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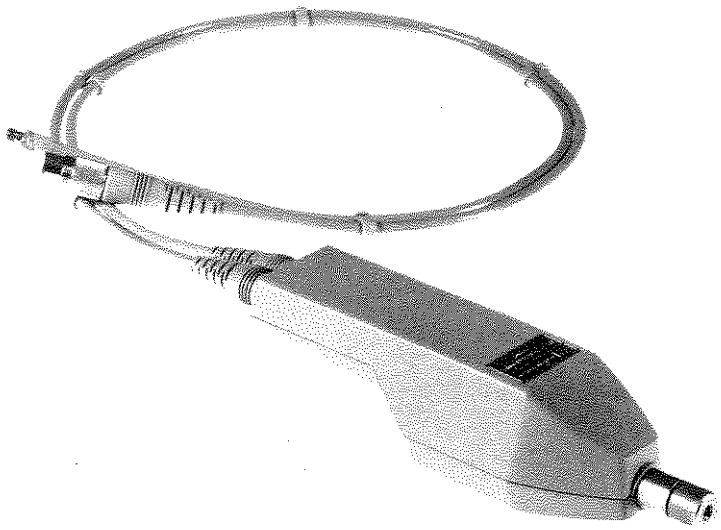
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OPERATING AND SERVICE MANUAL

HP 11792A SENSOR MODULE



HEWLETT PACKARD

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Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

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HP 11792A
SENSOR MODULE

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2407A.

For additional important information about serial numbers, refer to **"Instruments Covered by Manual"** in Paragraph 3.

First Edition

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1. GENERAL INFORMATION

This Operating and Service Manual contains information about initial inspection, operation, performance tests, adjustments, troubleshooting, and repair of the HP Model 11792A Sensor Module.

2. Specifications

Instrument specifications are listed in Table 1. These specifications are the performance standards or limits against which the instrument can be tested. The supplemental characteristics listed in Table 2 are not specifications but are typical characteristics included as additional information for the user.

Table 1. Specifications

Characteristics	Performance Limits	Conditions
Power Range	−20 dBm to +30 dBm (10 μW to 1W)	
Frequency Range	50 MHz to 26.5 GHz	
	50 MHz to 18 GHz	Option 001
Linearity	+2%, −4%	+20 dBm to +30 dBm
		<+20 dBm
Input SWR		Sensor Module connected to an HP 8901B or HP 8902A and HP 11793A
RF Power	<1.40	18 GHz to 26.5 GHz; Except Option 001
	<1.28	2 GHz to 18 GHz
	<1.10	50 MHz to 2 GHz
Tuned RF Level	<1.43	18 GHz to 26.5 GHz; Except Option 001
	<1.32	1.3 GHz to 18 GHz; Except Option 001
	<1.35	1.3 GHz to 18 GHz; Option 001 Only
	<1.15	50 MHz to 1.3 GHz; Except Option 001
	<1.10	50 MHz to 1.3 GHz; Option 001 Only

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Table 2. Supplemental Characteristics

Supplemental characteristics are typical, but non-warrented performance parameters. They are only intended to provide information which can be useful in determining instrument application.
RF INPUT
Maximum Average Power: 1W
Maximum Peak Power: 100 Wpk or 300 W•μs per pulse
Input Impedance: 50Ω nominal
Input Connector: APC 3.5mm male or Type N male (Option 001)
Switch Life: >1 000 000 Switchings
PHYSICAL CHARACTERISTICS
Module Dimensions:
Length: 209 mm (8.2 in.) Standard 215 mm (8.5 in.) Option 001
Height: 51 mm (2 in.)
Width: 62 mm (2.5 in.)
Weight: Net: 0.8 kg (1.75 lb.) Shipping: 1.2 kg (2.6 lb.)
Cable Lengths:
RF Cable: 925 mm (36.4 in.)
Sensor Cable: 944 mm (37.2 in.)

3. Instruments Covered by Manual

This instrument has a two-part serial number. The first four digits and the letter comprise the serial-number prefix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The last five digits form a sequential suffix which is unique to each instrument. The contents of this manual apply directly to instruments having the serial prefix listed under Serial Numbers on the title page.

An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the manual for this instrument is supplied with a Manual Changes supplement that documents the differences.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number that appear on the title page.

