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HEWLETT PACKARD

Operating and Service Manual

HP 8481D
Power Sensor

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HP 8481D
POWER SENSOR

OPERATING AND SERVICE MANUAL

SERIAL NUMBERS

This manual supplement applies directly to instruments with serial numbers prefixed 2927A.
For additional important information about serial numbers, see "Instruments Covered by Manual".



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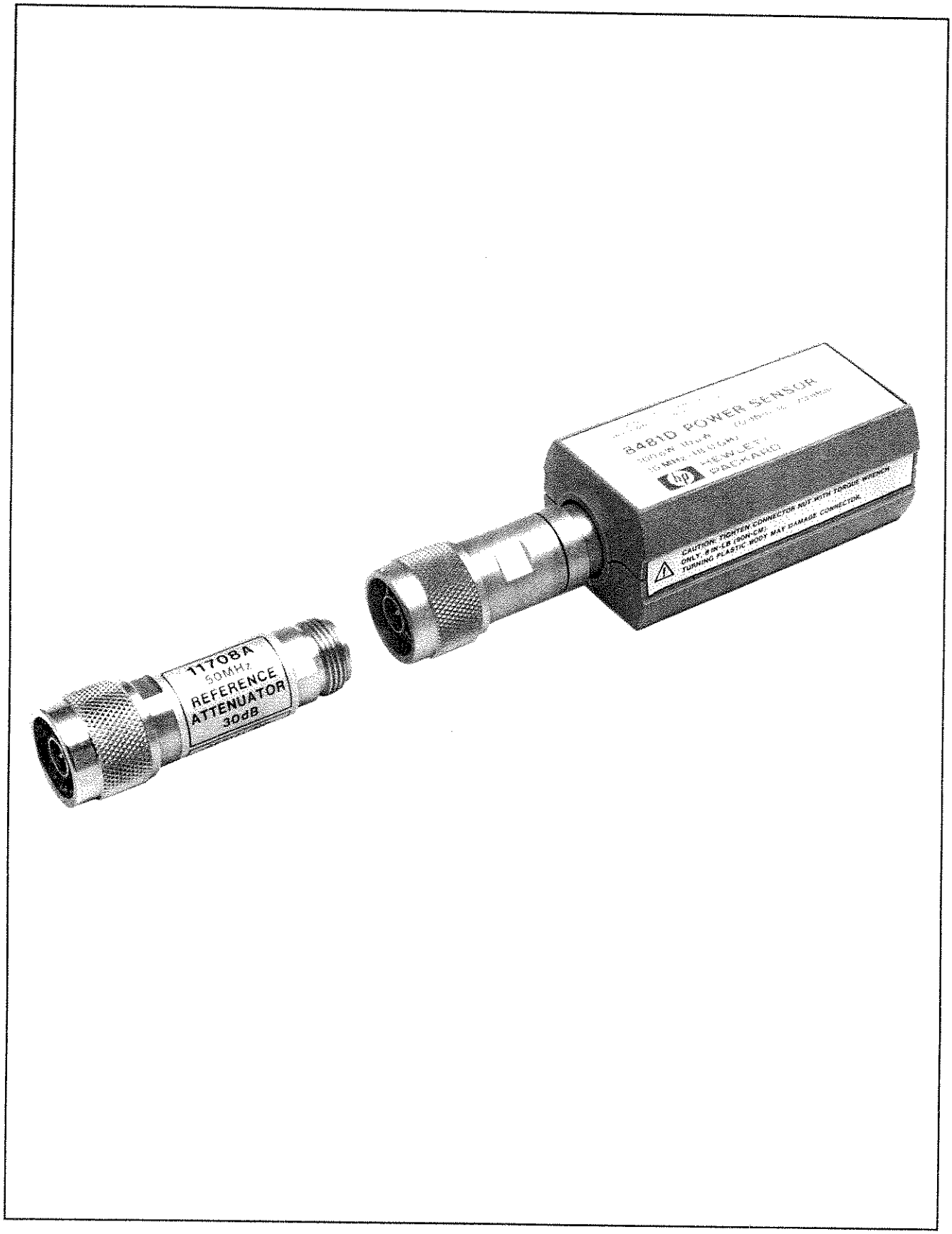


Figure 1. HP 8481D Power Sensor with HP 11708A Attenuator

General Information

This Operating and Service Manual contains information about initial inspection, operation, performance tests, troubleshooting and repair of the HP 8481D Power Sensor.

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 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 number prefix listed under SERIAL NUMBERS on the title page.

Manual Changes Supplement

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

In addition to change information, the supplement may contain information for correcting errors in the manual. The supplement is keyed to the manual print date and part number, both of which appear on the title page of the Manual Change supplement.

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

Warranty

The Power Sensor is warranted and certified as indicated on the inside cover of this manual.

Description

The HP 8481D Power Sensor is a diode power sensor. It measures power levels in a range from −70 dBm to −20 dBm (100 pW to 10 μW) The HP 8481D measures at frequencies from 10 MHz to 18.0 GHz. (Specifications for the Power Sensor are in Table 1.)

The Power Sensor measures power dissipated in a 50Ω power sensor load placed on the source. The power dissipated in this 50Ω load is displayed on a compatible power meter in nW (or μW) and dBm.

Note



The HP 8481D Power Sensor is compatible with the HP 435B, HP 436A, HP 437B, HP 438A, and HP 70100A power meters. The HP 8481D Power Sensor cannot be used with the HP 435A Power Meter.

Calibration data is provided by a table on the Power Sensor. Further calibration data is also provided on a data sheet included with each Power Sensor. The calibration data, individually prepared for each Power Sensor, shows the calibration factor (CAL FACTOR) at selected frequencies from 10 MHz to 18 GHz.

Caution



The HP 8481D Power Sensor is extremely static sensitive. Do not open the Power Sensor unless you and the Power Sensor are at a static free work station.

Accessories

Included with each Power Sensor is the HP 11708A 30 dB Attenuator. To calibrate the HP 8481D, the 50 MHz 1 mW RF reference power supplied by the power meter must be reduced to 1 μW. The reference attenuator provides a means to do this.

Note



The HP 11708A 30 dB Attenuator is intended for use only at the 50 MHz POWER REF output of the power meter. Its usefulness as a calibration reference may be compromised if used for other purposes.

Specifications

The specifications listed in Table 1 are the performance standards or limits against which the Power Sensor may be tested.

