Agilent N8480 Series Power Sensors

Operating and Service Guide

Agilent Technologies

Notices

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CAUTION

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WARNING

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Safety Symbols

The following symbol on the instrument and in the documentation indicates precautions that must be taken to maintain safe operation of the instrument.

	Direct current (DC)		Off (supply)
	Alternating current (AC)		On (supply)
	Both direct and alternating current		Caution, risk of eletric shock
	Three-phase alternating current		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	Earth (ground) terminal		Caution, hot surface
	Protective conductor terminal		Out position of a bi-stable push control
	Frame or chassis terminal		In position of a bi-stable push control
	Equipotentiality		Equipment protected throughout by double insulation or reinforced insulation
	This symbol indicates that a device, or part of a device, may be susceptible to electrostatic discharges (ESD) which can result in damage to the product. Observe ESD precautions given on the product, or its user documentation, when handling equipment bearing this mark.		

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CE ISM 1-A	The CE mark shows that the product complies with all the relevant European legal Directives (if accompanied by a year, it signifies when the design was proven).		The C-tick mark is a registered trademark of the Spectrum management Agency of Australia. This signifies compliance with the Australian EMC Framework regulations under the terms of the Radio Communications Act of 1992.
ICES/NMB-001	This ISM device complies with the Canadian ICES-001, Cet appareil ISM est conforme à la norme NMB-001 du Canada.		This product complies with the WEEE Directive (2002/96/EC) marking equipment. The affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.

General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING **BEFORE CONNECTING THE POWER SENSOR TO OTHER INSTRUMENTS ensure that all instruments are connected to the protective (earth) ground. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.**

CAUTION

- Use the device with the cables provided.
- Repair or service that is not covered in this manual should only be performed by qualified personnels.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instruction complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is shown as below:

Do not dispose in domestic household waste

To return this unwanted instrument, contact your nearest Agilent office, or visit

www.agilent.com/environment/product

for more information.

Environmental Conditions

This instrument is designed for indoor use only. The table below shows the general environmental requirements for the product.

Operating Environment

Environmental Conditions	Requirements
Temperature	0 °C to 55°C (Operating)
Humidity	Maximum: 95 % at 40 °C Minimum: 15 % at 40 °C
Altitude	Operating up to 4,600 metres (15,000 feet)

Storage Conditions

Environmental Conditions	Requirements
Temperature	–40 °C to 70 °C (Non-operating)
Humidity	Non-operating up to 90 % at 65 °C (Non-condensing)
Altitude	Non-operating up to 4,600 metres (15,000 feet)

CAUTION

The N8480 Series power sensors complies with the following EMC requirements:

- IEC 61326-2002/EN 61326:1997+A1:1998+A3:2003
- Canada: ICES-001:2004
- Australia/New Zealand: AS/NZS CISPR11:2004

Agilent Technologies	**DECLARATION OF CONFORMITY** According to EN ISO/IEC 17050-1:2004	CE

Manufacturer's Name: Agilent Technologies Microwave Products (M) Sdn. Bhd
Manufacturer's Address: Bayan Lepas Free Industrial Zone,
11900, Bayan Lepas, Penang, Malaysia

Declares under sole responsibility that the product as originally delivered

Product Name: Agilent N8480 Series Power Sensor
Models Number: N8481A, N8482A, N8485A
Product Options: This declaration covers all options of the above product(s)

complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

EMC Directive (2004/108/EC)

and conforms with the following product standards:

EMC	Standard	Limit
	IEC 61326:2002 / EN 61326:1997+A1:1998+A2:2001+A3:2003	
	CISPR 11:1990 / EN55011:1990	Class A Group 1
	IEC 61000-4-2:1995 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995 / EN 61000-4-3:1996	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995 / EN 61000-4-5:1995	0.5 kV line-line, 1 kV line-ground
	IEC 61000-4-6:1996 / EN 61000-4-6:1996	3 V, 0.15-80 MHz
	IEC 61000-4-11:1994 / EN 61000-4-11:1994	1 cycle / 100%

Canada: ICES-001:2004
Australia/New Zealand: AS/NZS CISPR11:2004

The product was tested in a typical configuration with Agilent Technologies test systems.

This DoC applies to above-listed products placed on the EU market after:

27-March-2008
Date

Tay Eng Su
Quality Manager

Product Regulations

EMC

	Performance Criteria
IEC 61326-1:2002 / EN 61326-1:1997+A1:1998+A2:2001+A3:2003	
CISPR 11:1990 / EN 55011:1990 – Group 1 Class A	
IEC 61000-4-2:1995 / EN 61000-4-2:1995 (ESD 4kV CD, 8kV AD)	A
IEC 61000-4-3:1995 / EN 61000-4-3:1996 (3V/m, 80% AM)	A
IEC 61000-4-4:1995 / EN 61000-4-4:1995 (EFT 0.5kV line-line, 1kV line-earth)	A
IEC 61000-4-5:1995 / EN 61000-4-5:1995 (Surge 0.5kV line-line, 1kV line-earth)	A
IEC 61000-4-6:1996 / EN 61000-4-6:1996 (3V, 0.15~80 MHz, 80% AM, power line)	A
IEC 61000-4-11:1994 / EN 61000-4-11:1994 (Dips 1 cycle, 100%)	A
Canada: ICES-001:2004	
Australia/New Zealand: AS/NZS CISPR11:2004	

Additional Information:

The product herewith complies with the essential requirements of the EMC Directive 2004/108/EC and carries the CE Marking accordingly (European Union).

[1]Performance Criteria:

A Pass - Normal operation, no effect.
B Pass - Temporary degradation, self recoverable.
C Pass - Temporary degradation, operator intervention required.
D Fail - Not recoverable, component damage.
N/A – Not applicable

Notes:

Regulatory Information for Canada

ICES/NMB-001:2004
This ISM device complies with Canadian ICES-001.
Cet appareil ISM est confomre à la norme NMB-001 du Canada.

Regulatory Information for Australia/New Zealand

This ISM device complies with Australian/New Zealand AS/NZS CISPR11:2004

N10149

In This Guide ...

1 **Introduction** Chapter 1 introduces the overview and operation of the N8480 Series power sensors.

2 **Specifications and Characteristics** Chapter 2 describes the specifications and characteristics of the N8480 Series power sensors.

3 **Service** Chapter 3 elaborates on the information about principle of operations, troubleshooting,and repair of the N8480 Series power sensors.

