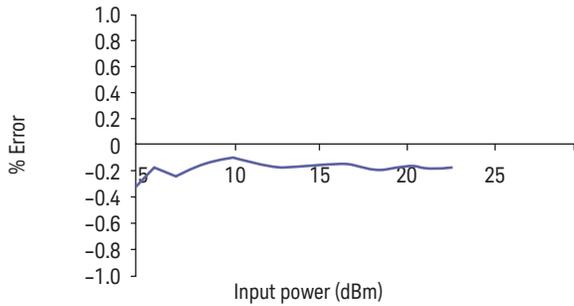
| Sensor model  | Power range      | Linearity (25 ±10°C) | Linearity (0 to 55°C) |
|---|------------------|----------------------|-----------------------|
| N8481A, N8482A, N8485A, N8487A, N8488A,<br>N8486AR, N8486AQ | -1 to < +15 dBm  | ±0.52%               | ±0.80%                |
|   | +15 to +20 dBm   | ±0.80%               | ±1.90%                |
| N8481B, N8482B  | +29 to < +39 dBm | ±0.52%               | ±0.80%                |
|   | +39 to +44 dBm   | ±1.66%               | ±2.75%                |
| N8481H, N8482H  | +17 to < +30 dBm | ±0.77%               | ±1.05%                |
|   | +30 to +35 dBm   | ±2.84%               | ±3.93%                |

1. After zero and calibration at ambient environment conditions



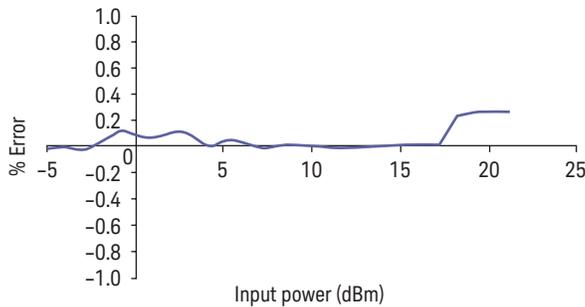
| Power level   | Measurement uncertainty |
|---------------|-------------------------|
| -1 to +20 dBm | ±0.35%                  |

Typical N8481A/2A/5A/7A/8A and N8486AR/AQ power linearity at 25°C, after zero and calibration with associated measurement uncertainty



| Power level  | Measurement uncertainty |
|--------------|-------------------------|
| 29 to 40 dBm | ±0.35%                  |
| 40 to 44 dBm | ±1.21%                  |

Typical N8481B/2B power linearity at 25°C, after zero and calibration with associated measurement uncertainty



| Power level  | Measurement uncertainty |
|--------------|-------------------------|
| 17 to 30 dBm | ±0.60%                  |
| 30 to 35 dBm | ±2.39%                  |

Typical N8481H/2H power linearity at 25°C, after zero and calibration with associated measurement uncertainty