Table 1. HP 8481D Specifications

Characteristics and Conditions	Limits	Comments
Frequency Range	10 MHz to 18 GHz	
Power Range	−70 dBm to −20 dBm (100 pW to 10 μW)	
Impedance	50 ohm	nominal
Connectors	Type N (Male)	
Maximum Standing Wave Ratio (SWR) and Reflection Coefficient (Rho)		
Frequency	SWR Rho	
10 MHz to 30 MHz	1.40 0.167	
30 MHz to 4 GHz	1.15 0.070	
4 GHz to 10 GHz	1.20 0.091	
10 GHz to 15 GHz	1.30 0.130	
15 GHz to 18 GHz	1.35 0.150	
HP 11708A	1.05 0.024	at 50 MHz
HP 11708A Accuracy	30 ±0.05 dBm	At 50 MHz and 25°C, NIST traceable, temperature coefficient 0.003 dB typ. per degree C.
Maximum Average Power	100 mW peak 100 mW average	
Worst Case Power Linearity		
100 pW to 1 μW	Negligible	−70 dBm to −30 dBm
1 μW to 10 μW	±2%	−30 dBm to −20 dBm
Operating Temperature	0 to 55°C	
Net Weight	0.14 kg (0.28 lb)	
Dimensions	length: 102 mm (4.03 in) Width: 38 mm (1.5 in) Height: 30 mm (1.19 in)	
HP 11708A	Length: 60 mm (2.4in) Diameter: 20 mm (0.79 in)	

Calibration Factor (CF) and Reflection Coefficient (Rho)

CF and Rho data at 2 GHz increments are provided on a label attached to the sensor cover. Calibration factor and Reflection coefficient data are given at 1 GHz increments on a data sheet included with the Power Sensor. This data is unique to each sensor. If you have two sensors, match the serial number on the data sheet with the serial number on the Power Sensor to avoid confusion. Maximum uncertainties of the CAL FACTOR data are listed in Table 2. The CAL FACTOR compensates for the frequency response of the sensors.

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

$$SWR = (1+\rho)/(1-\rho)$$

Table 2. HP 8481D Calibration Factor Uncertainty at 1 μW

Frequency (GHz)	(RSS) Probable Uncertainty (%)
1.0 GHz	1.9%
2.0	1.8
4.0	1.8
6.0	1.8
8.0	2.0
10.0	2.2
12.0	2.8
14.0	3.2
16.0	3.4
18.0	3.7

Installation

Initial Inspection

Inspect the shipping container for damage. If the shipping container or packaging 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.

Interconnections

The HP 8481D Power Sensor has one input: a Type N male connector.

Refer to the power meter operating and service manual for interconnecting instructions.

Storage and Shipment

Environment

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

Temperature	−55 to +75°C
Relative Humidity	< 95% at 40°C
Altitude	< 15,300 metres (50,000 feet)

Original Packaging

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard 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.

Table 3. Recommended Test Equipment

Instrument Type	Critical Specifications	Suggested Model	Use
Power Meter	No substitute	HP 435B	Adjustments
Digital Voltmeter	Input Impedance: 10 megohms Resolution: 10 μV Accuracy: ±0.05%, ±1 digit	HP 3478A	Troubleshooting and Adjustments
Oscilloscope	Bandwidth: dc to 50 MHz Vertical sensitivity: 0.2V/div Horizontal sensitivity: 1 ms/div	HP 54200A	Troubleshooting and Adjustments
10:1 Divider Probe	10 Megohms	HP 10004D	Troubleshooting
DC Power Supply	Range: 0 to 20V dc	HP 6200B	Troubleshooting

Operation

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.

Operating Environment

The operating environment for the Power Sensor should be within the following limits:

Temperature	0° to 55°C
Relative humidity	< 95%
Altitude	< 4530 metres (15,000 feet)

Operating Precautions

If the following energy and power levels are exceeded, the power meter system may be damaged.

a. Maximum Average Power: 100 mW

b. Maximum Peak Power: 100 mW

c. Maximum Energy/Pulse: 10 W · μs

Maximum torque at the Type N connector should not exceed 8 lb-in (90 N-cm) to avoid damage to the connector.

Connect the Power Sensor by turning only the knurled portion of the connector. Damage can occur if torque is applied to the Power Sensor body.

The Type-N connector plastic insulator bead deteriorates when contacted by acetone, trichlorethylene, carbon tetrachloride, benzene, etc. Clean the connector face with a cotton swab saturated in isopropyl alcohol only.

Power Meter Calibrations

The procedure for calibrating one power meter may be different for another power meter. Follow the calibration directions given in your power meter manual.

Power Measurements

To correct for varying responses at different frequencies a cal factor chart is included on the Power Sensors. To use the cal factor at the frequency of interest, adjust the power meter's CAL FACTOR control according to the instructions in the power meter's operating and service manual. If you are using an HP 435B or HP 436A, the minimum cal factor setting is 85% and the maximum is 100%.

If the cal factor setting for your frequency of interest is below the meter's minimum or above the meter's maximum, set the cal factor control to 100%, and divide the reading in watts units (milliwatts or microwatts) by the decimal equivalent of the cal factor. For example, if the cal factor is 75%, divide the reading by 0.75. (This will result in a larger value of power than that displayed by the meter.) If the cal factor is 104% divide the reading by 1.04. (This will result in a smaller value of power than that displayed by the meter.)

Note

To calculate corrected dBm use the following formula:

Correction dB = Reading dB − (10 × Log_{10} Cal Factor decimal)

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. Typical temperature sensitivity variations are shown in Figure 2.

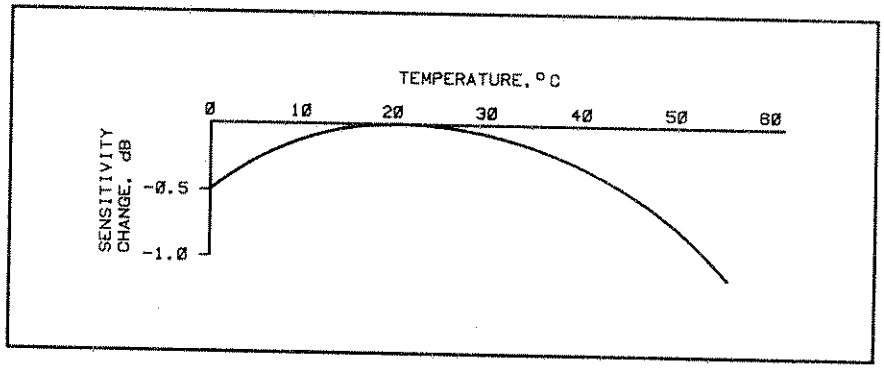


Figure 2. Typical Influence of Temperature on Sensitivity

Operating Instructions

To operate the Power Sensor, refer to the operating instructions in Section 3 of the power meter operating and service manual.

Modulation Effects

When measuring microwave 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 exactly the chopper frequency, they can usually be eliminated by averaging since the amplitudes are plus and minus the actual power. These frequencies may also be avoided by changing the modulation frequency slightly, if possible.