Contents

List of Figures

List of Tables

1 Introduction

This chapter contains information about initial inspection and overview of the Agilent N8480 Series power sensors.

General Information

This guide contains information about the initial inspection, connections, specifications, operation, and performance tests of the N8480 Series power sensors. You can also find a copy of this guide on the *EPM and EPM- P Series Power Meter Documentation CD* supplied with the power meter.

Figure 1-1 N8480 Series power sensors

Initial Inspections

1 Inspect the shipping container for damage. Signs of damage may include a dented or torn shipping container or cushioning material that shows signs of unusual stress or compacting.

2 Carefully remove the contents from the shipping container and verify that your order is complete.

NOTE

- If the shipping container or packaging material is damaged, it should be kept until the contents have been checked mechanically and electrically. If there is mechanical damage, notify the nearest Agilent Technologies office. Keep the damaged shipping materials (if any) for inspection by the carrier and Agilent representative. If required, you can find a list of Agilent Sales and Service Offices on the last page of this guide.
- Ensure you have read and understand the preceding safety information before proceed.

Accessories Shipped with the Instrument

The following items are shipped with every purchase of N8480 Series power sensor:

- Certificate of Calibration
- N8480 Series power sensors Operating and Service Guide
- Product Reference CD

Verify that any options ordered are included with the shipment by checking the packing list included with the shipment.

Original Packaging

Containers and materials indentical to those used in the factory pakaging are available through Agilent Technologies office. If the instrument is being returned to Agilent technologies for servicing, attach a tag indicating the type of service required, return address, model number, and serial number. Also mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Power Meter and Sensor Cable Requirements

Table 1- 1 lists the length of cable option for N8480 Series power sensors.

Table 1-1 Power sensor cable options

Power Sensor Cable Option	Description	Supported Power Meter
11730 Family Sensor Cables (Grey)		EPM Series power meters
11730A	1.5 m (5-ft) cable length	
11730B	3 m (10-ft) cable length	
11730C	6.1 m (20-ft) cable length	
11730D	15.2 m (50-ft) cable length	
11730E	30.5 m (100-ft) cable length	
11730F	61 m (200-ft) cable length (operate up to 45 °C)	
E9288 Family Sensor Cables (Blue)		EPM Series power meters EPM-P Series power meters
E9288A	1.5 m (5-ft) cable length	
E9288B	3 m (10-ft) cable length	
E9288C	10 m (31-ft) cable length	
N1917 Family Sensor Cable Adapter		P-Series power meters
N1917A	1.5 m (5-ft) cable length	
N1917B	3 m (10-ft) cable length	
N1917C	10 m (31-ft) cable length	

Interconnection and Calibration

Connect one end of the supported sensor cable to the N8480 Series power sensor and connect the other end of the cable to the power meter's channel input. Allow a few seconds for the power meter to download the data from the power sensor's EEPROM.

Figure 1-2 Connecting a sensor cable to power meter

WARNING **BEFORE CONNECTING THE POWER SENSOR TO OTHER INSTRUMENTS ensure that all instrumnets are connected to the protective (earth) ground. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.**

To carry out a zero and calibration cycle as requested by the power meter, refer to the respective meter's user's guide for details of the power sensor's zero and calibration procedures.

Recommended Calibration Interval

Agilent Technologies recommends a one- year calibration cycle for the N8480 Series power sensors.

Temperature Sensitivity

The sensitivity of the power sensor is influenced by ambient temperature. The sensor should be recalibrated at each change in temperature to obtain the most accurate results. The sensor has a built- in temperature compensation that ensures the accuracy of measurement carried out within 0 to 55°C, refer to Table 2- 5 for details. For measurement below –25 dBm, it is recommended to re- apply zero procedure when there has been a temperature variation of > ±5 °C since the last zeroing.

Operating Instructions

To operate the power sensor, refer to the operating instructions in the power meter's user's guide.

Modulation Effect

When measuring RF or microwave sources that are modulated at the chopper frequency (nominally 440 Hz), at the first or second harmonic or submultiples of the chopper frequency, beat notes may occur. Unless these beat notes are exactly the chopper frequency, they can usually be eliminated by averaging (filtering) since the amplitudes are plus and minus the actual power. These frequencies may also be avoided by changing the modulation frequency slightly, if possible.

Refer to the power meter's user's guide for information on setting the averaging (filtering).

Torque

Table 1- 2 shows the connector type (for connection to DUT) for the power sensor models. A torque wrench must be used to tighten these connectors. Only use a wrench set to the correct torque value.

Table 1-2 RF connector type, wrench size and torque values

Model	Option	RF Connector	Wrench Size	Torque Value
N8481A	N8481A-100	Type-N (male)	3/4 inch open end	12 lb-in
	N8481A-200	APC-7		
N8482A	N8482A-100	Type-N (male)		
N8485A	N8485A-100	APC 3.5 mm (male)	3/4 inch open end	8 lb-in

Overview of the N8480 Series Power Sensors

The N8480 Series power sensors are high accuracy thermocouple power sensors that allow direct measurement of RF or microwave power through the heating effect it has on a terminating load. All calibration data for the N8480 Series sensors is stored in EEPROM[1] and is downloaded to the power meter when the sensor is connected. In terms of functionality and performance, they replace and surpass the popular 8480 thermocouple sensors (8481A, 8482A and 8485A)

The N8480 Series power sensors is used for measuring the average power supplied by an RF or microwave source or a device- under- test (DUT). In use, the power sensor is connected to the RF or microwave source and to a compatible power meter. The N8480 Series is compatible with the EPM Series power meters (E4418B and E4419B), EPM- P Series power meters (E4416A and E4417A) and P- Series power meters (N1911A and N1912A) only. The N8480 Series power sensors places a 50 Ω load on the RF or microwave source. The power meter indicates the power dissipated in this load in mW or dBm.

The N8480 sensors (excluding Option CFT) measure power levels from –35 dBm to +20 dBm (316 nW to 100 mW), at frequencies from 100 kHz to 33 GHz and have two independent power measurement range (upper and lower range).

Table 1-3 Power range in the Range setting

Sensor	Range Setting	Lower Range	Upper Range
N8481/2/5A excluding Option CFT	AUTO (Default)	–35 dBm to –1 dBm	–1 dBm to +20 dBm
	LOWER	–35 dBm to –1 dBm	-
	UPPER[2]	-	–30 dBm to +20 dBm

Meanwhile, the N8480 sensors with Option CFT only measure power levels from –30 dBm to +20 dBm (1 µW to 100 mW) in single range. Similiar to the E- Series power sensors, the N8480 Series power sensors are also equipped with EEPROM to store sensor's characteristics such as model number, serial number, linearity, temperature compensation, calibration factor and so forth.