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Complimentary copies of the supplement are available on request from your nearest Hewlett-Packard office.

For information concerning a serial prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

4. Description

The HP Model 11792A Sensor Module is a companion accessory to the HP 8901B Modulation Analyzer and the HP 8902A Measuring Receiver. It contains a microwave power sensor and RF switching which routes the input signal either into the power sensor or into the measuring instrument.

The Sensor Module input connects directly to the RF source under test via a 3.5 mm RF connector or, for Option 001, a Type-N RF connector. The two output cables connect to the RF and sensor inputs of the measuring instrument. The Sensor Module reduces manual connecting and disconnecting of the power sensor and through-path and improves the repeatability of the measurement system. Path switching is controlled by the measuring instrument.

The power sensor within the Sensor Module is a low SWR, 50 ohm load. The average RF power dissipated by the sensor is read and displayed by the measuring instrument. The sensor's range is -20 dBm to +30 dBm (10 uW to 1W) from 50 MHz to 26.5 GHz. Each Sensor Module is individually calibrated and traceable to the U.S. National Bureau of Standards. Calibration factors are listed on a label on the module's bottom cover. Worst case uncertainties of the calibration factors are listed in Table 3.

Table 3. Uncertainty of Calibration Factor Data

Frequency (GHz)	Root Sum Square Uncertainies	Sum of Uncertainties (%)
Standard 3.5 mm Male Connector		
2.0	2.0	3.2
6.0	2.3	4.2
10.0	2.5	4.6
14.0	3.3	5.8
18.0	3.5	6.3
22.0	3.5	6.9
26.5	4.3	8.1
Option 001 Type-N Connector		
2.0	1.7	2.6
6.0	2.0	2.5
10.0	2.5	4.6
14.0	2.9	4.9
18.0	3.7	6.9

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A 10 dB attenuator in the Sensor Module is placed ahead of the RF switch to increase the operating range of the sensor to 1W. The measuring instrument notes the presence of the attenuator and automatically compensates for the 10 dB loss.

When the Sensor Module is used with a microwave down-converter (such as the HP 11793A Microwave Converter), a general-purpose, microwave measurement system is created. For example an HP 8901B Modulation Analyzer or HP 8902A Measuring Receiver with the HP 11793A Microwave Converter, and an external local oscillator with a frequency range to 26 GHz, creates a system with a range of 10 kHz to 26.5 GHz. (option 001), 50 Mhz. to 26.5 Mhz. standard.

5. Options

Option 001 changes the 3.5 mm input connector to a male, Type-N input connector. Specifications apply to only 18 GHz with Option 001.

6. Accessories Supplied

A Type-N male to 3.5 mm female adaptor, J1, is supplied with the Sensor Module. For AM/FM or RF Power calibration, the J1 connector is neccessary to connect the Sensor Module with the 3.5 mm male connector to the measuring instrument.

7. Recommended Test Equipment

Functional testing requires only a suitable RF source (such as an HP 8673B Synthesized Signal Generator) and a compatible measuring instrument (such as an HP 8901B Modulation Analyzer or HP 8902A Measuring Receiver). Performance testing requires equipment with a frequency range of 26.5 GHz and of accuracy better than the parameter being measured as indicated in Table 1, **Specifications**.

8. INSTALLATION

CAUTION

To prevent physical damage to the Sensor Module or device-under-test, pay careful attention to the mechanical setup. The mechanical design of the Sensor Module minimizes SWR. However, the weight and length of the module, combined with the stiffness of the interconnect cables, enables the exertion of considerable leverage at the module's input connector. To prevent physical damage to the Sensor Module, the device-under-test, and the mating connectors, and to assure best electrical performance, observe the following precautions:

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CAUTION

1. *Do not permit the interconnect cables of the Sensor Module to extend out where anyone passing by could accidentally push and exert leverage on the cables. This consideration is especially important when the device-under-test is a light-weight instrument that sits freely on a table.*

2. *When possible, lay the Sensor Module on a supportive surface. This consideration is especially important when rigid RF adapters are used to directly interconnect the Sensor Module to the device-under-test. RF adapters lengthen the leverage arm of the Sensor Module and are often flimsy. When level-accuracy requirements permit, use flexible cables to interconnect the Sensor Module to the device-under-test.*