## Performance Characteristics (continued)

### Zero set, zero drift and measurement noise

| Sensor model   | Sensor option | Range            | Conditions (RH) <sup>1</sup> | Zero set <sup>4</sup> | Zero drift <sup>2,4</sup> | Measurement noise <sup>3,4</sup> |
|--|---------------|------------------|------------------------------|-----------------------|---------------------------|----------------------------------|
| N8481A, N8482A,<br>N8485A, N8487A,<br>N8486AR, N8486AQ | Standard      | Upper            | up to 70%                    | ±63 nW                | < ±7 nW                   | < 114 nW                         |
|  |               | Lower            | up to 70 %                   | ±25 nW                | < ±3 nW                   | < 80 nW                          |
|  | Option CFT    | N/A <sup>5</sup> | up to 70%                    | ±63 nW                | < ±7 nW                   | < 114 nW                         |
| N8488A   | Standard      | Upper            | up to 70%                    | ±63 nW                | < ±7 nW                   | < 114 nW                         |
|  |               | Lower            | up to 70 %                   | ±25 nW                | < ±3 nW                   | < 80 nW                          |
|  | Option CFT    | N/A <sup>5</sup> | N/A <sup>5</sup>             | N/A <sup>5</sup>      | N/A <sup>5</sup>          | N/A <sup>5</sup>                 |
| N8481B, N8482B   | Standard      | Upper            | up to 70%                    | ±63 μW                | < ±7 μW                   | < 114 μW                         |
|  |               | Lower            | up to 70 %                   | ±25 μW                | < ±3 μW                   | < 80 μW                          |
|  | Option CFT    | N/A <sup>5</sup> | up to 70%                    | ±63 μW                | < ±7 μW                   | < 114 μW                         |
| N8481H, N8482H   | Standard      | Upper            | up to 70%                    | ±6.3 μW               | < ±0.7 μW                 | < 11.4 μW                        |
|  |               | Lower            | up to 70 %                   | ±2.5 μW               | < ±0.3 μW                 | < 8 μW                           |
|  | Option CFT    | N/A <sup>5</sup> | up to 70%                    | ±6.3 μW               | < ±0.7 μW                 | < 11.4 μW                        |

1. RH is the abbreviation for relative humidity.
2. Average hourly drift, at constant temperature. If there is an abrupt change of temperature, it is strongly recommended to perform zeroing or waiting for 30 minutes before taking the measurement.
3. The number of averages at 16 for normal mode and 32 for x2 mode, at a constant temperature, measured over one-minute interval and two standard deviations.
4. The zero set, zero drift, and measurement noise specifications are tested at 50 MHz.
5. N/A is the abbreviation for "not applicable."

### Effects of averaging on noise

Averaging over 1 to 1024 readings is available for reducing noise. The table below provides the measurement noise for a particular sensor with the number of averages set at 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.

Example:

N8481A power sensor, normal mode, number of averages = 4

Measurement noise calculation:

$$< 80 \text{ nW} \times 2.75 = < 220 \text{ nW}$$

| Number of averages      | 1   | 2    | 4    | 8    | 16   | 32   | 64   | 128  | 256  | 512  | 1024 |
|-------------------------|-----|------|------|------|------|------|------|------|------|------|------|
| <b>Noise multiplier</b> |     |      |      |      |      |      |      |      |      |      |      |
| Normal mode             | 5.5 | 3.89 | 2.75 | 1.94 | 1    | 0.85 | 0.61 | 0.49 | 0.34 | 0.24 | 0.17 |
| x2 mode                 | 6.5 | 4.6  | 3.25 | 2.3  | 1.63 | 1    | 0.72 | 0.57 | 0.41 | 0.29 | 0.2  |

## Performance Characteristics (continued)

### Switching point

The N8480 Series power sensors (excluding Option CFT) have two measurement ranges: a lower power range and an upper power range. The power meter automatically selects the proper power level range. To avoid unnecessary switching when the power level is near the switch point, switching point hysteresis has been added.

### N8481A/82A/85A/87A/88A and N8486AQ/AR power sensors

This hysteresis causes the lower power range to remain selected until approximately  $-0.5$  dBm as the power level is increased. Above this power, the upper power range is selected.

Likewise, the upper power range remains selected until approximately  $-1.5$  dBm as the signal level decreases. Below this power, the lower power range is selected.

### N8481B/82B power sensors

This hysteresis causes the lower power range to remain selected until approximately  $29.5$  dBm as the power level is increased. Above this power, the upper power range is selected.

Likewise, the upper power range remains selected until approximately  $28.5$  dBm as the signal level decreases. Below this power, the lower power range is selected.

### N8481H/82H power sensors

This hysteresis causes the lower power range to remain selected until approximately  $17.5$  dBm as the power level is increased. Above this power, the upper power range is selected.

Likewise, the upper power range remains selected until approximately  $16.5$  dBm as the signal level decreases. Below this power, the lower power range is selected.