[1] The calibration factor table stored in the EEPROM is not applicable for N8480 Series sensors with Option CFT.

[2] Recommended for pulse signals measurement with period of more than one second.

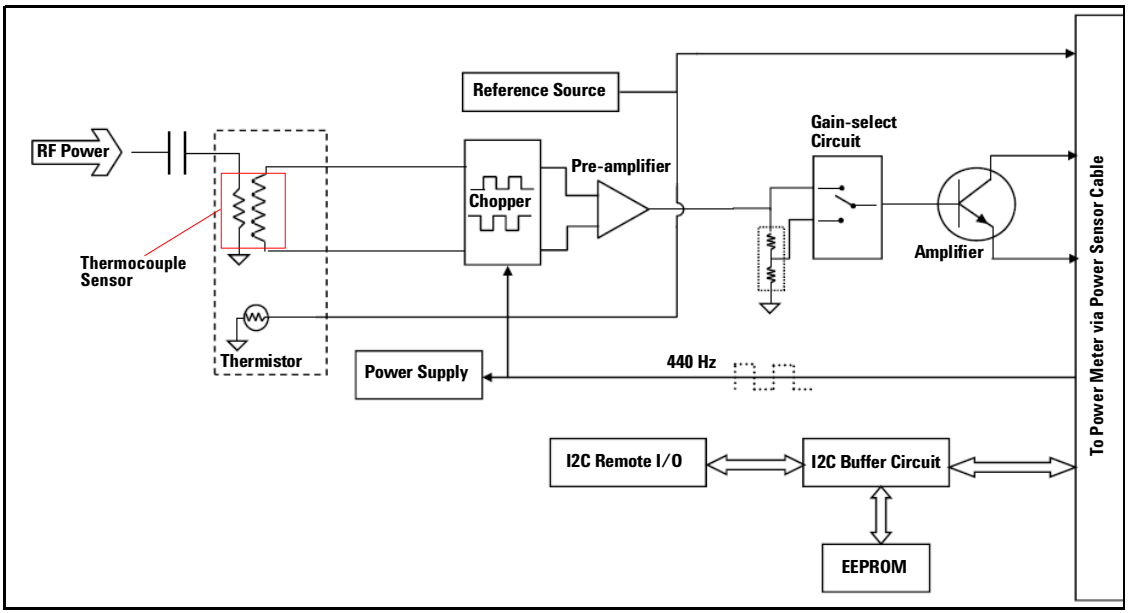

Figure 1-3 N8480 Series power sensor simplified block diagram

This feature ensures the correct calibration data is applied by any compatible power meter connected with N8480 Series sensor, and to ensure the accuracy of the measurements.

Figure 1-3 shows a basic power sensor block diagram for thermocouple power sensing elements. From the RF or microwave signal input, the thermocouple detector mounts generate a very low voltage – in the order of nV. As the DC voltage is very low, it requires amplification before it can be transferred to the power meter on the standard cables.

The amplification is provided by an input amplifier assembly that consists of a balanced chopper and an AC coupled low- noise amplifier. The dc voltage is routed through gold wires to the chopper circuit, which converts the low- level DC voltage to an AC voltage. To do this, the chopper is controlled by a 440 Hz square- wave generated by the power meter (the Chop Signal). The result is an AC output signal proportional to the DC input. The AC signal is then amplified to a relatively high- level AC signal that can be routed to the power meter by standard cables (Agilent 11730 Series cable available up to 61 metres from –5 °C to 45 °C).

N8480 Series, Options

N8485A Option 033

The N8485A power sensor with Option 033 is calibrated to measure power levels in the 10 MHz to 33 GHz frequency range.

N8481A Option 200

The N8481A power sensor is fitted with N- type (m) connector as standard. Users can choose the sensor to be fitted with APC- 7 connector by choosing the Option 200.

N8480 Series power sensors with Option CFT (N8481A Option CFT, N8482 Option CFT and N8485A Option CFT)

The N8480 Series power sensors with Option CFT covers –30 dBm to +20 dBm in a single power range and allows users to use the calibration factor in two methods:

- manually enter the calibration factor for a particular frequency prior to make a measurement; or
- manually enter the sensors calibration factor table and select the frequency of the signal to be measured

The calibration factor data is provided on the label attached to the power sensor's cover. This calibration factor is used to make frequency dependent efficiency correction and it is unique to each sensors.

For Option CFT specifications and characteristics, see Chapter 2, "Specifications and Characteristics."

NOTE

- The calibration factor table stored in the EEPROM is not applicable for N8480 Series power sensors with Option CFT.
- Please refer to the respective power meter's user's guide on how to make a measurement using the calibration factor table.

Power Meter Firmware Compatibility

Before using N8480 Series power sensors, make sure the power meter is using the latest firmware as shown in Table 1- 4. This is to ensure that the power meter is compatible with N8480 Series power sensors.

Table 1-4 Power meter firmware

Power Meter	Model Number	Compatible Firmware Revision
EPM Series power meters	E4418B	A1.09.00 and above
	E4419B	A2.09.00 and above
EPM-P Series power meters	E4416A	A1.05.00 and above
	E4417A	A2.05.00 and above
P-Series power meters	N1911A	A.05.00 and above
	N1912A	

For detailed information on the firmware installation, refer to the respective power meter Web site located at www.agilent.com under **Technical Support** > **Drivers & Software** > **Firmware Update**.

NOTE You can also find the compatible power meter's firmware as well as the firmware upgrade procedures in *N8480 Series Power Sensors Product Reference CD*.

Power Meter Configuration Changes

The Agilent EPM Series, EPM- P Series or P- Series power meters recognize when an Agilent N8480 Series power sensor is connected. The N8480 Series power sensors (excluding Option CFT) calibration data is automatically read by the power meter. In addition, the auto- averaging settings shown in Figure 1- 4 are also automatically configured.

