Errata

Title & Document Type: **8349A Microwave Amplifier Operating and Service Manual**

Manual Part Number: **08349-90001**

Revision Date: **February 1984**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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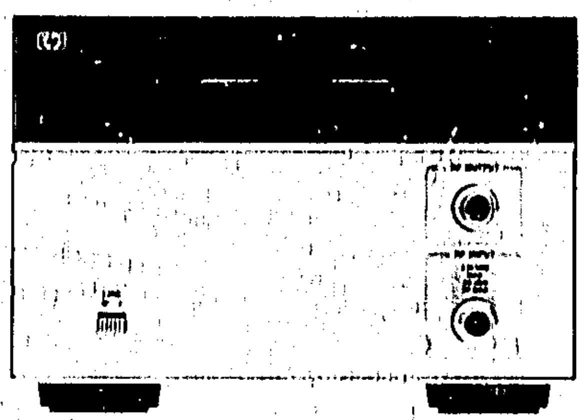
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

OPERATING AND SERVICE MANUAL

HP 8349A MICROWAVE AMPLIFIER



HEWLETT PACKARD

CERTIFICATION

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.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HP 8349A
MICROWAVE AMPLIFIER

SERIAL NUMBERS

This manual applies directly to HP Model 8349A Microwave Amplifier having serial number prefix 2403A.

With changes described in Section VII, this manual also applies to instruments with serial number prefix 2340A.

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

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1400 FOUNTAINGROVE PARKWAY, SANTA ROSA, CA 95401 U.S.A.

MANUAL PART NO. 08349-90001
Microfiche Part No. 08349-90002

Printed: FEBRUARY 1984

HEWLETT PACKARD

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SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS

⚠ Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents).

ϟ Indicates hazardous voltages.

⏚ Indicates earth (ground) terminal.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer, make sure the common terminal is connected to the neutral (grounded) side of mains supply.

SERVICING

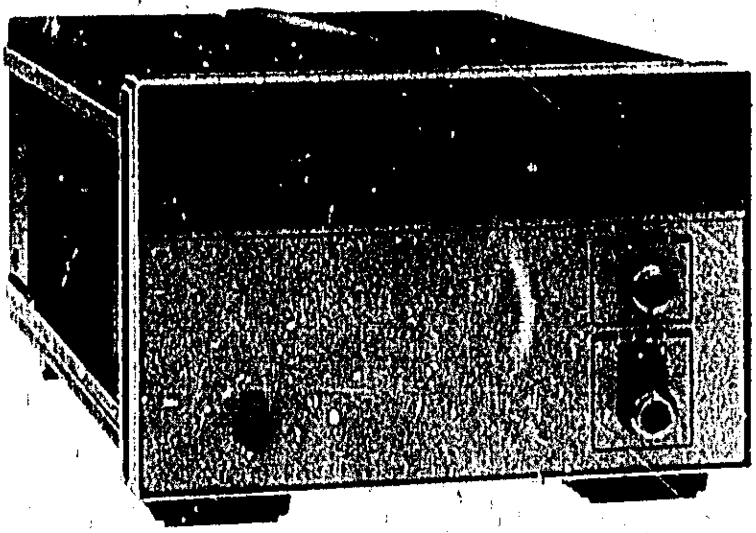
WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

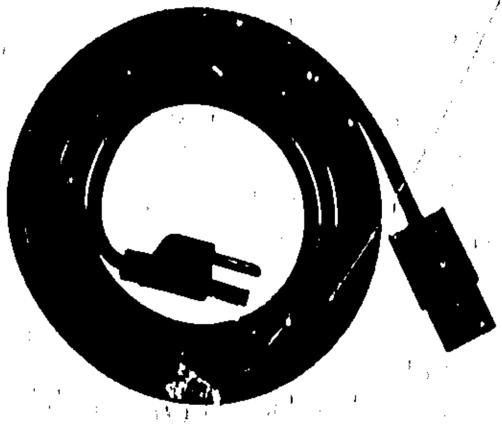
Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.



HP 8349A
MICROWAVE AMPLIFIER



LINE POWER CABLE
(HP Part No. 8120-1348)

Figure 1-1. HP Model 8349A Microwave Amplifier with Accessory Power Cable

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains operating and service information for the Hewlett-Packard Model 8349A microwave amplifier. Figure 1-1 shows the standard instrument and accessories supplied. Differences between the standard instrument and options are discussed later in this section.

1-3. Listed on the title page of this manual, below the manual part number, is a microfiche part number. This number can be used to order 4 x 6 inch microfilm transparencies. Each transparency contains up to 60 photoduplicate manual pages. The microfiche package also includes the latest Manual Changes supplement.

1-4. Refer any questions regarding this manual, the Manual Changes supplement, or the instrument to the nearest HP Sales/Service office. Always identify the instrument by model number, complete name, and complete serial number in all correspondence. Refer to the inside rear cover of this manual for a listing of HP Sales/Service offices.

1-5. MANUAL ORGANIZATION

1-6. This manual is divided into eight sections as follows:

SECTION I, GENERAL INFORMATION, contains the instrument description and specifications, explains accessories and options, and lists recommended test equipment.

SECTION II, INSTALLATION, contains information concerning the initial mechanical inspection, preparation for use, operating environment, packaging and shipping.

SECTION III, OPERATION, contains instructions for operation of the instrument.

SECTION IV, PERFORMANCE TESTS, contains the necessary tests to verify that the electrical operation of the instrument is in accordance with published specifications.

SECTION V, ADJUSTMENTS, contains the necessary adjustment procedures to properly adjust the instrument after repair.

SECTION VI, REPLACEABLE PARTS, contains the information necessary to order parts and/or assemblies for the instrument.

SECTION VII, MANUAL BACKDATING CHANGES, contains backdating information to make this manual compatible with earlier equipment configurations, if such configurations exist.

SECTION VIII, SERVICE, contains schematic diagrams, block diagrams, component location illustrations, circuit illustrations, circuit descriptions, and troubleshooting information to aid in repair of the instrument.

1-7. INSTRUMENTS COVERED BY MANUAL

1-8. Serial Numbers

1-9. Attached to the rear of your instrument is a serial number label (Figure 1-2). The serial number is in two parts. The first four digits and the letter are the serial number prefix; the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page. A backdating section, if any, makes the manual compatible with instruments having serial numbers earlier than listed on the title page.

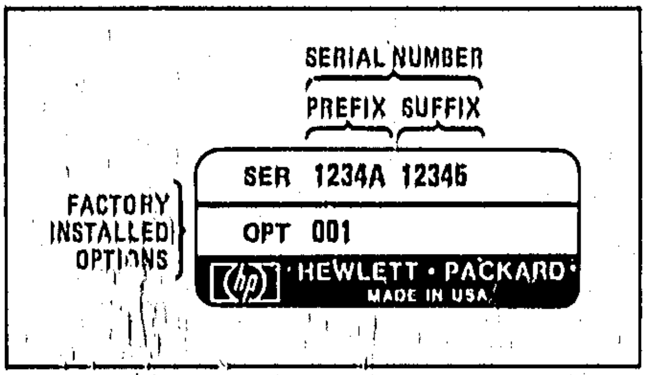


Figure 1-2. Typical Serial Number Plate

1-10. Manual Changes Supplement

1-11. 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 the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains change information which tells you how to adapt the manual to the newer instrument.

1-12. 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 for this manual is identified with this manual's print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from your nearest Hewlett-Packard Sales/Service office.

1-13. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard Sales/Service office.

1-14. Manual Backdating Changes

1-15. Instruments manufactured **before** the printing of this manual have been assigned serial number prefixes other than those for which this manual was written directly. Manual backdating information is provided in Section VII to adapt this manual to any such earlier assigned serial number prefix.

1-16. This information should not be confused with information contained in the yellow Manual Changes supplement, which is intended to adapt this manual to instrument changes which occurred **after** its printing.

1-17. SAFETY CONSIDERATIONS

1-18. Before operating this instrument, you should familiarize yourself with the safety markings on the instrument and safety instructions in this manual. This instrument has been manufacturered and tested according to international safety standards. However, to ensure safe operation of the instrument and personal safety of the user and service personnel, the cautions and warnings in this manual must be followed. Refer to the summary of safety considerations near the front of this manual. Refer also to individual sections of this manual for detailed safety notations concerning the use of the instrument as described in those individual sections.

1-19. SPECIFICATIONS

1-20. Specifications for the HP 8349A are shaded and listed in Table 1-1. These are the performance standards against which the amplifier is tested (performance tests are provided in Section IV). In some instances typical or nominal values are included. They are included as additional information only and are not the warranted performance standards (specifications) for the instrument.

1-21. INSTRUMENT DESCRIPTION

1-22. The HP 8349A is a general purpose, fully self-contained microwave amplifier. Within its decade frequency range of 2 to 20 GHz, it delivers a minimum of 100 milliwatts (+20 dBm) of unleveled power, and 80 milliwatts (+19 dBm) of leveled power. It may be used with a fixed or swept frequency source. Leveled flatness is ±1.25 dB, and minimum small signal (−5 dBm) gain is 15 dB.

1-23. EQUIPMENT SUPPLIED

1-24. The HP 8349A microwave amplifier is supplied with a power cable as shown in Figure 1-1. Additionally, the following service accessories are supplied:

- (1) Extender Bracket
  HP Part No. 08349-00011
- (1) Extender Bracket
  HP Part No. 08349-00005
- (1) Extender Board Assembly
  HP Part No. 08349-60017
- (1) Extender Board Assembly
  HP Part No. 08349-60023

1-25. OPTIONS

1-26. Option 001, Rear Panel RF Input/Output

1-27. Option 001 places the input and output connectors on the rear panel of the HP 8349A amplifier.

1-28. Option 002, Rear Panel RF Input and Front Panel RF Output

1-29. Option 002 places the input connector on the rear panel, and the output connector on the front panel.

1-30. Option 910, Additional Operation and Service Manual

1-31. Instruments ordered with Option 910 are supplied with two Operation and Service Manuals. Additional manuals are also available through your nearest Hewlett-Packard Sales/Service office by ordering the HP part number listed on the title page.

1-32. RACK MOUNTING KITS AND CABINET ACCESSORIES

1-33. Rack mounting kits are available for mounting the instrument in a rack of 482.6 mm (19 inch) width. Other accessories such as filler panels, joining kits, shelves, and ball handles are also available. Refer to your current Hewlett-Packard Electronics Instrument catalog for details. All of these kits and accessories are available through your nearest Hewlett-Packard Sales/Service office.

1-34. RECOMMENDED TEST EQUIPMENT AND ACCESSORIES

1-35. Test equipment and accessories recommended for servicing the HP 8349A microwave amplifier are listed in Table 1-2. If substitute equipment is used, it must meet the minimum specifications shown in the table.

Table 1-1. Specifications and Supplemental Characteristics for the HP 8349A

Shaded values refer to specifications. Specifications are the warranted performance standards for the instrument. Supplemental characteristics (typical or nominal values) are unshaded, and are included as additional information only. They are not the warranted performance standards (specifications) of the instrument.

Unless otherwise noted, all specifications apply over the temperature range 0°C to 55°C.

FREQUENCY RANGE: 2.0 to 20.0 GHz

INPUT AND OUTPUT (25°C ±5°C)

Impedance (Input and Output): 50 ohms, nominal

Minimum Output Power (25°C ±5°C):

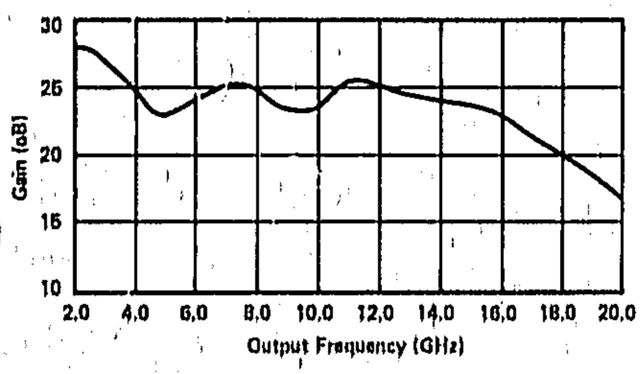
Frequency Range (GHz)	Input	Output	
		Leveled	Unleveled
2.0 to 18.6	5 dBm (3.2mW)	19 dBm (80mW)	20 dBm (100mW)
18.6 to 20.0	6 dBm (4.0mW)	19 dBm (80mW)	20 dBm (100mW)

Output Power Temperature Stability: 0.1 dB/°C

Power Flatness (Leveled): ±1.25 dB

1 dB Compression Point: +21 dBm, nominal

Minimum Small Signal Gain (at −5 dBm input): 15 dB



Typical Small Signal Gain (at −5 dBm input)

Gain Temperature Stability: 0.1 dB/°C

Noise Figure: <13 dB, typical

SWR

Frequency Range (GHz)	Input	Output	
		Leveled	Unleveled (typical)
2.0 to 5.0	≤2.8	≤2.5	≤4.8
5.0 to 11.0	≤2.8	≤2.5	≤3.8
11.0 to 18.0	≤2.8	≤2.5	≤3.2
18.0 to 20.0*	≤2.8	≤2.5	≤3.2

*SWR from 18.0 to 20.0 GHz is typical

INPUT AND OUTPUT (Cont'd)

Maximum Continuous Input, to the input or output ports: +27 dBm (RF), ±10V

DETECTOR OUTPUT Voltage (Rear Panel, Used to Level): >−1.0mV/mW, typical

SPECTRAL PURITY

Harmonics (dBc, at 20 dBm output power)	Fundamental Frequency (GHz)
≤−20	2.0 to 11.0
≤−30 (typical)	11.0 to 20.0

Non-Harmonic Spurious: ≤−55 dBc

Third Order Intercept: +33 dBm, nominal

PULSE TRANSMISSION CAPABILITY

Rise/Fall Time: <10 ns, typical

Delay Time (input to output): <8 ns, typical

GENERAL

Power Display (25°C ±5°C, CW Frequencies, and Full Band Sweep Times >4 sec)

Range: 0 dBm to +20 dBm
Accuracy: ±1.3 dB, typical

Reverse Isolation: >50 dB, typical

RF Input/Output Connectors: Type N Female

Power Requirements: 50 to 400 Hz, 100, 120, 220, 240 Volts (±10%); 30 VA maximum

Weight: Net 7 kg (15 lb), Shipping 14 kg (31 lb)

Dimensions:

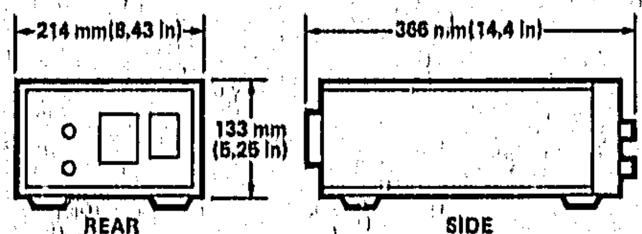


Table 1-2. Recommended Test Equipment (1 of 2)

Instrument	Critical Specifications	Recommended Model	Use[1]
Sweep Oscillator	Compatible with Plug-In	HP 8350B	P, A, T
RF Plug-In	2 – 20 GHz Coverage, ≥+7 dBm Leveled Output Power, External Leveling Capability	HP 83590A	P, A, T
Network Analyzer	Capable of Transmission/Reflection Measurements, Waveform Storage and Normalization	HP 8756A	P, T
Spectrum Analyzer	2 – 20 GHz Coverage, 2 Channel Display, Waveform Storage and Normalization Capability	HP 8566A	P, T
Power Meter	−10 to +20 dBm	HP 436A	P, A, T
Power Sensor	2 – 20 GHz Coverage, Calibrated Range −10 to +20 dBm, Maximum Input +24 dBm	HP 8485A	P, A, T
Digital Voltmeter	Range: −50V to +50V Accuracy: ±0.01% Input Impedance: ≥10M ohms	HP 3456A	A, T
Dual Directional Coaxial Coupler	2 – 18 GHz Coverage, 30 dB Directivity, Type N-Male Test Port	HP 11692D Option 002	P
Directional Coaxial Coupler	2 – 20 GHz Coverage	HP P/N 0955-0125	P
Detector	2 – 20 GHz Coverage, +10 dBm Max Input, Compatible with Plug-In	HP 8473C	P
Detectors (2)	2 – 18 GHz Coverage, Compatible with Network Analyzer Range: −20 to +10 dBm	HP 11664A	P
Detector	2 – 20 GHz Coverage, Compatible with Network Analyzer Range: −20 to +20 dBm	HP 11664B	P
Attenuator	10 dB, 2 – 20 GHz Coverage	HP 8493C Option 010	P
Airlines (2)	20 cm, SWR ≤1.08 at 18 GHz	HP 11567A	P

Table 1-2. Recommended Test Equipment (2 of 2)

Instrument	Critical Specifications	Recommended Model	Use[1]
50 Ohm Load	Type N-Male, SWR ≤1.30 at 18 GHz	HP 909A Option 012	P
50 Ohm Load	APC-7®[2] SWR ≤1.25 at 18 GHz	HP 909A	P
Extender Boards (2)	Supplied with Instrument	HP P/N 08349-60017 HP P/N 08349-60023	A
Brackets (2)	Supplied with Instrument	HP P/N 08349-00005 HP P/N 08349-00011	A
Open	Type N-Female	HP P/N 85032-20001	P, A, T
Short	Type N-Female	HP 11511A	P, A, T
Short	APC-7	HP 11565A	P, A, T
Adapter (4)	Type N-Male to APC-3.5[3] Female	HP P/N 1250-1744	P, A, T
Adapter	Type N-Male to APC-3.5 Male	HP P/N 1250-1743	P, A, T
Adapter	Type N-Male to APC-7	HP 11525A	P, A, T
Adapter	APC-7 to APC-3.5 Female	HP P/N 1250-1747	P, A, T
Cable	BNC Connectors 61 cm (24 in)	HP 11170B	P, A, T
Cable (3)	BNC Connectors 122 cm (48 in)	HP 11170C	P, A, T
Cable (2)	SMA Connectors 61 cm (24 in)	HP P/N 8120-3124	P, A, T
Cable	Type N-Male Connectors, 61 cm (24 in)	HP 11500B	P, A, T

1. P = Performance Test; A = Adjustment; T = Troubleshooting
2. APC-7 is a registered trademark of Bunker Ramo Corporation.
3. APC-3.5 is a product of the Bunker Ramo Corporation.

INSTALLATION

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section includes information on initial inspection, preparation for use, storage and shipment of the HP 8349A microwave amplifier.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electronically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrial performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The HP 8349A requires a power source of 100, 120, 220, or 240 volts, ±10%; 50 to 400 Hz. Maximum power consumption is less than 30VA.

2-8. Line Voltage and Fuse Selection

WARNING

BEFORE THIS INSTRUMENT IS SWITCHED ON, its protective earth terminals must be connected to the protective conductor of the (mains) power cable (cord). The (mains) power cable plug shall only be inserted in a socket outlet provided with a protective earth contact. DO NOT negate the earthgrounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor. Failure to ground the instrument properly may result in serious personal injury.

CAUTION

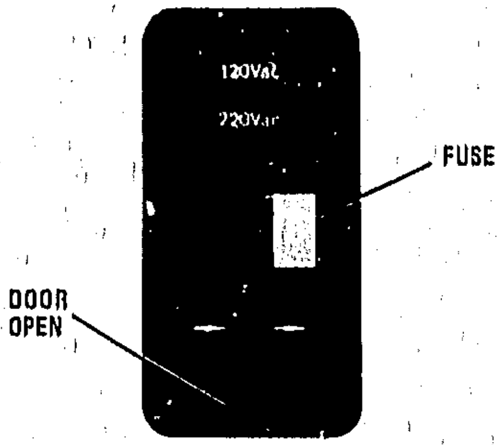
BEFORE SWITCHING ON THIS INSTRUMENT, make sure it is adapted to the voltage of the ac power source. You must set the voltage selector switch correctly to adapt the HP 8349A to the power source. Failure to set the ac power input of the instrument for the correct voltage level could cause damage to the instrument when it is switched on.

2-9. Adapt the instrument to the ac line voltage level as follows:

1. Determine the ac line voltage.
2. Refer to Figure 2-1. At the instrument's rear panel power line module, pry open the module door to reveal a rotating cam. Select the line voltage on the cam that is nearest the line voltage determined in step 1. Note that the available line voltage must be within ±10% of the line voltage selected on the rotating cam. If it is not, you must use an autotransformer between the ac source and the HP 8349A.
3. The rated fuse for all ac line voltage levels is 1 ampere.

2-10. Power Cable

2-11. In accordance with international safety standards, this instrument is equipped with a three wire power cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet.



Replacement of Fuse

1. Pry open POWER MODULE cover door.
2. Pull out grey carrier.
3. Insert fuse of proper rating.
4. Replace carrier in POWER MODULE.

Selection of Operating Voltage

1. Pry open POWER MODULE cover door.
2. Rotate cam to desired voltage such that voltage is visible through window when door is closed.
3. Close cover door.

Figure 2-1. Line Voltage Selection with Power Module Rotating Cam

WARNING

Instrument grounding may be lost if any power cable other than the 3-pronged type is used to couple the ac line voltage to the instrument.

2-12. Operating Environment

2-13. This instrument should be operated within the following limits:

Temperature.................... 0°C to 55°C
Altitude............ <4572 meters (15,000 feet)
Humidity... 5% to 80% relative at +25°C to +40°C

2-14. STORAGE AND SHIPMENT

2-15. Environment

2-16. The instrument may be stored or shipped in environments within the following limits:

Temperature............... −40°C to +75°C
Altitude........... <7620 meters (25,000 feet)
Humidity... 5% to 95% relative at 0°C to +40°C

2-17. The instrument should also be protected from temperature extremes which may cause condensation in the instrument.

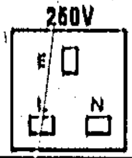
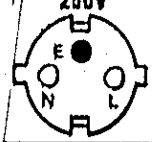
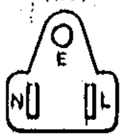
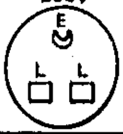
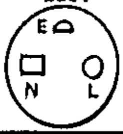
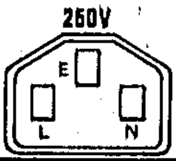
2-18. Packaging

2-19. Original Packaging. Containers and materials identical with those used in factory packaging are available through Hewlett-Packard offices. Figure 2-2 illustrates the proper method of packaging the instrument for shipment using factory packaging materials. 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 full serial number. A page of these tags is provided at the end of this section. Mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number, and full serial number.

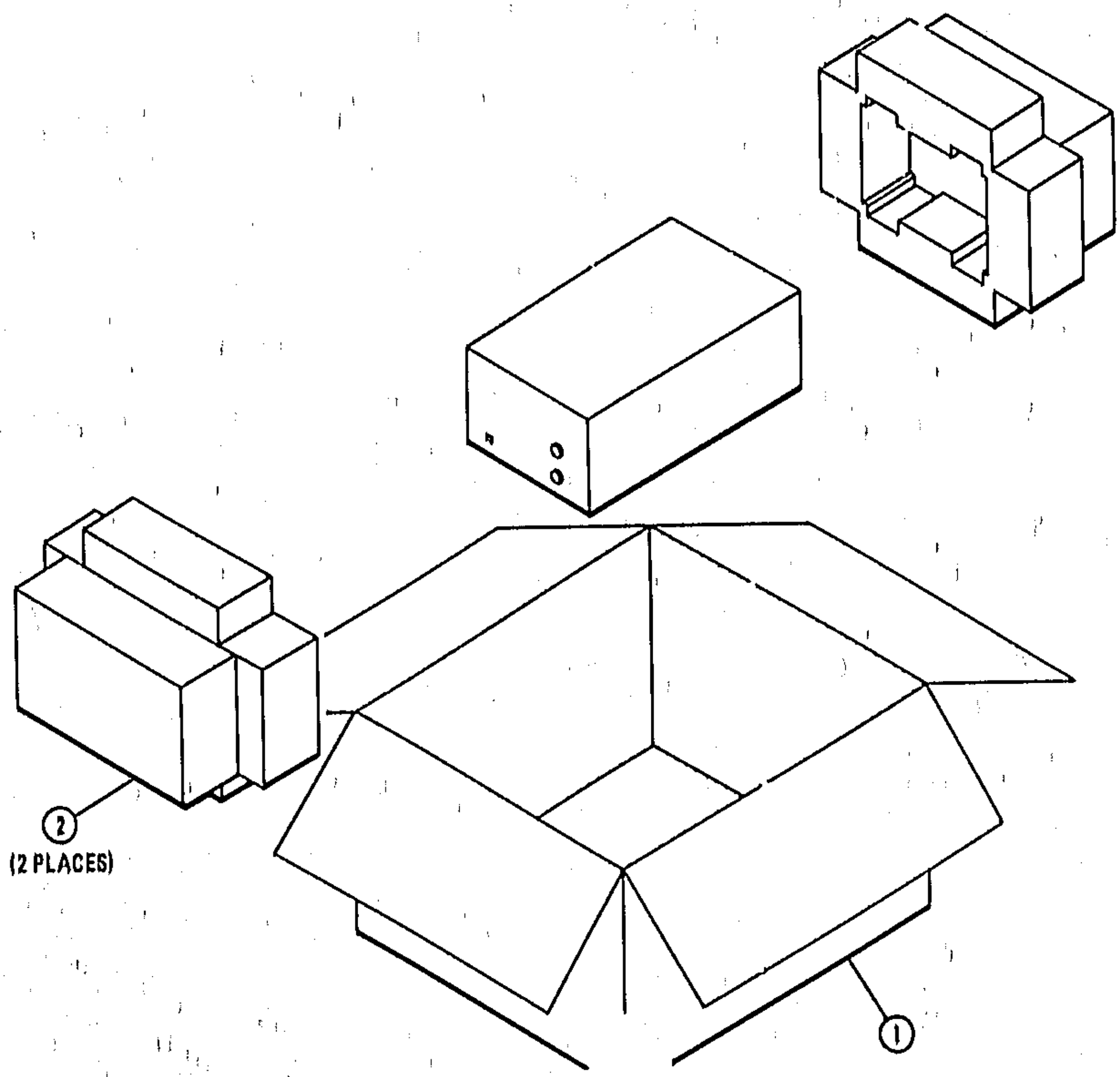
2-20. Other Packaging. The following general instructions should be used for repackaging with commercially available materials:

1. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)
2. Use a strong shipping container. A double wall carton made of 350 pound test material is adequate.
3. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the control panel with cardboard.
4. Seal the shipping container securely.
5. Mark the shipping container FRAGILE to ensure careful handling.

Table 2-1. AC Power Cables and Plugs

Plug Type [1]	Cable HP Part Number [2]	CD [3]	Plug Description [2]	Cable Length (Inches)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	0 6	Straight BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
250V 	8120-1369 8120-0696	0 4	Straight NZSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight CEE7-VII 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, Republic of So. Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight NEMA5-15P 90° Straight NEMA5-15P Straight NEMA5-15P 90° Straight NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	3	Straight SEV1011.1959 24507, Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight NEMA6-15P			United States, Canada
220V 	8120-1957 8120-2956	2 3	Straight DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	6	Straight CEE22-VI (System Cabinet Use)			

1. E = Earth Ground; L = Line; N = Neutral
2. Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
3. The Check Digit (CD) is a coded digit that represents the specific combination of numbers used in the HP Part Number. It should be supplied with the HP Part Number when ordering any of the power assemblies listed above, to expedite speedy delivery.



Item	Quantity	HP Part Number	CD	Description
1	1	9211-4893		Outer Carton
2	2	5180-7809		Foam Pads

Figure 2-2. HP 8349A Factory Packaging

OPERATION

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides information, both general and specific, that will enable you to utilize the HP 8349A microwave amplifier in a variety of applications.

3-3. PANEL FEATURES

3-4. The amplifier's front and rear panel controls and connectors are identified and functionally described in Figure 3-1.

3-5. OPERATOR'S CHECK

3-6. Figure 3-2 is an operator's check of the HP 8349A, which allows the operator to make a quick check of the amplifier prior to use. The procedures cover the entire measurement system, and incorrect indications may be caused by any portion of the system. If the amplifier is suspected, use the performance tests in Section IV to determine if the amplifier is working correctly. If not, refer to Section VIII, Service, to isolate the problem.

3-7. APPLICATIONS

3-8. The HP 8349A microwave amplifier may be used in a wide range of applications. The following descriptions and illustrations (Figures 3-3 through 3-5) explain three possible applications.

3-9. Remember that the HP 8349A amplifier is a portable extension of the source. The spectral purity of the amplifier output will depend primarily on the power levels of the fundamental and harmonic input signals from the source. However, there will be some low power harmonically related spurious signals generated by the HP 8349A during high power inputs. These spurious signals are specified to be below the power level of the fundamental input signal by at least 20 dB (see SPECIFICATIONS, Table 1-1). As with all amplifiers and sources, the spectral purity of the output may be improved by using low pass or tracking filters.

3-10. Power Amplifier

3-11. As a power amplifier, the HP 8349A microwave amplifier may be used in an unleveled or an externally leveled mode when combined with an appropriate microwave source operating between 2 and 20 GHz. Using the HP 8349A, source output power may be increased to at least +20 dBm. This enables one to do the following: TWT amplifier testing, antenna pattern analysis, long RF cable testing, RFI measurements, and mixer driving. Sources used in high power pulsed microwave applications can also benefit from the minimal pulse rise/fall time (typically less than 10 ns), and input to output delay time (typically less than 8 ns).

3-12. Figure 3-3 shows a general equipment configuration with the HP 8349A used as a power amplifier. The power level at the output of the amplifier is adjusted with the signal source power control, to a value between 0 and +20 dBm as read on the HP 8349A power display. When used in an unleveled mode, the power display may not be able to respond to rapid power variations associated with, for instance, a fast sweep rate (update rate is approximately 30 milliseconds). While sweep rate has no effect on the power output of the HP 8349A, to maintain instantaneous power display accuracy, in the unleveled mode, the sweep rate should be at least 22 ms per GHz.

3-13. By connecting the detector output of the HP 8349A to the external detector input of your source, up to +19 dBm of leveled power is available. Leveled output power is indicated by the state of the "UNLEVELED" indicator on the source. To achieve maximum leveled power, increase source output power until the "UNLEVELED" indicator on the source lights. Then back off until the light goes out. The HP 8349A is now delivering maximum leveled power.

The external leveling circuitry of the source must be compatible with the amplifier's built-in detector. The detector has a sensitivity of approximately −1.0 mV/mW and is able to drive impedances as low as 100 ohms.