### Power range in range setting

| Sensor  | Range setting      | Lower range        | Upper range        |
|---|--------------------|--------------------|--------------------|
| N8481A/82A/85A/87A/88A and<br>N8486AQ/AR excluding Option CFT | AUTO (default)     | $-35$ to $-1$ dBm  | $-1$ to $+20$ dBm  |
|   | LOWER              | $-35$ to $-1$ dBm  | –                  |
|   | UPPER <sup>1</sup> | –                  | $-30$ to $+20$ dBm |
| N8481B/82B excluding Option CFT                               | AUTO (default)     | $-5$ to $+29$ dBm  | $+29$ to $+44$ dBm |
|   | LOWER              | $-5$ to $+29$ dBm  | –                  |
|   | UPPER <sup>1</sup> | –                  | $0$ to $+44$ dBm   |
| N8481H/82H excluding Option CFT                               | AUTO (default)     | $-15$ to $+17$ dBm | $+17$ to $+35$ dBm |
|   | LOWER              | $-15$ to $+17$ dBm | –                  |
|   | UPPER <sup>1</sup> | –                  | $-10$ to $+35$ dBm |

1. Recommended for pulse signals measurement with period of more than one second

## Performance Characteristics (continued)

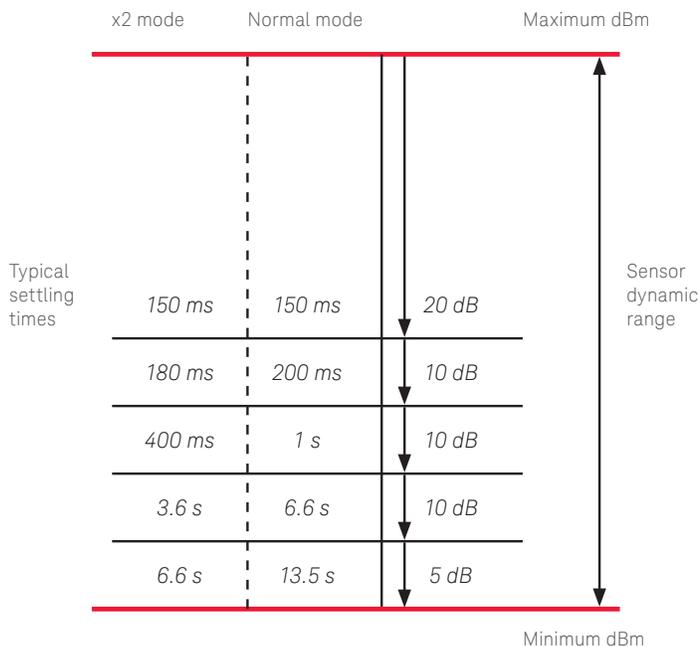
### Settling time<sup>1</sup>

Manual filter, 10-dB decreasing power step for normal and x2 modes (not across switching point)

| Number of averages | 1    | 2    | 4    | 8    | 16   | 32  | 64  | 128 | 256 | 512  | 1024 |
|--------------------|------|------|------|------|------|-----|-----|-----|-----|------|------|
| Settling time (s)  |      |      |      |      |      |     |     |     |     |      |      |
| Normal speed       | 0.15 | 0.2  | 0.3  | 0.5  | 1.1  | 1.9 | 3.4 | 6.6 | 13  | 27   | 57   |
| x2 speed           | 0.15 | 0.18 | 0.22 | 0.35 | 0.55 | 1.1 | 1.9 | 3.5 | 6.9 | 14.5 | 33   |

1. Settling time: 0 to 99% settled readings over the GPIB

Auto filter, default resolution, 10-dB decreasing power step for normal and x2 modes (not across switching point)



### Calibration factor and reflection coefficient

Calibration factor (CF) and reflection coefficient (Rho) data are unique to each sensor. The CF corrects for the frequency response of the sensor. The Keysight EPM Series, EPM-P Series, and P-Series power meters automatically read the CF data stored in the sensor's EEPROM and use it to make the corrections.