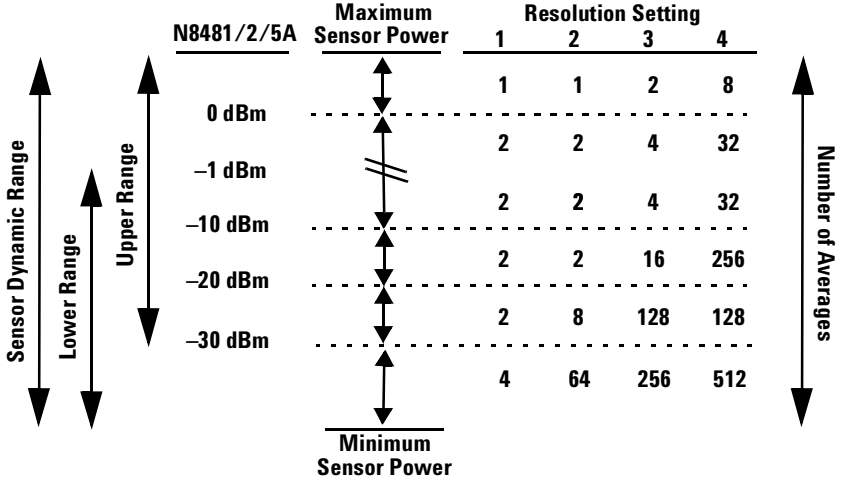

Figure 1-4 Auto-averaging settings

NOTE These values are valid only for the power meter channel connected to an Agilent N8480 Series power sensor. Averaging settings can also be manually configured. Refer to the power meter's user's guide for information on setting the averaging (filtering).

Measurement Accuracy and Speed

The power meter has no internal ranges. The only ranges you can set are those of the Agilent N8480 Series power sensors and other Agilent E- Series power sensors. With an Agilent N8480 Series power sensor or E- Series power sensor, the range can be set either automatically or manually. Use autoranging when you are not sure of the power level you are about to measure.

Measurement Considerations

While autoranging is a good starting point, it is not ideal for all measurements. Signal characteristics such as crest factor or duty cycle may cause the power meter to select a range which is not the optimum configuration for your specific measurement needs. Signals with average power levels close to the range switch point require you to consider your needs for measurement accuracy. When measuring pulse signals, you are recommended to select manual filtering. This allows you to choose the averaging to cover the many periods of the pulse signal instead of having it determined by measurement noise. Selecting manual filtering also changes the behaviour of the autoranging to help prevent frequency range changes due to pulses. For a very long pulse periods (> one second), it may be better to select UPPER range as this will prevent any possibility of range changes upsetting the measurement.

1 Introduction

2
Specifications and Characteristics

This chapter contains information about specifications and characteristics of the Agilent N8480 Series power sensors.

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°C 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 sensor meet its 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.

Specifications

NOTE

- Specifications stated in this chapter refer to all N8480 Series power sensors unless otherwise stated.
- The term “standard” used in table under the Sensor Option column is refering to all N8480 Series sensors except Option CFT.

Frequency and Dynamic Power Range

Table 2-1 Frequency and dynamic power range

Sensor Option	Sensor Model	Frequency Range	Dynamic Power Range
Standard	N8481A	10 MHz to 18 GHz	–35 dBm to +20 dBm
	N8482A	100 kHz to 6 GHz	
	N8485A	10 MHz to 26.5 GHz	
	N8485A Option 033	10 MHz to 33 GHz	
Option CFT	N8481A	10 MHz to 18 GHz	–30 dBm to +20 dBm
	N8482A	100 kHz to 6 GHz	
	N8485A	10 MHz to 26.5 GHz	
	N8485A Option 033	10 MHz to 33 GHz	

Damage Level

Table 2-2 Damage level at average and peak power

Sensor Model	Damage Level (Average Power)	Damage Level (Peak Power)
N8481A N8482A N8485A	+25 dBm	15 W/2 µs

Maximum SWR

Table 2-3 Maximum SWR (25 °C ± 10 °C)

Sensor Model	Frequency Band	Maximum SWR
N8481A	10 MHz to 30 MHz	1.37
	30 MHz to 50 MHZ	1.10
	50 MHz to 2 GHz	1.05
	2 GHz to 12.4 GHz	1.16
	12.4 GHz to 18 GHz	1.23
N8482A	100 kHz to 300 kHz	1.52
	300 kHz to 1 MHz	1.12
	1 MHz to 2 GHz	1.06
	2 GHz to 6 GHz	1.07
N8485A	10 MHz to 50 MHz	1.33
	50 MHz to 100 MHz	1.06
	100 MHz to 2 GHz	1.04
	2 GHz to 12.4 GHz	1.13
	12.4 GHz to 18 GHz	1.18
	18 GHz to 26.5 GHz	1.25
	26.5 GHz to 33 GHz [3]	1.31

[3] Only applicable for N8485A Option 033

Table 2-4 Maximum SWR (0 °C to 55 °C)

Sensor Model	Frequency Band	Maximum SWR
N8481A	10 MHz to 30 MHz	1.57
	30 MHz to 50 MHZ	1.16
	50 MHz to 2 GHz	1.07
	2 GHz to 12.4 GHz	1.16
	12.4 GHz to 18 GHz	1.25
N8482A	100 kHz to 300 kHz	1.57
	300 kHz to 1 MHz	1.13
	1 MHz to 2 GHz	1.06
	2 GHz to 6 GHz	1.08
N8485A	10 MHz to 50 MHz	1.53
	50 MHz to 100 MHz	1.11
	100 MHz to 2 GHz	1.05
	2 GHz to 12.4 GHz	1.14
	12.4 GHz to 18 GHz	1.20
	18 GHz to 26.5 GHz	1.38
	26.5 GHz to 33 GHz [3]	1.36