3-14. Wideband Preamplifier

3-15. The HP 8349A microwave amplifier may be used as a wideband preamplifier for spectrum analyzers, microwave frequency counters, and scalar network analyzers. Spectrum analyzers with 30 dB noise figures may typically realize 15 to 20 dB signal to noise ratio improvements (Figure 3-4).

3-16. Microwave frequency counters with −25 dBm sensitivity may typically realize a 10 to 20 dB sensitivity improvement (Figure 3-5).

3-17. Scalar network analyzers may go beyond the typical 60 dB dynamic range and achieve greater than 80 dB dynamic range when using the HP 8349A in a extended dynamic range configuration (Figure 3-6).

CAUTION

With a +5 dBm input, output power from the amplifier may be as high as +26 dBm. Therefore, it is very important to insure adequate protection of the following device or instrument input circuitry.

3-18. Rack Mounted Operation

3-19. The physical configuration of the HP 8349A makes it compatible with EIA and IEC racking standards. The half rack configuration of the HP 8349A allows for mounting in a rack by itself, or closely alongside another instrument. Mounted either way, the effective convection cooling system of the HP 8349A enables it to operate at less than 10°C above the ambient temperature of the rack environment.

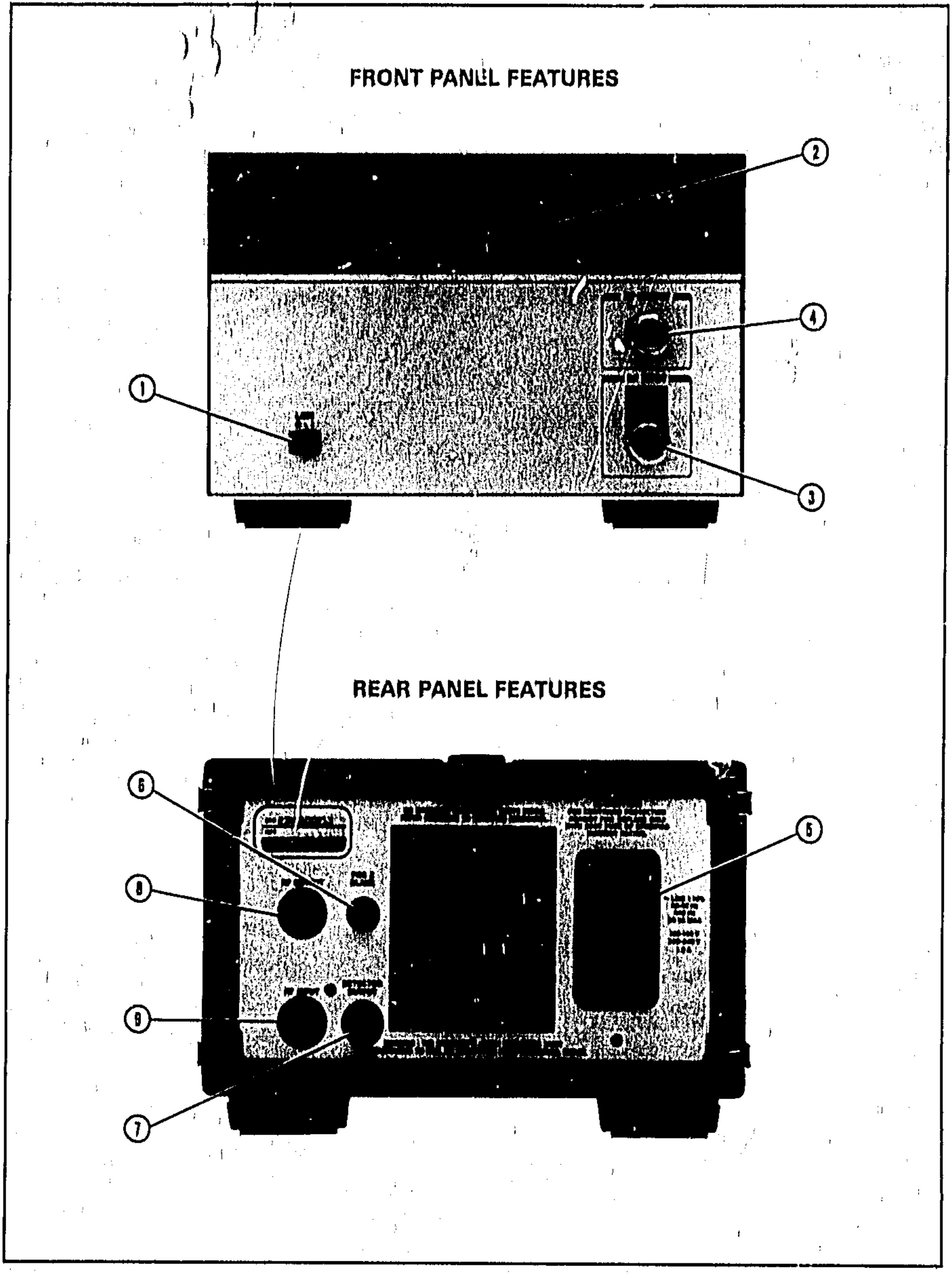


Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators (1 of 2)

1. **Line ON—OFF.** AC line switch. Turns the instrument primary power on and off.

2. **POWER LEVEL.** An internal power indicator displays output power to tenths of dBm, from 0 to +20 dBm.

3. **RF INPUT (standard).** A type N (female) connector supplies RF input power to the amplifier.

CAUTION

To avoid damaging the amplifier's internal circuitry, signals applied to the INPUT connector must not exceed +27 dBm RF, or ±10V.

4. **RF OUTPUT (standard).** A type N (female) connector supplies amplified RF output power.

5. **AC POWER MODULE.** Contains the three-wire ac power receptacle, line voltage (100, 120, 220, 240 volts) selector, and line fuse.

6. **POS Z BLANK.** Holds the power meter display, and the external display (network analyzer, etc.) while the swept source passes switch points, or retraces.

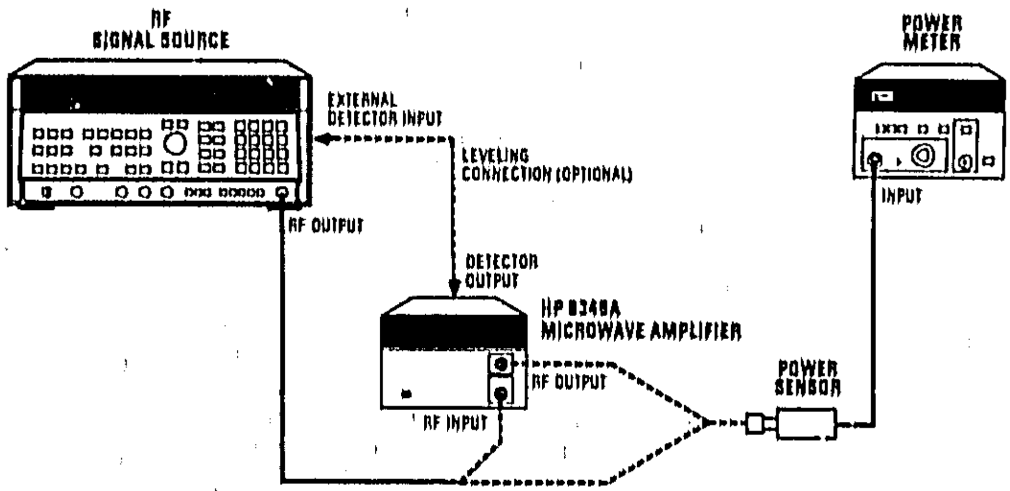
7. **DETECTOR OUTPUT.** A BNC (female) connector outputs approximately −1.0 mV/mW for use when leveling.

8. **RF OUTPUT (option 001).** A type N (female) connector supplies amplified RF output power, at the rear panel.

9. **RF INPUT (option 001 or 002).** A type N (female) connector supplies RF input power to the amplifier, at the rear panel.

Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators (2 of 2)

HP 8349A OPERATOR'S CHECK



EQUIPMENT

RF Signal Source .... See Table 1-2
Amplifier .... HP 8349A
Power Meter .... See Table 1-2

PROCEDURE

1. Set signal source to desired frequency (or frequency range).
2. Connect power sensor to source output. Set source output power to approximately +5 dBm.
3. Connect source output to amplifier input. Connect power sensor to amplifier output. Power meter should read approximatley +19 dBm (leveled), or +20 dBm (unleveled).

NOTE

This is only a rough check. For a more complete check go to Section IV, Performance Tests.

Figure 3-2. HP 8349A Operator's Check

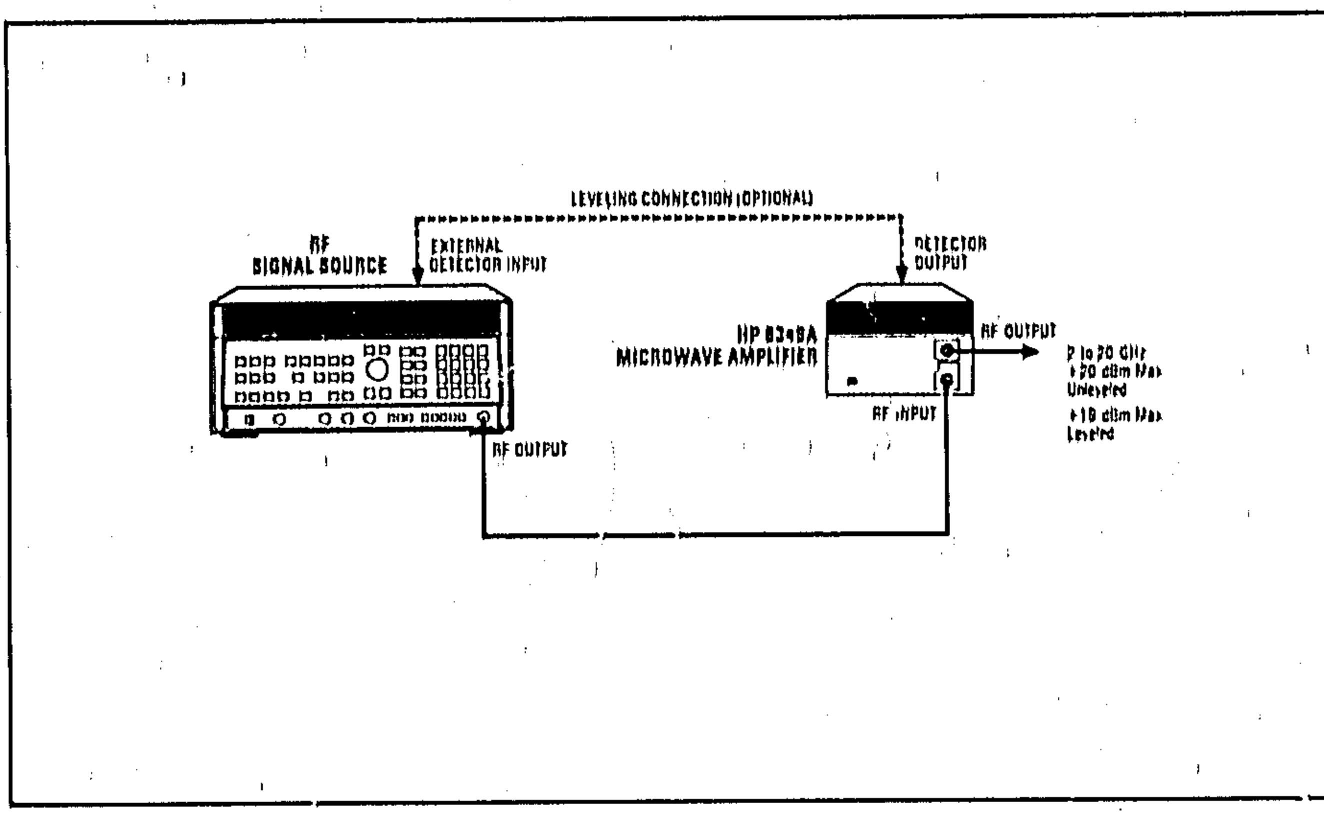


Figure 3-3. HP 8349A Used as a Power Amplifier

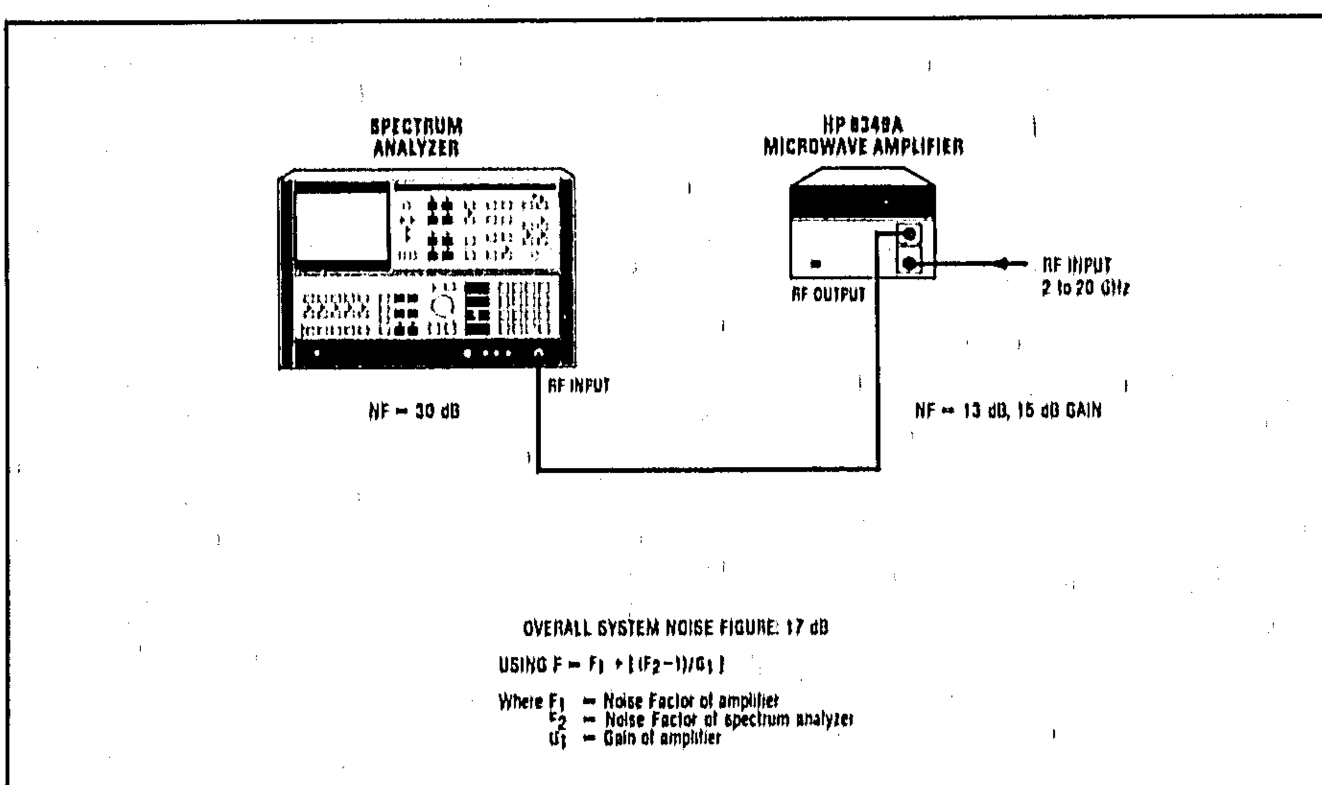


Figure 3-4. HP 3349A Used as Preamplifier for a Spectrum Analyzer

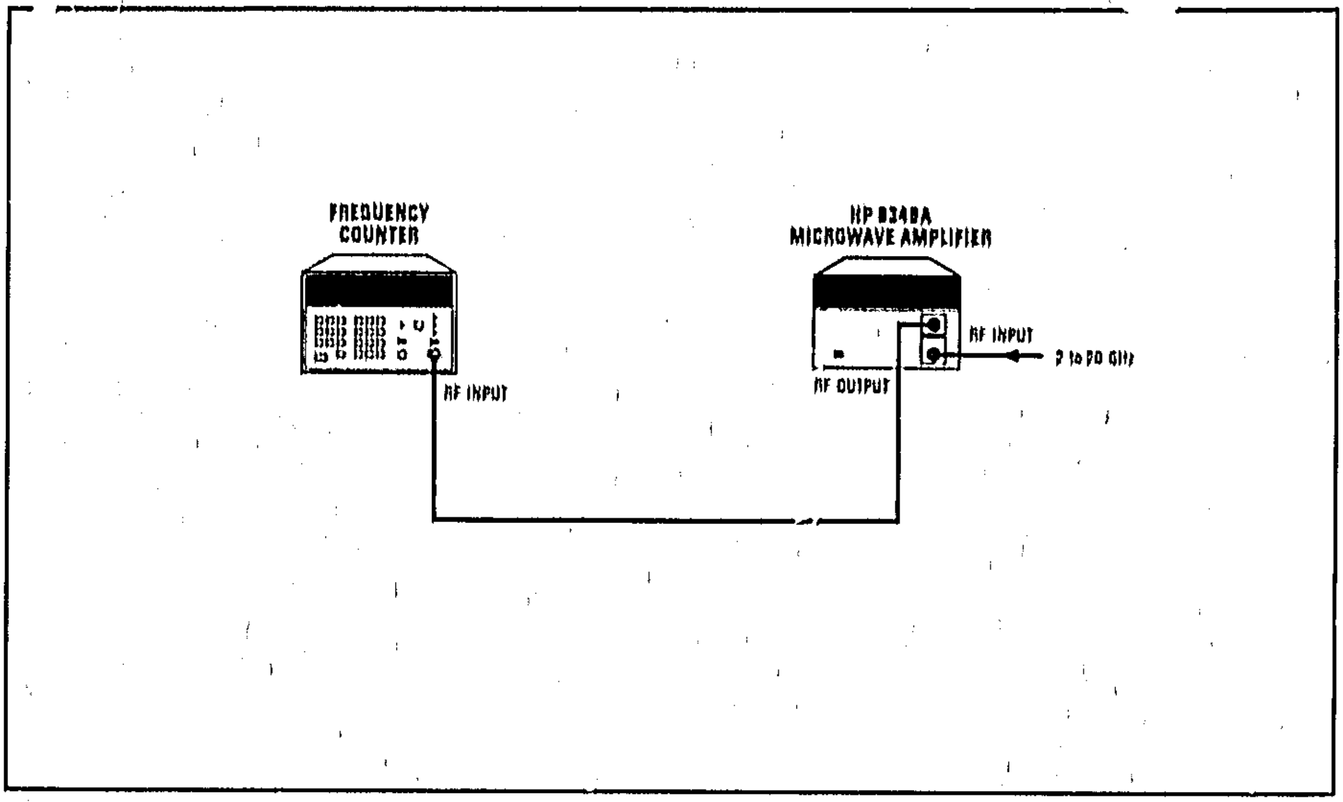


Figure 3-5. HP 8349A Used as Preamplifier for a Frequency Counter

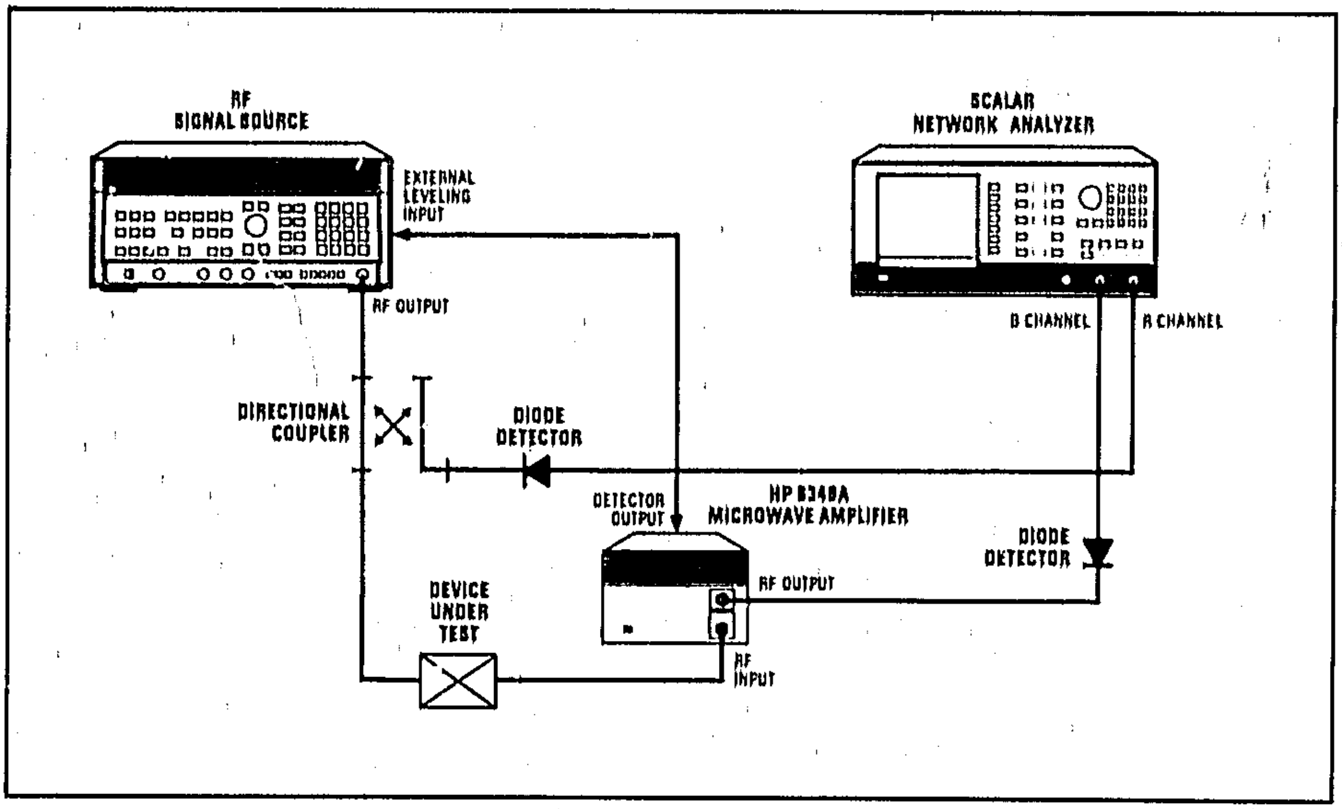


Figure 3-6. HP 8349A Used as a Dynamic Range Extender with a Scalar Network Analyzer

PERFORMANCE CHECK

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the electrical performance of the HP 8349A using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under Operator's Check.

4-3. The performance test procedures must be performed in the sequence given, since some procedures rely on satisfactory test results in foregoing steps. If a test measurement is slightly out of tolerance, go to Section V and perform the related adjustment procedures. If a function fails to operate, go to Section VIII for troubleshooting information.

4-4. EQUIPMENT REQUIRED

4-5. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models.

4-6. OPERATION VERIFICATION

4-7. The Operation Verification consists of performing the Output Power, Gain, and Flatness performance tests in paragraph 4-10. These tests provide reasonable assurance that the amplifier is functioning properly and should meet the needs of an incoming inspection (80% verification).

4-8. TEST RECORD

4-9. Results of the performance tests may be recorded in the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test Results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-10. OUTPUT POWER, GAIN, AND FLATNESS

SPECIFICATION:

Minimum Output Power (25°C ±5°C):

Frequency Range (GHz)	Input	Output	
		Leveled	Unleveled
2.0 to 18.6	5 dBm (3.2mW)	19 dBm (80mW)	20 dBm (100mW)
18.6 to 20.0	6 dBm (4.0 mW)	19 dBm (80mW)	20 dBm (100mW)

Power Flatness (Leveled): ±1.25 dB

Minimum Small Signal Gain (at −5 dBm Input): 15 dB

DESCRIPTION:

In the Small Signal Gain measurement, the sweep oscillator is set up for a 2.0 to 20.0 GHz sweep and externally leveled at −5 dBm. The source's output signal is stored into the network analyzer's memory and then the source is connected to the HP 8349A's RF INPUT. The network analyzer is connected to the RF OUTPUT and then set up for a measurement minus memory display. Minimum Small Signal Gain is read directly from the display.

Two separate tests are performed to measure Unleveled Output Power. The first is done for a frequency range of 2.0 to 18.6 GHz and the second for 18.6 to 20.0 GHz. In both, the HP 8349A's minimum output power frequency is determined by adjusting a frequency marker to the minimum power point on the network analyzer's swept display. The source is set up for CW at the marker frequency and then adjusted for exactly +5 dBm (+6 for 18.6 to 20.0 GHz) output power. The source is then connected to the HP 8349A's RF INPUT and the Unleveled Output Power is measured at the output with the power meter.

Leveled Output Power and Flatness are verified in the same test. The HP 8349A's DETECTOR OUTPUT is connected to the source's EXT ALC INPUT and external leveling is selected. The amplifier's minimum power frequency is found by manually sweeping the source while observing the power meter. The output power is then set to +19 dBm. The maximum power point is found in the same manner as above and the difference between the maximum and minimum power is calculated to verify the Flatness specification. Being able to level at +19 dBm also verifies the Leveled Output Power specification.

4-10. OUTPUT POWER, GAIN, AND FLATNESS (Cont'd)

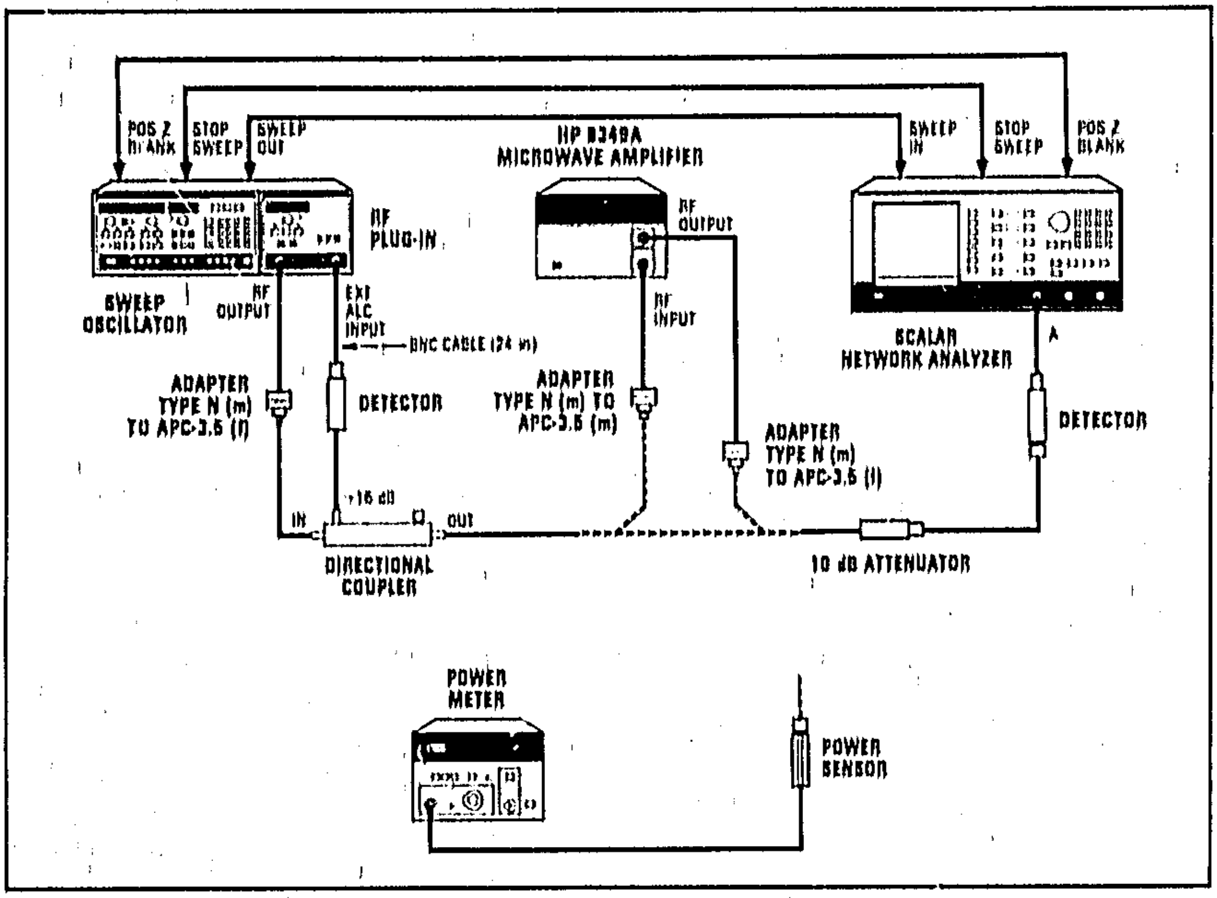


Figure 4-1. Small Signal Gain Test Setup

EQUIPMENT:

Sweep Oscillator	HP 8350B
RF Plug-In	HP 83590A
Scalar Network Analzyer	HP 8756A
Detector	HP 11664B
Power Meter	HP 436A
Power Sensor	HP 8485A
Attenuator	HP 8493C Option 010
Detector	HP 8473C
Directional Coupler	HP P/N 0955-0125
Adapters:	
Type N (m) – APC-3.5 (f) (2 required)	HP P/N 1250-1744
Type N (m) – APC-3.5 (m)	HP P/N 1250-1743
Cables:	
SMA (m)	HP P/N 8120-3124
BNC (m) (48 in., 3 required)	HP 11170C
BNC (m) (24 in.)	HP 11170B

4-10. OUTPUT POWER, GAIN, AND FLATNESS (Cont'd)

PROCEDURE:

Small Signal Gain

1. Connect the equipment as shown in Figure 4-1 with the coupler output connected to the 10 dB attenuator.

2. Set the network analyzer to display the power measured on the A input. Set the reference level to −15 dBm and scale to 10 dB/DIV. Place the reference line on the center graticule.

3. Set up the sweep oscillator as follows:

   Start Frequency: 2.0 GHz
   Stop Frequency: 20.0 GHz
   Sweep Time: 0.5 sec
   Sweep Trigger: Internal
   Power Level: −5 dBm
   ALC Mode: External
   27.8 kHz Square Wave Modulation: On
   Display Blanking: On

   Adjust the power level to center the waveform on the −15 dBm reference line.

4. Press the HP 8349A LINE switch on. Allow the equipment to warm up for 30 minutes.

5. Change the scale on the network analyzer to 1 dB/DIV and adjust the output power of the plug-in for the flattest waveform about the −15 dBm reference (use the slope feature of the plug-in if necessary).

6. Store the waveform into the network analyzer's memory.

7. Connect the coupler to the RF INPUT of the HP 8349A and the 10 dB attenuator to the RF OUTPUT.

8. Set the network analyzer to display measurement minus memory and set the reference to +20 dB. Adjust the reference to place the minimum point of the waveform on the display. Determine the dB value of the minimum point (HP 8349A's minimum small signal gain). The measured value should be ≧15 dB.