The reflection coefficient (Rho or  $\rho$ ) relates to the SWR according to the following formula:

$$SWR = \frac{1+\rho}{1-\rho}$$

Typical measurement uncertainties of the calibration factor (CF) are listed in the following table. There is only one set of CF data used for both the high and low range of each sensor. The typical measurement uncertainty data listed in the table is meant to help users on the measurement uncertainty estimation. These values are only a guideline and are not to be used in any accurate uncertainty calculations. For accurate measurement uncertainty values, please refer to the measurement report<sup>1</sup> of the specific sensor.

1. Only applicable with the purchase of Option 1A7 or Option A6J

## Performance Characteristics (continued)

### Calibration factor uncertainty

The typical measurement uncertainties listed are not to be taken as the maximum CF measurement uncertainties.

| Frequency          | 25 ±3°C |        |        |        |        |        |        |        |         |         |
|--------------------|---------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
|                    | N8481A  | N8481B | N8481H | N8482A | N8482B | N8482H | N8485A | N8487A | N8486AR | N8486AQ |
| 100 kHz to 10 MHz  | –       | –      | –      | 0.91   | 1.48   | 0.89   | –      | –      | –       | –       |
| 10 to 30 MHz       | 0.82    | 1.42   | 0.77   | 0.78   | 1.43   | 0.79   | 0.82   | –      | –       | –       |
| 30 to 500 MHz      | 0.77    | 1.48   | 0.89   | 0.77   | 1.49   | 0.89   | 1.24   | 1.33   | –       | –       |
| 500 MHz to 1.2 GHz | 0.78    | 1.48   | 0.89   | 0.78   | 1.49   | 0.89   | 1.26   | 1.35   | –       | –       |
| 1.2 to 6 GHz       | 0.91    | 1.58   | 1.06   | 0.89   | 1.56   | 1.02   | 1.35   | 1.41   | –       | –       |
| 6 to 14 GHz        | 1.26    | 1.77   | 1.46   | –      | –      | –      | 1.66   | 1.61   | –       | –       |
| 14 to 18 GHz       | 1.59    | 1.92   | 1.73   | –      | –      | –      | 1.83   | 1.73   | –       | –       |
| 18 to 26.5 GHz     | –       | –      | –      | –      | –      | –      | 2.67   | 2.26   | –       | –       |
| 26.5 to 33 GHz     | –       | –      | –      | –      | –      | –      | 3.32   | 2.58   | 2.68    | –       |
| 33 to 34 GHz       | –       | –      | –      | –      | –      | –      | –      | 2.80   | 3.19    | 3.14    |
| 34 to 35 GHz       | –       | –      | –      | –      | –      | –      | –      | 2.80   | 3.19    | 3.40    |
| 35 to 40 GHz       | –       | –      | –      | –      | –      | –      | –      | 2.80   | 3.19    | 3.14    |
| 40 to 45 GHz       | –       | –      | –      | –      | –      | –      | –      | 3.66   | –       | 3.19    |
| 45 to 50 GHz       | –       | –      | –      | –      | –      | –      | –      | 4.23   | –       | 3.26    |

| Frequency         | 25 ±3°C |
|-------------------|---------|
|                   | N8488A  |
| 100 kHz to 50 MHz | 1.70    |
| 50 to 100 MHz     | 1.60    |
| 100 MHz to 2 GHz  | 1.58    |
| 2 to 12.4 GHz     | 1.75    |
| 12.4 to 18 GHz    | 1.92    |
| 18 to 26.5 GHz    | 2.43    |
| 26.5 to 50 GHz    | 4.56    |
| 50 to 67 GHz      | 5.30    |
| 67 to 70 GHz      | 5.81    |

## Performance Characteristics (continued)

### Calibration factor uncertainty (continued)

The typical measurement uncertainties listed are not to be taken as the maximum CF measurement uncertainties.