If you are using an HP 437B Power Meter select a manual filter setting of at least 128 averages (as displayed on power meter) to minimize beat note interference. To minimize beat note interference using an HP 438A Power Meter select a filter number of at least 7.

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 4.

To measure SWR from 10 MHz to 18 GHz,

Table 4. Power Sensor SWR and Reflection Coefficient

Frequency	System Rho Uncertainty	Actual Measurement	Maximum SWR (Rho)
10 MHz to 30 MHz	±0.0085	_____	0.167
30 MHz to 4 GHz	±0.0084	_____	0.070
4 to 10 GHz	±0.0087	_____	0.091
10 to 15 GHz	±0.0087	_____	0.130
15 to 18 GHz	±0.0087	_____	0.150

FET Balance Adjustment

Warning



The following procedure exposes high voltage areas within the power meter. Use extreme care while working around these areas or personal injury could occur.

Caution



Electrostatic discharge will render the Power Sensor inoperative. Do not open the Power Sensor unless you and the Power Sensor are at a static free work station.

Equipment

Oscilloscope	HP 54200A
Power Meter	HP 435B
Multimeter	HP 3478A

The sampling gate balance is affected by the relative positions of the wires in the Power Sensors, which connect to pins G and H of connector J1. One wire is black and white; the other is brown and white. Moving the black and white wire will adjust the switching transient amplitude (spike). Moving the brown and white wire will change the offset. Once positioned, care must be used not to displace these wires. To correctly position these wires, after replacement of A1 Bulkhead Assembly or A2 Input Amplifier Assembly, or if the wires have been moved so as to affect the sampling gate balance, perform the following procedure.

Note

If the Power Sensor printed circuit board A2 has been removed for repair, make sure all surfaces are thoroughly clean and free of flux residues before attempting the following adjustments.

1. Set the multimeter controls as follows:

FUNCTION	Voltage
RANGE	20 mV, full scale

2. Set oscilloscope controls as follows:

SENSITIVITY	0.2 V/DIV
SWEEP	1ms/DIV
TRIGGER	INT+
DISPLAY	A

3. Set the power meter CAL FACTOR to 100%. Set the power meter RANGE to 1 mW (0 dBm).
4. Open the Power Sensor (see Disassembly Procedure, Steps 1 through 3). Zero and calibrate the power meter. Leave the opened Power Sensor connected to the power meter POWER REF output. Heat can affect the adjustments so handle the sensor as little as possible.
5. Make sure the POWER REF switch on the rear panel of the power meter is in the OFF position.
6. Remove the HP 435B bottom panel. This will expose the circuit side of the A5 printed circuit board. On A5 you will see a long double row of soldered terminals numbered 1 to 44.
7. Connect a probe from pin 40 (the number 902 is printed on the board next to pin 40) to the multimeter input.
8. Lay the HP 435B on its left side and remove the right panel. This will expose the A4 assembly.
9. Connect a 1:1 probe from TP4 to channel A on the oscilloscope.
10. **Offset.** Read the multimeter and adjust the position of the brown and white wire until the reading is between -4.0 mV and +4.0 mV.

11. **Switching transients.** Read the oscilloscope and adjust position of the black and white wire until the switching transients are less than 0.8V peak to peak.

Note

The positioning of the wires is not an exact procedure. Each Power Sensor is slightly different. Generally, the brown and white wire will cross over the black and white wire at right angles. The black and white wire runs roughly parallel to the chassis. You will find that positioning the wire for switching transients affects the offset. Go back and forth between the two wires, positioning and repositioning, until both adjustments are within specifications.

Replaceable Parts

Table 5 is a list of replaceable parts. Figure 3 is the illustrated parts breakdown (IPB) that identifies the major locations of the components on the A2 Input Amplifier Assembly are shown in Figure 4. To order a part, quote the Hewlett-Packard part number and Check Digit (CD), specify the quantity required, and address the order to the nearest Hewlett-Packard office.

Note

Within the USA, it is better to order directly from the HP Parts Center in Roseville, California. Ask your nearest HP office for information and forms for the "Direct Mail Order System." Also your nearest HP office can supply toll free telephone numbers for ordering parts and supplies.