Unleveled Output Power (2.0 − 18.6 GHz)

9. Select dBm mode on the power meter and calibrate.

10. Reconnect the network analyzer to the output of the coupler as shown in Figure 4-1.

11. Set the network analyzer to display the power measured on the A input. Set the reference level to −5 dBm and scale to 10 dB/DIV.

12. Set the sweep oscillator's stop frequency to 18.6 GHz. Set the plug-in's output power to +5 dBm and then adjust it to center the waveform on the network analyzer's reference line.

13. Change the scale on the network analyzer to 1 dB/DIV and readjust the output power of the plug-in for the flattest waveform about the reference (use the slope feature of the plug-in if necessary).

4-10. OUTPUT POWER, GAIN, AND FLATNESS (Cont'd)

14. Store the waveform into memory.

15. Reconnect the coupler to the HP 8349A's RF INPUT and the network analyzer to the RF OUTPUT.

16. Set the network analyzer to display measurement minus memory and the reference to +15 dB. Adjust the reference to place the minimum point of the waveform on the display.

17. Set one of the sweep oscillator's frequency markers to lowest point of the waveform displayed on the network analyzer. Select marker to center frequency and then select CW mode. This should set the sweep oscillator output frequency to the marker frequency. Turn the square wave modulation off.

18. Adjust the CAL FACTOR % on the power meter to the value given on the sensor for the frequency selected.

19. Disconnect the coupler from the HP 8349A and connect the power sensor to the coupler output. Adjust the plug-in's output power until the power meter measures +5.0 dBm.

20. Disconnect the power sensor, connect the attenuator to the coupler output and connect the power sensor to the attenuator. Determine the amount of attenuation.

21. Reconnect the coupler to the RF INPUT of the HP 8349A and the attenuator and power sensor to the RF OUTPUT. Add the amount of attenuation determined in step 20 to the dBm value now displayed on the power meter. The sum is the minimum output power with a +5 dBm input over the 2.0 to 18.6 GHz range and should be ≧+20 dBm.

Unleveled Output Power (18.6 – 20 GHz)

22. Reconnect the network analyzer to the output of the coupler as shown in Figure 4-1.

23. Set the network analyzer to display the power measured on the A input. Set the reference level to −4 dBm and scale to 10 dB/DIV.

24. Set the sweep oscillator's start frequency to 18.6 GHz and stop frequency to 20 GHz. Turn the 27.8 kHz square wave modulation on. Set the plug-in's output power to +6 dBm and then adjust it to center the waveform on the network analyzer's reference line.

25. Repeat steps 13 through 18.

26. Disconnect the coupler from the HP 8349A and connect the power sensor to the coupler output. Adjust the plug-in output power until the power meter measures +6.0 dBm.

27. Disconnect the power sensor, connect the attenuator to the coupler output and connect the power sensor to the attenuator. Determine the amount of attenuation.

28. Reconnect the coupler to the RF INPUT of the HP 8349A and the attenuator and power sensor to the RF OUTPUT. Add the amount of attenuation determined in step 27 to the dBm value now displayed on the power meter. The sum is the minimum output power with a +6 dBm input over the 18.6 to 20 GHz range and should be ≧+20 dBm.

4-10. OUTPUT POWER, GAIN AND FLATNESS (Cont'd)

Leveled Output Power and Flatness

29. Connect the equipment as shown in Figure 4-2 with the power sensor connected to the HP 8349A's RF output (attenuator not installed).

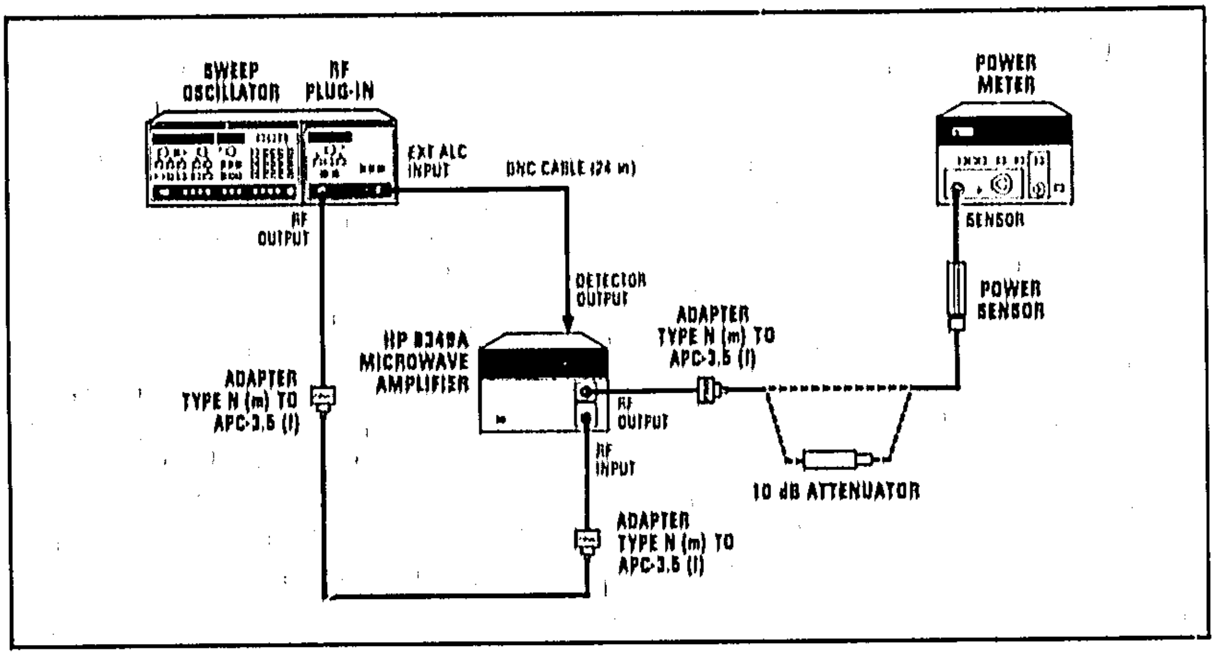


Figure 4-2. Leveled Output Power and Flatness Test Setup

30. Set up the sweep oscillator as follows:

    Start Frequency: 2.0 GHz
    Stop Frequency: 20.0 GHz
    Sweep: Manual
    ALC Mode: External
    Power Level: 19 dBm
    Square Wave Modulation: Off

NOTE

In order to level the HP 8349A at +19 dBm, it may be necessary to adjust the RF plug-in's front panel EXT ALC CAL adjustment.

31. While monitoring the power meter, adjust the manual frequency from 20 GHz to 2 GHz and determine the frequency of the minimum power point (minimum point will typically occur at the higher frequencies). Return the sweep oscillator to the frequency of the minimum power point.

32. Adjust the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected and then adjust the output power of the plug-in for a +19 dBm power meter reading.

4-10. OUTPUT POWER, GAIN AND FLATNESS (Cont'd)

33. Connect the 10 dB attenuator between the adapter and power sensor as shown in Figure 4-2. While monitoring the power meter, adjust the manual frequency from 2 to 20 GHz and determine the frequency of the maximum power point. Return the sweep oscillator to the frequency of the maximum power point.

34. Adjust the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected. Subtract 9 dBm from the value shown on the power meter to determine the leveling accuracy of the HP 8349A. This value should be ≦2.5 dB.

35. To meet leveling requirements, the unleveled indicator on the RF plug-in should remain off during forward sweep. Set the sweep oscillator for a 5 second sweep from 2.0 to 20.0 GHz and verify that the unleveled indicator remains off during forward sweep.

4-11. SWR

SPECIFICATION:

SWR

Frequency Range (GHz)	Input	Output (Leveled)
2.0 to 18.0	≤2.8	≤2.5

DESCRIPTION:

In the Input SWR test, the equipment is set up as shown in Figure 4-3 and the network analyzer is set up for an A/R measurement. An open-short calibration is performed at the test port of the coupler and the calibration is stored into the network analyzer's memory. The network analyzer is set for measurement minus memory and the amplifier is connected to the coupler. The dB value of the maximum point on the network analyzer is determined and this value is then converted to SWR.

In the Output SWR test, the 2.0 to 18.0 GHz frequency range is tested in four separate 4 GHz bandwidths. This is done to increase the resolution of the network analyzer display. The dual directional coupler is set up as a single directional coupler and then a load is placed on the end of the air line (see Figure 4-3) to prevent any reflections from being seen at the coupled port. The signal at the coupled port is then stored into the network analyzer's memory. A short is then placed on the air line, the network analyzer is set to display measurement minus memory, and the maximum change in power is measured. System errors are corrected by measuring the system loss in one direction and then multiplying by two. Finally, through several calculations, the SWR of the amplifier is determined.

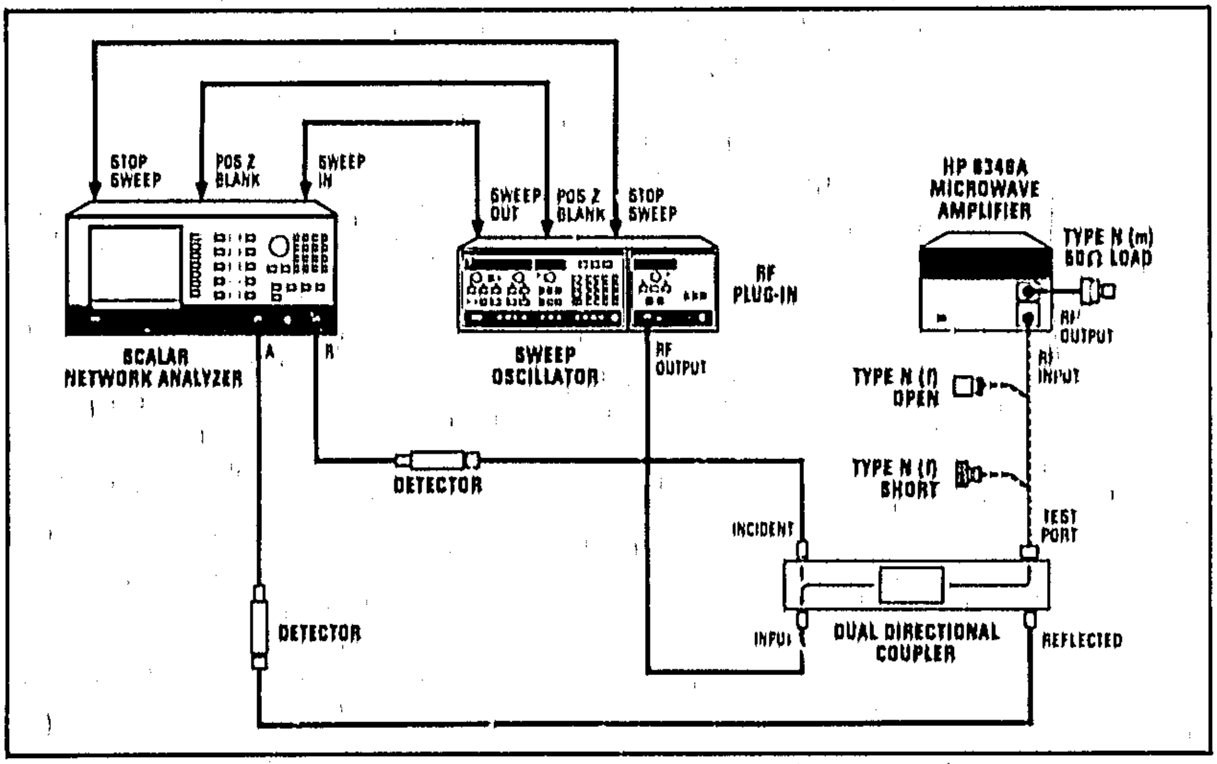


Figure 4-3. Input SWR Test Setup

4-11. SWR (Cont'd)

EQUIPMENT:

Sweep Oscillator	HP 8350B
RF Plug-In	HP 83590A
Scalar Network Analyzer	HP 8756A
Detector (2 required)	HP 11664A
Dual Directional Coupler	HP 11692D Option 002
20 cm Air Line (2 required)	HP 11567A
Type N (f) Short	HP 11511A
Type N (f) Open	HP P/N 85032-20001
Type N (m) 50Ω Load	HP 909A Option 012
APC-7 Short	HP 11565A
APC-7 50Ω Load	HP 909A
Adapters:	
Type N (m) – APC-7	HP 11525A
APC-7 – APC-3.5 (f)	HP P/N 1250-1747
Type N (m) – APC-3.5 (f) (3 required)	HP P/N 1250-1744
Cables:	
Type N (m) (24 in.)	HP 11500B
BNC (m) (48 in., 3 required)	HP 11170C
BNC (m) (24 in.)	HP 11170B
SMA (m)	HP P/N 8120-3124

PROCEDURE:

Input SWR

1. Connect the equipment as shown in Figure 4-3 with the short connected to the coupler's Test Port.

2. Set the sweep oscillator as follows:

   Start Frequency: 2.0 GHz
   Stop Frequency: 20.0 GHz
   Sweep Time: 1 sec
   Sweep Trigger: Internal
   27.8 kHz Square Wave Modulation: On
   Display Blanking: On
   Power Level: 5 dBm
   ALC Mode: Internal

3. Set the network analyzer as follows:

   Channel 1: On
   Channel 2: Off
   Measure: A/R
   Display: Measurement
   Scale: 5 dB/DIV
   Reference Level: 0 dB

4. Press the HP 8349A LINE switch on. Allow the equipment to warm up for 30 minutes.

4-11. SWR (Cont'd)

NOTE

In steps 5 and 6, an open-short calibration is performed. The HP 8756A has a special CAL function incorporated which automatically stores the calibration information into memory when the calibration is complete. Use this feature when performing steps 5 and 6.

5. Perform a short calibration.

6. Connect the open to the Test Port of the coupler and perform an open calibration.

7. Connect the Test Port of the coupler to the HP 8349A's RF INPUT. Set the network analyzer to display input minus memory and adjust the reference to place the waveform onto the display.

8. Determine the dB value of the maximum point on the waveform and use the following formula to calculate the SWR. The SWR should be ≤2.8.

   $SWR = 10^{(-x/20)}$

   where x = the dB value of the maximum point.

Output SWR

9. Connect the equipment as shown in Figure 4-4 with the load connected to the air line.

10. Set the sweep oscillator as follows:

    Start Frequency: 2.0 GHz
    Stop Frequency: 6.0 GHz
    Sweep Time: 0.5 sec
    Sweep Trigger: Internal
    ALC Mode: External
    Power Level: 15 dBm
    Display Blanking: On
    27.8 kHz Square Wave Modulation: On

4-11. SWR (Cont'd)

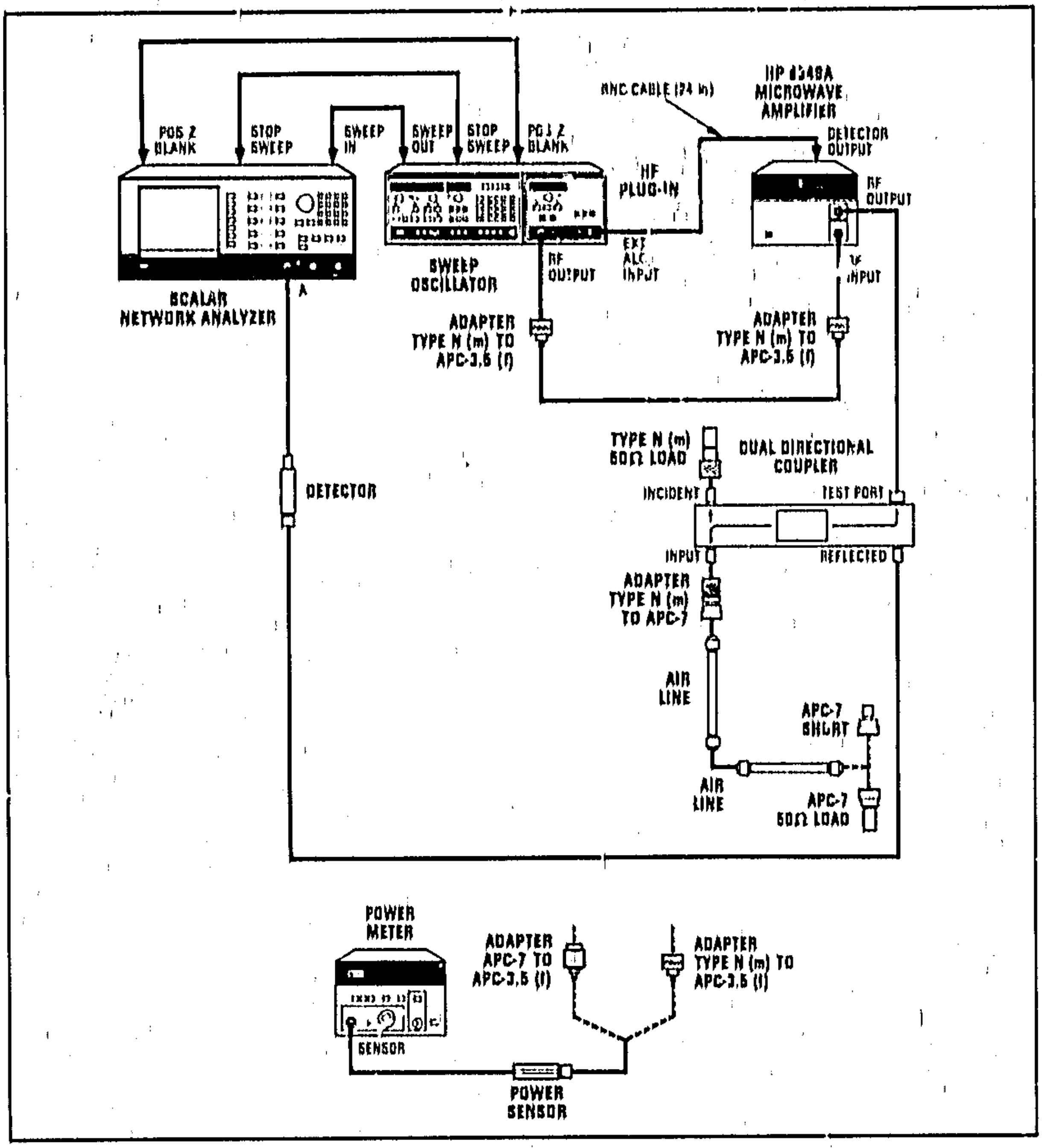


Figure 4-4. Output SWR Test Setup

4-11. SWR (Cont'd)

NOTE

In order to level the output power of the HP 8349A, it may be necessary to adjust the RF plug-in's front panel EXT ALC CAL adjustment. Ensure that the RF plug-in's unleveled indicator remains off during forward sweep before continuing with this test.

11. Set up the network analyzer to measure the power on the A input. Center the waveform on the display and then store it into memory.

12. Connect the short to the air line as shown in Figure 4-4 and set the network analyzer to display measurement minus memory.

13. A ripple waveform should now be displayed on the network analyzer. Find the point where the greatest peak to peak variation occurs (adjacent minimum to maximum) and determine the dB change from the minimum to the maximum (*should be a positive number*). Enter the dB change onto Table 4-1 in the column labeled Δ dB.

Table 4-1. Output SWR Test Data

Frequency Range (GHz)		Δ dB (dB)	MSL (dB)
Start	Stop		
2.0	6.0		
6.0	10.0		
10.0	14.0		
14.0	18.0		

14. Center a frequency marker between the maximum and minimum points. Set the sweep oscillator to CW mode and enter the marker frequency.

15. Set the power meter mode to dBm and calibrate. Set the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected.

16. Disconnect the short and connect the power sensor to the air line. Turn the 27.8 kHz square wave modulation off and note the power level.

17. Disconnect the coupler and connect the power sensor to the HP 8349A's RF OUTPUT. Note the power level.

18. Subtract the power level measured in step 16 from the level measured in step 17. The difference is the loss of the measurement system (MSL). Enter the value onto Table 4-1.

19. Repeat steps 9 through 18 for the frequency ranges given in Table 4-1.

4-11. SWR (Cont'd)

20. Using the data entered in Table 4-1 for the 2.0 to 6.0 GHz frequency range, perform the following calculations to determine the output SWR of the HP 8349A.

   a. Convert Δ dB to measured SWR (SWR_M) using the following equation:

$$SWR_M = 10^{-(\Delta dB/20)}$$

$$SWR_M = \_\_\_\_\_\_\_\_$$

   b. Convert SWR_M to the measured reflection coefficient (ρ_M) using the following equation:

$$\rho_M = \frac{SWR_M - 1}{SWR_M + 1}$$

$$\rho_M = \_\_\_\_\_\_\_\_$$

   c. Convert MSL to the reflection coefficient of the test system (ρ_{TS}) using the following equation:

$$\rho_{TS} = 10^{-2(MSL/20)}$$

$$\rho_{TS} = \_\_\_\_\_\_\_\_$$

   d. Calculate the reflection coefficient of the HP 8349A (ρ_A) using the following equation:

$$\rho_A = \rho_M / \rho_{TS}$$

$$\rho_A = \_\_\_\_\_\_\_\_$$

   e. Calculate the output SWR of the HP 8349A (SWR_A) using the following equation and then enter the value onto Table 4-2 in the 2.0 to 6.0 GHz Frequency Range column.

$$SWR_A = \frac{1 + \rho_A}{1 - \rho_A}$$

$$SWR_A = \_\_\_\_\_\_\_\_$$

4-11. SWR (Cont'd)

Table 4-2. Output SWR Test Results

Frequency Range	2.0 to 6.0	6.0 to 10.0	10.0 to 14.0	14.0 to 18.0
SWR				

21. Repeat step 20 using the data entered in Table 4-1 for the 6.0 to 10.0 GHz, 10.0 to 14.0 GHz, and 14.0 to 18.0 GHz frequency ranges.

22. The largest value entered for SWR in Table 4-2 is the HP 8349A's worst case SWR. This value should be ≦2.5.

4-12. SPECTRAL PURITY

SPECIFICATION:

Fundamental Frequency (GHz)	Harmonics (dBc, at 20 dBm Output Power)	Non-Harmonic Spurious
2.0 to 11.0	≦−20	≦−55 dBc

DESCRIPTION:

In the Harmonics test, the HP 8349A is tested over the frequency range where the harmonic content is the greatest (3.2 to 6.3 GHz). Initially, the test system is calibrated by sweeping the source from 6.4 to 12.6 GHz and storing a calibration line into the spectrum analyzer's memory. The calibration line is then set to 0 dB in order to allow the harmonic content to be directly read in dBc. The spectrum analyzer is then set for measurement minus memory and the source is swept from 3.2 to 6.3 GHz. After several sweeps, the harmonic level (in dBc) is read directly from the spectrum analyzer.

In the Non-Harmonic Spurious test, a frequency of interest is selected and then the spectrum analyzer is tuned from 2.0 to 18.0 GHz while looking for spurious responses.

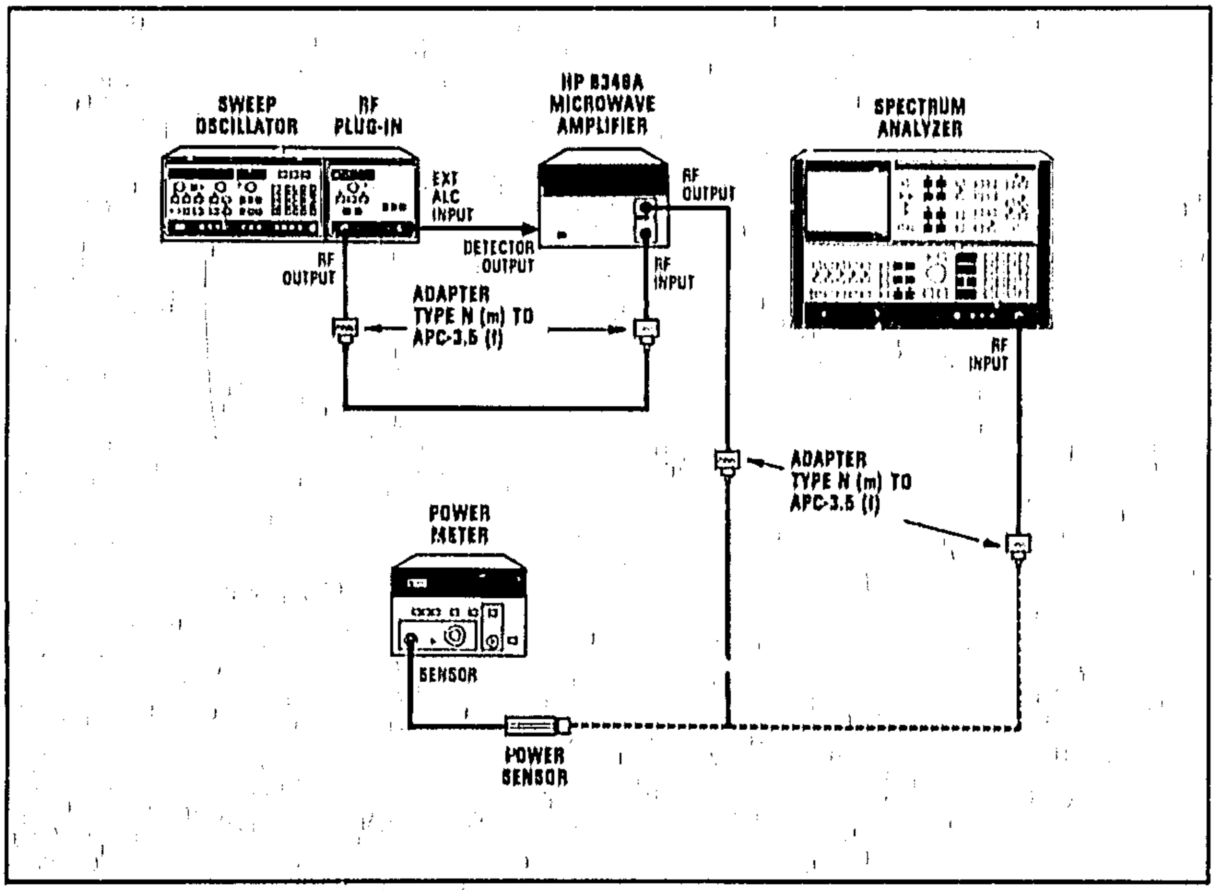


Figure 4-5. Spectral Purity Test Setup

4-12. SPECTRAL PURITY (Cont'd)

EQUIPMENT:

Sweep Oscillator	HP 8350B
RF Plug-In	HP 83590A
Spectrum Analyzer	HP 8566A
Power Meter	HP 436A
Power Sensor	HP 8485A
Adapter:	
Type N (m) – APC-3.5 (f) (4 required)	HP P/N 1250-1744
Cables:	
SMA (m) (2 required)	HP P/N 8120-3124
BNC (m) (24 in.)	HP 11170B

PROCEDURE:

Harmonics

1. Switch the equipment off and then connect it as shown in Figure 4-5 with the HP 8349A's RF OUTPUT connected to the spectrum analyzer.

2. Switch the spectrum analyzer on and then set it as follows:

   Start Frequency: 6.4 GHz
   Stop Frequency: 12.6 GHz
   Reference Level: 20 dBm
   RF Input Attenuation: 30 dB
   Scale: 5 dB/DIV

3. Set up the sweep oscillator as follows:

   CW: 12.6 GHz
   Sweep Time: 100 sec
   Sweep Trigger: Single
   RF Blanking: On
   Display Blanking: On
   ALC Mode: External
   Power Level: 16 dBm

4. Switch the HP 8349A LINE on. Allow the equipment to warm up for 30 minutes.

5. Adjust the output power of the RF plug-in until the display on the HP 8349A reads 20.0 dBm. Set the sweep oscillator's start frequency to 6.4 GHz and stop frequency to 8.4 GHz.

6. Set the spectrum analyzer to blank channel A. Clear channel B and then select maximum hold.

7. Press single sweep on the sweep oscillator.

8. At the end of the sweep, change the sweep oscillator's start frequency to 8.4 GHz and stop frequency to 10.4 GHz. Press single sweep.

4-12. SPECTRAL PURITY (Cont'd)

9. At the end of the sweep, change the sweep oscillator's start frequency to 10.4 GHz and stop frequency to 12.6 GHz. Press single sweep.

10. At the end of the sweep, a trace with some small power drop outs should be displayed on the spectrum analyzer. To remove the power drop outs, set channel A on the spectrum analyzer to write and set the sweep oscillator to CW. Adjust the frequency of the sweep oscillator to the points where the drop outs occur. When the sweep oscillator frequency equals a drop out frequency, the drop out should be removed.

11. On the spectrum analyzer, blank channel A and then select enter display line. Set the display line to 0 dBm and then select channel B minus display line. Set the spectrum analyzer to display channel A minus channel B. Blank channel B and select a reference level of 0 dBm.

12. Set the sweep oscillator as follows:

    Start Frequency: 3.2 GHz
    Stop Frequency: 6.3 GHz
    Sweep Trigger: Internal

13. On the spectrum analyzer, clear channel A and then set it for maximum hold. Allow the sweep oscillator to sweep three times through the frequency range set in step 12.

14. Adjust the spectrum analyzer's frequency marker from 6.4 to 12.6 GHz. Determine the dBm value and frequency of the maximum point. The measured value should be ≤−20 dBm (due to the calibration performed in previous steps, the measured value converts directly to dBc).

15. If the maximum harmonic level measured in step 14 is within specification, proceed to step 24. If the test failed, proceed to step 16.

16. Select CW mode on the sweep oscillator and enter the frequency of the harmonic that exceeds the specification. Enter a power level of 10 dBm.

17. Calibrate the power meter and set the CAL FACTOR % to the value given on the power sensor for the frequency selected. Connect the power sensor to the HP 8349A RF OUTPUT. Note the power meter reading.

18. Set the sweep oscillator frequency to one-half of the harmonic frequency if it is the second harmonic that exceeds specification, or one-third the harmonic frequency if it is the third harmonic.

19. Adjust the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected. Adjust the power level of the RF plug-in for a power meter reading of 20 dBm.

20. Disconnect the power sensor and reconnect the spectrum analyzer to the HP 8349A's RF OUTPUT. Clear channel A on the spectrum analyzer and note the power level of the harmonic.

21. Repeat step 16.

4-12. SPECTRAL PURITY (Cont'd)

22. Measure the power level on spectrum analyzer. Calculate the insertion loss of the test system by subtracting the power level measured in this step from the power level noted in step 17 (insertion loss = power level step 17 minus power level step 22).

23. Determine the power level of the harmonic by adding the insertion loss calculated in step 22 to the power level noted in step 20. Subtract 20 from the sum to determine the power level of the harmonic in dBc. The difference should be ≦−20 dBc.