[3] Only applicable for N8485A Option 033

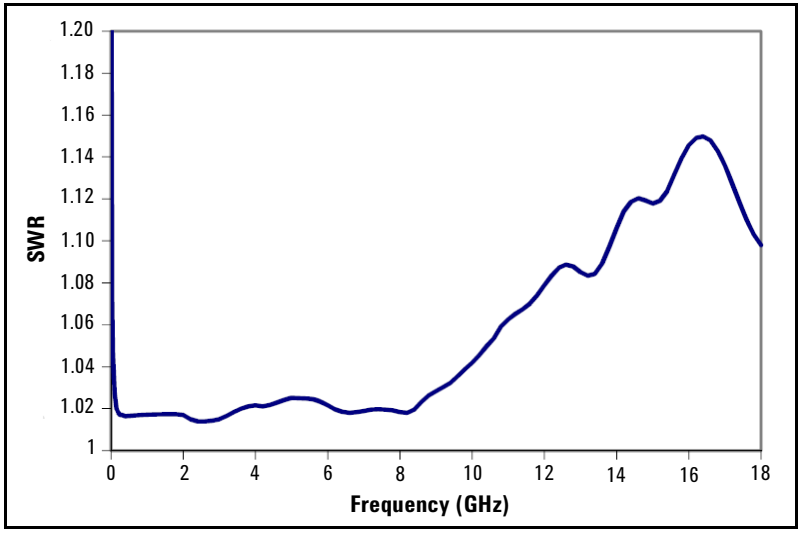

Figure 2-1 *Typical SWR, 10 MHz to 18 GHz (25 °C ±10 °C) for N8481A sensor*

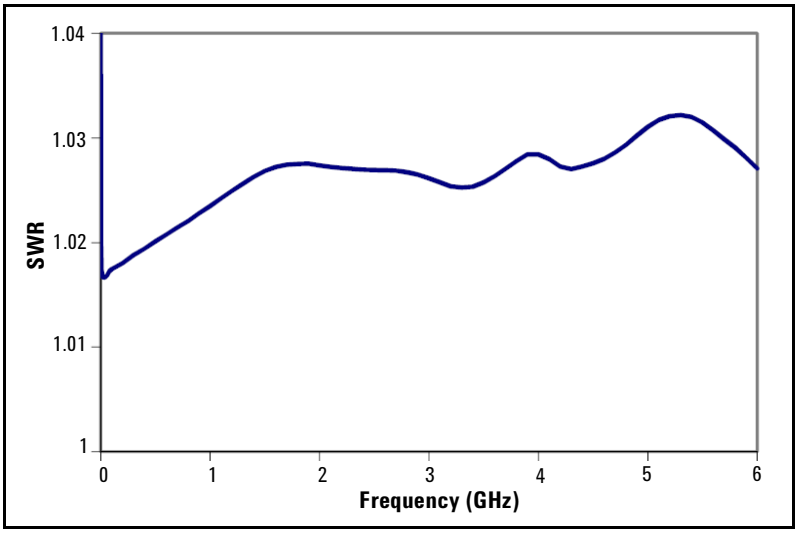

Figure 2-2 *Typical SWR, 100 kHz to 6 GHz (25 °C ±10 °C) for N8482A sensor*

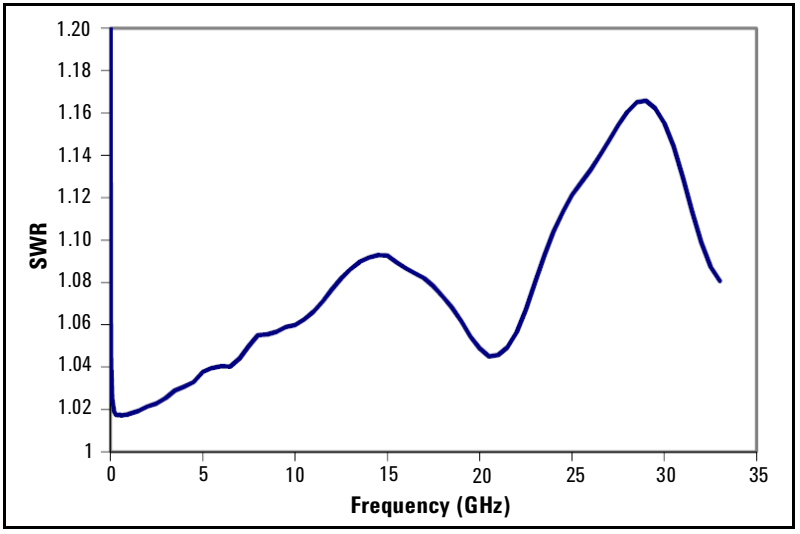

Figure 2-3 *Typical SWR, 10 MHz to 26.5 GHz (25 °C ±10 °C) for N8485A sensor*

Power Linearity

After zero and calibration at ambient environment conditions.

NOTE The N8480 Series power sensors' linearity is negligible except for the power range specified in Table 2-5.

Table 2-5 Power linearity

Sensor Model	Power Range	Linearity (25 °C ± 10 °C)	Linearity (0 °C to 55 °C)
N8481A	–1 dBm to +10 dBm	±0.52%	±0.80%
N8482A	+10 dBm to +15 dBm	±0.52%	±0.80%
N8485A	+15 dBm to +20 dBm	±0.80%	±1.90%

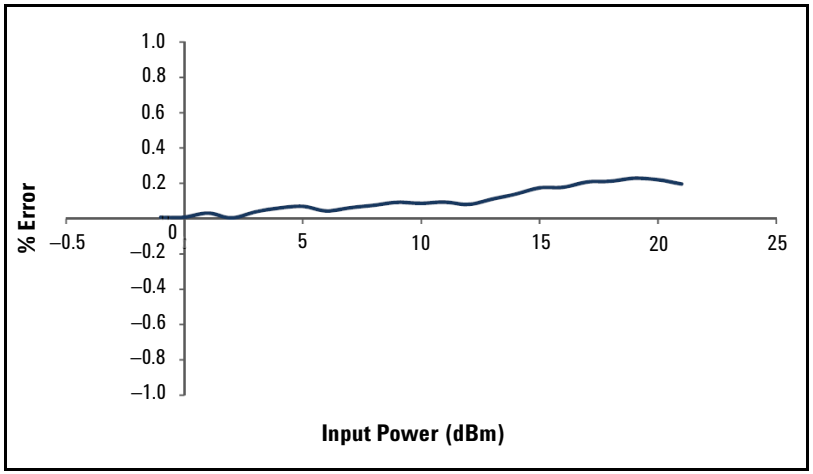

Figure 2-4 *Typical N8481/2/5A power linearity at 25 °C, after zero and calibration with associated measurement uncertainty*

N8481/2/5A	–1 dBm to +10 dBm	+10 dBm to +15 dBm	+15 dBm to +20 dBm
Measurement Uncertainty (%)	*±0.35*	*±0.35*	*±0.35*

Switching Point

NOTE Switching point is applicable for standard N8480 Series power sensors only.

The N8480 Series power sensors (excluding Option CFT) have two power measurement range, a lower range covering –35 dBm to –1 dm, and upper range covering –1 dBm to +20 dBm. The power meter automatically selects the proper power range. To avoid unnecessary switching when the power level is near the –1 dBm point, **Switching Point Hysteresis** has been added.

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

The upper range remains selected until approximately –1.5 dBm as the signal level decreases, below this power the lower range is selected.