| Frequency          | 25 ±10°C |        |        |        |        |        |        |        |         |         |
|--------------------|----------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
|                    | N8481A   | N8481B | N8481H | N8482A | N8482B | N8482H | N8485A | N8487A | N8486AR | N8486AQ |
| 100 kHz to 10 MHz  | –        | –      | –      | 1.28   | 2.40   | 0.99   | –      | –      | –       | –       |
| 10 to 30 MHz       | 1.47     | 1.98   | 1.39   | 1.03   | 1.84   | 0.86   | 0.94   | –      | –       | –       |
| 30 to 500 MHz      | 1.03     | 1.91   | 1.10   | 1.03   | 1.83   | 0.98   | 1.43   | 1.84   | –       | –       |
| 500 MHz to 1.2 GHz | 0.97     | 1.91   | 1.15   | 1.08   | 1.94   | 1.00   | 1.52   | 2.10   | –       | –       |
| 1.2 to 6 GHz       | 1.23     | 1.97   | 1.42   | 1.81   | 2.68   | 1.19   | 1.68   | 2.36   | –       | –       |
| 6 to 14 GHz        | 1.85     | 2.69   | 3.87   | –      | –      | –      | 2.26   | 2.87   | –       | –       |
| 14 to 18 GHz       | 2.17     | 3.20   | 7.01   | –      | –      | –      | 2.47   | 3.14   | –       | –       |
| 18 to 26.5 GHz     | –        | –      | –      | –      | –      | –      | 3.75   | 3.77   | –       | –       |
| 26.5 to 33 GHz     | –        | –      | –      | –      | –      | –      | 4.79   | 4.17   | 3.48    | –       |
| 33 to 34 GHz       | –        | –      | –      | –      | –      | –      | –      | 4.55   | 4.07    | 5.02    |
| 34 to 35 GHz       | –        | –      | –      | –      | –      | –      | –      | 4.55   | 4.07    | 4.99    |
| 35 to 40 GHz       | –        | –      | –      | –      | –      | –      | –      | 4.55   | 4.07    | 5.02    |
| 40 to 45 GHz       | –        | –      | –      | –      | –      | –      | –      | 5.40   | –       | 5.17    |
| 45 to 50 GHz       | –        | –      | –      | –      | –      | –      | –      | 6.02   | –       | 5.20    |

| Frequency         | 25 ±10°C |
|-------------------|----------|
|                   | N8488A   |
| 100 kHz to 50 MHz | 2.83     |
| 50 to 100 MHz     | 1.98     |
| 100 MHz to 2 GHz  | 1.84     |
| 2 to 12.4 GHz     | 2.45     |
| 12.4 to 18 GHz    | 2.89     |
| 18 to 26.5 GHz    | 3.52     |
| 26.5 to 50 GHz    | 4.99     |
| 50 to 67 GHz      | 6.46     |
| 67 to 70 GHz      | 7.29     |

## Performance Characteristics (continued)

### Calibration factor uncertainty (continued)

The typical measurement uncertainties listed are not to be taken as the maximum CF measurement uncertainties.