Non-Harmonic Spurious

24. Set the sweep oscillator to a CW frequency of interest. Connect the power sensor to the RF OUTPUT of the HP 8349A and adjust the output power of the plug-in until the power meter reads 20.0 dBm.

25. Reconnect the spectrum analyzer to the HP 8349A's RF OUTPUT and tune the spectrum analyzer from 2.0 to 20.0 GHz. Look for any spurious responses. When one is found, determine if it is harmonically or non-harmonically related. If non-harmonically related, the spurious signal sould be ≦−55 dBc.

Table 4-3. HP 8349A Test Record

Hewlett-Packard Model 8349A Microwave Amplifier			**Date:** ______	
Serial Number: ______			**Tested By:** ______	
Specification Tested	**Step**	**Test Conditions**	**Specification**	**Measured Value**
4-10. Small Signal Gain	8	Input Power: −5 dBm	15 dB	______ dB
4-10. Unleveled Output Power	21	Frequency Range: 2.0 to 18.6 GHz Input Power: 5 dBm	20 dBm	______ dBm
4-10. Unleveled Output Power	28	Frequency Range: 18.6 to 20.0 GHz Input Power: 6 dBm	20 dBm	______ dBm
4-10. Output Power Flatness	34	Minimum Output Power: 19 dBm. Leveled	±1.25 dB	______ dB pk-pk
4-11. Input SWR	8		≦2.8	______
4-11. Output SWR	22	Output Power: 20 dBm, Leveled	≦2.5	______
4-12. Spectral Purity: Harmonics	14	Output Power: 20 dBm, Leveled	≦20 dBc	______ dBc
4-12. Spectral Purity: Non-Harmonic Spurious	25	Output Power: 20 dBm, Leveled	≦55 dBc	______ dBc

ADJUSTMENTS

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section provides adjustment procedures for the HP 8349A microwave amplifier. These procedures should not be performed as routine maintenance but should be used (1) after replacement of a part or component, or (2) when performance tests show that the specifications listed in Table 1-1 cannot be met. Table 5-1 lists the adjustment procedures described in this section. Table 5-2 lists all the adjustable components by reference designation and adjustment name, giving the paragraph number of the adjustment procedure and a description of the function performed by the adjustment.

NOTE

Allow the HP 8349A microwave amplifier to warm up for 30 minutes prior to making any adjustments.

5-3. SAFETY CONSIDERATIONS

5-4. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition. Adjustments and service should be performed only be a skilled person who is aware of the hazards involved.

WARNING

Adjustments in this section are performed with power supplied to the instrument while protective covers are removed. There are voltages at points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Adjustments should be performed only by a skilled person who is aware of the hazards involved.

Capacitors inside the instrument may still be charged, even if the instrument has been disconnected from its source of supply.

NOTE

Use a non-metallic adjustment tool whenever possible.

5-5. EQUIPMENT REQUIRED

5-6. The equipment required for the adjustment procedures is listed in Section I of this manual. If the test equipment recommended is not available, other equipment may be substituted if its performance meets the critical specifications listed in the table. The equipment required for each adjustment is specified in each procedure.

5-7. RELATED ADJUSTMENTS

5-8. All of the adjustments in the HP 8349A microwave amplifier are interrelated. If adjustments are required, all the adjustment procedures should be performed, in the sequence provided here.

Table 5-1. Adjustment Procedures

Paragraph	Procedure
5-9	+8V and −10V Power Supply Adjustments
5-10	Display Zero Adjustment
5-11	Displayed Power Level Adjustments

Table 5-2. Adjustable Components

Reference Designation	Adjustment Name	Adjustment Paragraph	Description
A5R35	+3V ADJ	5-9	Adjusts the dc voltage at the output of voltage regulator U1 to +8V.
A5R36	−10V ADJ	5-9	Adjusts the dc voltage at the output of voltage regulator U4 to −10V.
A1R9	MTR CAL	5-10	Calibrates the front panel display.
A4R14	0 DB ADJ	5-11	Compensates for the detection diode in the A2 microcircuit to set the displayed power level at 0 dBm.
A4R22	10 DB ADJ	5-11	Adjusts the gain of A4U5 to set the displayed power level at 10 dBm.
A4R13	20 DB ADJ	5-11	Adjusts the bias current for the dual-slope logger circuit to set the displayed power level at 20 dBm.

5-9. +8V AND −10V POWER SUPPLY ADJUSTMENTS

REFERENCE

A5 Power Supply Assembly

DESCRIPTION

The +8V and −10V power supplies are adjusted to the proper levels.

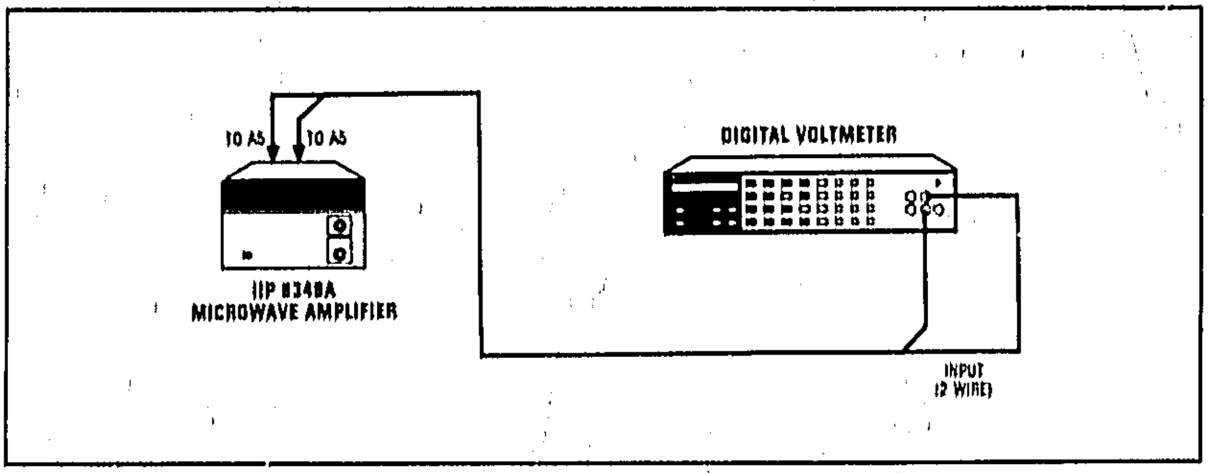


Figure 5-1. Power Supply Adjustment Setup

EQUIPMENT

Digital Voltmeter (DVM) .... HP 3456A

PROCEDURE

1. With the LINE power off, remove the top cover of the HP 8349A microwave amplifier as follows: remove the screw from the rear cover-strip of the carrying handle; slide the top cover back to expose the cover's front edge, and lift it off.
2. Switch on the LINE power, and allow the instruments to warm up for 30 minutes.
3. Connect the DVM LO terminal to A5TP6 (A GND 2), and the HI terminal to A5TP1 (+8V). Refer to Figure 5-2 for A5 power supply assembly adjustment locations.
4. Adjust A5R35 (see Figure 5-2) for a DVM reading of +8.000 ± .001 Vdc.
5. Connect the DVM HI termianl to A5TP4 (−10V).
6. Adjust A5R36 for a DVM reading of −10.000 ± .001 Vdc.

5-9. +8V AND −10V POWER SUPPLY ADJUSTMENTS (Cont'd)

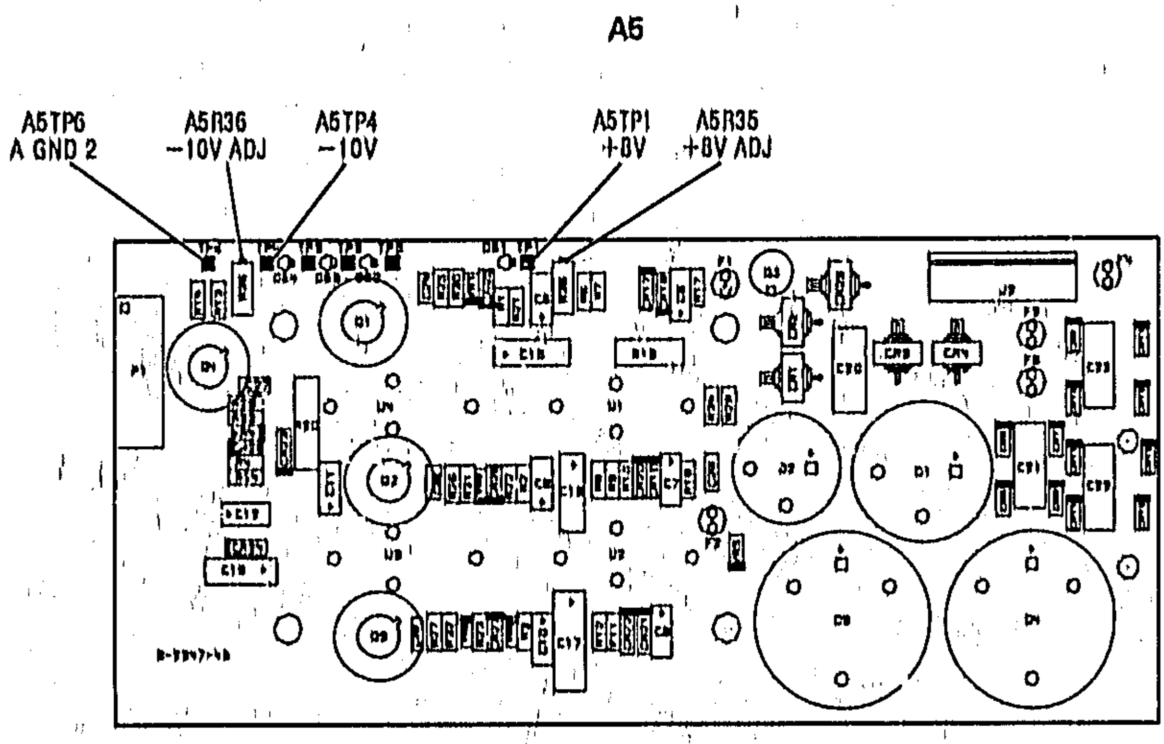


Figure 5-2. Power Supply Assembly Adjustment Locations

5-10. DISPLAY ZERO ADJUSTMENT

REFERENCE

A1 Front Panel Assembly

DESCRIPTION

With the A4 signal conditioning assembly removed from the instrument, the input signal to the front panel display is forced to 0 volts. A1 R9 (MTR CAL) on the front panel assembly is then adjusted to cause the POWER LEVEL display to correspond with the 0V input signal.

EQUIPMENT

Extender Board .... HP Part Number 08349-60017

PROCEDURE

1. Make sure the LINE power to the instrument is OFF.
2. Remove the display window (the upper front dress panel) by pushing both clips to the left and allowing the window to drop forward.
3. Remove the top and bottom covers of the instrument. To remove the top cover, unscrew the rear cover-strip of the carrying handle; slide the top cover back to expose the cover's front edge, and lift it off. To remove the bottom cover it is only necessary to remove the single screw from the center of the rear frame and slide the cover back and off.
4. Remove the A4 signal conditioning assembly from the instrument as follows. Disconnect W3 rear panel cable from A4. Disconnect coax cable W2 from A4 and secure it out of the way. Remove the allen screws holding the top and bottom of the A4 assembly onto the center divider standoffs. Pull the A4 assembly out of its motherboard socket.
5. Connect the extender board to the motherboard in place of the A4 signal conditioning assembly.
6. Switch on the LINE power and allow the instrument to warm up for 30 minutes.
7. Connect a jumper between pin 9 of the extender board and A5TP6 (A GND 2) on the power supply assembly. The voltage at pin 9 is the display board input signal, which is thus forced to 0V.
8. Adjust A1 R9 (MTR CAL) (see Figure 5-3) until the front panel POWER LEVEL display reads −00.0. Continue to adjust until the minus sign just blanks out.
9. Replace the A4 signal conditioning assembly in the instrument. Reconnect W3 rear panel cable to A4J1. Reconnect W2 coax cable to A4J2.

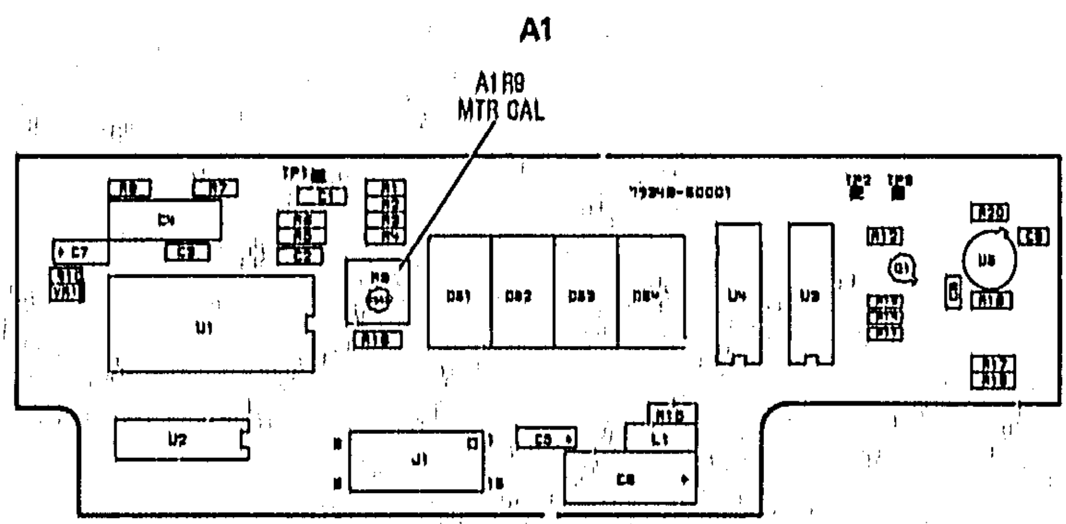


Figure 5-3. Display Zero Adjustment Location

5-11. DISPLAYED POWER LEVEL ADJUSTMENTS

REFERENCE

A4 Signal Conditioning Assembly

DESCRIPTION

The source is swept across the frequency range of the HP 8349A microwave amplifier to find the maximum and minimum output power levels of the amplifier. The average power level is calculated, and the adjustments are performed at a frequency where the output power is at this level.

A4R14 (0 DBM ADJ) is adjusted to compensate for the sensitivity of the detection diode in the A2 microcircuit. A4R22 (10 DBM ADJ) adjusts the gain of A4U5 to obtain 250 mV/dBm on the output at A4TP3. A4R13 (20 DBM ADJ) adjusts the bias current for the dual-slope logger circuit. The adjustments are interactive.

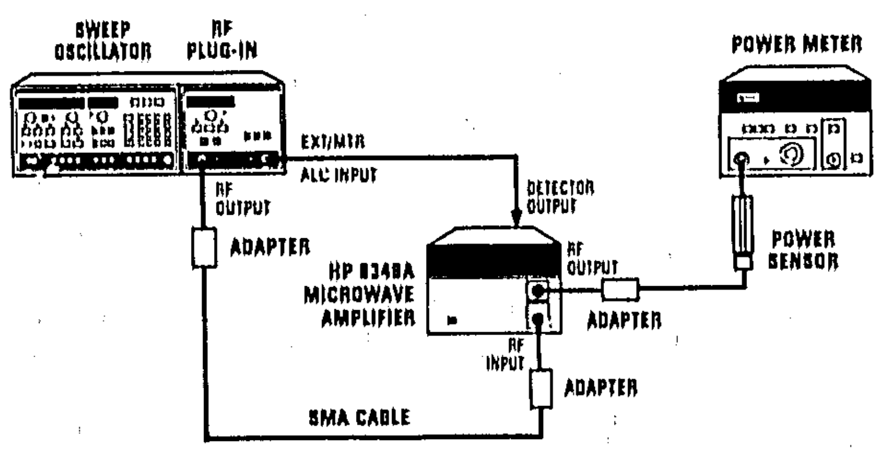


Figure 5-4. Displayed Power Level Adjustment Setup

EQUIPMENT

Sweep Oscillator .... HP 8350B
RF Plug-In .... HP 83590A
Power Meter .... HP 436A
Power Sensor .... HP 8485A
Adapters (3) APC-3.5(f) to N(m) .... HP Part Number 1250-1744
SMA Cable .... HP Part Number 8120-3124

5-11. DISPLAYED POWER LEVEL ADJUSTMENTS (Cont'd)

PROCEDURE

Finding an Appropriate Frequency

1. Remove the top and bottom covers of the HP 8349A as described in the Display Zero Adjustment procedure.

2. Adjust the potentiometers on the A4 signal conditioning assembly to the center of their range.

3. Calibrate the power meter.

4. Connect the equipment as shown in Figure 5-4. Switch on the LINE power and allow the instruments to warm up for 30 minutes.

5. On the sweep oscillator, press **[INSTR PRESET] [CW], [EXT]** ALC MODE. Make sure that **[⊔⊓ MOD]** is OFF. Adjust the power level to obtain a power meter reading of 10.00 dBm.

6. Manually sweep the sweep oscillator across the frequency range while observing the power meter display for peaks and valleys in the power reading. Note the highest and lowest power readings and calculate the average of these.

   Average power = (Pmax + Pmin) / 2

7. On the sweep oscillator, press **[CW] [6] [GHz]**. Manually sweep up the frequency range until you reach a frequency where the power meter reading is equal to the value calculated in step 6. Note this frequency for reference.

8. Compensate the power meter for the calibration factor of the power sensor at the frequency of interest.

Making the Adjustments

9. On the sweep oscillator, press **[POWER LEVEL] [0] [dBm]**. Manually adjust the power level until the power meter shows a reading of 0.00 dBm. If the required power meter reading cannot be obtained, adjust the EXT/MTR ALC CAL adjustment on the front panel of the RF plug-in.

10. On the HP 8349A signal conditioning assembly, adjust A4R14 (0 DBM ADJ) until the HP 8349A display reads 00.0 dBm. Refer to Figure 5-5 for the location of A4R14.

11. Adjust the sweep oscillator power level to obtain a power meter reading of 10.00 dBm. If the required power meter reading cannot be obtained, adjust the EXT/MTR ALC CAL adjustment on the front panel of the RF plug-in.

12. Adjust A4R22 (10 DBM ADJ) until the HP 8349A display reads 10.0 dBm.

13. Adjust the sweep oscillator power level to obtain a power meter reading of 20.00 dBm. If the required power meter reading cannot be obtained, adjust the EXT/MTR ALC CAL adjustment on the front panel of the RF plug-in.

6-11. DISPLAYED POWER LEVEL ADJUSTMENTS (Cont'd)

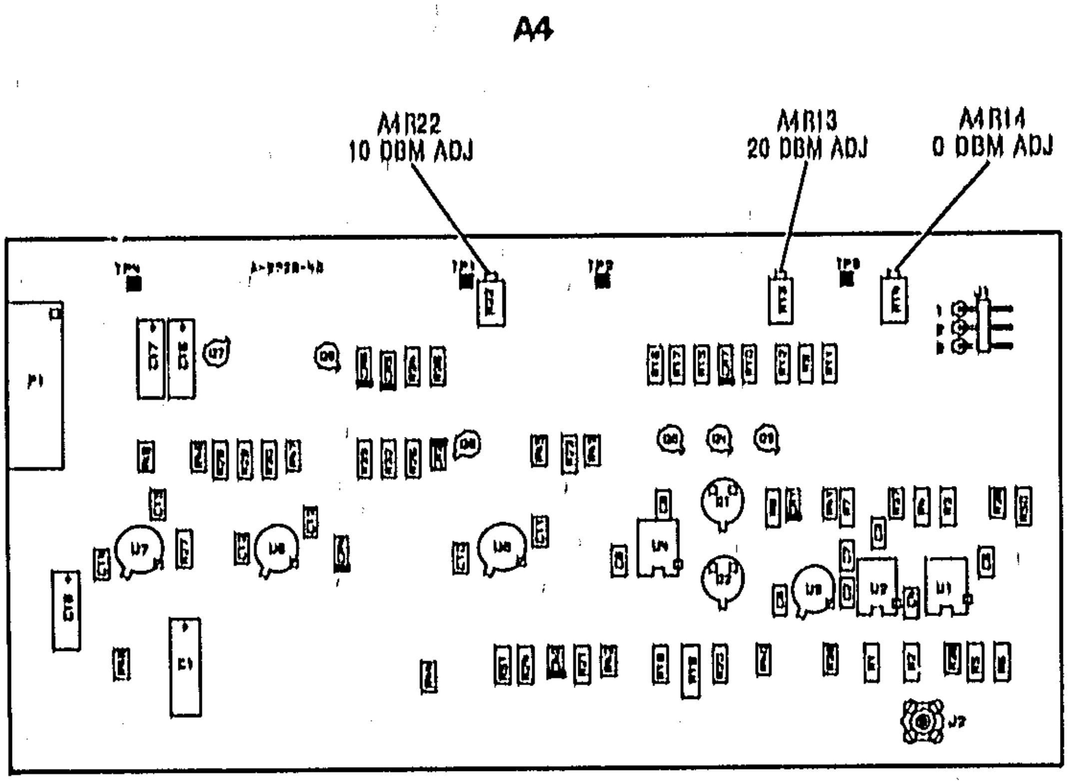


Figure 5-5. Signal Conditioning Assembly Adjustment Locations

14. Adjust A4R13 (20 DBM ADJ) until the HP 8349A display reads 20.0 dBm.

15. Iterate between power meter readings of 10.00 dBm and 20.00 dBm. Readjust A4R22 and A4R13 if necessary until the HP 8349A display matches the power meter reading at both settings.

16. Set the sweep oscillator to obtain a power meter reading of 00.00 dBm, and make sure that the HP 8349A display still reads 00.0 dBm. If it is necessary to readjust A4R14 for a 00.0 dBm display, recheck the display at 10 dBm and 20 dBm, and ensure that it still matches the power meter readings. (Note: If repeated iterations of adjustments cause the potentiometers to reach the end of their range, recenter the potentiometers and repeat the adjustment procedure).

PARTS LIST

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists the available exchange assemblies. Table 6-2 lists abbreviations used in the parts list and the names and addresses that correspond to the manufacturers' code numbers. Table 6-3 lists all replaceable parts in reference designator order.

6-3. EXCHANGE ASSEMBLIES

6-4. Table 6-1 lists assemblies within the instrument that may be replaced on an exchange basis, thus affording a considerable cost savings. Exchange factory repaired and tested assemblies are available only on a trade-in basis, therefore the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number.

6-5. ABBREVIATIONS

6-6. Table 6-2 contains three major sections: **Reference Designations** expands the designators used in the parts list; **Abbreviations** defines abbreviations used in the descriptions of replaceable parts; **Manufacturers Code List** references the name and address of a typical manufacturer with the code number provided in the parts list.

6-7. REPLACEABLE PARTS LIST

6-8. Table 6-3 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Miscellaneous chassis-mounted parts in alpha-numerical order by reference designation.

c. Instrument options and their components in alpha-numerical order.

d. Service accessories.

e. Attaching hardware.

6-9. The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. Part number check digit (CD).

c. The total quantity (Qty) in the instrument.

d. The description of the part.

e. A typical manufacturer of the part in a five-digit code.

f. The manufacturer's number for the part.

6-10. The total quantity for each part is given only once — at the first appearance of the part number in the list.

NOTE

Total quantities for optional assemblies are totaled by assembly and not integrated into the standard list.

6-11. ILLUSTRATIONS

6-12. Figure 6-1, Miscellaneous Parts, indicates the location of the replaceable miscellaneous chassis-mounted parts listed in Table 6-3. Figure 6-2, Attaching Hardware, references the Hewlett-Packard part number for the hardware used with at least one location in the instrument. (Locations of major assemblies are illustrated in Section VIII.)

6-13. ORDERING INFORMATION

6-14. To order a part listed in the Replaceable Parts List, quote the Hewlett-Packard part number with its check digit (CD), indicate the quantity, and address the order to the nearest Hewlett-Packard Office. The check digit will ensure accurate and timely processing of your order.

6-15. To order a part that is not listed in the Replaceable Parts List, include the instrument model number, instrument serial number, description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard Office.

6-16. SPARE PARTS KIT

6-17. Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has a Spare Parts Kit available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the Recommended Spares list for this instrument may be obtained on request and the Spare Parts Kit may be ordered through your nearest Hewlett-Packard Office.

Table 6-1. Exchange Parts

Reference Designation	Description	New Part Number	Rebuilt-Exchange Part Number
A2	2-20 GHz Amplifier Assembly (includes bias board assembly A3, RF input and output cables W4 and W5, connectors J1 and J2, heat sink, transistor block, and attaching hardware)	08349-60010	08349-60024
A2 (Opt 001)	Same as above for Option 001 (rear panel RF input and output)	08349-60020	08349-60025
A2 (Opt 002)	Same as above for Option 002 (rear panel RF input, front panel RF output)	08349-60021	08349-60026

NOTE

For module exchange procedure, see Paragraph 8-29.

Table 6-2. Manufacturer's Code List, Reference Designations, and Abbreviations (1 of 3)

MANUFACTURER'S CODE LIST

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
00000	ANY SATISFACTORY SUPPLIER			
00904	DENVER PLASTIC INC	LAKEWOOD	CO	80214
01121	ALLEN-BRADLEY CO.	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
06665	PRECISIONMONOLITHICS INC.	SANTA CLARA	CA	95050
11236	CTS OF BERNE INC.	BERNE	IN	46711
13606	SPRAGUE ELECT CO. SEMICONDUCTOR DIV	CONCORD	NH	03301
19701	MEPCO/ELECTRA CORP.	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON	NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
31585	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
51167	ARIES ELECTRONICS INC	FRENCHTOWN	NJ	08825
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON	ST LOUIS	MO	63107
75915	LITTELFUSE INC.	DES PLAINES	IL	60016

Table 6-2. Manufacturers Code List, Reference Designations, and Abbreviations (2 of 3)

REFERENCE DESIGNATIONS

A .... Assembly
AT .... Attenuator, Isolator, Limiter, Termination
C .... Capacitor
CR ... Diode, Diode Thyristor, Step Recovery Diode (SCR), Varactor
DC .... Directional Coupler
DS .... Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device (Audible or Visible)
E .... Miscellaneous Electrical Part
F .... Fuse
FL .... Filter
H .... Hardware
J .... Electrical Connector (Stationary Portion), Jack
K .... Relay
L .... Coil, Inductor
MP .... Miscellaneous Mechanical Part
P .... Electrical Connector (Movable Portion), Plug
Q .... Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor
R .... Resistor
S .... Switch
T .... Transformer
TP .... Test Point
U .... Integrated Circuit, Microcircuit
VR .... Breakdown Diode (Zener), Voltage Regulator
W .... Cable, Transmission Path, Wire
X .... Socket
Y .... Crystal Unit (Piezoelectric, Quartz)
Z ... Tuned Cavity, Tuned Circuit

ABBREVIATIONS

A

A .... Across Flats, Acrylic, Air (Dry Method), Ampere
ADJ .... Adjust, Adjustment
ALC .... Alcohol, Automatic Level Control
AMP .... Amperage
AMPL .... Amplifier
ANLG .... Analog
ASSY .... Assembly
ASTBL .... Astable
ATTEN .... Attenuation, Attenuator
AWG ...... American Wire Gage

B

BD .... Board, Bundle
BE .... Baume, Beryllium
BFR .... Before, Buffer
BLK .... Black, Blank, Block
BNC .... Type of Connector
BSC .... Basic
BVR .... Reverse Breakdown Voltage

C

C .... Capacitance, Capacitor, Center Tapped, Centistoke, Ceramic, Cermet, Circular Mil Foot, Closed Cup, Cold, Compression
CBL .... Cable
CER .... Ceramic
CH .... Center Hole
CHAM .... Chamfer
CHAN .... Channel
COAX .... Coaxial
COM ..... Commercial, Common
CONN .... Connect, Connection, Connector
CONT ..... Contact, Continuous, Control, Controller
CONV .... Converter
CP .... Cadmium Plate, Candle Power, Centipoise, Conductive Plastic, Cone Point

D

D .... Deep, Depletion, Depth, Diameter, Direct Current
D/A .... Digital-to-Analog
DAP .... Diallyl Phthalate
DB .... Decibel, Double Break
DC .... Direct Current, Double Contact
DBL .... Double
DCDR .... Decoder
DEG .... Degree
DIA .... Diameter
DIFF .... Differential
DIP .... Dual In-Line Package
DO ... Package Type Designation
DRVR .... Driver

E

E .... Enamel (Insulation, Enhancement, Extension)
E-MODE .... Enhancement Mode
EPROM .... Eraseable Programmable Read Only Memory
EXCL ...... Excluding, Exclusive
EXT .... Extended, Extension, External, Extinguish

F

F .... Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Flint, Fluorine, Frequency
FEM .... Female
FF .... Flange, Female Connection; Flip Flop
FM .... Flange, Male Connection; Foam, Frequency Modulation
FT ..... Current Gain Bandwidth Product (Transition Frequency); Feet, Foot
FXD .... Fixed

G

GEN .... General, Generator
GL .... Glass
GP ...... General Purpose, Group

H

H .... Henry, Hermaphrodite, High, Hole Diameter, Hot, Hub Inside Diameter, Hydrogen
HD .... Hand, Hard, Head, Heavy Duty
HEX .... Hexadecimal, Hexagon, Hexagonal

I

IC .... Collector Current, Integrated Circuit
ID .... Identification, Inside Diameter

Table 6-2. Manufacturers Code List, Reference Designations, and Abbreviations (3 of 3)

IF ... Forward Current, Intermediate Frequency
IMPD ... Impedance
IN ... Inch, Indium
INP ... Input
INT ... Integral, Intensity, Internal
INTL ... Internal, International
INV ... Invert, Inverter

J

JFET ... Effect Transistor

K

K ... Kilo, Potassium
KB ... Knob

L

LED ... Light Emitting Diode
LG ... Length, Long
LIN ... Linear, Linear Taper, Linearity
LK ... Link, Lock
LKG ... Leakage, Locking
LKWR ... Lockwasher
LS ... Loudspeaker, Low Power Schottky, Series Inductance
LUM ... Luminous

M

M ... Male, Maximum, Mega, Mil, Milli, Mode, Momentary, Mounting Hole Centers, Mounting Hole Diameter
MA ... Milliampere
MACH ... Machined
MAX ... Maximum
MCD ... Millicandela
MICPROC ... Microprocessor
MISC ... Miscellaneous
MLD ... Mold, Molded
MM ... Magnetized Material (Restricted Articles Code): Millimeter
MOD ... Model, Modified, Modular, Modulated, Modulator
MOSFET ... Metal Oxide Semiconductor Field Effect Transistor
MTG ... Mounting
MTR ... Meter
MULTIPLXR ... Multiplexer
MUW ... Music Wire
MW ... Milliwatt