Table 2-6 *Switching point hysteresis*

Sensor Model	Switching Point Hysteresis
N8481A N8482A N8485A	*0.5 dB*

Zero Set, Zero Drift and Measurement Noise

Table 2-7 Zero set, zero drift and measurement noise

Sensor Model	Sensor Option	Conditions (RH)[1]	Zero Set	Zero Drift[2]	Measurement Noise[3]
N8481A N8482A N8485A	Standard	20% to 70%	±25 nW	*< ±3 nW*	*< 80 nW*
	Option CFT	20% to 70%	±63 nW	*< ±7 nW*	*< 114 nW*

1. RH is the abbreviation for Relative Humidity

2. Within one hour after zero set, at a constant temperature, after a 24 hour warm-up of the power meter with sensor connected.

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.

Settling Time

In normal and x2 mode, manual filter, 10 dB decreasing power step (not across the switching point), the settling time is:

Table 2-8 *Settling time in normal and x2 mode*

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

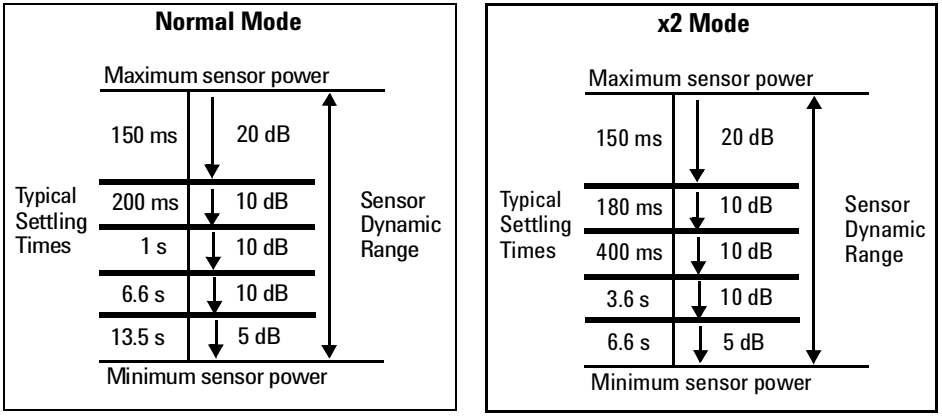

Figure 2-5 *Autofilter, default resolution, 10 dB decreasing power step (not across the switching point)*

Calibration Factor and Reflection Coefficient

Calibration Factor (CF) and Reflection Coefficient (Rho) data are provided 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 Agilent EPM Series, EPM- P Series or P- Series power meters automatically read the CF data stored in the sensor's EEPROM and use it to make the corrections.

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

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

Typical measurement uncertainties of the Calibration Factor (CF) are listed in the following tables. There is only one set of CF data used for both high and low range of each sensors. Therefore, there is only one set of measurement uncertainty data available. The typical measurement uncertainty data listed in this guide 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 certificate of calibration of the specific sensor.

NOTE Do not assume the typical measurement uncertainty listed in this guide as the maximum calibration factor measurement uncertainty.

Calibration Factor Uncertainty

Table 2-9 Calibration factor uncertainty

Frequency	25°C ± 10°C			0°C to 55°C		
	N8481A	N8482A	N8485A	N8481A	N8482A	N8485A
100 kHz to 10 MHz	-	1.28	-	-	1.59	-
10 MHz to 30 MHz	1.63	1.03	0.94	4.71	0.88	1.25
30 MHz to 500 MHz	1.13	0.96	1.43	1.73	1.16	1.99
500 MHz to 1.2 GHz	1.14	1.08	1.45	1.79	1.44	2.07
1.2 GHz to 6 GHz	1.38	1.97	1.68	2.20	2.13	2.41
6 GHz to 14 GHz	1.97	-	2.28	2.78	-	3.05
14 GHz to 18 GHz	2.26	-	2.51	3.47	-	3.48
18 GHz to 26.5 GHz	-	-	3.81	-	-	5.03
26.5 GHz to 33 GHz	-	-	4.88	-	-	6.78

Supplemental Characteristics

Supplemental characteristics are intended to provide additional information, useful in applying the power sensor by giving a typical but not warranted performance parameters.

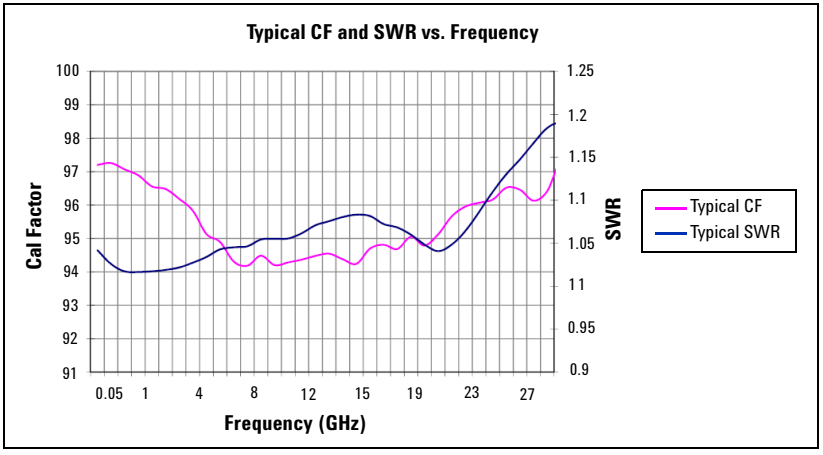

Figure 2-6 *Typical cal factor and SWR vs. frequency*

Physical Characteristics

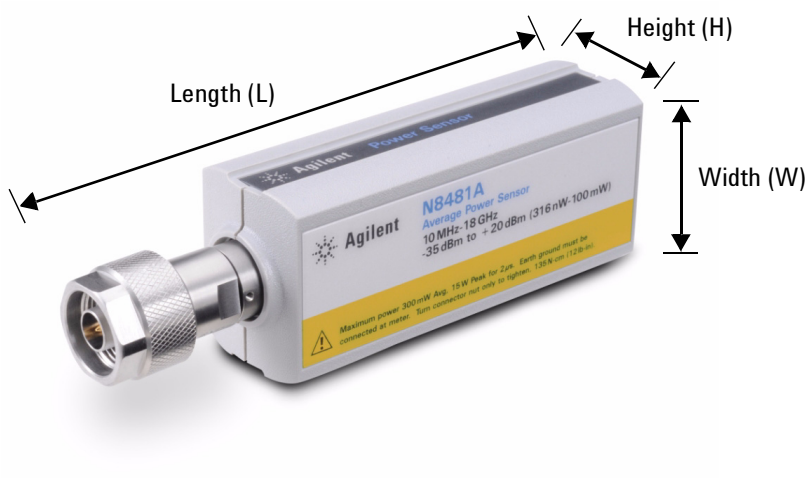

Table 2-10 *Physical dimensions*

Sensor Model	Dimensions	Weight
N8481A N8482A	*38 mm W x 30 mm H x 130 mm L* *(1.5 in X 1.2 in X 5.1 in)*	Net: *0.181 kg (0.40 lb)* Shipping: *0.90 kg (1.98 lb)*
N8485A	*38 mm W x 30 mm H x 121 mm L* *(1.5 in X 1.25 in X 4.75 in)*	Net: *0.183 kg (0.40 lb)* Shipping: *0.90 kg (1.98 lb)*

3 Service

This chapter contains information about principle of operations, troubleshooting and repair of the Agilent N8480 Series power sensors.