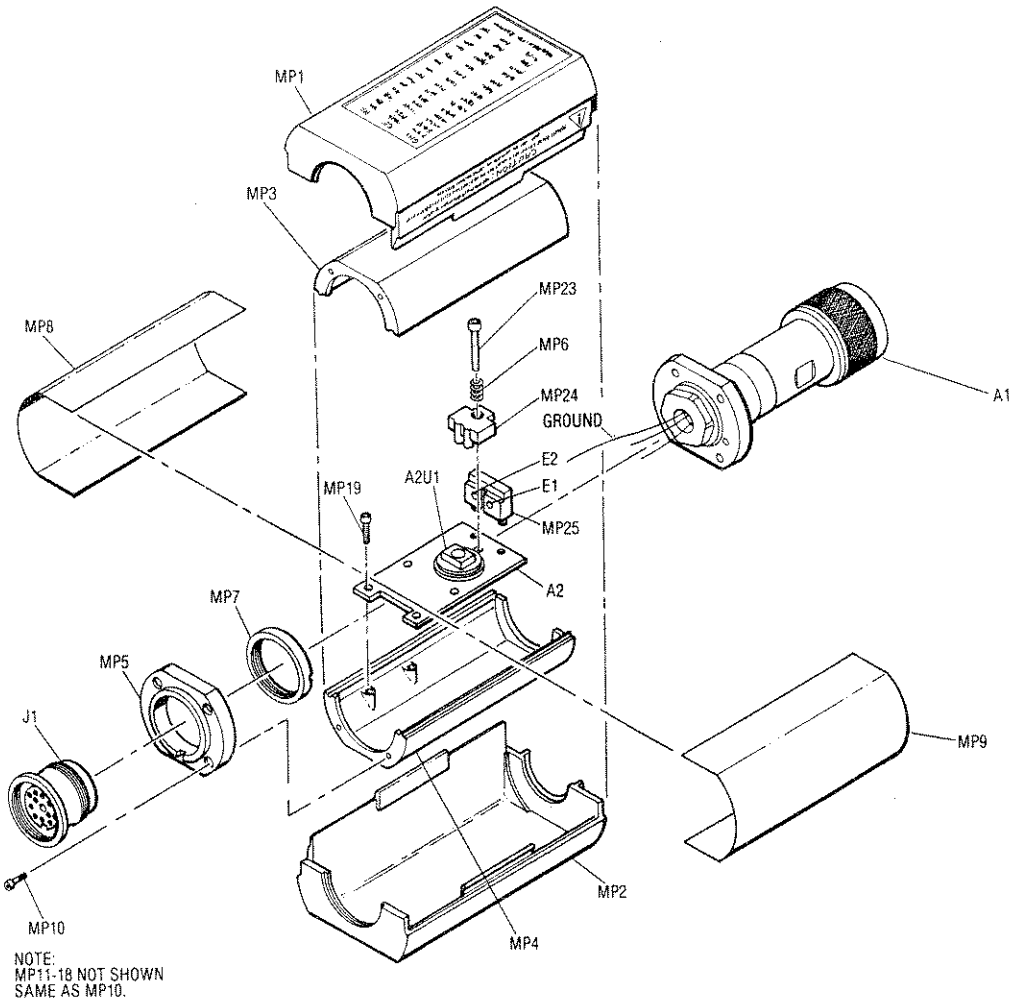


Figure 3. Illustrated Parts Breakdown

Table 5. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A1	08481-60022	5	1	BULKHEAD ASSY	28480	08481-60022
A2	08485-60006	9	1	POWER SENSOR BOARD ASSY	28480	08485-60006
				A2 MISCELLANEOUS PARTS		
	0590-1040	1	1	THREADED INSERT-NUT 0-80 .06-IN-LG SST	46384	YC3-1505
	5040-6938	6	1	SPACER	28480	5040-6938
				CHASSIS PARTS		
J1	08486-60003	7	1	CONNECTOR ASSEMBLY-12 PIN	28480	08486-60003
MP1	5040-6998	8	2	SHELL-PLASTIC	28480	5040-6998
MP2	5040-6998	8		SHELL-PLASTIC	28480	5040-6998
MP3	08481-20011	8	2	CHASSIS	28480	08481-20011
MP4	08481-20011	8		CHASSIS	28480	08481-20011
MP5	08481-20008	3	1	END BELL	28480	08481-20008
MP6	1460-1978	0	1	SPRING-CPRSN .088-IN-OD .188-IN-OA-LG	84830	C1-012B-2-SS
MP7	1251-3363	8	1	NUT-AUDIO CONN	05876	91-T-1335-6-9
MP8	08481-00002	5	2	SHIELD	28480	08481-00002
MP9	08481-00002	5		SHIELD	28480	08481-00002
MP19	3030-0422	8	4	SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
MP20	3030-0422	8		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
MP21	3030-0422	8		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
MP22	3030-0422	8		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
MP10	3030-0954	1	9	SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP11	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP12	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP13	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP14	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP15	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP16	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP17	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP18	3030-0954	1		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-304	00000	ORDER BY DESCRIPTION
MP23	3030-0436	4	1	SCREW-SKT HD CAP 0-80 .5-IN-LG SST-300	00000	ORDER BY DESCRIPTION
MP24	5040-6939	7	1	CLAMP	28480	5040-6939
MP25	5040-6940	0	1	BLOCK	28480	5040-6940
MP26	08481-80011	4	1	LABEL-IDENTIFICATION	28480	08481-80011
MP27	7121-2422	9	1	LABEL-CAUTION	28480	7121-2422
MP28	08486-80006	2	1	CAL-LABEL (BLANK)	28480	08486-80006
MP29	08481-80005	6	1	MYLAR TAPE (COVERS CAL LABEL)	28480	08481-80005
MP30	08486-80005	1	1	LABEL INFO (SIDE)	28480	08486-80005

Table 6. Code List of Manufacturers

Mfr. Code	Manufacturer Name	Address		Zip Code
00000	ANY SATISFACTORY SUPPLIER			
05876	U S POLYMERTIC INC	STAMFORD	CT	06904
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
46384	PENN ENGINEERING & MFG CORP	DOYLESTOWN	PA	18901
84830	LEE SPRING CO	BROOKLYN	NY	11219

Service

Service instructions consist of principles of operation, troubleshooting, and repairs. Test equipment which meets or exceeds the critical specifications in Table 3 may be used in place of the recommended instruments for troubleshooting the Power Sensor.

Principles of Operation

Refer to the schematic Figure 5 and the operational amplifier diagram Figure 6 for the following explanation. The operational amplifier is made up of the Power Sensor input amplifier, A2Q1, and the first amplifier stage in the power meter.

The A1 Bulkhead Assembly provides a 50 ohm load to the rf signal applied to the Power Sensor. A diode assembly in the bulkhead rectifies the applied rf to produce a dc voltage which varies with the square of the rf power across the 50 ohm load. Thus the voltage varies with the rf power dissipated in the load. With maximum specified rf power (10 μW) the dc voltage is approximately 5mV.

This low level dc voltage is passed on gold wires through A2E1 and A2E2. A2E1 and A2E2 are ferrite beads which increase the inductance of the wires causing that portion of the wires to act as an rf choke. The result is to minimize rf feedthrough to the A2 input amplifier assembly.

The dc voltage from the bulkhead assembly must be amplified before it can be 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 voltage to an ac voltage. To do this, the chopper uses two field effect transistors (FETs) in A2U1 controlled by a 220 Hz square wave generated by the power meter. The amplitude of the sampling gate output (at pin 3 of A2U1) is a 220 Hz square wave proportional to the power input. The sampled 220 Hz ac output is applied to the input ampifier A2Q1 which is the input for the first amplifier stage in the power meter. (Figure 6). The ac gain of the operational amplifier is approximately 1700.

Resistors A2R22, A2R23, A2R24, and A2R25 together with capacitor A2C11, thermistor A2RT3, and diode A2CR1, make up a shaping network. This network brings about a linear change in the amplitude of the square wave output as rf input power changes. A shaping network is necessary in the HP 8481D Diode Power Sensor to compensate for the characteristics of the thermocouple type shaping network in the power meter and to make minor diode corrections (Figure 6). In order to bring about a liner change in amplitude, A2R22, A2R23, and A2R25 are factory selected to match variations of the diode assembly in the bulkhead.

A dc feedback voltage from the power meter Auto Zero Chopper circuit is coupled to the input of FET A2U1Q1 to set the zero level. A2R21 is factory selected to match variation of the diode assembly in the bulkhead.

When the Power Sensor is used with a compatible power meter, the short to ground at J1-K (Mount Resistor) causes the power meter to automatically select the proper measurement range of −70 to −30 dBm.