N

N-CHAN ... N-Channel
N-CHAN ... N-Channel Metal Oxide Semiconductor
NO ... Normally Open, Number
NPN ... Negative Positive Negative (Transistor)
NS ... Nanosecond, Non-Shorting, Nose

O

OCTL ... Octal
OD ... Olive Drab, Outside Diameter
OP ... Operational
OPT ... Optical, Option, Optional
OXD ... Oxide

P

PC ... Picocoulomb, Piece, Printed Circuit
PCB ... Printed Circuit Board
PD ... Pad, Palladium, Pitch Diameter, Power Dissipation
PKG ... Package
PL ... Phase Lock, Plain, Plate, Plug
PLSTC ... Plastic
PNP ... Positive Negative Positive (Transistor)
POLYE ... Polyester
POS ... Position, Positive
POZI ... Pozidriv Recess
PRCN ... Precision
PRP ... Purple, Purpose
PT ... Part, Pint, Platinum, Point, Pulse Time
PVC ... Polyvinyl Chloride
PW ... Power Wirewound, Pulse Width

Q

QUAD ... Set of Four

R

RES ... Research, Resistance, Resistor, Resolution
RET ... Retaining
RF ... Radio Frequency
RGLTR ... Regulator
RKR ... Rocker
RND ... Round
RPG ... Rotary Pulse Generator
RR ... Rear
RVT ... Rivet, Riveted

S

SCR ... Screw, Scrub, Silicon Controlled Rectifier
SGL ... Single
SHFT ... Shaft
SI ... Silicon, Square Inch
SIG ... Signal, Significant
SIP ... Single In-Line Package
SKT ... Skirt, Socket
SLDR ... Solder
SM ... Samarium, Seam, Small, Square Meter, Sub Modular, Subminiature
SMB ... Subminiature, B Type (Snap-On Connector)
SQ ... Square
STL ... Steel
SZ ... Size

T

TA ... Ambient Temperature, Tantalum
TC ... Thermoplastic
THD ... Thread, Threaded
THK ... Thick
TO ... Package Type Designation, Troy Ounce
TPL ... Triple
TRIG ... Trigger, Triggerable, Triggering, Trigonometry
TRMR ... Trimmer
TRN ... Turn, Turns
TTL ... Tan Translucent, Transistor Transistor Logic

U

UNCT ... Undercut
UF ... Microfarad

V

V ... Vanadium, Variable, Violet, Volt, Voltage
VA ... Volt Ampere
VDC ... Volts, Direct Current
VID ... Video

W

W ... Watt, Wattage, White, Wide, Width, Wire
WB ... Wide Band
WD ... Width, Wood

X

XSTR ... Transistor

Y

YTM ... YIG Tuned Multiplier

Z

ZNR ... Zener

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08349-60001	9	1	DISPLAY BD ASSY	28480	08349-60001
A1C1	0160-4084	8	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1C2	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1C3	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1C4	0160-4653	7	2	CAPACITOR-FXD .1UF +-5% 100VDC MET-POLYP	28480	0160-4653
A1C5	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1C6	0180-2207	5	1	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1C8	0160-3879	7	16	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1DS1	1990-0619	7	4	DISPLAY-NUM-SEG 1-CHAR .3-H	28480	1990-0619
A1DS2	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H	28480	1990-0619
A1DS3	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H	28480	1990-0619
A1DS4	1990-0619	7		DISPLAY-NUM-SEG 1-CHAR .3-H	28480	1990-0619
A1L1	9100-1644	3	1	INDUCTOR RF-CH-MLD 33UH 5% .2DX.45LG	28480	9100-1644
A1Q1	1853-0007	7	1	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A1R1	0698-7277	6	2	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1R2	0698-7244	7	1	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1R3	0698-7221	0	1	RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-F
A1R4	0698-7287	8	1	RESISTOR 133K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1333-F
A1R5	0698-6348	0	1	RESISTOR 3K .1% .125W F TC=0+-25	28480	0698-6348
A1R6	0698-6362	8	4	RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A1R7	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1R8	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A1R9	2100-3210	6	1	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A1R10	0698-7229	8	1	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A1R11	0698-7260	7	3	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1R12	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1R13	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1R14	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1R15	0698-3444	1	8	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1R16	0757-0279	0	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1R17	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A1R18	0698-6619	8	1	RESISTOR 15K .1% .125W F TC=0+-25	28480	0698-6619
A1R19	0698-7212	9	14	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1R20	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1TP1	0360-2050	8	3	CONNECTOR-SGL CONT	28480	0360-2050
A1TP2	0360-2050	8		CONNECTOR-SGL CONT	28480	0360-2050
A1TP3	0360-2050	8		CONNECTOR-SGL CONT	28480	0360-2050
A1U1	1826-0431	4	1	IC CONV 24-DIP-C PKG	04713	MC14433L
A1U2	1858-0047	5	1	TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A1U3	1820-1413	2	1	IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	3L585	CD4511BE
A1U4	1810-0346	7	1	NETWORK-RES 16-DIP180.0 OHM X 8	11236	761-3-R180
A1U5	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP-P PKG	01295	SN72311P
A1VR1	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A1XA2	1200-0693	4	4	SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A1XA3	1200-0693	4		SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A1XA4	1200-0693	4		SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A1XA5	1200-0693	4		SOCKET-IC 10-CONT DIP DIP-SLDR	51167	10-513-11
A2	08349-60010	0	1	2-20 GHZ AMPLIFIER ASSEMBLY (INCLUDES BIAS BOARD ASSEMBLY A3, RF INPUT & OUTPUT CABLE W4 & W5, CONNECTORS J1 & J2, HEAT SINK, TRANSISTOR BLOCK AND CONNECTING HARDWARE)	28480	08349-60010
A2	08349-60024	6		REBUILT-EXCHANGE 08349-60010 2-20 GHZ AMPLIFIER ASSEMBLY	28480	08349-60024
A2 (Opt 001)	08349-60020	2		2-20 GHZ AMPLIFIER ASSEMBLY FOR OPTION 001 (REAR PANEL RF INPUT AND OUTPUT)	28480	08349-60020
A2	08349-60025	7		REBUILT-EXCHANGE 08349-60020 2-20 GHZ AMPLIFIER ASSEMBLY (OPT. 001)	28480	08349-60025
A2 (OPT 002)	08349-60021	3		2-20 GHZ AMPLIFIER ASSEMBLY FOR OPTION 002 (REAR PANEL RF INPUT)	28480	08349-60021
A2	08349-60026	8		REBUILT-EXCHANGE 08349-60021 2-20 GHZ AMPLIFIER ASSEMBLY (OPT. 002)	28480	08349-60026

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	08349-60003	1	1	BIAS BOARD ASSY DOES NOT INCLUDE A3Q3-A3Q6 OR A3E1-A3E4	28480	08349-60003
A3C1	0160-4832	4	17	CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C2	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C3	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C4	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C5	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C6	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C7	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C8	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C9	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C10	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C11	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3C12	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A3E1	0340-0162	7	4	INSULATOR-XSTR ALUMINUM	28480	0340-0162
A3E2	0340-0162	7		INSULATOR-XSTR ALUMINUM	28480	0340-0162
A3E3	0340-0162	7		INSULATOR-XSTR ALUMINUM	28480	0340-0162
A3E4	0340-0162	7		INSULATOR-XSTR ALUMINUM	28480	0340-0162
A3J1	1251-5267	5	2	CONNECTOR 40-PIN M POST TYPE	28480	1251-5267
A3J2	1251-5267	5		CONNECTOR 40-PIN M POST TYPE	28480	1251-5267
A3MP2	1251-3172	7	23	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A3MP3	0380-1245	3	1	SPACER-RVT-ON 4-MM-LG 3.8-MM-ID	00000	ORDER BY DESCRIPTION
A3MP4	1200-0173	5	2	INSULATOR-XSTR DAP-GL	28480	1200-0173
A3MP6	0380-1246	4	5	SPACER-RVT-ON 6-MM-LG 3.8-MM-ID	00000	ORDER BY DESCRIPTION
A3MP9	1251-2313	6	30	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A3P1	1251-8603	9	4	CONN-POST TYPE .100-PIN-SPCG 24-CONT	28480	1251-8603
A3P2	1251-8603	9		CONN-POST TYPE .100-PIN-SPCG 24-CONT	28480	1251-8603
A3Q1	1854-0637	1	2	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A3Q2	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A3Q3	1854-0072	8	4	TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	3L585	2N3054
A3Q4	1854-0072	8		TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	3L585	2N3054
A3Q5	1854-0072	8		TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	3L585	2N3054
A3Q6	1854-0072	8		TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	3L585	2N3054
A3R1*			18	FACTORY SELECTED, NOT REPLACEABLE		
A3R2*				FACTORY SELECTED, NOT REPLACEABLE		
A3R3*				FACTORY SELECTED, NOT REPLACEABLE		
A3R4*				FACTORY SELECTED, NOT REPLACEABLE		
A3R5*				FACTORY SELECTED, NOT REPLACEABLE		
A3R6*				FACTORY SELECTED, NOT REPLACEABLE		
A3R7*				FACTORY SELECTED, NOT REPLACEABLE		
A3R8*				FACTORY SELECTED, NOT REPLACEABLE		
A3R9*				FACTORY SELECTED, NOT REPLACEABLE		
A3R10*				FACTORY SELECTED, NOT REPLACEABLE		
A3R11*				FACTORY SELECTED, NOT REPLACEABLE		
A3R12*				FACTORY SELECTED, NOT REPLACEABLE		
A3R13	0757-0438	3	8	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R15	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R17	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R19*				FACTORY SELECTED, NOT REPLACEABLE		
A3R20*				FACTORY SELECTED, NOT REPLACEABLE		
A3R21*				FACTORY SELECTED, NOT REPLACEABLE		
A3R22*				FACTORY SELECTED, NOT REPLACEABLE		
A3R23*				FACTORY SELECTED, NOT REPLACEABLE		
A3R24*				FACTORY SELECTED, NOT REPLACEABLE		
A3R25	0698-8812	7	4	RESISTOR 1 1% .125W F TC=0±100	28480	0698-8812
A3R26	0698-8812	7		RESISTOR 1 1% .125W F TC=0±100	28480	0698-8812
A3R27	0698-8812	7		RESISTOR 1 1% .125W F TC=0±100	28480	0698-8812
A3R28	0698-8812	7		RESISTOR 1 1% .125W F TC=0±100	28480	0698-8812
A3R29	0698-3547	5	2	RESISTOR 1 5% .5W CC TC=0+412	01121	EB10G5
A3R30	0698-3547	5		RESISTOR 1 5% .5W CC TC=0+412	01121	EB10G5
A3R31	0757-0442	9	11	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A3R32	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A3R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A3R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A3R37	0698-3392	8	2	RESISTOR 23.7 1% .5W F TC=0±100	28480	0698-3392
A3R38	0698-3392	8		RESISTOR 23.7 1% .5W F TC=0±100	28480	0698-3392
A3U1	1810-0316	1	3	NETWORK-RES 16-DIP10.0K OHM X 8	01121	316B103

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3U2	1810-0316	1		NETWORK-RES 16-DIP10.0K OHM X 8	01121	316B103
A3U3	1810-0316	1		NETWORK-RES 16-DIP10.0K OHM X 8	01121	316B103
A3XI	1200-0552	4	1	SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0552
A4	08349-60004	2	1	SIGNAL CONDITIONING BOARD ASSEMBLY	28480	08349-60004
A4C1	0160-4653	7		CAPACITOR-FXD .1UF ±5% 100VDC MET-POLYP	28480	0160-4653
A4C2	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C3	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C4	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C5	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C6	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C7	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C8	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C9	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C10	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C11	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C12	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C13	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C14	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C15	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A4C16	0180-0116	1	6	CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A4C17	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A4C18	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A4CR1	1901-0518	8	3	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A4CR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A4CR3	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A4CR4	1901-0376	6	1	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A4CR5	1901-0033	2	3	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4J1	1251-4684	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4684
A4P1	1251-8603	9		CONN-POST TYPE .100-PIN-SPCG 24-CONT	28480	1251-8603
A4Q1	1854-0295	7	2	TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A4Q2	1854-0295	7		TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A4Q3	1853-0451	5	4	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A4Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A4Q5	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A4Q6	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A4Q7	1855-0414	4	1	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A4Q8	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A4R1	0698-6977	1	2	RESISTOR 30K .1% .125W F TC=0±25	28480	0698-6977
A4R2	0698-6977	1		RESISTOR 30K .1% .125W F TC=0±25	28480	0698-6977
A4R3	0698-6360	6	2	RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A4R4	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A4R5	0698-6362	8		RESISTOR 1K .1% .125W F TC=0±25	28480	0698-6362
A4R6	0698-6362	8		RESISTOR 1K .1% .125W F TC=0±25	28480	0698-6362
A4R7	0757-0405	4	1	RESISTOR 162 1% .125W F TC=0±100	24546	C4-1/8-T0-162R-F
A4R8	0757-0833	2	3	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A4R9	0757-0289	2	2	RESISTOR 13.3K 1% .125W F TC=0±100	19701	MF4C1/8-T0-1332-F
A4R10	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0±100	19701	MF4C1/8-T0-1332-F
A4R11	0757-0419	0	2	RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A4R12	0698-3445	2	1	RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-T0-348R-F
A4R13	2100-3759	8	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	28480	2100-3759
A4R14	2100-3758	7	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	28480	2100-3758
A4R15	0698-3151	7	1	RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-T0-2871-F
A4R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A4R17	0698-3266	5	1	RESISTOR 237K 1% .125W F TC=0±100	24546	C4-1/8-T0-2373-F
A4R18	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0±100	24546	C4-1/8-T0-2371-F
A4R19	0837-0119	7	1	THERMISTOR ROD 5K-OHM TC=+.7%/C-DEG	28480	0837-0119
A4R20	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0±100	24546	CT4-1/8-T0-4641-F
A4R21	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A4R22	2100-0670	6	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	32997	3292X-1-103
A4R23	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1212-F
A4R24	0698-3157	3	2	RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A4R26	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-T0-1961-F
A4R27	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A4R28	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A4R29	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-T0-1331-F
A4R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A4R32	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R33	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A4R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A4R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A4R36	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R37	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R38	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R39	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R40	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R41	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R42	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R43	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R44	0698-3440	7	2	RESISTOR 196 1% .125W F TC=0±100	24546	C4-1/8-T0-196R-F
A4R45	0698-3440	7		RESISTOR 196 1% .125W F TC=0±100	24546	C4-1/8-T0-196R-F
A4R46	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R47	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R48	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R49	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-T0-100R-F
A4R50	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A4R51	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A4TP1	0360-0535	0	10	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A4TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A4TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A4TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A4TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A4U1	1826-0932	0	3	IC OP AMP PRCN 8-DIP-C PKG	06665	OP-27FZ
A4U2	1826-0932	0		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-27FZ
A4U3	1826-0987	5	2	IC OP AMP PRCN 8-DIP-C PKG	28480	1826-0987
A4U4	1826-0932	0		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-27FZ
[illegible]	1826-0987	5		IC OP AMP PRCN 8-DIP-C PKG	28480	1826-0987
A4U6	1826-0371	1	2	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A4U7	1826-0371	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A5	08349-60006	4	1	REGULATOR BOARD ASSEMBLY DOES NOT INCLUDE A5U1-A5U4 & A5E1-A5E4	28480	08349-60006
A5C1	0180-3394	3	1	CAPACITOR-FXD .01F+50-10% 25VDC AL	28480	0180-3394
A5C2	0180-3132	7	1	CAPACITOR-FXD 4700UF+-20% 35VDC AL	28480	0180-3132
A5C3	0180-3395	4	2	CAPACITOR-FXD 1000UF±20% 200VDC AL	28480	0180-3395
A5C4	0180-3395	4		CAPACITOR-FXD 1000UF±20% 200VDC AL	28480	0180-3395
A5C5	0180-0291	3	6	CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A5C6	0180-0291	3		CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A5C7	0180-0291	3		CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A5C8	0180-0291	3		CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A5C9	0180-0230	0	2	CAPACITOR-FXD 1UF±20% 50VDC TA	56289	150D105X0050A2
A5C10	0180-0230	0		CAPACITOR-FXD 1UF±20% 50VDC TA	56289	150D105X0050A2
A5C11	0180-0291	3		CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A5C12	0180-0291	3		CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A5C15	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A5C16	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A5C17	0180-2610	4	1	CAPACITOR-FXD 10UF±10% 75VDC TA	00904	T110A106K075AS
A5C18	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A5C20	0160-0168	1	4	CAPACITOR-FXD .1UF ±10% 200VDC POLYE	28480	0160-0168
A5C21	0160-0168	1		CAPACITOR-FXD .1UF ±10% 200VDC POLYE	28480	0160-0168
A5C22	0160-0168	1		CAPACITOR-FXD .1UF ±10% 200VDC POLYE	28480	0160-0168
A5C23	0160-0168	1		CAPACITOR-FXD .1UF ±10% 200VDC POLYE	28480	0160-0168
A5C24	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A5C25	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A5C26	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A5C27	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A5C28	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A5CR1	1901-0662	3	6	DIODE-PWR RECT 100V 6A	04713	MR751
A5CR2	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A5CR3	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A5CR4	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A5CR5	1901-0693	0	12	DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR6	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR7	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR8	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR9	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR10	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR11	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR12	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR13	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR14	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR15	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5CR16	1901-0693	0		DIODE-PWR RECT 100V 1A 200NS DO-41	04713	1N4934
A5CR17	1901-0028	5	12	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR18	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR19	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR20	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR21	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR22	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR23	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR24	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR25	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR26	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR27	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR28	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A5CR29	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A5DS1	1990-0485	5	4	LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0485
A5DS2	1990-0485	5		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0485
A5DS3	1990-0485	5		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0485
A5DS4	1990-0485	5		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0485
A5E1	1200-0043	8	4	INSULATOR-XSTR ALUMINUM	28480	1200-0043
A5E2	1200-0043	8		INSULATOR-XSTR ALUMINUM	28480	1200-0043
A5E3	1200-0043	8		INSULATOR-XSTR ALUMINUM	28480	1200-0043
A5E4	1200-0043	8		INSULATOR-XSTR ALUMINUM	28480	1200-0043
A5F1	2110-0425	0	2	FUSE 2A 125V .25X.27	28480	2110-0425
A5F2	2110-0046	1	1	FUSE .5A 125V .25X.27	28480	2110-0046
A5F3	2110-0425	0		FUSE 2A 125V .25X.27	28480	2110-0425
A5F4	2110-0047	2	1	FUSE 1A 125V .25X.27	71400	GMW-1
A5F5	2110-0618	3	1	FUSE 5A 125V NTD .25X.27	28480	2110-0618
A5J2	1251-8032	8	1	CONN-POST TYPE .156-PIN-SPCG 8-CONT	28480	1251-8032
A5MP2	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A5MP3	0380-1664	0	2	STANDOFF-RVT-ON 20-MM-LG M2.5 X 0.45-THD	28480	0380-1664
A5MP5	0380-1246	4		SPACER-RVT-ON 6-MM-LG 3.8-MM-ID	00000	ORDER BY DESCRIPTION
A5MP10	1205-0011	0	4	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A5P1	1251-8603	9		CONN-POST TYPE .100-PIN-SPCG 24-CONT	28480	1251-8603
A5Q1	1884-0073	2	4	THYRISTOR-SCR TO-5 VRRM=100	28480	1884-0073
A5Q2	1884-0073	2		THYRISTOR-SCR TO-5 VRRM=100	28480	1884-0073
A5Q3	1884-0073	2		THYRISTOR-SCR TO-5 VRRM=100	28480	1884-0073
A5Q4	1884-0073	2		THYRISTOR-SCR TO-5 VRRM=100	28480	1884-0073
A5Q5	1884-0018	5	1	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A5R1	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R2	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R3	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R4	0757-0421	4	2	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A5R6	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A5R7	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A5R8	0698-3443	0	2	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A5R9	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R10	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A5R11	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A5R12	0698-6624	5	2	RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A5R13	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A5R14	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A5R17	0757-0346	2	7	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R18	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R19	0698-3601	2	2	RESISTOR 10 5% 2W MO TC=0+-200	27167	FP42-2-T00-10R0-J
A5R20	0698-3601	2		RESISTOR 10 5% 2W MO TC=0+-200	27167	FP42-2-T00-10R0-J
A5R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R25	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R26	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R27	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R28	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R30	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R31	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R32	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R33	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R34	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R35	2100-3755	4	2	RESISTOR-TRMR 50 10% C SIDE-ADJ 17-TRN	28480	2100-3755
A5R36	2100-3755	4		RESISTOR-TRMR 50 10% C SIDE-ADJ 17-TRN	28480	2100-3755

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A5TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A5TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A5TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A5TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A5TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A5U1	1826-0677	0	2	IC-V RGLTR-ADJ-POS 1.2/32V TO-3 PKG	28480	1826-0677
A5U2	1826-0677	0		IC-V RGLTR-ADJ-POS 1.2/32V TO-3 PKG	28480	1826-0677
A5U3	1826-0423	4	1	IC V RGLTR TO-3	27014	LM317K
A5U4	1826-0523	5	1	IC 337 V RGLTR TO-3	27014	LM337K
A5VR1	1902-0958	2	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A5VR2	1902-0953	7	1	DIODE-ZNR 6.2V 5% DO-35 PD=.4W TC=+.053%	28480	1902-0953
A5VR3	1902-3256	9	1	DIODE-ZNR 23.7V 5% DO-35 PD=.4W	28480	1902-3256
A5VR4	1902-3182	0	1	DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A5VR5	1902-3330	0	1	DIODE-ZNR 44.2V 2% DO-35 PD=.4W	28480	1902-3330
A5VR6	1902-3203	6	1	DIODE-ZNR 14.7V 5% DO-35 PD=.4W	28480	1902-3203
A6	08349-60002	0	1	MOTHER BD ASSY	28480	08349-60002
A6MP2	0380-1258	8	5	STANDOFF-PRESS-IN 16 MM LG; M3 X 0.5	00000	ORDER BY DESCRIPTION
A6P1	1251-8494	6	3	CONN-POST TYPE .10-PIN-SPCG 24-CONT	28480	1251-8494
A6P2	1251-8494	6		CONN-POST TYPE .10-PIN-SPCG 24-CONT	28480	1251-8494
A6P3	1251-8494	6		CONN-POST TYPE .10-PIN-SPCG 24-CONT	28480	1251-8494
A6XA4	1200-0507	9	1	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
				MISCELLANEOUS PARTS		
CR1	1901-0033	2	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
E1	08349-20019	5	1	INSULATOR-SWITCH	28480	08349-20019
E2	5040-0345	7	2	INSULATOR-CONNECTOR	28480	5040-0345
F1	2110-0061	8	1	FUSE 1A 250V NTD 1.25X.25 UL	75915	312001
FL1	9135-0217	7	1	LINE MODULE FILTER	28480	9135-0217
J1	86290-60005	7	2	CONNECTOR TYPE-N F (RF INPUT)	28480	86290-60005
J2	86290-60005	7		CONNECTOR TYPE-N F (RF OUTPUT)	28480	86290-60005
J3	1250-0083	1	1	CONNECTOR-RF BNC F (POS Z BLANK)	28480	1250-0083
J4	1250-0118	3	1	CONNECTOR-RF BNC F (DET OUTPUT)	28480	1250-0118
MP1	08349-00001	3	1	FRONT PANEL-DRESS	28480	08349-00001
MP2	08349-00003	5	1	FRONT SUB-PANEL, LOWER	28480	08349-00003
MP3	0370-2248	7	1	LINE POWER ON/OFF KNOB	28480	0370-2248
MP4	0370-0914	0	1	BEZEL-PB KNOB,.490LG,.330W,.165HI,JADE	28480	0370-0914
MP5	5020-8815	0	1	FRONT FRAME	28480	5020-8815
MP6	08349-00002	4	1	FRONT SUB-PANEL, UPPER	28480	08349-00002
MP7	08349-20011	7	1	DISPLAY WINDOW	28480	08349-20011
MP8	5040-6937	5	2	WINDOW CLIP	28480	5040-6937
MP9	08349-00006	8	1	CENTER SUPPORT	28480	08349-00006
MP10	6960-0027	3	2	PLUG BUTTON	28480	6960-0027
MP11	5040-7201	8	4	FOOT-BOTTOM	28480	5040-7201
MP12	5001-0439	8	2	TRIM STRIP-SIDE FRONT	28480	5001-0439
MP13	5040-7203	0	1	TRIM STRIP-TOP	28480	5040-7203
MP14	5040-7219	8	1	COVER STRIP-HANDLE-FRONT	28480	5040-7219
MP15	5040-7220	1	1	COVER STRIP-HANDLE-REAR	28480	5040-7220
MP16	5060-9802	1	1	HANDLE	28480	5060-9802
MP17	08349-60012	2	1	TOP COVER-PERFORATED	28480	08349-60012
MP18	5060-9972	6	1	BOTTOM COVER-PERFORATED	28480	5060-9972
MP19	08349-20012	8	1	PUSHBUTTON ROD	28480	08349-20012
MP20	00438-20025	5	1	PUSHROD CLIP	28480	00438-20025
MP21	0360-2023	5	1	TERMINAL BLOCK-40 TERMINALS	28480	0360-2023
MP22	08349-00008	0	1	BRACKET-RF CONNECTOR	28480	08349-00008
MP23	08349-00010	4	1	BRACKET-RF CONNECTOR (OPT. 001/002)	28480	08349-00010
MP24	08349-20008	2	1	TRANSISTOR BLOCK	28480	08349-20008
MP25	08349-20018	4	2	HEAT SINK, PAINTED	28480	08349-20018
MP26	08349-20007	1	1	REGULATOR BLOCK	28480	08349-20007
MP27	7100-0120	6	1	TRANSFORMER COVER .656-DP	28480	7100-0120
MP28	7121-2380	8	1	LABEL-SERIAL NUMBER	28480	7121-2380
MP29	5020-8816	1	1	REAR FRAME	28480	5020-8816
MP30	08349-00004	6	1	REAR PANEL	28480	08349-00004
MP31	08349-00007	9	1	SHIELD	28480	08349-00007
MP32	1251-8167	0	8	TERMINAL-SLIP-ON	28480	1251-8167
MP33	02932-00038	1	2	LINE MODULE RETAINER	28480	02932-00038

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
S1	3101-2216	3	1	SWITCH-PB DPDT ALTNG 4A 250VAC	28480	3101-2216
T1	5180-2625	6	1	TRANSFORMER (INCLUDES T1W1)	28480	5180-2625
W1	08349-60014	4	1	CABLE ASSEMBLY-RIBBON-DISPLAY BOARD	28480	08349-60014
W2	08349-60022	4	1	CABLE ASSEMBLY-COAX	28480	08349-60022
W3	08349-60027	9	1	CABLE-SIGNAL COND-REAR PANEL	28480	08349-60027
W4	08349-20009	3	1	RF CABLE-INPUT (SEMI-RIGID)	28480	08349-20009
W4 (OPT 001)	08349-20015	1	1	RF CABLE-INPUT (OPT, 001)	28480	08349-20015
W4 (OPT 002)	08349-20014	0	1	RF CABLE-INPUT (OPT, 002)	28480	08349-20014
W5	08349-20010	6	1	RF CABLE-OUTPUT (SEMI-RIGID)	28480	08349-20010
				OPTION 001		
A2	08349-60020	2	1	2-20 GHZ AMPLIFIER ASSEMBLY (OPT, 001) (INCLUDES BIAS BOARD ASSEMBLY A3, RF INPUT & OUTPUT CABLES W4 & W5, CONNECTORS J1 & J2, HEAT SINK, TRANSISTOR BLOCK, & ATTACHING HARDWARE)	28480	08349-60020
A2	08349-60025	7		REBUILT-EXCHANGE 08349-60020 2-20 GHZ AMPLIFIER ASSEMBLY (OPT, 001)	28480	08349-60025
MP23	08349-00010	4	1	BRACKET-RF CONNECTOR (OPT, 001/002) (DELETE MP22)	28480	08349-00010
W4 (OPT 001)	08349-20015	1	1	RF CABLE-INPUT (OPT, 001) (DELETE STANDARD W4)	28480	08349-20015
				OPTION 002		
A2	08349-60021	3	1	2-20 GHZ AMPLIFIER ASSEMBLY (OPT, 002) (INCLUDES BIAS BOARD ASSEMBLY A3, RF INPUT & OUTPUT CABLES W4 & W5, CONNECTORS J1 & J2, HEAT SINK, TRANSISTOR BLOCK, & ATTACHING HARDWARE)	28480	08349-60021
A2	08349-60026	8		REBUILT-EXCHANGE 08349-60021 2-20 GHZ AMPLIFIER ASSEMBLY (OPT, 002)	28480	08349-60026
MP23	08349-00010	4	1	BRACKET-RF CONNECTOR (OPT, 001/002)	28480	08349-00010
W4 (OPT 002)	08349-20014	0	1	RF CABLE-INPUT (OPT, 002) (DELETE STANDARD W4)	28480	08349-20014
				SERVICE ACCESSORIES		
	08349-00011	5	1	EXTENDER BRACKET-BOARD	28480	08349-00011
	08349-00005	7	1	EXTENDER BRACKET-HEATSINK	28480	08349-00005
	08349-60017	7	1	AMPLIFIER EXTENDER BOARD ASSEMBLY	28480	08349-60017
	08349-60023	5	1	POWER SUPPLY EXTENDER BOARD ASSEMBLY	28480	08349-60023
	9222-0399	1	1	BAG-PLSTC ZIP-LOCK 4X10-IN	28480	9222-0399
				ATTACHING HARDWARE		
1	0510-1148	2	5	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1148
2	0515-0219	6	6	SCREW-MACH M3 X 0,5 6MM-LG 90-DEG-FLH-HD	00000	ORDER BY DESCRIPTION
3	0515-0481	4	15	SCREW-SKT-HD-CAP M3 X 0,5 6MM-LG	00000	ORDER BY DESCRIPTION
4	0515-0484	7	10	SCREW-SKT-HD-CAP M3 X 0,5 12MM-LG	00000	ORDER BY DESCRIPTION
5	2190-0584	0	38	WASHER-LK HLCL 3,0 MM 3,1-MM-ID	28480	2190-0584
6	0590-0639	2	1	NUT-SHMET-FLT 10-32-THD STL	28480	0590-0639
7	2680-0172	1	2	SCREW-MACH 10-32 ,375-IN-LG 100 DEG	28480	2680-0172
8	3030-0950	7	8	SCREW-SKT FL HD CAP 8-32 ,375-IN-LG 82	28480	3030-0950
9	3050-1186	5	16	WASHER SHLDR NO,4 ,12-IN-ID	28480	3050-1186
10	3050-0105	6	8	WASHER-FL MTLC NO,4 ,125-IN-ID	28480	3050-0105
11	0515-0478	9	4	SCREW-SKT-HD-CAP M2,5 X 0,45 12MM-LG	28480	0515-0478
12	0515-0965	9	11	SCREW-SKT-HD-CAP M3 X 0,5 14MM-LG	28480	0515-0965
13	0515-0966	0	2	SCREW-SKT-HD-CAP M3 X 0,5 8MM-LG	28480	0515-0966
14	0515-0967	1	10	SCREW-SKT-HD-CAP M2,5 X 0,45 8MM-LG	28480	0515-0967
15	2190-0583	9	14	WASHER-LK HLCL 2,5MM 2,6-MM-ID	28480	2190-0583
16	2200-0143	0	4	SCREW-MACH 4-40 ,375-IN-LG PAN-HD-POZI	28480	2200-0143
17	2260-0009	3	16	NUT-HEX-W/LKWR 4-40-THD ,094-IN-THK	00000	ORDER BY DESCRIPTION
18	08350-20004	1	12	CONNECTOR PIN-THREADED	28480	08350-20004
19	0360-0037	7	1	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0037
20	0360-0042	4	1	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0042