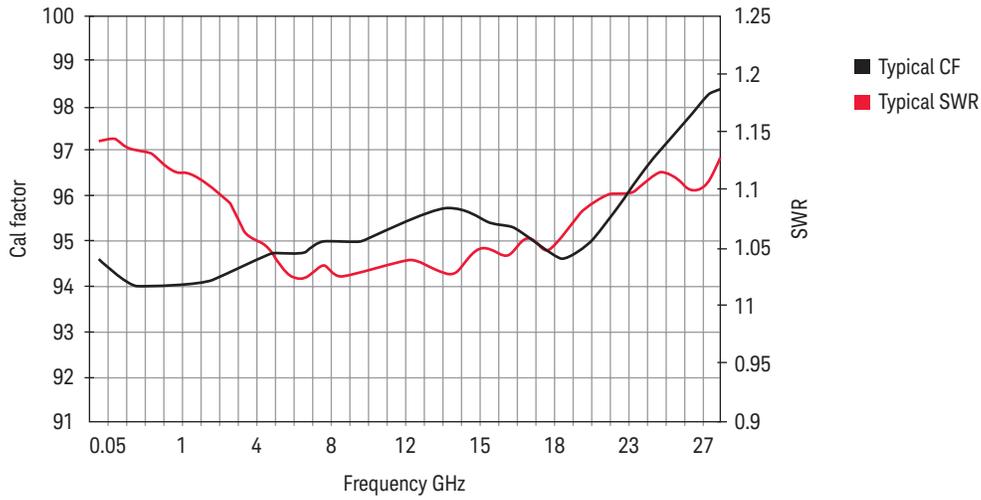
| Frequency          | 0 ±55°C |        |        |        |        |        |        |        |         |         |
|--------------------|---------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
|                    | N8481A  | N8481B | N8481H | N8482A | N8482B | N8482H | N8485A | N8487A | N8486AR | N8486AQ |
| 100 kHz to 10 MHz  | –       | –      | –      | 1.59   | 2.67   | 1.41   | –      | –      | –       | –       |
| 10 to 30 MHz       | 4.46    | 3.64   | 2.83   | 0.91   | 1.73   | 0.86   | 1.25   | –      | –       | –       |
| 30 to 500 MHz      | 1.57    | 2.22   | 1.44   | 1.16   | 1.77   | 1.03   | 1.98   | 2.14   | –       | –       |
| 500 MHz to 1.2 GHz | 1.65    | 2.49   | 1.60   | 1.54   | 2.12   | 1.07   | 2.07   | 2.45   | –       | –       |
| 1.2 to 6 GHz       | 2.04    | 2.85   | 1.96   | 1.99   | 3.91   | 1.40   | 2.40   | 2.65   | –       | –       |
| 6 to 14 GHz        | 2.62    | 3.81   | 4.81   | –      | –      | –      | 2.99   | 3.17   | –       | –       |
| 14 to 18 GHz       | 3.27    | 4.30   | 9.74   | –      | –      | –      | 3.35   | 3.41   | –       | –       |
| 18 to 26.5 GHz     | –       | –      | –      | –      | –      | –      | 4.70   | 4.04   | –       | –       |
| 26.5 to 33 GHz     | –       | –      | –      | –      | –      | –      | 6.41   | 4.43   | 3.76    | –       |
| 33 to 34 GHz       | –       | –      | –      | –      | –      | –      | –      | 4.84   | 4.25    | 6.04    |
| 34 to 35 GHz       | –       | –      | –      | –      | –      | –      | –      | 4.84   | 4.25    | 6.04    |
| 35 to 40 GHz       | –       | –      | –      | –      | –      | –      | –      | 4.84   | 4.25    | 6.04    |
| 40 to 45 GHz       | –       | –      | –      | –      | –      | –      | –      | 5.70   | –       | 5.86    |
| 45 to 50 GHz       | –       | –      | –      | –      | –      | –      | –      | 6.19   | –       | 6.59    |

| Frequency         | 0 ±55°C |
|-------------------|---------|
|                   | N8488A  |
| 100 kHz to 50 MHz | 3.69    |
| 50 to 100 MHz     | 2.63    |
| 100 MHz to 2 GHz  | 2.40    |
| 2 to 12.4 GHz     | 2.61    |
| 12.4 to 18 GHz    | 3.15    |
| 18 to 26.5 GHz    | 4.50    |
| 26.5 to 50 GHz    | 5.67    |
| 50 to 67 GHz      | 7.18    |
| 67 to 70 GHz      | 8.69    |

## Performance Characteristics (continued)

### Typical CF and SWR versus frequency

The chart below shows supplemental characteristics intended to provide additional information, useful in applying the power sensor by giving typical but not warranted performance parameters.