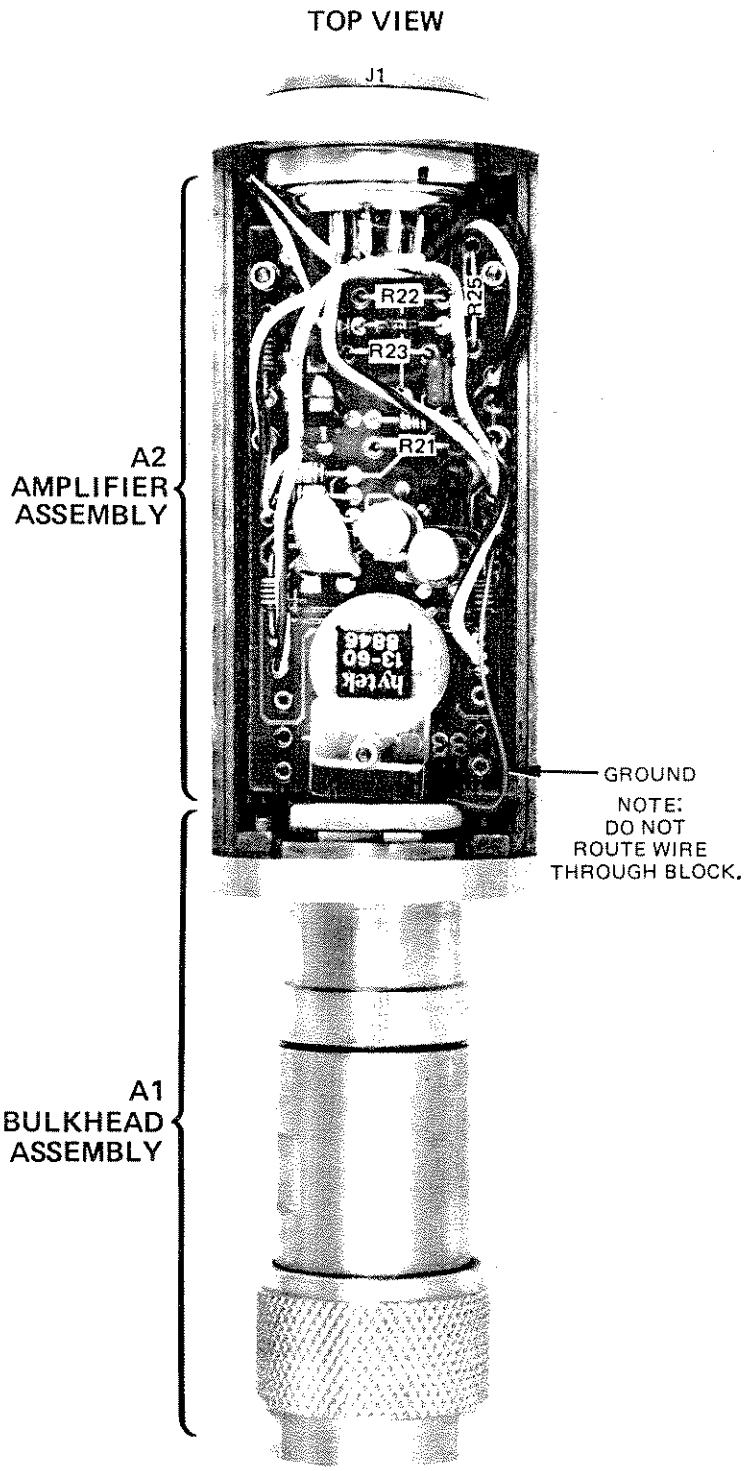


Figure 4. Component and Assembly Locations

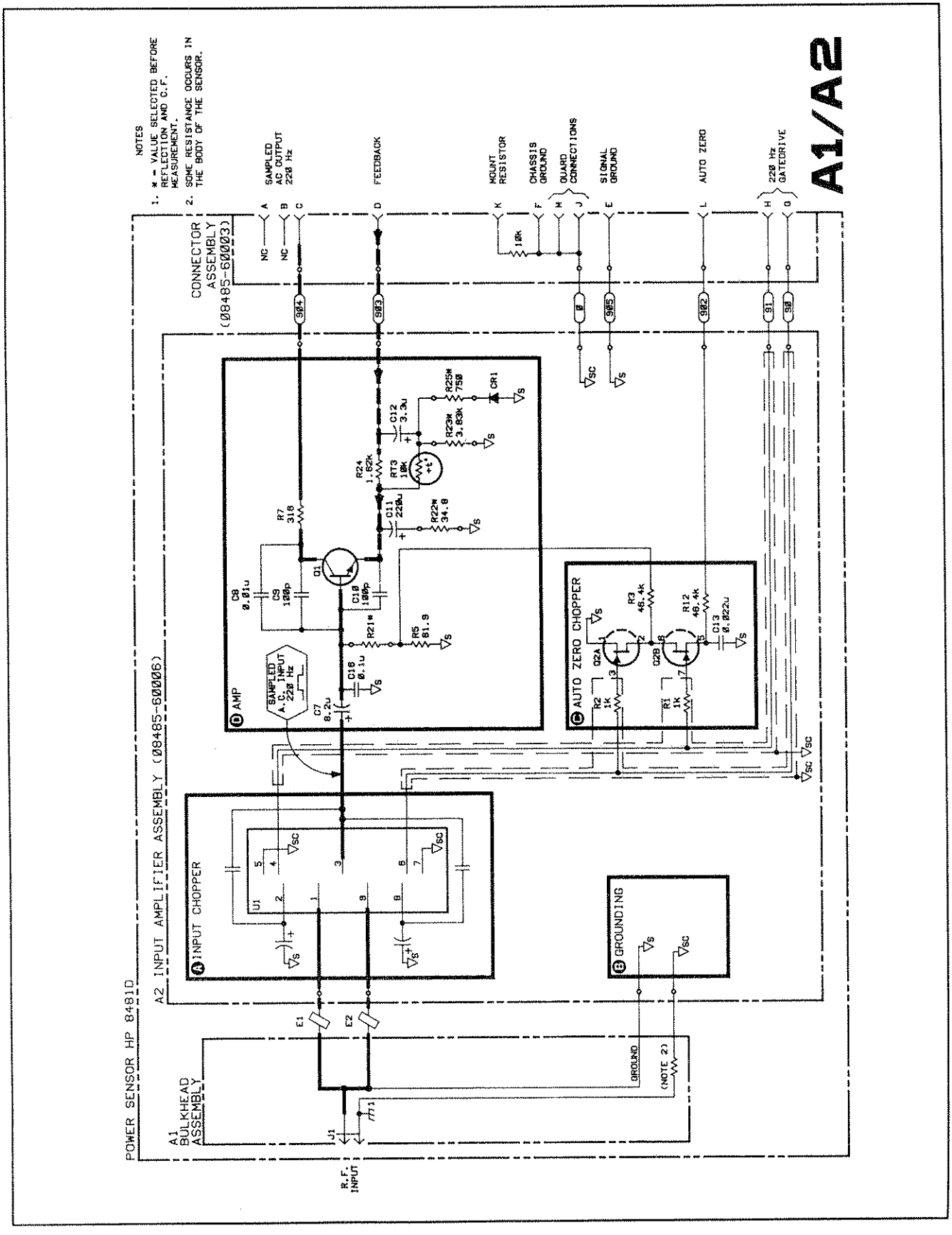


Figure 5. Power Sensor Schematic Diagram

Troubleshooting

Troubleshooting information is intended to first isolate the Power Sensor or power meter as the defective component. When the Power Sensor is isolated, troubleshooting information is intended to identify A1 Bulkhead Assembly or A2 Input Amplifier Assembly as the defective component.