3. *If possible, do not repeatedly bend or coil the interconnect cables to a diameter circumscribing less than 150 mm (6 in.). When instruments are rack-mounted and interconnected to rear-panel connectors, the interconnect cables can be coiled up to a diameter circumscribing 50 mm (2 in.). Repeated flexing of coiled, interconnect cables can degrade SWR and increase RFI of the through-path interconnect cable.*

4. *Do not attempt to tighten the Type-N connector by twisting the body of the Sensor Module.*

9. Initial Inspection

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is mechanical damage or if the instrument does not pass the performance tests, notify the nearest Hewlett-Packard office. Keep the damaged shipping materials (if any) for inspection by the carrier and a Hewlett-Packard representative.

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10. Interconnections

NOTE

For proper system operation, the Sensor Module should be connected to a compatible power measuring instrument using only the cables attached to the Sensor Module. No extension cables are available. The power sensor cable has control lines for the RF switch that are not common to other power sensor cables.

When using the Sensor Module with a down-converter (and its associated external local oscillator) and an appropriate measuring instrument, refer to Figure 1 and the following instructions.

1. Connect the input of the Sensor Module to the RF source.
2. Connect the module's sensor cable to the sensor input of the measuring instrument.
3. Connect the module's RF cable to the RF input of the microwave down-converter.
4. Connect the IF output of the down-converter to the RF input of the measuring instrument.
5. Connect the external LO output to the LO input of the microwave down-converter.

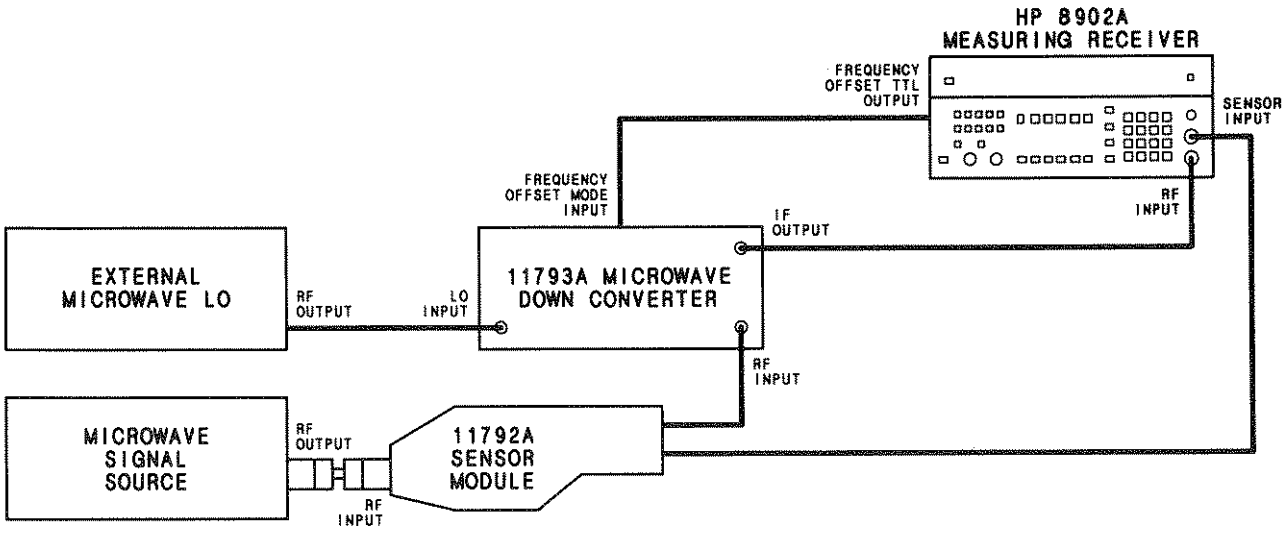


Figure 1. Sensor Module Interconnections

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11. Storage and Shipment

Environment. The module should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

1. Temperature, -25°C to +75°C (-13°F to +167°F)
2. Relative Humidity, less than 95%
3. Altitude, less than 7600 meters (25 000 feet)

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the module is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Other Packaging. The following general instructions should be used for repackaging with commercially available materials:

1. Wrap the module in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the service required, return address, model number, and full serial number.)
2. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.
3. Use enough shock absorbing material (75 to 100 mm layer; 3 to 4 in.) around all sides of the module to provide firm cushion and prevent movement in the container.
4. Seal the shipping container securely. That is, mark the shipping container FRAGILE to ensure careful handling.