Cleaning

Use a clean, damp cloth to clean the body of the N8480 Series power sensors.

Connector Care

A solution of pure isopropyl or ethyl alchohol can be used to clean connectors but make sure to keep in mind on its flammable nature.

CAUTION

- The RF connector bead deteriorates when contacted with any chlorinated or aromatic hydrocarbon such as acetone, thrichlorethane, carbon tetrachloride, and benzene.
- Do not attempt to clean connectors with anything metallic such as pins or paper clips.

Clean the connector only at a static free workstation. Electrostatic discharge to the center pin of the connector will render the power sensor inoperative.

Clean the connector face by first using a blast of compressed air. If the compressed air fails to remove contaminants, use a cotton swab dipped in isopropyl or ethyl alcohol. If the swab is too big, use a round wooden toothpick wrapped in a lint free cloth dipped in isopropyl or ethyl alcohol.

Principle of Operations

The A1 module assembly on the Agilent N8480 Series power sensors provides a 50 Ω load to the RF signal applied to the power sensor. A thermocouple assembly in the bulkhead converts the applied RF to produce DC voltages which vary with the RF power across the 50 Ω load.

The low- level DC voltages from the bulkhead assembly are amplified before they are transferred on standard cables to the power meter. The amplification is provided by an input amplifier assembly which consists of a chopper (sampling gate) and an input amplifier. The chopper circuit converts the DC voltages to AC voltages. The chopper is controlled by a 440 Hz square wave generated by the power meter. The amplitude of the sampling gate output is a 440 Hz square wave which varies with the RF power input. The 440 Hz AC output is applied to an amplifier which provides the input to the power meter.

The Agilent EPM Series, EPM- P Series or P- Series power meters automatically detects when an Agilent N8480 Series power sensors is connected and downloads the correction data from the sensor's EEPROM. The auto- averaging settings are also configured automatically for use with Agilent N8480 Series power sensors. This configures the power meter to operate over the range with that particular sensor's unique correction data applied.

Performance Test

Standing Wave Ratio (SWR) and Reflection Coefficient (Rho) Performance Test

This section does not establish preset SWR test procedures since there are several test methods and different equipment available for testing the SWR or reflection coefficient. Therefore, the actual accuracy of the test equipment must be accounted for when measuring against instrument specifications to determine a pass or fail condition. The test system used must not exceed the system Rho uncertainties shown in Table 3- 1 when testing the N8480 Series power sensors.

Table 3-1 Reflection coefficient for N8481A, N8482A and N8485A (25 °C ± 10 °C)

Sensor Model	Frequency	System Rho Uncertainty	Actual Measurement	Maximum Rho
N8481A	10 MHz to 30 MHz	±0.005		0.130
	30 MHz to 50 MHz	±0.005		0.041
	50 MHz to 2 GHz	±0.005		0.018
	2 GHz to 12.4 GHz	±0.011		0.060
	12.4 GHz to 18 GHz	±0.012		0.089
N8482A	100 kHz to 300 kHz	±0.014		0.200
	300 kHz to 1 MHz	±0.003		0.053
	1 MHz to 2 GHz	±0.003		0.019
	2 GHz to 6 GHz	±0.006		0.025
N8485A	10 MHz to 50 MHz	±0.010		0.112
	50 MHz to 100 MHz	±0.006		0.025
	100 MHz to 2 GHz	±0.005		0.015
	2 GHz to 12.4 GHz	±0.008		0.052
	12.4 GHz to 18 GHz	±0.010		0.073
	18 GHz to 26.5 GHz	±0.013		0.095
	26.5 GHz to 33 GHz	±0.019		0.117

Replaceable Parts

Figure 3- 1 illustrates the parts breakdown of the N8480 Series power sensors that identifies all the replaceable parts. To order a part, quote the Agilent part number, specify the quantity required, and address the order to the nearest Agilent office.

NOTE

If you are located within United States, you are adviced to order directly from the Agilent Parts Center in Roseville, California.

Ask your nearest Agilent office for ordering information and forms for the “Direct Mail Order System”. Information such as toll free telephone number will be provided.