Note

FETs in A2U1 are light sensitive and dc levels are shifted slightly when the FETs are exposed.

Caution

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.

220 Hz Drive

To ensure the 220 Hz signal from the power meter is correct, check the following levels of the square wave with an oscilloscope.

1. At the white-black wire: -0.05 ± 0.05 Vdc (top of square wave).
2. At the white-brown wire: below -9.0 Vdc (bottom of square wave as indicated on display).

If the levels are correct the Power Sensor is at fault. Continue with troubleshooting the Bulkhead Assembly. If the levels are incorrect, the power meter is at fault. Refer to the power meter manual for troubleshooting information.

Bulkhead Assembly

A1 Bulkhead Assembly generates 0.9 mV to 1.5 mV when 1 μW is applied to the the input. If the voltage is incorrect, the bulkhead assembly is inoperative.

Caution

Disconnect the gold wires from the A2 assembly before measuring the resistance. Be extremely careful when measuring across the gold wires. They are delicate and can be damaged easily.

Detach the gold wires from the A2 assembly (step 4 Dissassembly Procedure). Place the HP 11708A between the 1 mW power reference of the power meter and the Power Sensor. Turn on the POWER REF switch of the power meter. Voltage measured across the two gold wires from the A1 assembly should be between 0.9 mV and 1.5 mV.

If the voltage is not correct, replace the A1 Bulkhead Assembly. If the voltage is correct, replace the A2 Assembly.

Operational Amplifier

In most cases, the operational amplifier (made up of A2Q1 and the first amplifier in the power meter, Figure 6) is operating correctly if the dc voltage on the metal cover of A2Q1 (collector) is -70 ± 30 mV dc.

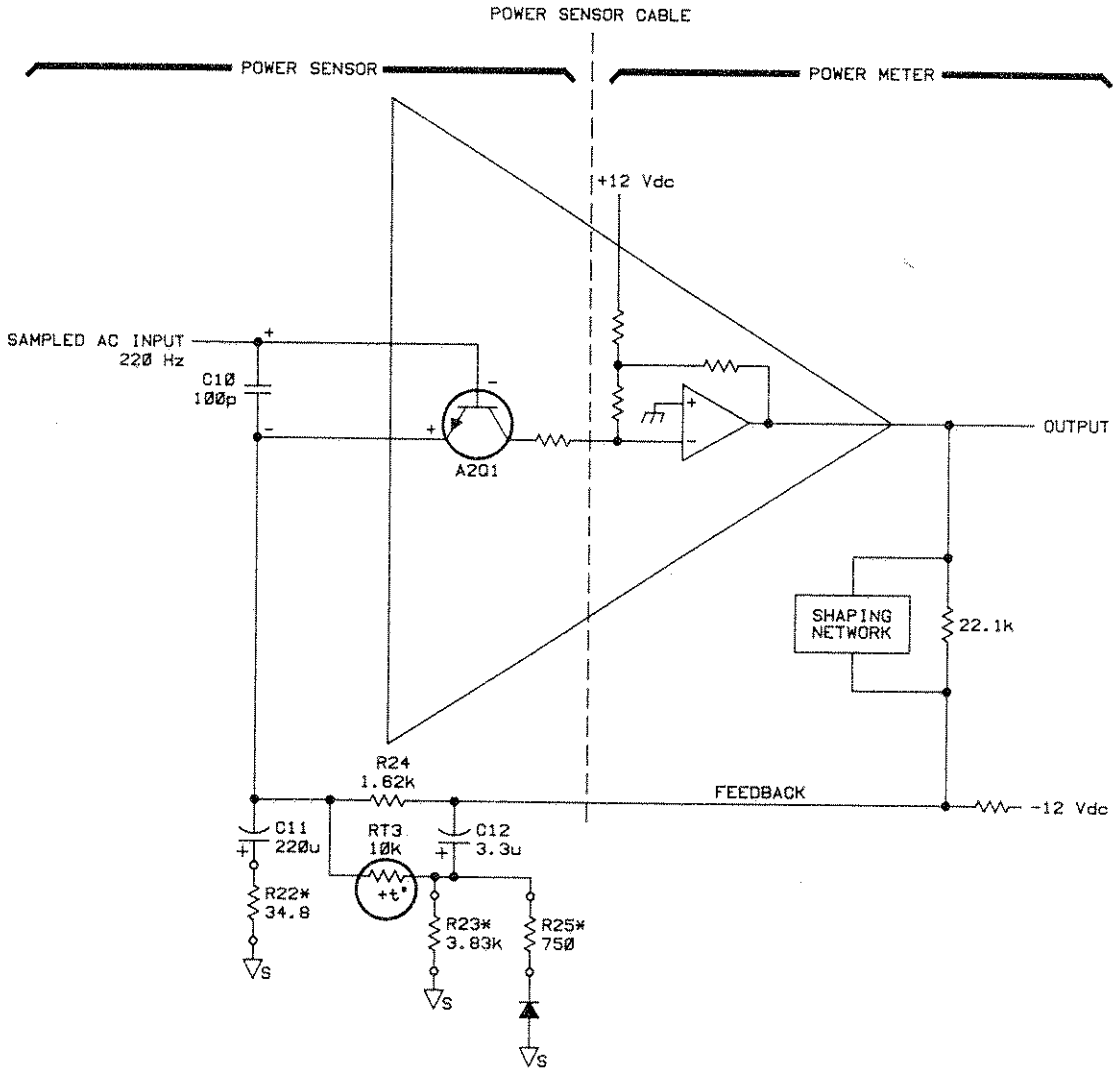


Figure 6. Operational Amplifier

Repair

Caution

Electrostatic discharge will render the Power Sensor inoperative. Perform repairs only at a static-free work station. You, the Power Sensor, and the soldering iron must be at the same static potential to avoid damage to the unit.

Soldering Procedures

The Power Sensor is a high sensitivity device, and is affected by very small differences in temperature between its components. Therefore, after doing any soldering in the unit, wait several hours for the unit to reach thermal equilibrium before using or testing it.

1. Use a temperature controlled 600°F (311°C) with a zero crossover tip.
2. Use a low temperature RMA flux, SN 62 solder.

A1 Bulkhead Assembly

There are no serviceable parts inside the A1 Bulkhead Assembly. If the bulkhead is defective, replace it with either a new or a restored bulkhead assembly (Table 5 Replaceable Parts). Each bulkhead replacement will come with selected resistors A2R21, A2R22, A2R23, and A2R25.