12. OPERATION

13. Environment

The operating environment for the Sensor Module should be as follows:

1. Temperature, 0°C to +55°C (+32°F to +131°F)
2. Relative Humidity, less than 95%
3. Altitude, less than 4600 meters (15 000 feet)

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14. Operating Precautions

Before connecting the Sensor Module, observe the following precautions:

WARNING

BEFORE CONNECTING THE SENSOR MODULE TO ANOTHER INSTRUMENT, ensure that the instrument and power meter are connected to the protective (earth) ground.

CAUTION

Do not apply torque to the Sensor Module's body when connecting or disconnecting the 3.5 mm or Type-N RF input connector.

Torque the 3.5 mm input connector to 0.5 N.m (4 in.lb) or the Type-N connector compatible to U.S. MIL-C 39012.

Do not apply excessive force to the Sensor Module's body from any axis when its input is connected to another instrument. Take particular care when the Sensor Module is suspended only by its RF input connector.

Exceeding the following energy and power levels may result in damage to the power meter system.

The absolute maximum RF power that may be applied to the Sensor Module is:

1. Maximum Average Power: 1W
2. Maximum Peak Power: 100 Wpk or 300 W•μs per pulse

15. Operating Characteristics

For detailed information on the Sensor Module's characteristics, refer to Table 1, **Specifications**, and Table 2, **Supplemental Characteristics.**

Remote Operation. The Sensor Module is switched between the through-path and the power sensor path with switch voltages from a compatible measuring instrument (such as the HP 8901B Modulation Analyzer or HP 8902A Measuring Receiver). The control lines for each switch are contained within the sensor cable. The switch voltages are activated when measurements are made, so when remote operation is initiated on the measuring instrument, the Sensor Module paths are remotely controlled.

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Calibration Factors. A table of calibration factors is provided on the bottom cover of the Sensor Module. These calibration factors have been individually determined to compensate for the response of the power sensing device within the module. Refer to the measuring instrument's operating manual for specific calibration instructions.

Modulation Effects. When measuring RF sources that are modulated at the chopper frequency (nominally 220 Hz), or at the first or second harmonic or submultiples of the chopper frequency, beat notes will occur. Unless these beat notes are at exactly the chopper frequency, they can usually be eliminated by averaging since the amplitudes are added to and subtracted from the actual power. These frequencies can also be avoided by slightly changing the modulation frequency when possible.

16. PERFORMANCE TESTS

No test procedures are included in this manual. Performance testing requires special equipment which can accurately make measurements to 26.5 GHz. Functional testing of the Sensor Module is documented in the measuring instrument's operating and service manual.

17. ADJUSTMENTS

No user-performed adjustments are given in this manual. Making adjustments to the Sensor Module necessitates microwave frequency calibration. Return the Sensor Module to the nearest Hewlett-Packard office if recalibration is required.

18. REPLACEABLE PARTS

Table 4 lists all user-replaceable parts in alphanumeric order by reference designator. Table 5 contains the names and addresses that correspond to the manufacturer's code number.

19. Replaceable Parts List

Table 4, **Replaceable Parts**, is directly cross-referenced to Figure 2. The following information is provided for each part:

1. The Hewlett-Packard part number.
2. Part number check digit (CD).
3. The total quantity (Qty) is provided on the first entry of the part number.
4. The description of the part.
5. A typical manufacturer of the part in a five-digit code.
6. The manufacturer's number for the part.

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20. Parts List Updating (Manual Changes Supplement)

Production changes to the instrument made after the publication date of this manual are denoted by a change in the serial-number prefix. Changes to the parts list are recorded by serial prefix on a Manual Changes supplement. Also, errors in the manual are noted in the Errata portion of the Manual Changes supplement.

21. Illustrated Parts Breakdowns

The components of the Sensor Module are identified in Figure 2.

22. Ordering Information

To order a part listed in the replaceable parts table, include the Hewlett-Packard part number with the check digit (CD) and the quantity required. Address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, description and function of the part, and the quantity of parts required. Address the order to the nearest Hewlett-Packard office.