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
21	0360-1190	6	1	TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	28480	0360-1190
22	0380-1422	8	2	SPACER-RND 20-MM-LG 4.5-MM-ID 8-MM-OD AL	28480	0380-1422
23	0390-0006	3	2	INSULATOR-FLG-BSHG NYLON	28480	0390-0006
24	0515-0055	8	4	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	28480	0515-0055
25	0515-0146	8	2	SCREW-MACH M4 X 0.7 50MM-LG PAN-HD	28480	0515-0146
26	0515-0150	4	2	SCREW-MACH M2.5 X 0.45 6MM-LG PAN-HD	28480	0515-0150
27	0515-0335	7	2	SCREW-MACH M4 X 0.7 70MM-LG PAN-HD	28480	0515-0335
28	0535-0004	9	2	NUT-HEX DBL-CHAM M3 X 0.5 2.4MM-THK	00000	ORDER BY DESCRIPTION
29	0535-0006	1	4	NUT-HEX DBL-CHAM M4 X 0.7 3.2MM-THK	00000	ORDER BY DESCRIPTION
30	2190-0005	0	8	WASHER-LK EXT T NO. 4 .116-IN-ID	28480	2190-0005
31	2190-0010	7	4	WASHER-LK EXT T NO. 8 .168-IN-ID	28480	2190-0010
32	2190-0016	3	2	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
33	2950-0001	8	2	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
34	3050-0239	7	4	WASHER-FL NM NO.8 .17-IN-ID .375-IN-OD	28480	3050-0239
35	3050-0139	6	2	WASHER-FL MLTC NO.8 .172-IN-ID	28480	3050-0139
36	2950-0132	4	2	NUT-HEX-DBL-CHAM 7/16-28-THD .094-IN-THK	28480	2950-0132
37	2190-0104	0	2	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104

See introduction to this section for ordering information
*Indicates factory selected value

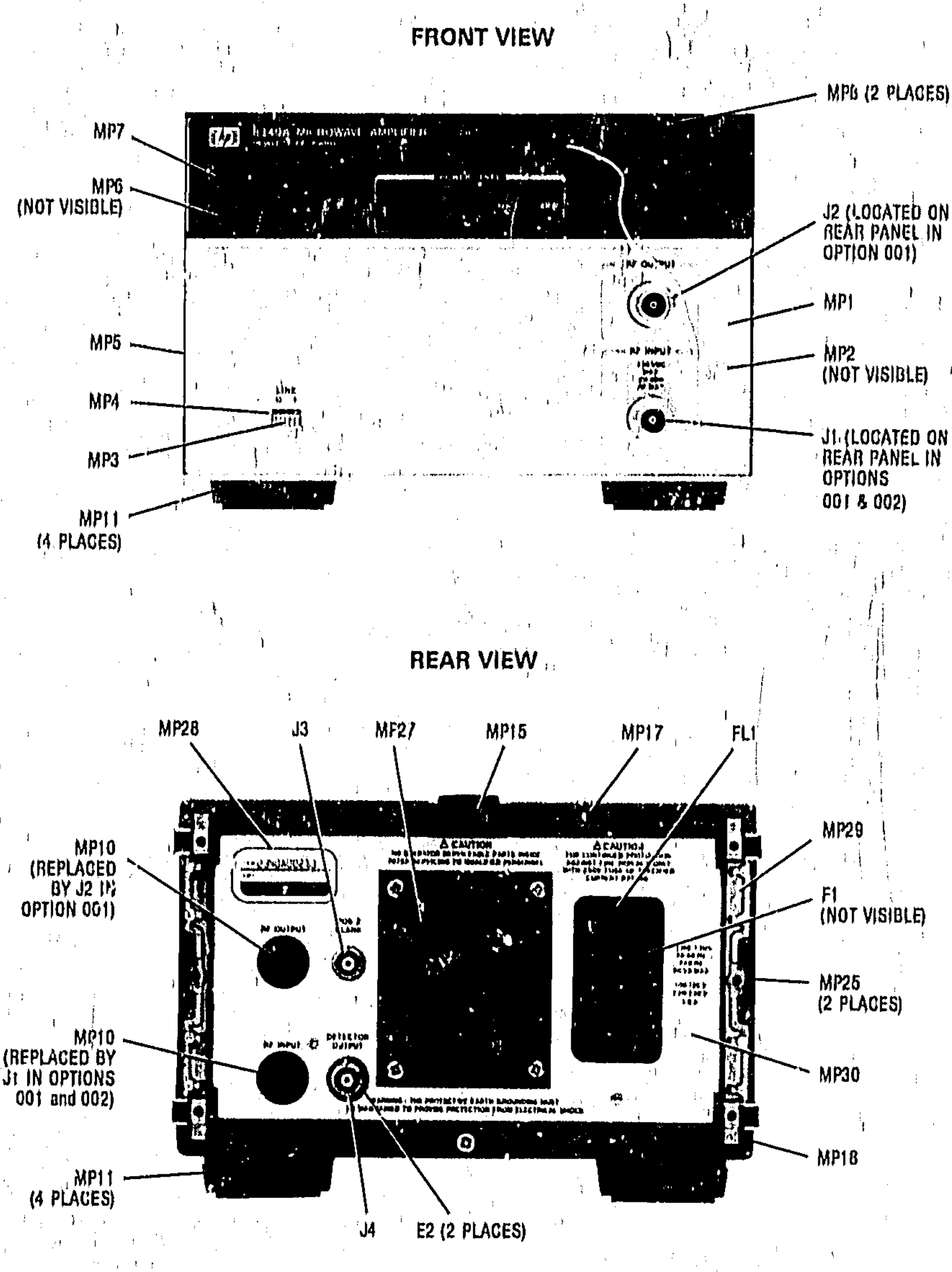
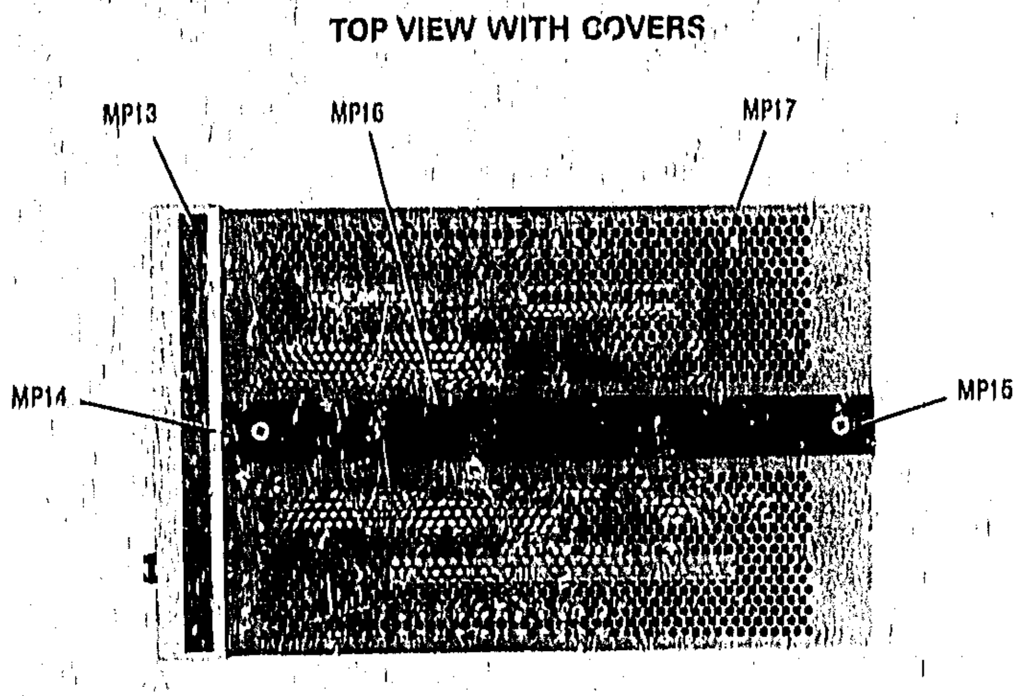


Figure 6-1. Miscellaneous Parts (1 of 4)



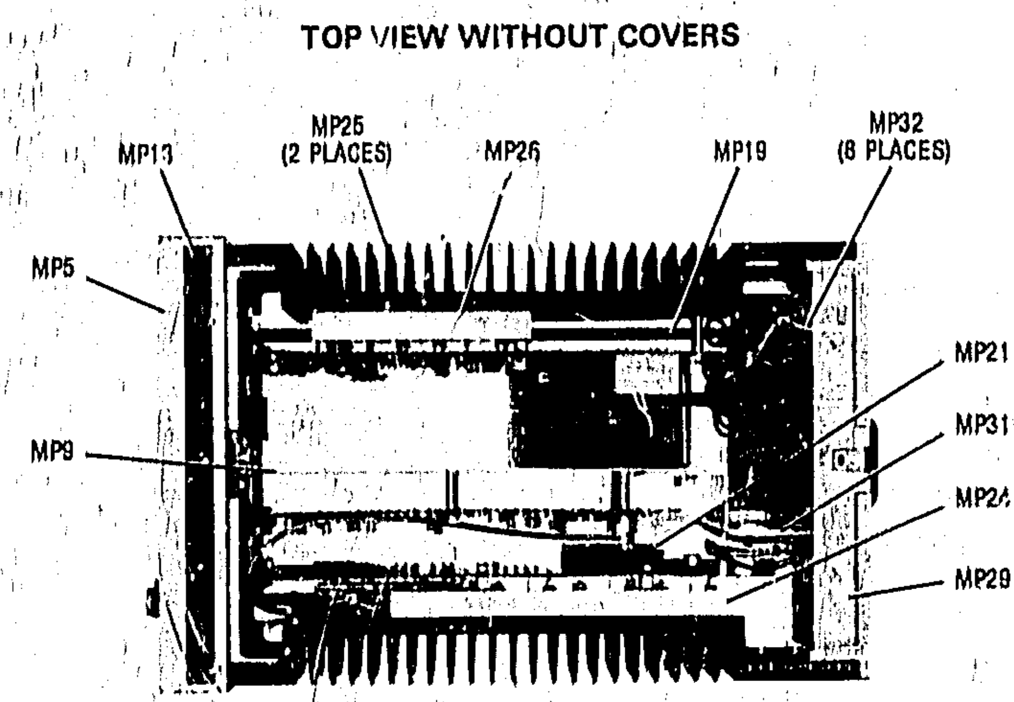
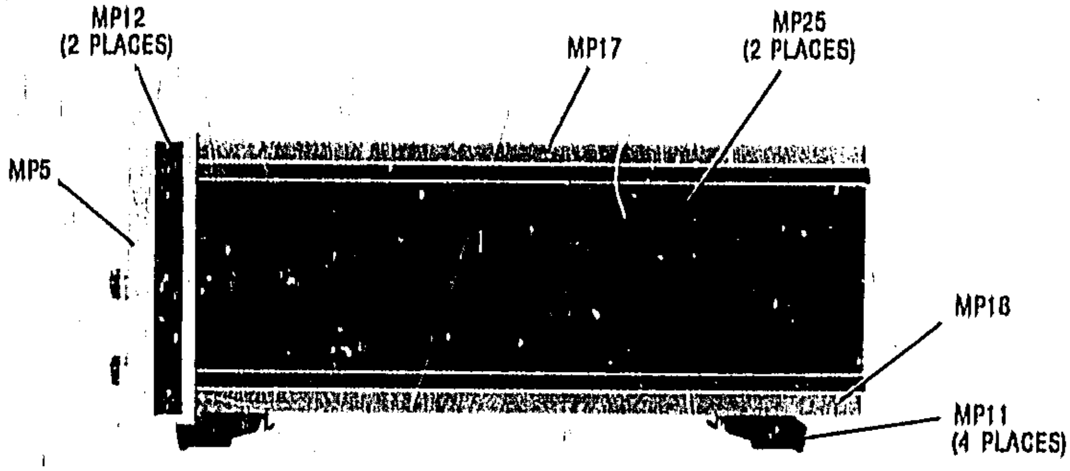


Figure 6-1. Miscellaneous Parts (2 of 4)

RIGHT SIDE



BOTTOM VIEW WITHOUT COVERS (A4 ASSEMBLY REMOVED)

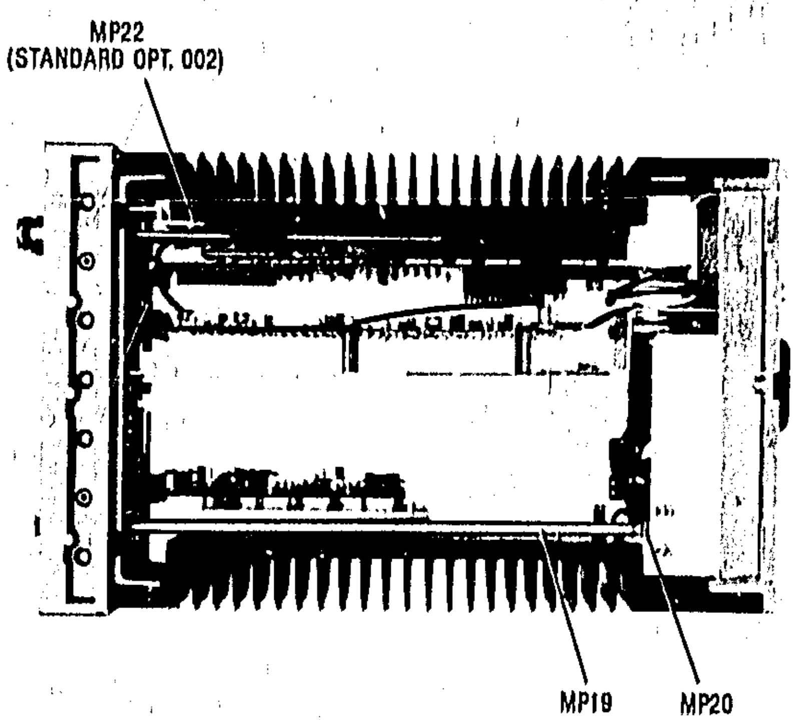


Figure 6-1. Miscellaneous Parts (3 of 4)

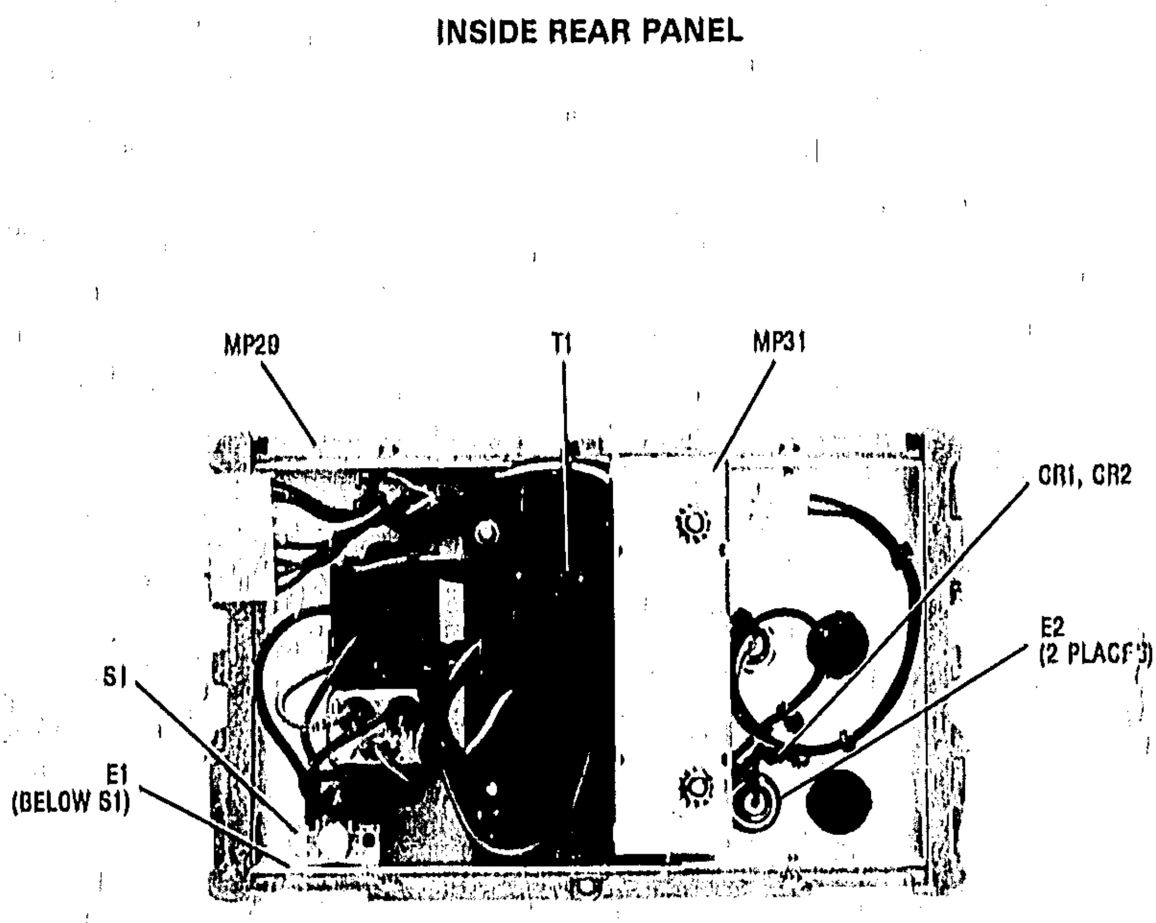


Figure 6-1. Miscellaneous Parts (4 of 4)

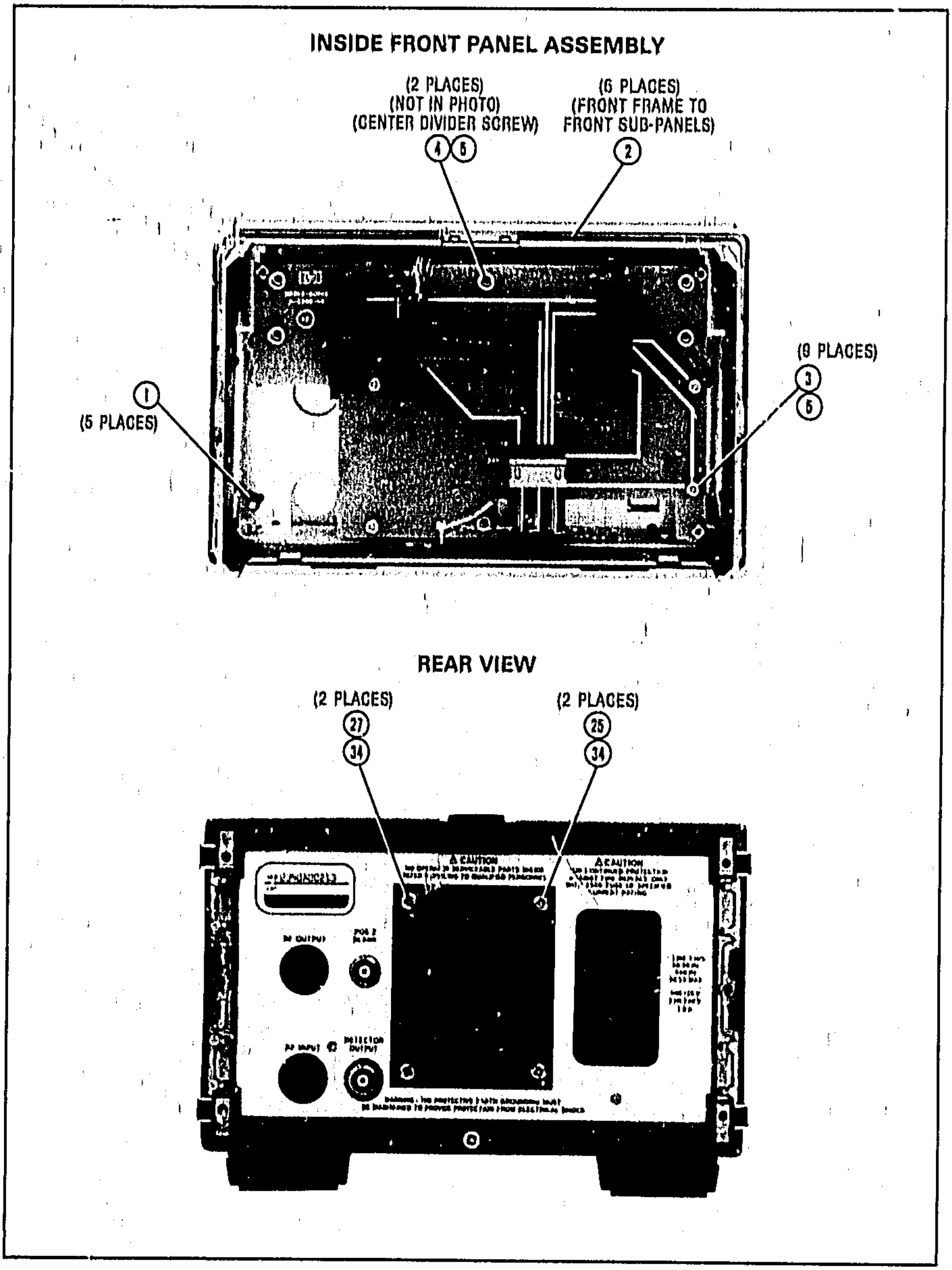
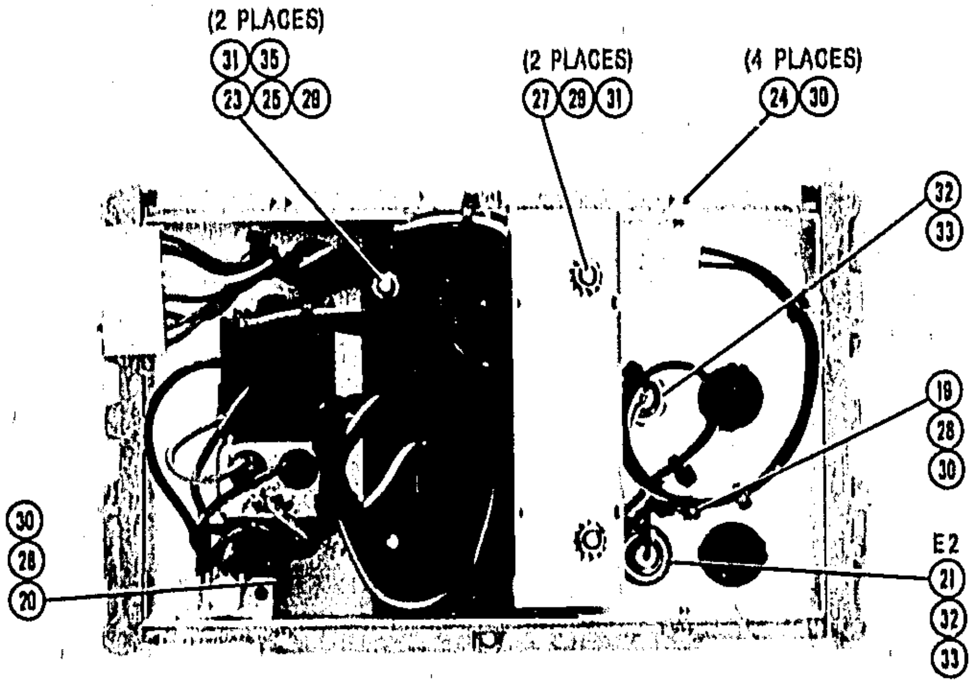


Figure 6-2. Attaching Hardware (1 of 5)

INSIDE REAR PANEL



TOP VIEW WITH COVERS

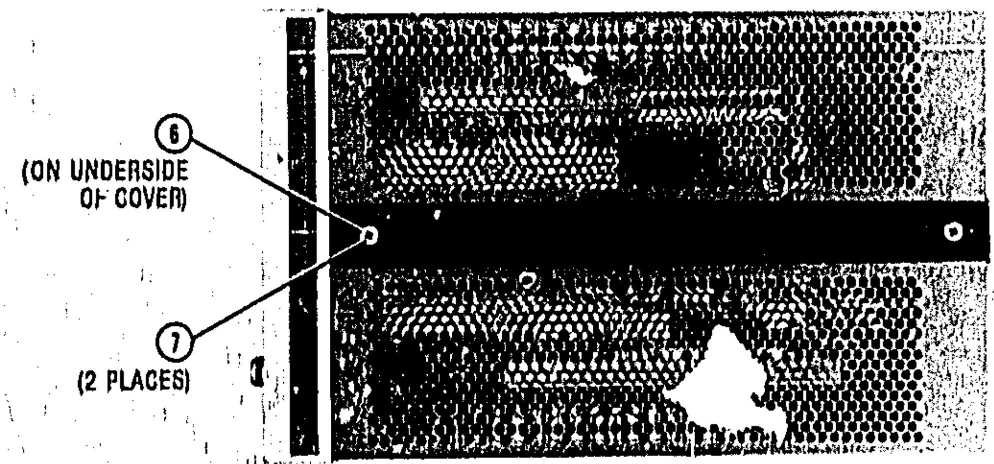


Figure 6-2. Attaching Hardware (2 of 5)

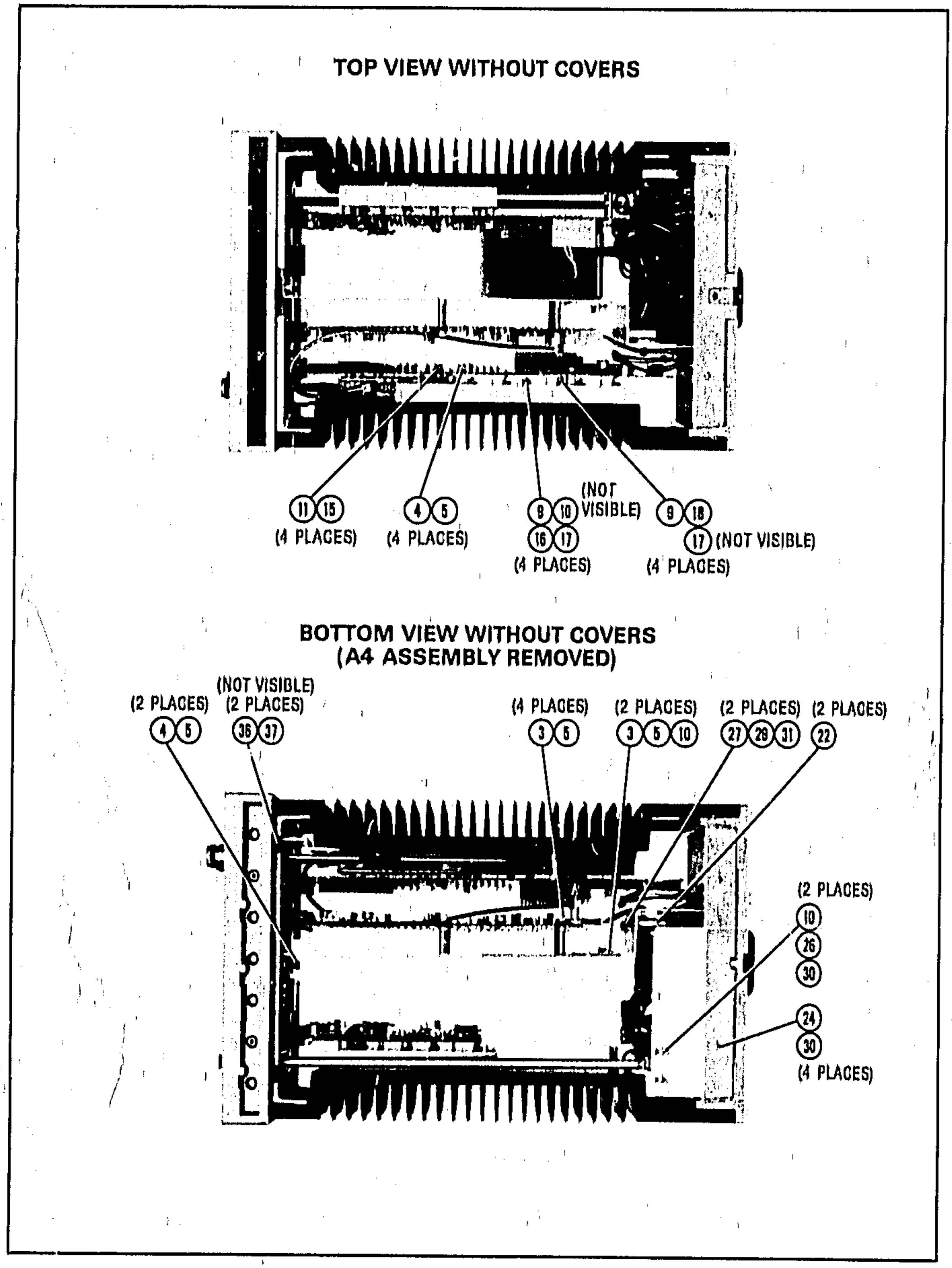


Figure 6-2. Attaching Hardware (3 of 5)