Replacement Procedure:

1. Remove the bulkhead assembly according to steps 1 through 7 in the disassembly procedure on the following page.
2. Remove and discard the socketed resistors A2R21, A2R22, A2R23, and A2R25 (Figure 4).
3. Replace the socketed resistors with the selected resistors which came with your replacement bulkhead.
4. Reassemble the Power Sensor according to steps 1 through 13 of the reassembly procedure (page 25).
5. Perform the FET balance adjustment (Page 10).
6. Reassemble the Power Sensor shields and shells.
7. Replace the CAL Factor label with the new label that came with your bulkhead assembly.

A2 Input Amplifier Assembly

There are no serviceable parts in the A2 Input Amplifier Printed Circuit Assembly. If you have determined A2 is faulty, replace it with the new or restored assembly listed in Table 5 Replaceable Parts.

Replacement Procedure:

1. Remove and label the socketed resistors A2R21, A2R22, A2R23, and A2R25.
2. Remove the A2 assembly according to the disassembly procedure on the following page.

3. Replace with a new A2 Assembly.
4. Replace the resistors into their proper sockets.
5. Clean flux residue thoroughly and perform the FET balance adjustment (Page 10).
6. Reassemble the Power Sensor according to the reassembly procedure steps 1 through 14 (page 24).

Cleaning

Caution

Do not handle the A2 input amplifier circuit board more than necessary. It is particularly important to keep the area around A2U1 clean. Dirt or moisture from the hands may make circuits inoperative.

Cleaning Solutions

Keeping in mind its flammable nature, a solution of pure isopropyl or ethyl alcohol can be used to clean printed circuits and connectors.

Connector Cleaning

Caution

The RF connector bead inside the calibration adapter deteriorates when contacted by hydrocarbon compounds such as acetone, trichlorethylene, carbon tetrachloride, and benzene.

Clean the connector only at a static free work station. Electrostatic discharge to the center pin of the connector will render the Power Sensor inoperative.

Clean the connector face using a cotton swab dipped in isopropyl alcohol. If the swab is too big use a round wooden toothpick wrapped in a lint free cotton cloth dipped in isopropyl alcohol.

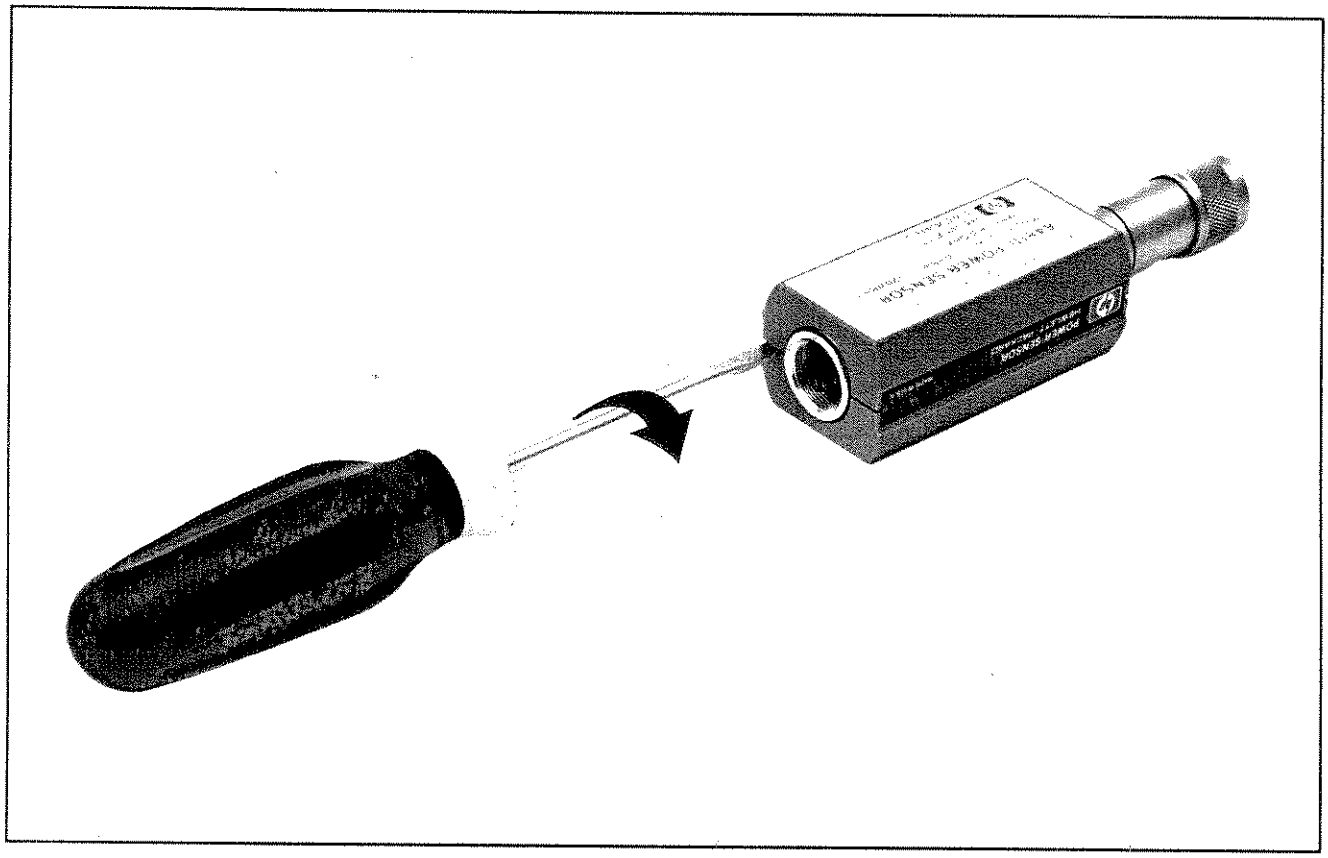


Figure 7. Removing Power Sensor Shell

Disassembly Procedure

Disassemble the Power Sensor by performing the following steps:

Caution

Disassembly must be performed in the sequence described below, otherwise damage may be caused to the two gold wires between the bulkhead assembly and the input amplifier assembly. If these wires are damaged, the A1 Bulkhead Assembly must be replaced.

Disassemble the Power Sensor only in a static free work station. Electrostatic discharge will render the Power Sensor inoperative.

Note

Every Power Sensor has an individually prepared table on the housing. If more than one power sensor is disassembled at a time, be sure to mate the correct Power Sensor and housing when reassembling.

1. At rear of Power Sensor, insert the blade of a screwdriver between the plastic shells (Figure 7). To prevent damage to the plastic shells use a screwdriver blade as wide as the slot between the two shells.
2. Pry alternately at both sided of connector J1 until the plastic shells are apart. Remove shells and magnetic shields.