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Table 4. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
J1	1250-1250	6	1	ADAPTER-COAX STR M-N F-SMA (EXCEPT OPTION 001)	28480	1250-1250
MP2	11792-60002	4	1	SENSOR MODULE CVR ASSY PLST TOP	28480	11792-60002
	0624-0355	2	2	SCREW-TPG 4-20 .375-IN-LG PAN-HD-PHL	00000	ORDER BY DESCRIPTION
	0624-0506	5	2	SCREW-TPG 4-20 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	11792-00005	1	1	SENSOR MODULE LABEL, ID	28480	11792-00005
MP3	11792-60008	0	1	SENSOR MODULE BOTTOM COVER	28480	11792-60008
	11722-40002	8	1	BOTTOM COVER WITHOUT LABEL	28480	11722-40002
	7121-2300	2	1	LABEL INFORMATION	28480	7121-2300
	7121-2514	0	1	LABEL PROTECTIVE COVER 47.6-MM-WD PA	28480	7121-2514
MP4	11722-20006	0	1	CABLE BRACKET (TOP)	28480	11722-20006
	3030-0083	7	1	SCREW-SET 2-56 .188-IN-LG SMALL CUP-PT	00000	ORDER BY DESCRIPTION
MP5	11722-20007	1	1	CABLE BRACKET (BOTTOM)	28480	11722-20007
	3030-0053	1	3	SCREW-SKT HD CAP 2-56 .625-IN-LG ALY STL	28480	3030-0053
	2190-0045	8	3	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
MP6	11722-40003	9	4	CABLE CLIPS, NYLON	28480	11722-40003
W2	11792-60007	9	1	CABLE, FLEXIBLE (RF FLEX CABLE)	28480	11792-60007
W4	11792-60001	3	1	CABLE, FLEXIBLE (SENSOR CABLE)	28480	11792-60001

Table 5. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address		Zip Code
00000	ANY SATISFACTORY SUPPLIER			
14140	EDISON ELEK DIV MCGRAW-EDISON	MANCHESTER	NH	03130
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
51959	VICLAN INC	SAN DIEGO	CA	92138
91949	AMPHENOL SALES DIV OF BUNKER-RAMO	BROADVIEW	IL	60153

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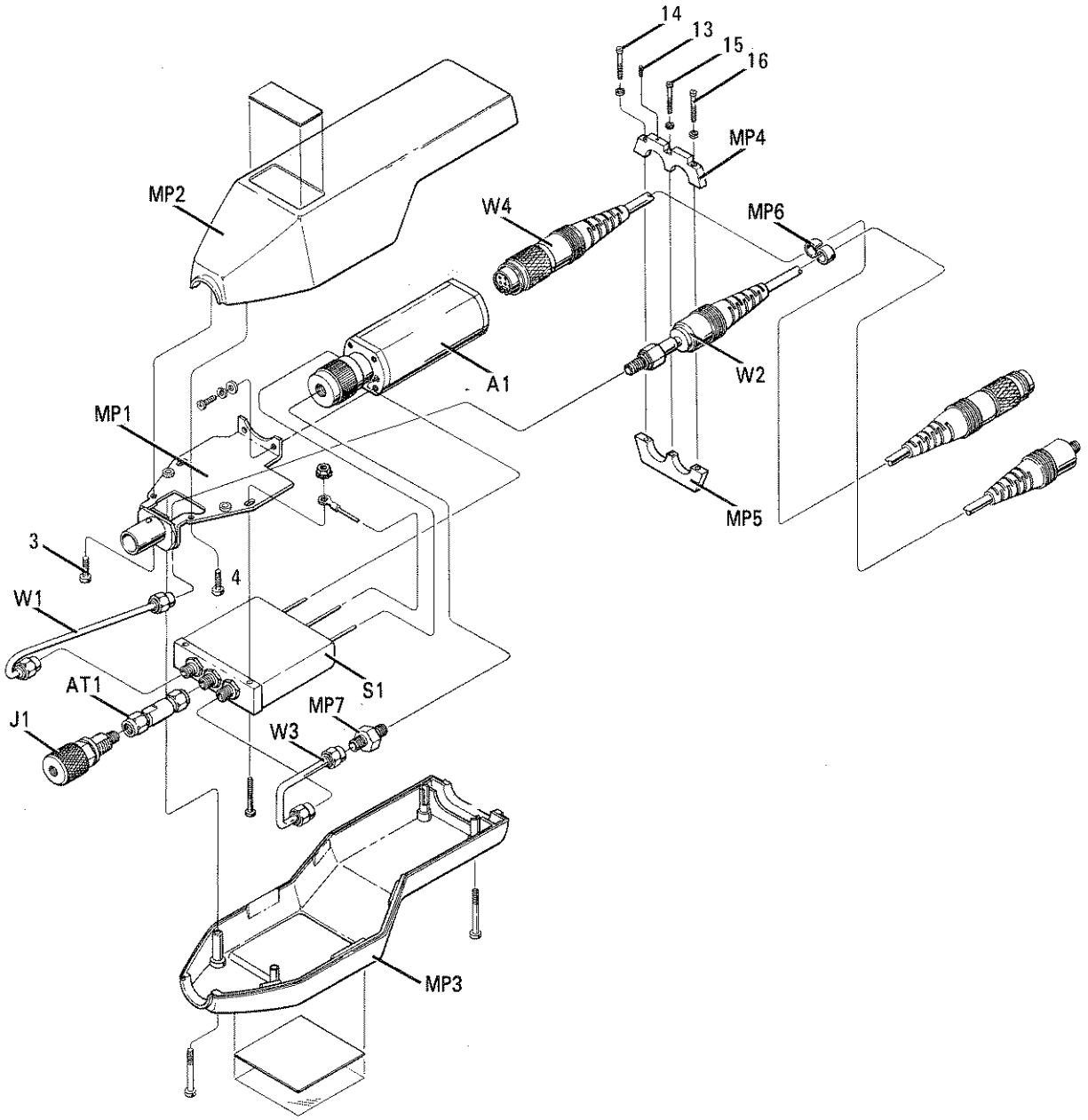