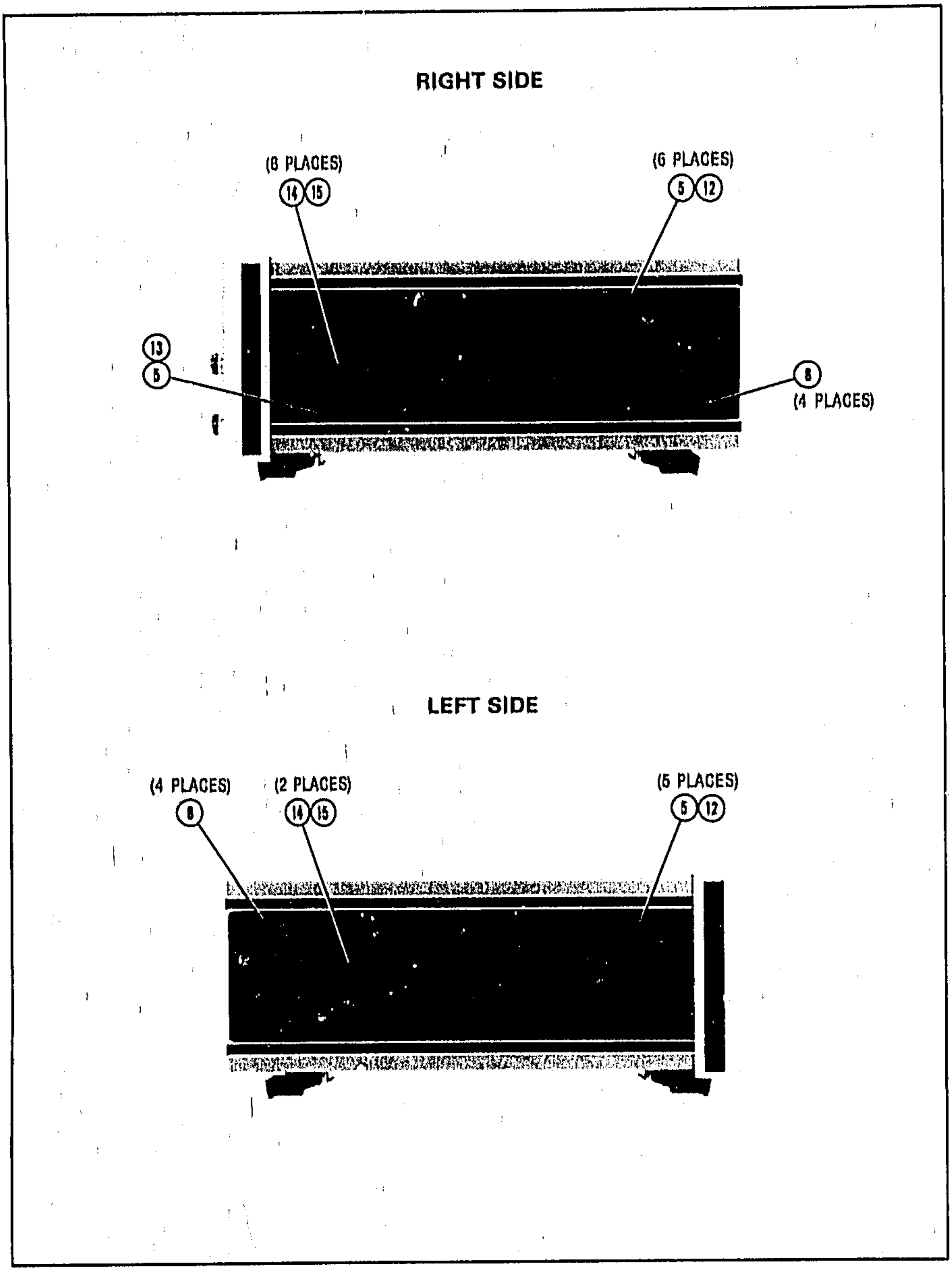


Figure 6-2. Attaching Hardware (4 of 5)

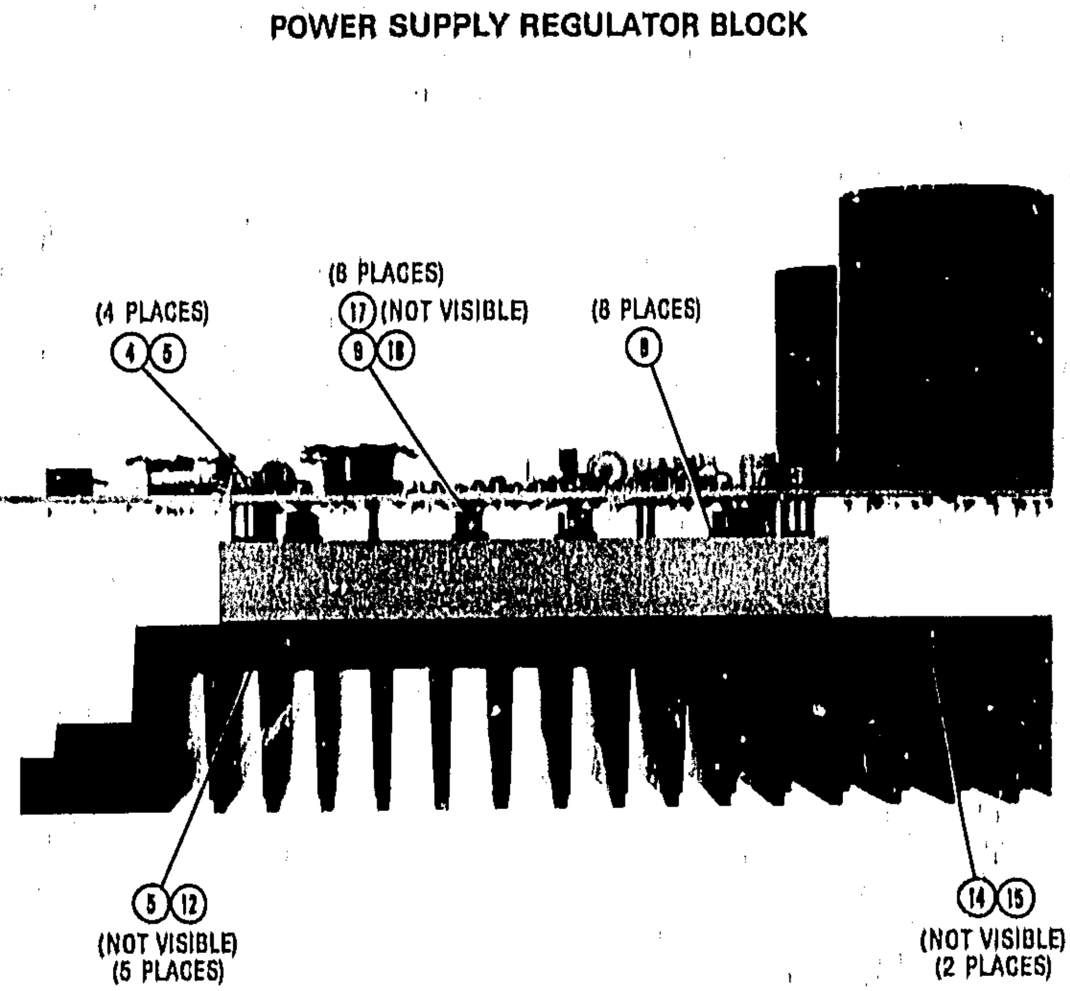


Figure 6-2. Attaching Hardware (5 of 5)

BACK DATING
MANUAL
CHANGES

SECTION VII
MANUAL BACKDATING CHANGES

7-1. INTRODUCTION

7-2. This manual has been written for and applies directly to instruments with serial prefixes listed in the first paragraph on the title page. Earlier versions of the instrument (serial prefixes listed in the second paragraph) may be slightly different in design or appearance. The purpose of this section of the manual is to document these differences.

7-3. With the information provided in this section, this manual can be corrected so that it applies to any earlier version or configuration of the instrument. Later versions of the instrument (with serial numbers prefixed higher than the one in the first paragraph of the title page) are documented in a yellow Manual Changes Supplement.

7-4. To adapt this manual to an earlier instrument, refer to paragraph 7-6 and make the change listed.

7-5. For additional information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

7-6. MANUAL CHANGE INSTRUCTIONS

7-7. Page 8-48, Figure 8-26 (Major Assemblies (2 of 3)), add the following note:

When W2 is replaced (coaxial cable from A2 to A4), the SMB connector soldered on the A4 signal conditioning board must be removed and the connector supplied with W2 soldered in its place.

SERVICE INFORMATION

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides instructions for troubleshooting and repairing the Hewlett-Packard Model 8349A microwave amplifier. It begins with an overall description and block diagram of the amplifier. Following this is theory, troubleshooting, component layout diagrams and schematics for each of the five major assemblies.

8-3. CAUTION NOTES

8-4. The CAUTION sign denotes a possible hazard to the instrument. It calls attention to an operating, maintenance, or repair procedure which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

Maintenance described in this section is performed with power supplied to the instrument and with the protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved. Where maintenance can be accomplished without power applied to the instrument, the power should be removed. When you have completed a repair, make sure all safety features are intact and functioning, and that all protective grounds are connected.

8-5. SCHEMATIC DIAGRAM SYMBOLS AND TERMS

8-6. Symbols and terms used on the schematic diagrams are explained in Figure 8-2, Schematic Diagram Notes.

8-7. SERVICE AIDS

8-8. Two extender brackets, HP part numbers 08349-00011 and 08349-00005; and two extender boards, HP part numbers 08349-60017 and 08349-60023, are supplied with the HP 8349A. They are shown in Figure 8-1. The boards and brackets enable one to raise specific assemblies up for troubleshooting while maintaining necessary connections.

8-9. THEORY OF OPERATION

8-10. The operation of the HP 8349A is described to assist with troubleshooting procedures. An overall block diagram, and schematic and component diagrams for the various sub-assemblies, are supplied.

8-11. TROUBLESHOOTING

8-12. Troubleshooting the HP 8349A begins by performing the Operator's Check (Section III) and the Performance Tests (Section IV). If a problem persists, refer to TROUBLESHOOTING PROCEDURES later in this section. The TROUBLESHOOTING PROCEDURES are designed to help the technician isolate a problem to the defective component.

8-13. RECOMMENDED TEST EQUIPMENT

8-14. Equipment recommended to test and maintain the instrument is listed in Section I, General Information. If the equipment listed is not available, equipment that meets the critical specifications listed may be substituted.

8-15. TROUBLESHOOTING EQUIPMENT

8-16. In addition to the previously recommended test equipment, the tools listed in Table 8-1 are necessary for disassembly and troubleshooting.

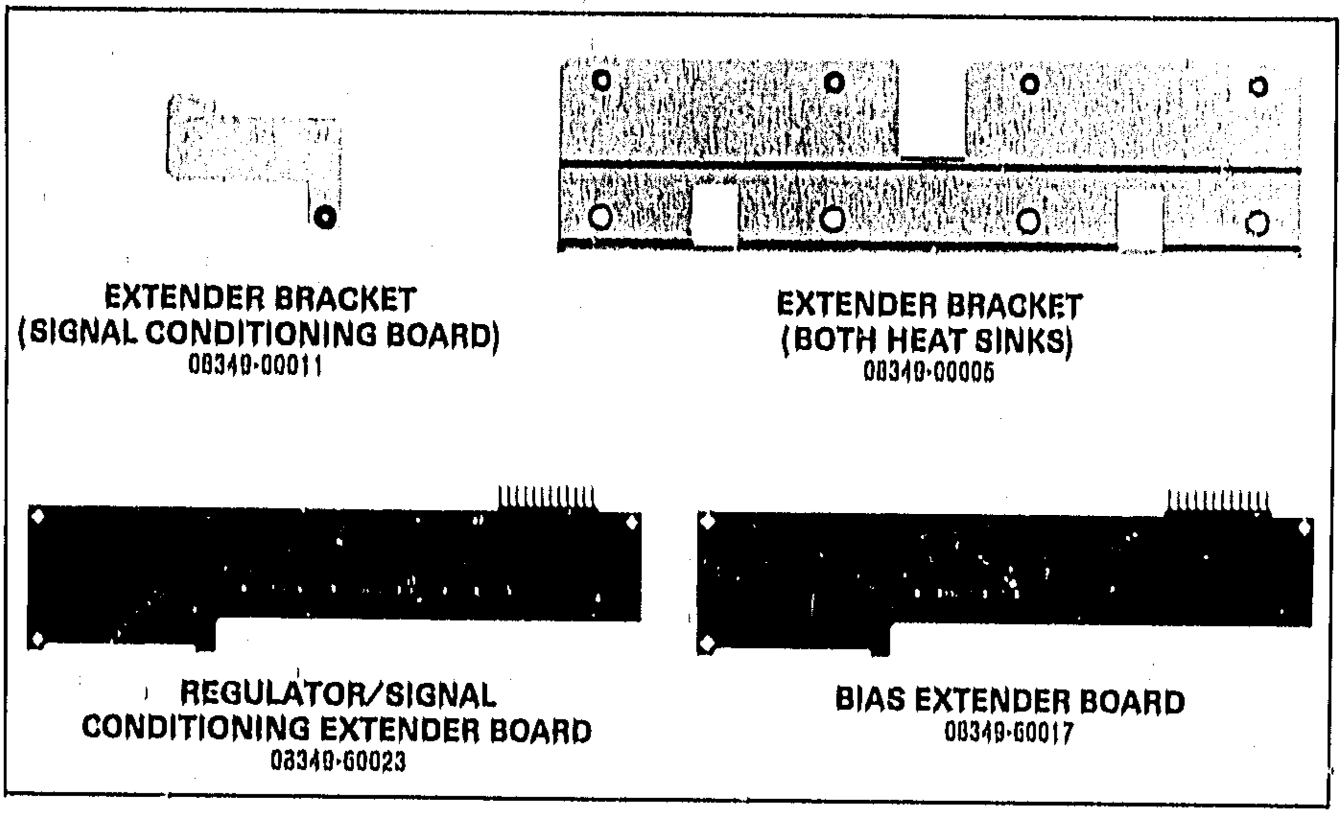


Figure 8-1. Service Accessories Supplied

Table 8-1. Troubleshooting Equipment

Quantity	Description	HP Part Number
1	2.5 mm Allen Wrench	8710-1181
1	3.0 mm Allen Wrench	8710-0911
1	Large Posidrive	8710-0900
1	Medium Posidrive	8710-0899
1	5/16 inch Open End Wrench	8720-0015
1	3/8 inch Open End Wrench	8720-0016
1	9/16 inch Open End Wrench	8720-0025
1	3/16 inch Nut Driver	8720-0001
1	1/4 inch Nut Driver	8720-0002
1	1/2 inch Nut Driver	8720-0007
1	5.5 mm Nut Driver	8710-1220
1	7 mm Nut Driver	8710-1217
1	Needlenose Pliers	8710-0595
1	Wirecutters	8710-0592
1	Wire Strippers	8710-0052
1	Soldering Iron	8690-0220

8-17. GENERAL MAINTENANCE

8-18. Microcircuit

CAUTION

When working inside the amplifier be very careful not to touch any of the exposed pins coming from the microcircuit. The microcircuit is extremely static sensitive, and may be damaged or destroyed by charges typically carried during everyday activities. When working near the microcircuit, always wear a static grounding strap. This strap provides a path on which static charges may travel thereby removing most of the danger. The strap should have a series resistance of no less than 1 Megohm, and no more than 2.5 Megohms. Alternatively the operator may ground himself before working on the amplifier by touching any grounded piece of equipment. A work station equipped with an anti-static surface should be used. Never touch the center contacts of the RF connectors.

Tests at Hewlett-Packard have revealed that repeated electrostatic charges as low as 250 V can destroy microwave devices. Ordinary activities around everyday materials can generate tens of thousands of volts. Materials conducive to static build-up include floor carpeting, nylon clothing, dry air, paper, adhesive tape, styrofoam, and vinyl. Use of the precautions described here will considerably reduce the probability of damage from electrostatic discharges.

8-19. Rigid Cables

8-20. If you must loosen or remove one of the rigid RF cables, be very careful not to bend it. Bending one of these cables can change its electrical characteristics.

8-21. Repairs on the Circuit Boards

8-22. Component mounting holes on the circuit board are plated through to both sides of the board. Because of this, you can solder or unsolder from either side.

CAUTION

Do not use a high-wattage soldering iron on the etched circuit board. Excessive heat can lift the printed wiring or burn the board. Also avoid using sharp metal objects to clean solder from plated-through component mounting holes. You may damage the plating and cause an open circuit. Use an anti-static type suction device or a toothpick for solder removal.

Use only mildly active rosin core solder (RMA) when repairing the circuit board. Do not attempt to clean excess flux from the soldered connections, as this can release chlorides that will cause corrosion. Always use a soldering iron with a ground tip and work at an anti-static work station to prevent static discharge damage during repairs.

8-23. Printed Circuit Board Markings. On the printed circuit board, a square pad is etched around one pin of some components to facilitate identification of the component terminals. The square pad indicates the following:

a. Cathode of a diode.

b. Emitter of a transistor.

c. Source terminal of an FET.

d. Pin one of an integrated circuit.

e. Pin one of an integrated circuit socket.

f. Pin one of a cable connector.

BASIC COMPONENT SYMBOLOGY

R, L, C	Resistance is in ohms, inductance is in microhenries, capacitance is in microfarads, unless otherwise noted.
P/O	Part of.
*	Indicates a factory selected component.
	Panel Control.
	Screwdriver adjustment.
	Encloses front panel designation.
	Encloses rear panel designation.
	Circuit assembly borderline.
	Other assembly borderline.
	Heavy line with arrows indicates path and direction of main signal.
	Indicates path and direction of main feedback.
	Earth ground symbol.
	Assembly ground. May be accompanied by a number or letter to specify a particular ground.
	Chassis ground.
n	Represents n number of transmission paths.
	Test Point: Terminal provided for test probe.
	Pin Edge Connector output of PC board.
(9)	Indicates wire or cable color code. Color code same as resistor color code. First number indicates base color, second and third numbers indicate colored stripes.
	Indicates shielding conductor for cables.
	Indicates a plug-in connection.
	Indicates a soldered or mechanical connection.
	Connection symbol indicating a male connection.
	Connection symbol indicating a female connection.
	Resistor.
	Variable Resistor.
	General purpose diode.
	Step recovery diode.
	Schottky diode.
	Breakdown Diode: Zener
	Light-Emitting Diode.
	SCR (Silicon Controlled Rectifier).
	FET: Field Effect Transistor (N-channel).
	FET: Field Effect Transistor-Guarded gate- (N channel).
	Dual Transistor.
	Transistor NPN
	Transistor PNP
	Electrolytic Capacitor.
	Toroid: Magnetic core inductor.
	Operational Amplifier.
	Fuse
	Pushbutton Switch.
	Toggle Switch.
	Thermal Switch.
Σ	Summing Point.
	Oscillator; RPG (Rotary Pulse Generator).
M	Fan, Motor.
	Toroidal Transformer

Figure 8-2. Schematic Diagram Notes

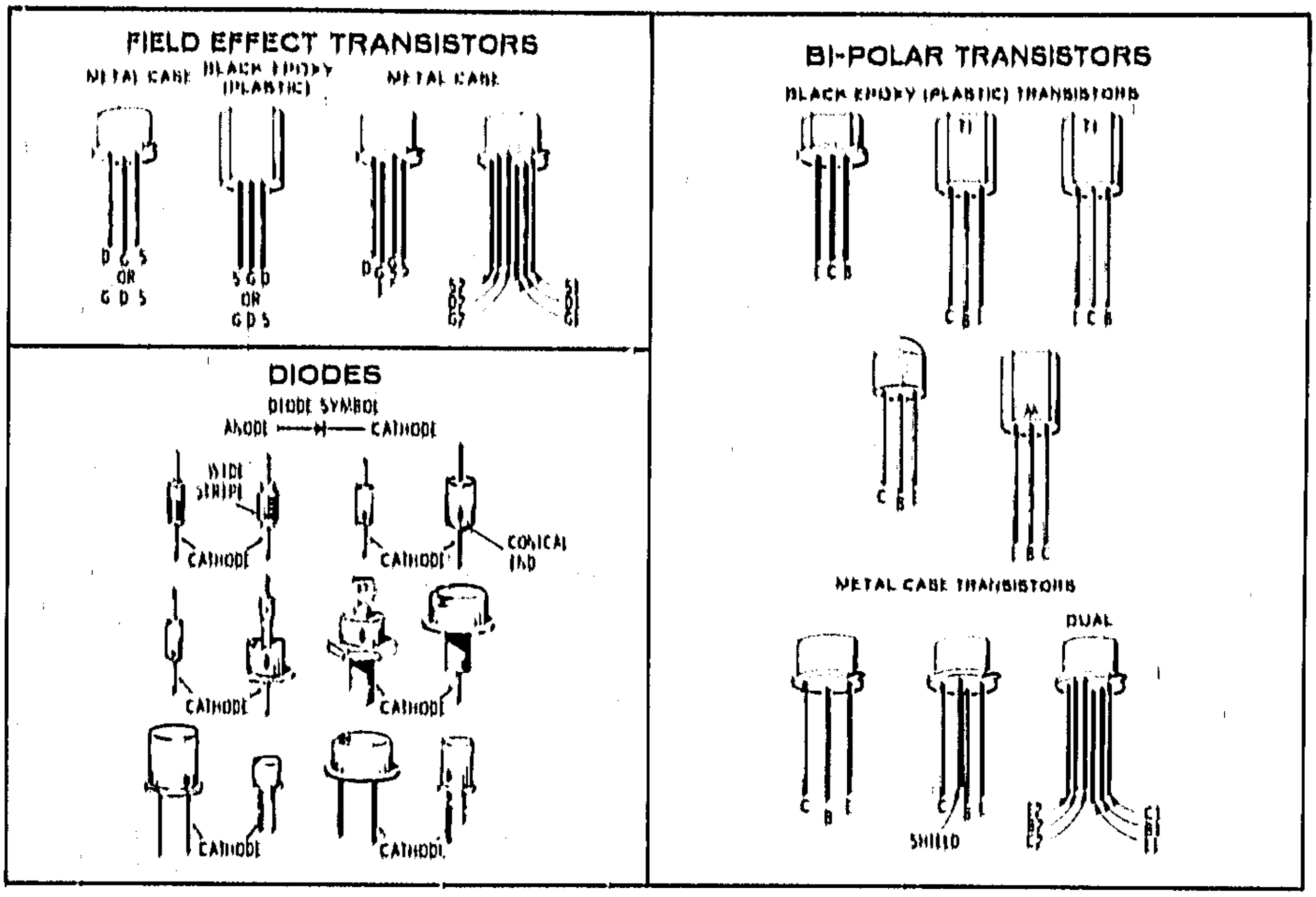


Figure 8-3. Examples of Diode and Transistor Marking Methods

Service

HP 8349A OVERALL DESCRIPTION

The major assemblies of the HP 8349A are the A1 display board, the A2 amplifier, the A3 bias board, the A4 signal conditioning board, the A5 regulator board and the A6 motherboard. The A2 amplifier takes the signal at the RF INPUT and amplifies it to produce the RF OUTPUT signal. The A3 bias board further regulates the power supply voltages produced by the A5 regulator board to provide the bias required by the A2 amplifier. The A4 signal conditioning board receives the detected RF OUTPUT signal (VDET) from the A2 amplifier and converts it to a signal (VDISP) which is proportional to RF power in dBm. The A1 display board receives VDISP from the A4 board and uses it to display the RF OUTPUT power on the front panel POWER LEVEL display. The A5 regulator board generates the dc voltages required by the HP 8349A. The A6 motherboard acts as the interconnect for the major assemblies in the HP 8349A.

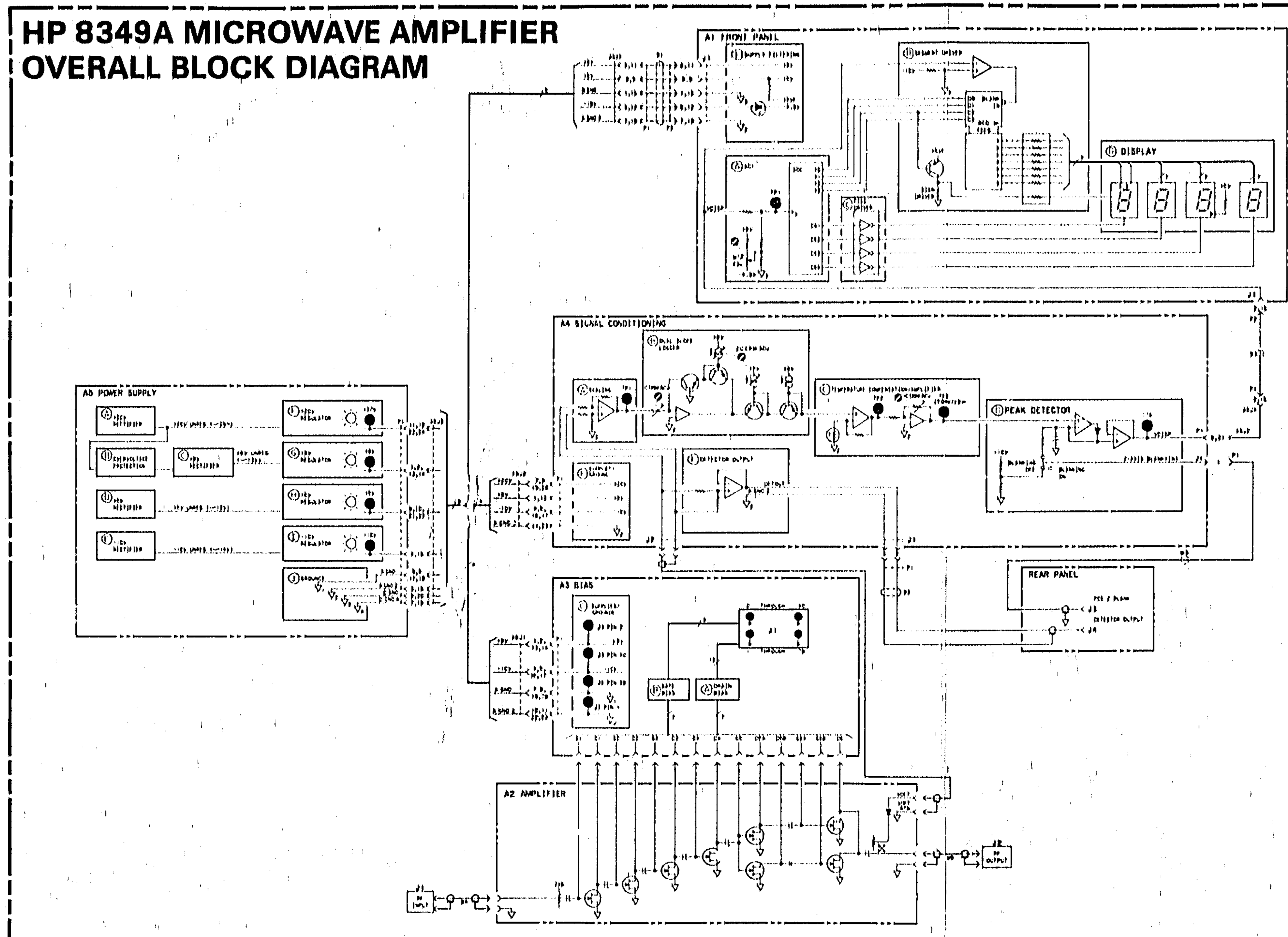


Figure 8-4. Overall Block Diagram

A1 DISPLAY BOARD, CIRCUIT DESCRIPTION

The display board is essentially a dc digital voltmeter that measures a tuning voltage (VDISP) from the signal conditioning board and converts it to a front panel power readout. The purpose of the display board is to display the amount of power at the RF OUTPUT of the HP 8349A.

A – ADC

U1 with its associated circuitry forms a dual-ramp, 3-1/2 digit Analog-to-Digital Converter (ADC) that converts an analog input voltage to a corresponding 8-4-2-1 BCD output once each measurement (conversion) cycle. The device contains CMOS digital logic providing counters, latches, and multiplexing circuitry as well as CMOS analog circuitry that provides the operational amplifiers and comparators required for a complete ADC. U1 also has an internal clock whose frequency is set by R7 at about 66 kHz.

During each measurement cycle, the offset voltages of the internal amplifiers and comparators are compensated for by the internal circuitry of U1.

Measurement Cycle

The ADC (U1) compares the unknown input voltage VDPM (TP1) to the reference voltage VREF to produce the BCD outputs Y0 through Y4. For a VDPM of +0.2V, which corresponds to +20 dBm, VREF is +2.0V. The reference voltage is set by precision resistors R5 and R6.

VREF, U1 pin 2, also functions as a reset for the ADC. When pin 2 is switched to Vee, the system is reset by internal circuitry to the beginning of a measurement cycle.

The entire measurement cycle requires slightly more than 16,000 clock periods (approximately 250 ms). Figure 8-5 shows the integrator waveforms at U1 pin 6 for typical positive and negative input voltages, with the cycle divided into six segments as described below.

In segment 1, offset capacitor C3, which compensates for the input offset voltages of the buffer and integrator amplifiers, is charged during this period, and integrator capacitor C4 is shorted. This segment requires 4000 clock periods.

In segment 2, the integrator output decreases to the comparator threshold voltage. At this time a number of counts equivalent to the input offset voltage of the comparator is stored in the offset latches for later use in the auto-zero process. The time for this segment is variable, but less than 800 clock periods is required.

Segment 3 is identical to segment 1.

Segment 4 is an up-going ramp cycle with VDPM as the input to the integrator. Figure 8-6 shows the equivalent configuration of the analog circuitry of U1. The actual configuration depends on the polarity of the input voltage during the previous conversion cycle.

Segment 5 is a down-going ramp with VREF as the input to the integrator. Segment 5 of the conversion cycle has a time equal to the number of counts stored in the offset storage latches during segment 2. As a result, the system zeroes automatically.

Segment 6 is an extension of segment 5. The time period for this portion is 4000 clock periods. The results of the conversion cycle are determined in this portion.