3. Position the Power Sensor as shown in Figure 8, top view so that the small hole (5) is on the left side of the rf input connector. Remove allen cap screws (1), (2), (10), and (13). Loosen screws (11), and (12). Remove the upper chassis from the Power Sensor.
4. Remove clamp screw (6) together with screw spring and clamp (16). This will free the two gold wires that come from the bulkhead assembly.
5. Remove cap screws (7), (3), and (4).
6. Desolder the brown wire that originates at the bulkhead and terminates in A2.
7. Slide bulkhead assembly straight out from the chassis.
8. If A2 Input Amplifier Assembly must be removed then remove cap screws (8), (9), (11), (12), (14), and (15).
9. Lift input amplifier and J1 connector out of the chassis.

Reassembly Procedure

Use the following procedure to assemble the Power Sensor.

Caution

The two gold wires connecting the A1 Bulkhead Assembly and the A2 Input Amplifier Assembly are extremely delicate and may be easily broken. Be careful when working around them.

1. Set printed circuit board and connector into place as shown in Figure 8, bottom view.
2. Insert cap screw (8), (9), (11), (12), (14), and (15) but do not tighten.
3. Center A2 circuit board so there is an equal air gap between each side and chassis. Tighten cap screws (8), (9), (14), and (15).
4. Remove the black plastic block (17) from the printed circuit board. Position the bulkhead assembly with the small hole (5) on your left; position block (17) with the flat side towards the bulkhead assembly (grooved side out), and guide pins down. Insert the gold wires through the holes in the block (17) (MP25, Figure 3).
5. Set the bulkhead assembly straight down on the chassis. Mate the two guide pins on the block (17) with the two holes in the printed circuit board (Figure 3.)
6. Resolder the brown wire into the printed circuit board.

Note

The gold wires will lay on or near the electrical gold pads at input to FET A2U1.

7. Insert screws (3) and (4) and tighten.

8. Using tweezers, position (adjust) the gold wires over the electrical pads.

Caution

DO NOT tighten clamp screw (**6**) excessively or the FET circuit may be broken.

9. Place and hold plastic clamp (**16**) over the gold wires. (Ensure that the wires have not moved from the position set in step 7.) As you tighten the clamp screw, watch the compression spring. Tighten clamp screw (**6**) only until the spring coils touch. Any further tightening could damage the FET circuit.

   If you cannot obtain a good contact, repeat steps 8 and 9 above and continue with the following procedure.

10. Loosen screws (**3**) and (**4**). Insert screw (**6**) and tighten.
11. Place upper chassis in position and insert cap screws (**1**), (**2**), (**10**), and (**13**).
12. Tighten screws (**1**), (**2**), (**3**), and (**4**).
13. Tighten screw (**10**), (**11**), (**12**), and (**13**).
14. Replace magnetic shields and plastic shells as shown in Figure 3. Snap plastic shells together.

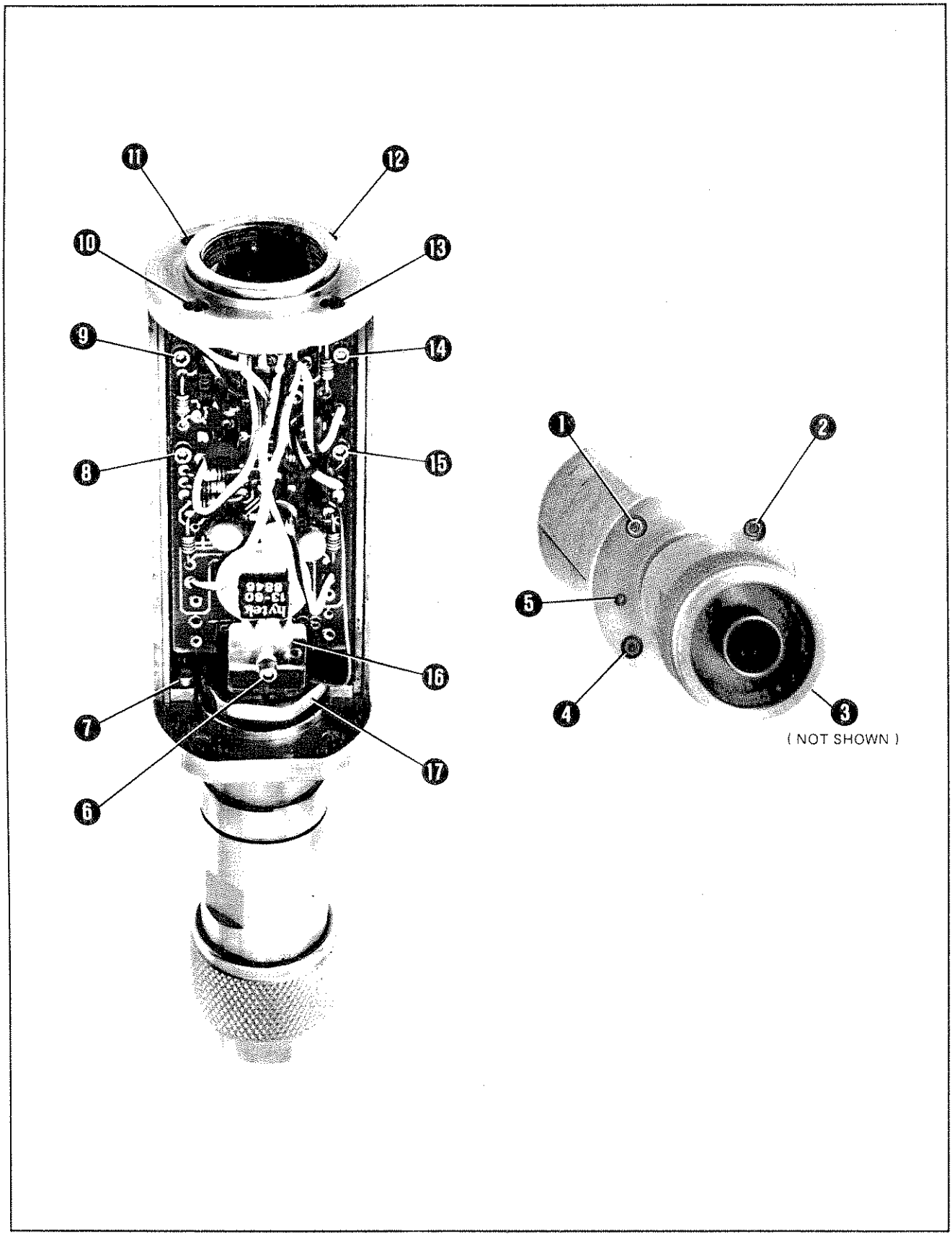


Figure 8. Power Sensor Hardware Locations

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