Figure 2. Sensor Module Exploded View

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23. SERVICE

CAUTION

Refer to the Caution in Paragraph 8, Installation, *that is concerned with the connection of the Sensor Module to other devices.*

NOTE

Because of the high operating frequencies of the Sensor Module, servicing of the module by the user is very limited. The service information in this manual is restricted to replacement of a few mechanical parts and the output cables. Servicing beyond this level requires recalibration. If the Sensor Module malfunctions, return it to the nearest Hewlett-Packard office.

Figure 2, Sensor Module Exploded View, *shows the locations of the assemblies and mechanical parts. Paragraphs 27 and 28 are simple disassembly and reassembly procedures.*

24. Principles of Operation

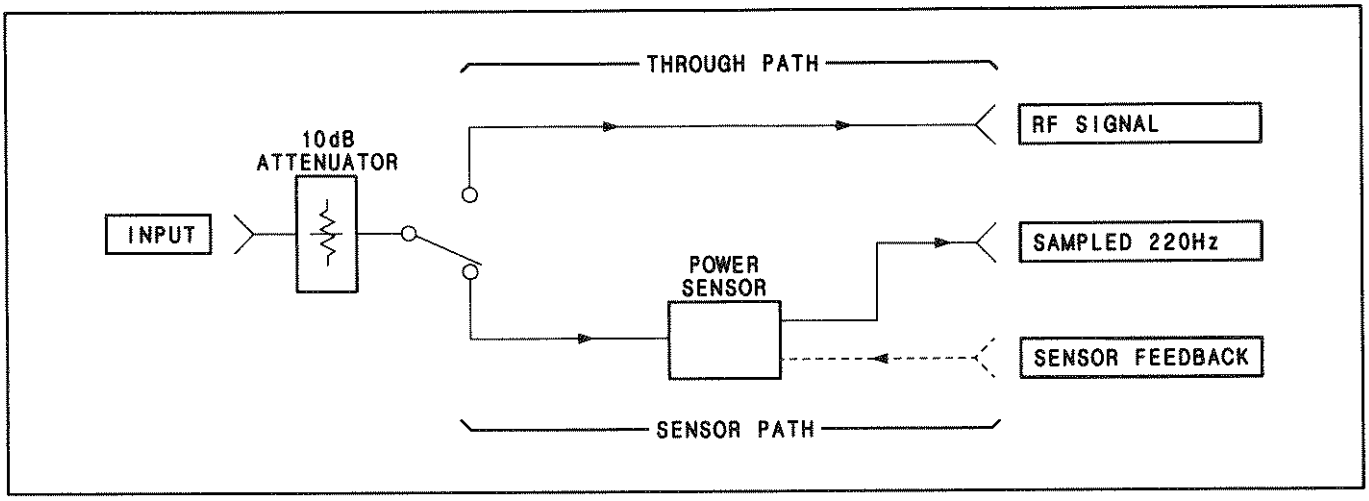


Figure 3. Simplified Block Diagram

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See Figure 3.