## Performance Characteristics (continued)

### General specifications

| Dimensions and weight     |  |
|---------------------------|--|
| Dimensions (W x H x L)    | N8481A/82A: 38 mm W x 30 mm H x 130 mm L<br>N8485A: 38 mm W x 30 mm H x 121 mm L<br>N8487A: 38 mm W x 30 mm H x 121 mm L<br>N8488A: 38 mm W x 30 mm H x 115 mm L<br>N8486AR: 38 mm W x 62 mm H x 152 mm L<br>N8486AQ: 38 mm W x 62 mm H x 152 mm L<br>N8481B/82B: 83 mm W x 114 mm H x 283 mm L<br>N8481H/82H: 38 mm W x 30 mm H x 174 mm L  |
| Weight                    | N8481A/2A: Net: 0.181 kg (0.40 lb) Shipping: 0.90 kg (1.98 lb)<br>N8485A: Net: 0.183 kg (0.40 lb); Shipping: 0.90 kg (1.98 lb)<br>N8487A: Net: 0.154 kg (0.34 lb); Shipping: 0.874 kg (1.92 lb)<br>N8488A: Net: 0.162 kg (0.36 lb); Shipping: 0.881 kg (1.94 lb)<br>N8486AR: Net: 0.202 kg (0.45 lb); Shipping: 0.922 kg (2.03 lb)<br>N8486AQ: Net: 0.204 kg (0.45 lb); Shipping: 0.924 kg (2.03 lb)<br>N8481B/82B: Net: 0.684 kg (1.51 lb); Shipping: 1.404 kg (3.09 lb)<br>N8481H/82H: Net: 0.234 kg (0.52 lb); Shipping: 0.954 kg (2.10 lb) |
| Operating environment     |  |
| Temperature               | 0 to 55°C  |
| Humidity                  | Maximum: 95% RH at 40 °C non-condensing  |
| Altitude                  | Up to 4600 m (15,000 ft)   |
| Storage conditions        |  |
| Temperature               | -40 to 70°C  |
| Humidity                  | Up to 90% RH at 65°C non-condensing  |
| Altitude                  | Up to 4600 m (15,000 ft)   |
| Other                     |  |
| Connector <sup>1</sup>    | N8481A/82A: N-type (male)<br>N8485A: 3.5 mm (male)<br>N8487A: 2.4 mm (male)<br>N8488A: 1.85 mm (male)<br>N8481B/82B: N-type (male)<br>N8481H/82H: N-type (male)<br>N8486AR: Waveguide flange UG-599/U<br>N8486AQ: Waveguide flange UG-383/U  |
| Programming language      | Standard: SCPI code-compatible to E-Series sensors<br>Option CFT: SCPI code-compatible to 8480 Series sensors  |
| Safety and EMC compliance | IEC 61326-2002/EN 61326:1997+A1:1998+A3:2003<br>Canada: ICES-001:2004, ICES/NMB-001:2004<br>Australia/New Zealand: AS/NZS CISPR11:2004   |
| Calibration interval      | 1 year   |
| Warranty <sup>1</sup>     | 3 years  |