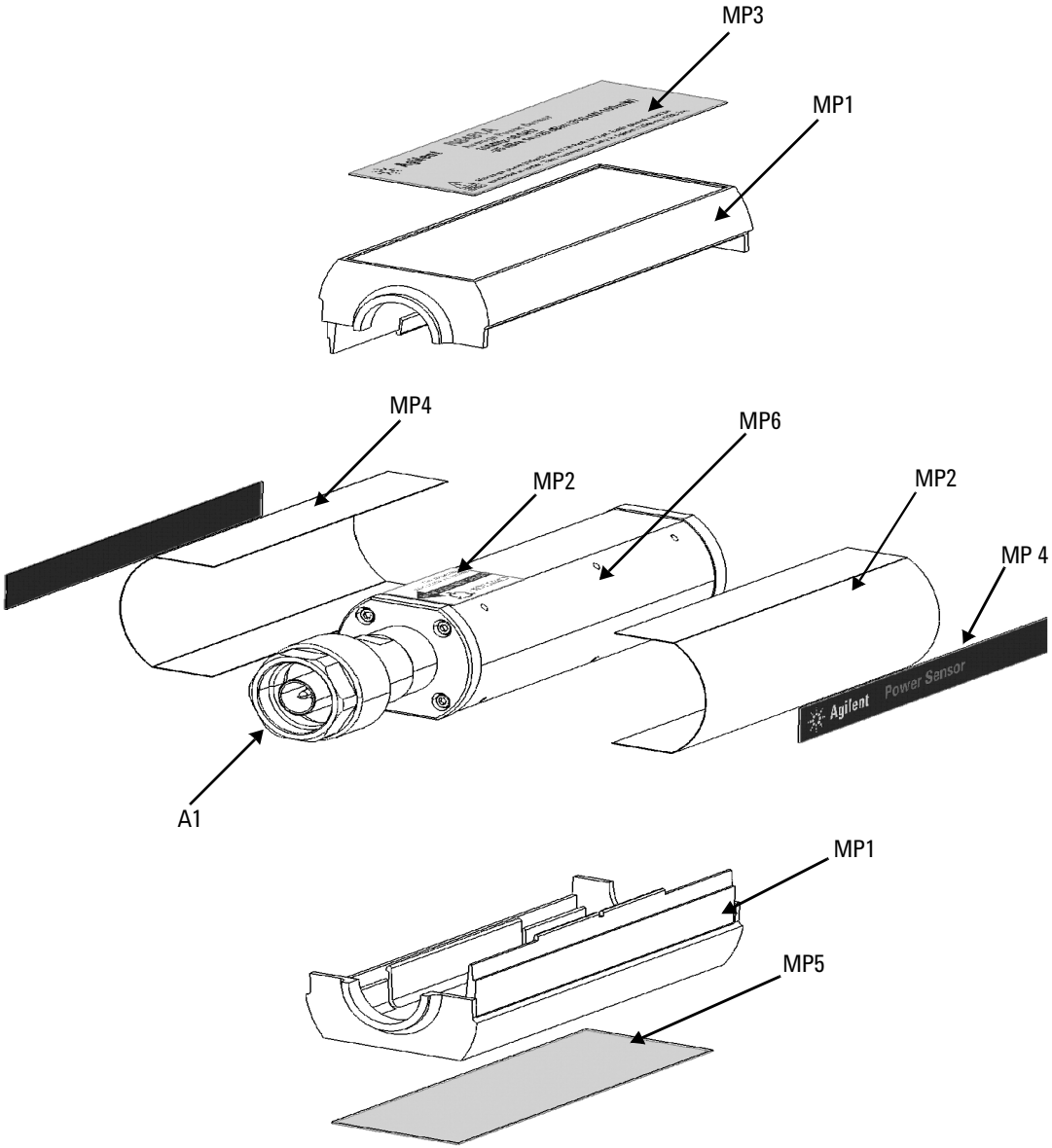

Figure 3-1 Illustrated Parts Breakdown

Table 3-2 Replaceable parts list for standard N8480 Series sensors

Reference Designaton	Option	Part Number	Quantity	Description
A1				
N8481A	N8481A-100	N8481-60007	1	N8481A (N-type) replacement module
	N8481A-200	N8481-60008	1	N8481A (APC-7) replacement module
N8482A	N8482A-100	N8482-60002	1	N8482A (N-type) replacement module
N8485A	N8485A-100	N8485-60002	1	N8485A (3.5 mm) replacement module
Chassis Parts				
MP1	-	E9321-40001	2	Plastic shell
MP2	-	E9321-00001	2	Shield
MP3	-	N8481-84301	1	Label-ID top (N8481A)
MP3	-	N8482-84301	1	Label-ID top (N8482A)
MP3	-	N8485-84301	1	Label-ID top (N8485A)
MP4	-	N8481-84304	2	Label-Side
MP5	-	N8481-84305	1	Label-Cert. bottom
MP6	-	00346-80011	1	Label-Information

Table 3-3 Replaceable parts list for N8480 Series sensors with Option CFT

Reference Designaton	Option	Part Number	Quantity	Description
A1				
N8481A	N8481A-100	N8481-60009	1	N8481A (N-type) replacement module, CFT Option
	N8481A-200	N8481-60010	1	N8481A (APC-7) replacement module, CFT Option
N8482A	N8482A-100	N8482-60007	1	N8482A (N-type) replacement module, CFT Option
N8485A	N8485A-100	N8485-60003	1	N8485A (3.5 mm), replacement module, CFT Option
Chassis Parts				
MP1	-	E9321-40001	2	Plastic shell
MP2	-	E9321-00001	2	Shield
MP3	-	N8481-84301	1	Label-ID top (N8481A)
MP3	-	N8482-84301	1	Label-ID top (N8482A)
MP3	-	N8485-84301	1	Label-ID top (N8485A)
MP4	-	N8481-84304	2	Label-Side
MP5	-	N8481-84306	1	Label ID Certification Bottom - CFT Option
MP6	-	00346-80011	1	Label-Information

Troubleshooting

Troubleshooting information is intended to first isolate the power sensor, cable, or power meter as the defective component. When the power sensor is isolated, an appropriate sensor module must be used for repair. See Table 3- 2 on page 35.

If error message 241 or 310 is displayed on the power meter, suspect a power sensor failure. Error 241 will occur if the sensor is missing. A supported cable must be used to connect the N8480 Series power sensors to a power meter.

If no error message is displayed, but a problem occurs when making a measurement, try replacing the cable from the power meter to the power sensor. If the problem still exists, try using a different power sensor to determine if the problem is in the power meter or in the power sensor.

Electrostatic discharge will render the power sensor inoperative. Do not, under any circumstances, open the power sensor unless you and the power sensor are in a static free environment.

Repair

There is no serviceable parts inside the N8480 Series power sensors. If the sensor is defective, send it back to the nearest Agilent Service Center for repair. The entire “module” of the defective sensor will be replaced with an appropriate replacement module listed in Table 3- 2.

Diassembly/Reassembly Procedures

Diassembly Procedure

Disassemble the power sensor by performing the following steps:

- Diassemble the power sensor only in a static free workstation. Electrostatic discharge renders the power sensor inoperative.
- At the rear of the power sensor, insert the blade of a screwdriver between the plastic shells (See Figure 3- 2). To prevent damage to the plastic shells use a screwdriver blade as wide as the slot between the two shells.
- Pry alternately at both sides of the connector until the plastic shells are apart. Remove the shells and the magnetic shields.

Figure 3-2 Removing power sensor shell

Reassembly Procedure

Replace the magnetic shields and the plastic shells. Snap the plastic shells together.

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Contact us

To obtain service, warranty or technical support assistance, contact us at the following phone numbers:

United States:
(tel) 800 829 4444 (fax) 800 829 4433
Canada:
(tel) 877 894 4414 (fax) 800 746 4866
China:
(tel) 800 810 0189 (fax) 800 820 2816
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