AT1 Attenuator. The AT1 Attenuator is a broadband, low SWR, 10 dB pad used to attenuate the input to raise the sensor's measurement range to 1W. The pad is placed between the input connector of the Sensor Module and the microwave switch.When the Sensor Module is connected to a microwave down-converter, the padding reduces noise pickup from the down-converter. Circuitry within the power sensor informs the measuring instrument that the 10 dB pad is present, and the measuring instrument automatically compensates the displayed reading for the presence of the 10 dB pad.

S1 Switch. The S1 Switch is a broadband, low SWR, high-isolation switch of the edge-line type. Control lines from the measuring instrument (such as the HP 8901B or HP 8902A) to the switch enable the measuring instrument to remotely select the RF path through the Sensor Module.

A1 Power Sensor Assembly. When the Sensor Module is measuring RF power, the RF input signal is applied to the A1 Power Sensor. The RF signal power is dissipated in a thermocouple in the sensor which generates a dc voltage that is proportional to the dissipated power.

The dc output from the thermocouple is input to a chopper which converts the dc voltage to an ac voltage with a frequency of 220 Hz (the chop rate). The output of the chopper is amplified by about 700 times. Circuitry within the measuring instrument converts the ac signal back to dc. The dc level is measured and displayed as the RF power.

With no signal applied to the sensor input, a dc voltage from the measuring instrument is applied to the thermocouple to cancel any dc offset in the sensor, thus zeroing the sensor.

Since the measuring instrument can operate with a variety of power sensor types, a resistor within the sensor is measured by the measuring instrument to uniquely identify the power sensor type and sensitivity. (In this case the power sensor is a 1W type.)

25. Troubleshooting

Troubleshooting consists of connecting the Sensor Module to a compatible measuring instrument and functionally verifying the operation of the Sensor Module. Functional testing of the Sensor Module is documented in the measuring instrument's operating and service manual. Troubleshooting beyond the functional level (that is, troubleshooting the microwave components) requires microwave frequency recalibration.

26. Repair

The only replaceable parts are listed in the parts list. Repair or replacement of microwave parts (except W2) requires microwave frequency recalibration. Return the Sensor Module to the nearest Hewlett-Packard office if recalibration is required.

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27. Sensor Module Partial Disassembly Procedure

CAUTION

Do not loosen or disconnect any RF cables or connectors (except W2) or recalibration of the microwave performance will be required. W2 can be replaced without necessitating recalibration.

NOTE

An individually prepared table of calibration factors is attached. If more than one Sensor Module is disassembled, be sure to match the proper cover with each module when it is reassembled.

Refer to Figure 2 for parts identification.

1. Remove four screws and plastic bottom cover MP3 from the module assembly.
2. Remove plastic top cover MP2 by unscrewing screws 3 and 4.
3. Loosen set screw 13 and remove screws 14, 15, and 16 (and their lock-washers) to remove cable brackets MP4 and MP5.
4. Disconnect RF flex cable W2 from W1 by turning the nut on W1 counter-clockwise.
5. Disconnect sensor cable W4 from A1 Power Sensor.

28. Sensor Module Reassembly Procedure

Refer to Figure 2 for parts identification.

1. Connect cable brackets MP4 and MP5 around cables W2 and W4. Rotate the strain relief on W2 so that the side cut-away is flush against the strain relief on W4. Tighten screws 14, 15, and 16, and set screw 13. One lockwasher should be inserted with each of screws 14, 15, and 16.
2. Insert the module assembly in plastic top cover MP2. Position the assembly so that the top half of cable bracket MP4 slides into the slot at the back of the cover. Connect deck plate MP1 to the top cover with screws 3 and 4.
3. Connect plastic bottom cover MP3 to the assembly with the remaining four screws. (The two self-tapping, nickel screws screw into the bottom of the bottom cover.)

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