### 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.

1. See "Ordering Information" for available options

## Ordering Information

### Power sensors

| <b>Standard power sensors</b>               | <b>Description</b>   | <b>Frequency range</b> | <b>Power range</b> |
|---|--|------------------------|--------------------|
| N8481A                                      | Standard N8481A model with EEPROM feature  | 10 MHz to 18 GHz       | -35 to +20 dBm     |
| N8482A                                      | Standard N8482A model with EEPROM feature  | 100 kHz to 6 GHz       | -35 to +20 dBm     |
| N8485A                                      | Standard N8485A model with EEPROM feature  | 10 MHz to 26.5 GHz     | -35 to +20 dBm     |
| N8487A                                      | Standard N8487A model with EEPROM feature  | 50 MHz to 50 GHz       | -35 to +20 dBm     |
| N8488A                                      | Standard N8488A model with EEPROM feature  | 10 MHz to 67 GHz       | -35 to +20 dBm     |
| N8481B                                      | Standard N8481B model with EEPROM feature  | 10 MHz to 18 GHz       | -5 to +44 dBm      |
| N8482B                                      | Standard N8482B model with EEPROM feature  | 100 kHz to 6 GHz       | -5 to +44 dBm      |
| N8481H                                      | Standard N8481H model with EEPROM feature  | 10 MHz to 18 GHz       | -15 to +35 dBm     |
| N8482H                                      | Standard N8482H model with EEPROM feature  | 100 kHz to 6 GHz       | -15 to +35 dBm     |
| N8486AR                                     | Standard N8486AR model with EEPROM feature   | 26.5 to 40 GHz         | -35 to +20 dBm     |
| N8486AQ                                     | Standard N8486AQ model with EEPROM feature   | 33 to 50 GHz           | -35 to +20 dBm     |
| <b>Other sensor options</b>                 | <b>Description</b>   |                        |                    |
| Option CFT                                  | N8480 sensor without the calibration factor table stored in the EEPROM. Calibration factor data is provided on the label attached to the power sensor  |                        |                    |
| N8485A-033                                  | N8485A model with EEPROM feature with extended frequency range, 10 MHz to 33 GHz   |                        |                    |
| <b>Standard-shipped</b>                     | <b>Description</b>   |                        |                    |
| Shipped as standard with every power sensor | <ul style="list-style-type: none"><li>- Certificate of Calibration</li><li>- Operating and Service Guide</li><li>- Product Reference CD (contains Migration Guide, Operating and Service Guide, firmware upgrades for EPM, EPM-P, and P-Series power meters, and upgrade procedures)</li></ul> |                        |                    |

## Ordering Information (continued)

### Accessories, calibration and documentation options

| Connectors          | Description   |
|---------------------|---|
| Option 100          | <ul style="list-style-type: none"><li>– Type-N (male) connector for N8481A/N8482A/N8481B/N8482B/N8481H/N8482H</li><li>– 3.5 mm (male) connector for N8485A</li><li>– 2.4 mm (male) connector for N8487A</li><li>– 1.85 mm (male) connector for N8488A</li><li>– Waveguide connector for N8486AR/N8486AQ</li></ul> |
| Option 200          | APC-7 (male) connector for N8481A only  |
| Cables              | Description   |
| 11730A              | For EPM Series power meters: 1.5 m (5 ft), grey   |
| 11730B              | For EPM Series power meters: 3 m (10 ft), grey  |
| 11730C              | For EPM Series power meters: 6.1 m (20 ft), grey  |
| 11730D              | For EPM Series power meters: 15.2 m (50 ft), grey   |
| 11730E              | For EPM Series power meters: 30.5 m (100 ft), grey  |
| 11730F <sup>1</sup> | For EPM Series power meters: 61 m (200 ft), grey<br>*operates up to 45 °C   |
| E9288A              | For EPM and EPM-P Series power meters: 1.5 m (5 ft), blue   |
| E9288B              | For EPM and EPM-P Series power meters: 3 m (10 ft), blue  |
| E9288C              | For EPM and EPM-P Series power meters: 10 m (31 ft), blue   |
| N1917A              | For P-Series power meters: 1.5 m (5 ft)   |
| N1917B              | For P-Series power meters: 3 m (10 ft)  |
| N1917C              | For P-Series power meters: 10 m (31 ft)   |
| Calibration         | Description   |
| Option 1A7          | ISO 17025 calibration with test data  |
| Option A6J          | ANSI Z540 calibration with test data  |
| Warranty            | Description   |
| Option R-51B-001-3C | Return to Keysight Technologies Warranty - 3 years  |
| Option R-51B-001-5C | Warranty Assurance Plan - Return to Keysight Technologies - 5 years   |
| Documentation       | Description   |
| Option OB1          | English language Operating and Service Guide  |
| Option ABJ          | Japanese localization Operating and Service Guide   |

1. Only applicable for E4418/19B power meters

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