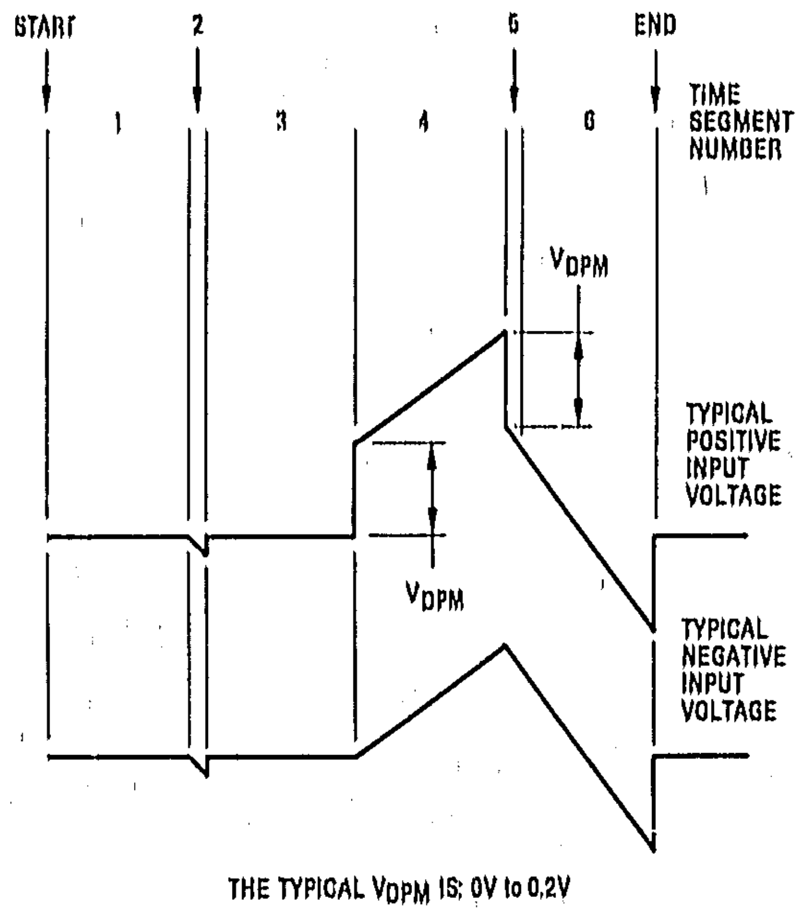


Figure 8-5. Integrator Waveforms

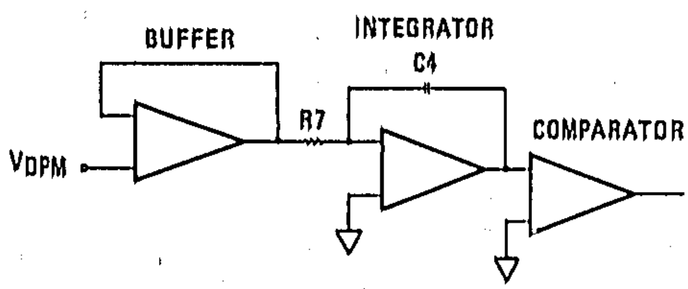


Figure 8-6. Equivalent Analog Circuitry of A1U1

End of Conversion

The end-of-conversion (EOC) output at U1 pin 14 produces a pulse at the end of each measurement cycle. The pulse width is one-half the period of the system clock, or 7.6 us.

Display Update

If a positive edge is received at U1 pin 9 (DISPLAY UPDATE) prior to the ramp-down portion, new data will be strobed into the output latches during that conversion cycle. Since pin 9 is wired to the EOC output (pin 14), every conversion is displayed.

Digit Select

The digit select outputs of U1 are DS2 through DS4, pins 16 through 19. Each digit select output goes high as the corresponding digit is selected. The most significant digit (the half digit) is turned on immediately after the EOC pulse, followed by the remaining digits in the sequence from the most significant digit (MSD) to the least significant digit (LSD); that is, DS1, DS2, DS3, DS4. A blanking time between digits of two clock periods is included to ensure that the BCD data has settled. Relative timing among digit select outputs and EOC signals is shown in Figure 8-7.

BCD Data Outputs

The multiplexed BCD data outputs of U1 are Y3, Y2, Y1, and Y0. During the digit select times DS2 through DS4, the numeric displays A1DS2 through A1DS4 display the full digits 0 through 9. The most significant digit is displayed on A1DS1 during digit select time DS1. However, only segments b, c, and g of that numeric display are connected, so A1DS1 can display only a "1", a minus sign, or a blank. Note that segment g is not lighted by any decoded state of U4.

Display Section

The Display Section includes BCD-to-Seven-Segment Decoder/Driver U3, resistor package U4, Digit Driver U2 and numeric displays A1DS1 through A1DS4.

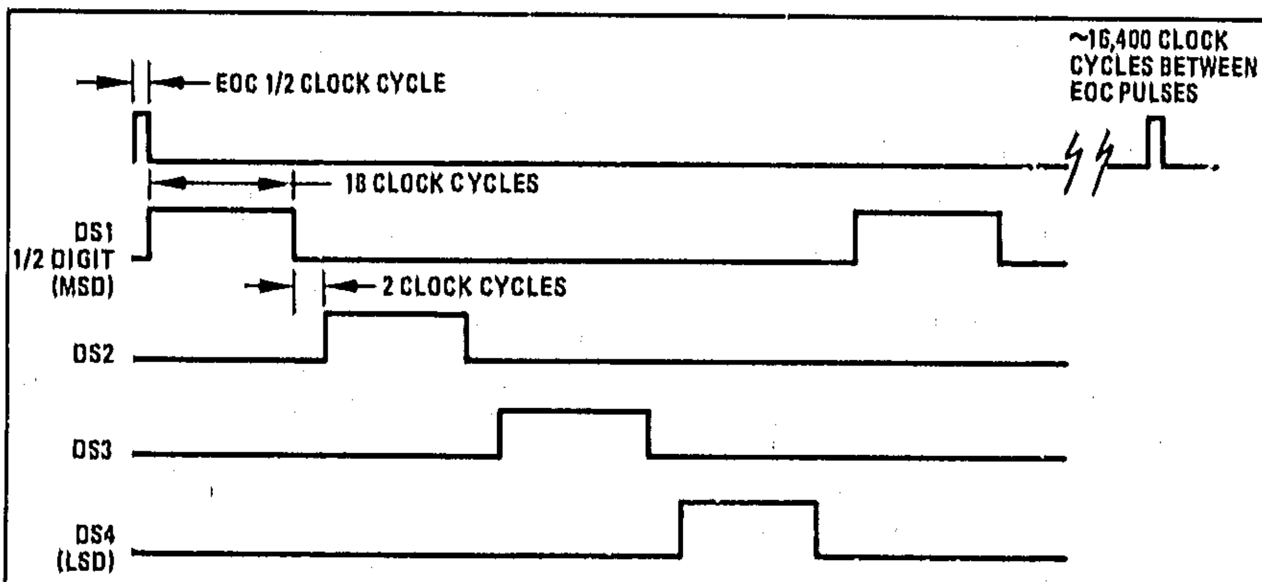
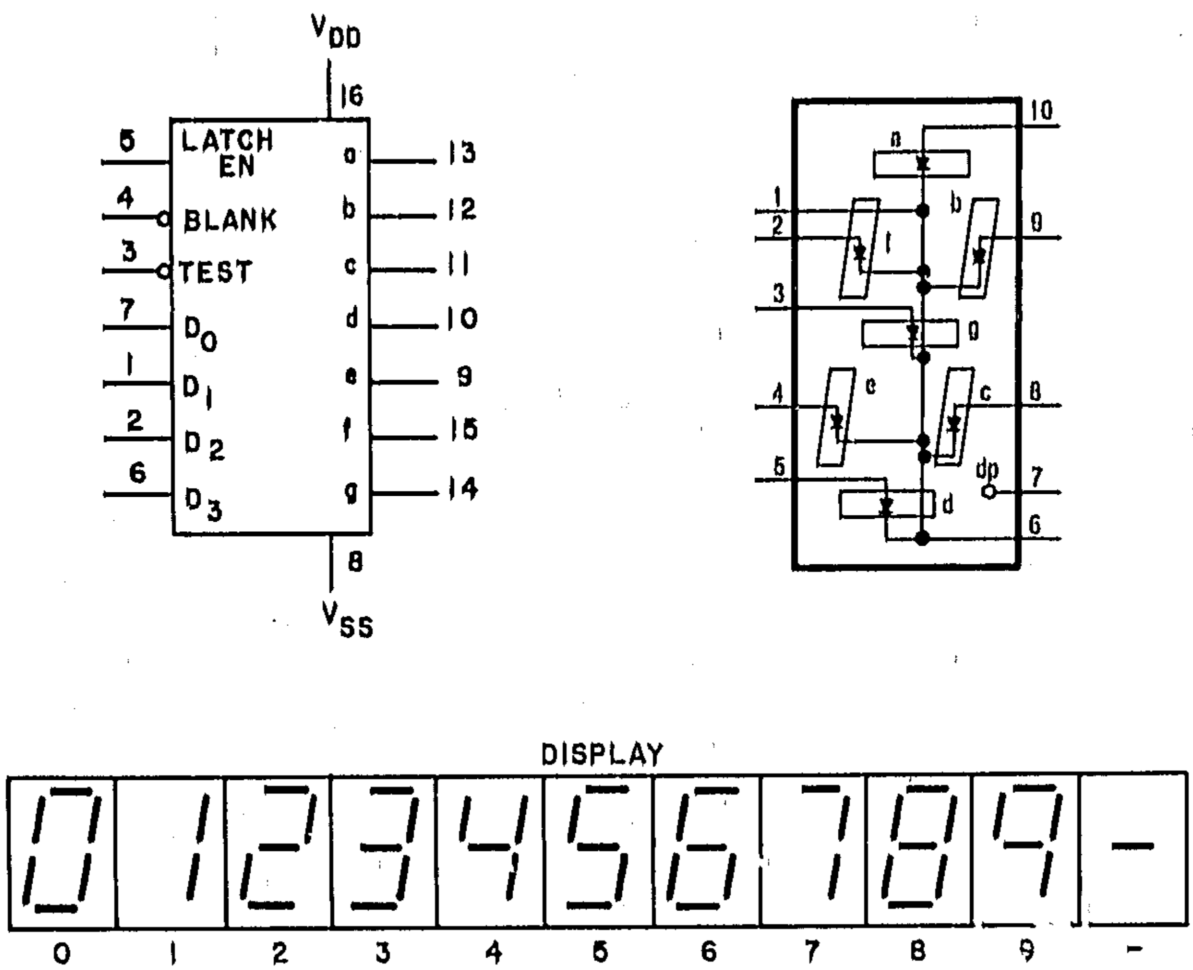


Figure 8-7. Digit Select Timing Diagram



TRUTH TABLE

Inputs				Outputs							
D_3	D_2	D_1	D_0	a	b	c	d	e	f	g	Display
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	0	0	1	1	9
1	0	1	0	0	0	0	0	0	0	0	Blank
1	0	1	1	0	0	0	0	0	0	0	Blank
1	1	0	0	0	0	0	0	0	0	0	Blank
1	1	0	1	0	0	0	0	0	0	0	Blank
1	1	1	0	0	0	0	0	0	0	0	Blank
1	1	1	1	0	0	0	0	0	0	0	Blank

Figure 8-8. Segment Driver

B – SEGMENT DRIVER

At the end of the measurement cycle, the BCD data outputs Y0 through Y3 of U1 are transmitted to Decoder/Driver U3 as data inputs D0 through D3. The decoded outputs, U3 pins 9 through 15, are connected to the appropriate segment anodes to display the decoded numbers in numeric displays A1DS1 through A1DS4.

Figure 8-8 shows the pin connections to U3, the seven segments of a numeric display, and a truth table. The Latch Enable, pin 5, is wired to ground (logic low). The Blanking Input, pin 4, is connected to the TTL output of a comparator. When VDISP is less than −0.6V, the voltage at pin 4 changes from a logic high to a logic low and the display is blanked. The minus sign and the decimal point remain lit. The Lamp Test, pin 5, may be grounded at TP3 to test the numeric displays by lighting all seven segments of A1DS2 through A1DS4 and segments b and c (numeral 1) segments of A1DS1. The Lamp Test does not test the minus sign, segment g.

The minus sign is displayed on A1DS1 only when VDPM is negative, since the voltages corresponding to 0 through −2 dBm are all negative. When VDPM is negative, a logic low at Y2 is applied to the base of Q1, turning Q1 on. A logic high is then applied to A1DS1 pin 3, which is the anode of segment g, and the minus sign is lit.

C – DIGIT DRIVER

Digit Driver U2 is a Darlington transistor array that comprises seven Darlington pairs. Each Darlington pair is shown as an inverter on the schematic, and a schematic of the actual configuration is shown in the schematic notes.

The digits are selected in sequence, starting with the most significant digit (displayed on A1DS1). A logic high on a digit-select output of U1 (DS1 through DS4) is inverted through U2 to place a low on the segment cathodes, pin 1 or pin 6, of the corresponding numeric display A1DS1 through A1DS4 (pins 1 and 6 are connected internally; the schematic indicates the external connections). Since the displays are of the common-cathode type and the segment anodes corresponding to the decoded numbers receive logic highs from U3, the segments are lit to display the power corresponding to VDPM.

D – DISPLAY

The POWER LEVEL display readout consists of four 7-segment numeric displays, A1DS1 through A1DS4. A1DS1, the most significant digit (MSD), is connected to display only the numeral 1 or the minus sign (which is lit when VDPM goes negative). The decimal point is connected to the +5V supply through R15 and is always lit.

Figure 8-9 relates the decoded status of Y0 through Y3 to the POWER LEVEL readout for digit select times DS1 through DS4. Note that Y0 through Y2 might be either high or low during DS1 since the decoded states 0, 3, 4, and 7 are all displayed as "1", as explained in the discussion of MSD codes.

MSD Codes

Only three segments of the MSD display A1DS1 are connected. The anodes of segments b and c (the numeral 1) are driven by U3, while segment g (the minus sign) is driven by Q1.

Only three segments of A1DS1 are connected because of the limited logic in the ADC, U1. As a result, four decoded outputs of Segment Driver U3 cause A1DS1 to blank and four decoded outputs cause A1DS1 to display numeral 1.

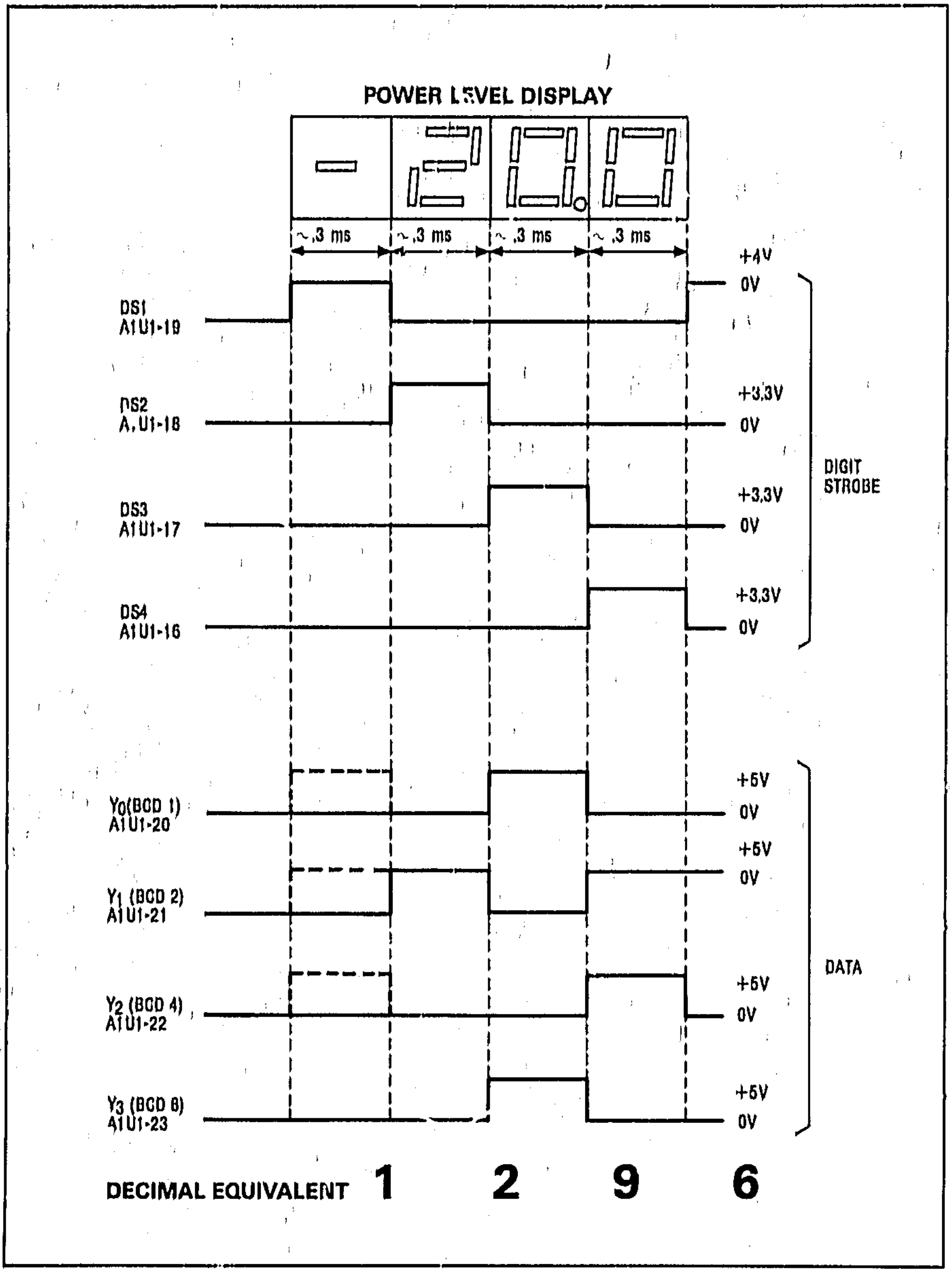


Figure 8-9. POWER LEVEL Display Timing

During digit select time DS1 (Figure 8-7), when A1 DS1 is driven, outputs Y3 through Y0 of the ADC might be decoded as any one of eight states. The following states cause A1 DS1 to be blanked.

Y3	Y2	Y1	Y0	Decoded State	A1 Display
1	0	1	0	10	Blank
1	0	1	1	11	Blank
1	1	1	0	14	Blank
1	1	1	1	15	Blank

Since only segments b and c of A1 DS1 are connected, the decoded states 0, 3, 4, and 7 all appear as 1 as shown in Figure 8-8.

Y3	Y2	Y1	Y0	Decoded State	A1 Display
0	0	0	0	0	1
0	0	1	1	3	1
0	1	0	0	4	1
0	1	1	1	7	1

A1 DISPLAY BOARD, TROUBLESHOOTING

Basic Checks

Verify that +8V, +5V, +5VF, −10V, and −4.9V power supply voltages are present on the assembly. The DVM should be referenced to D GND when checking the +5V and +5VF supply voltages or A GND 2 when checking the other supply voltages.

Verify that VDISP is present on the assembly. Note that VDISP should vary from 0V for an RF OUTPUT of 0 dBm, to approximately 5.0V for an RF OUTPUT of 20.0 dBm. For the same output power range, VDPM should vary from 0V to 0.2V.

Ground TP3 (Lamp Test) to A GND 2 and verify that all the segments of A1 DS2 through DS4 are lit. If this doesn't occur, suspect either the displays or A1 U3. Note that the minus sign is not lit during this test. It is only lit when VDISP goes negative.

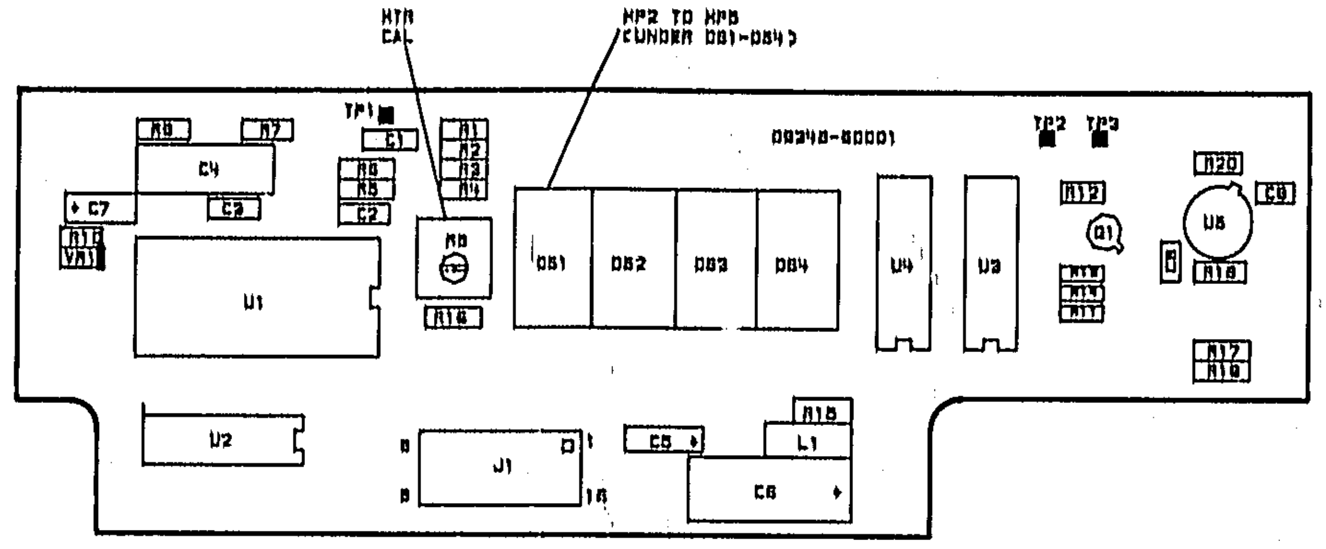
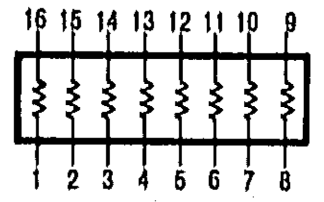


Figure 8-10. A1 Display Board, Component Locations

NOTES

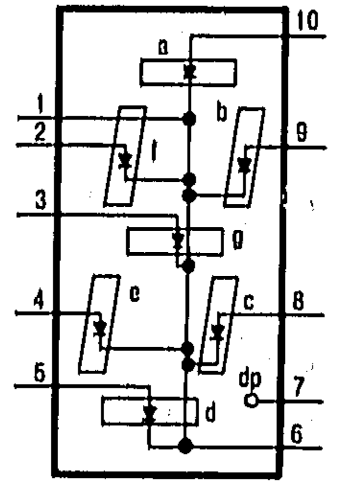
1. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
2. A1U4 PIN CONFIGURATION:

A1U4: 180Ω
(TOP VIEW)



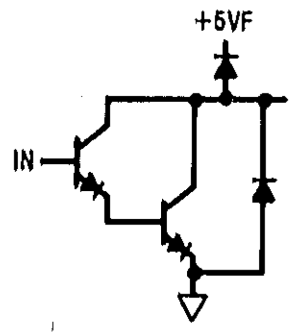
3. A1DS1 — DS4 SEGMENT CODE AND PIN CONFIGURATION:

SEGMENT CODE



4. A1U2 CONTAINS SEVEN DARLINGTON PAIRS SHOWN AS INVERTING DRIVERS.

DARLINGTON PAIR:



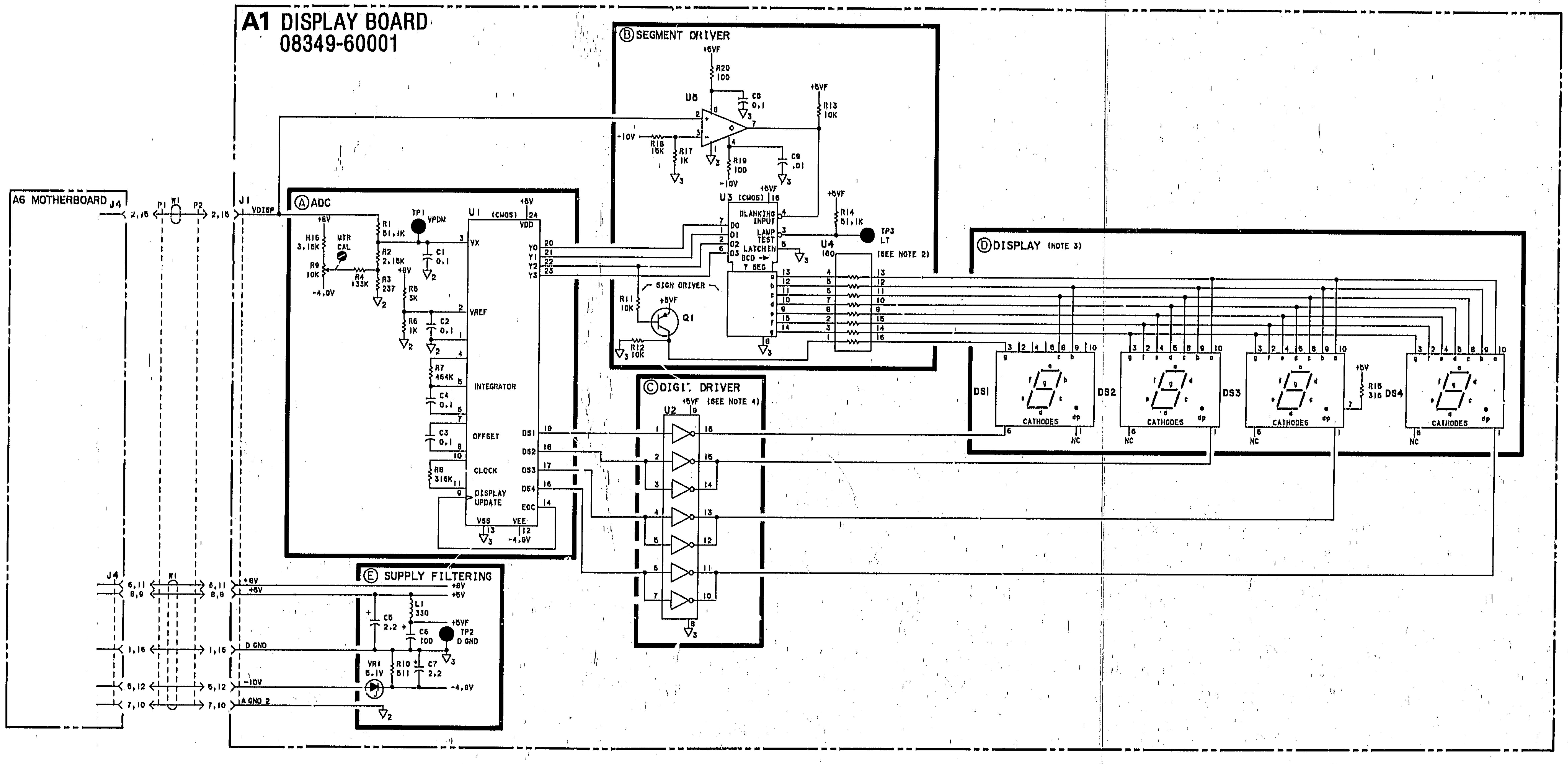


Figure 8-11. A1 Display Board, Schematic Diagram

A2 AMPLIFIER AND A3 BIAS BOARD, CIRCUIT DESCRIPTION

The A3 bias board provides independent drain and gate bias for the eight FETs in the A2 amplifier. This assembly is powered by the +8V and −10V power supplies.

The A2 amplifier contains eight FETs which amplify the RF input signal. At the amplifier's output stage, a portion of the RF OUTPUT power is coupled off, detected, and then sent as VDET to the A4 signal conditioning board. On the A4 assembly, VDET is converted to a signal which is used to drive the A1 display board where the RF OUTPUT power is displayed in dBm on the POWER LEVEL display.

A – DRAIN BIAS

The Drain Bias for the FETs in the amplifier is provided by six post regulators whose voltage is set by factory select resistors, R1 through R12, which are connected to a terminal strip on the bias board. Q1's and Q2's collector-to-emitter voltage is set by resistors R1, R2 and R3, R4 respectively. Resistors R37 and R38 are current limiting resistors which protect the FETs in the first stage of the amplifier in the event of an overvoltage condition.

Q3 through Q6 are configured as Vbe multipliers. The collector-to-emitter voltage is a non-integer multiple of the Vbe diode drop where $V_{ce} = 1 + Ra/Rb$; Ra = R5 and Rb = R6 for transistor Q3.

R25 through R30 are current sense resistors which can be accessed from test point connector J1 to measure the drain currents. The drain voltages can also be measured at these test points.

B – GATE BIAS

The FET gate bias is developed by resistor ratios set by factory select resistors R19 through R24. When one of these resistors is not loaded, the corresponding gate bias is set to zero volts.

C – SUPPLIES/GROUNDS

The instrument has two analog grounds: A GND, a high current ground, and A GND 2, a low current ground. Both grounds are connected to chassis ground through the screws which secure the A3 bias board to the microcircuit.

For troubleshooting, A GND, A GND 2, and the power supply voltages can be accessed at the test point connector J1.

A2 AMPLIFIER AND A3 BIAS BOARD, TROUBLESHOOTING

NOTE

The A2 amplifier is extremely static sensitive. Any troubleshooting of this assembly or the A2 bias board should be done at an anti-static work station.

NOTE

While troubleshooting the A2 amplifier and A3 bias board, the chassis ground connection must be maintained. If the assemblies need to be removed from the instrument for troubleshooting, they should be placed into their service position. Refer to the Service Position Installation Procedure below.

Basic Checks

Verify that +8V and −10V power supply voltages are present. The +8V supply can be measured by probing across A3J1 pin 2 and A3J1 pin 1 (A GND 2). The −10V supply can be measured by probing across A3J1 pin 40 and A3J1 pin 1.

Verify that RF INPUT and OUTPUT connectors and cabling are not defective. Measure the output power directly at the output of A2 to verify that W5 and J2 are not at fault. Measure the input power at the output of W4 to verify that W4 and J1 are not at fault.

Bias Checks

The following tests will determine if the biasing to each stage of the amplifier is correct. If an incorrect bias is found, further troubleshooting will be required to determine if the biasing problem is due to the bias circuit on the A3 bias board or the A2 amplifier.

With the DVM referenced to A GND 2 (A3J1 pin 1), measure the drain voltages at the points listed below. The measured values should be within ±0.3 V of the values given.

D1 (A3J1 pin 29) – +4.0 V
D2 (A3J1 pin 35) – +4.0 V
D3 (A3J1 pin 33) – +5.5 V
D4 (A3J1 pin 31) – +5.5 V
D5 (A3J1 pin 37) – +6.5 V
D6 (A3J1 pin 21) – +6.5 V

Attached to the Transistor Block is a label which gives the bias currents, ID3, ID4, ID5, and ID6, required by the amplifier (see Figure 8-12). ID3 through ID6 are the bias currents for the A2 amplifier's third through sixth stage and can be measured across R27, R28, R29, and R30 respectively. Since these resistors are 1 Ohm sense resistors, the voltage drop across these resistors corresponds to the bias current. For example, the bias current shown for ID3 in Figure 8-12 is 86 mA. To verify that stage 3 of the amplifier is biased correctly, the positive lead of a DVM would be connected to A3J1 pin 9 and the ground lead connected to A3J1 pin 33. The DVM should indicate 86.0 mV ±4.3 mV which corresponds to 86.0 mA ±4.3 mA. The ±4.3 mV (mA) bias variation corresponds to ±5% bias range over which the amplifier may be set.

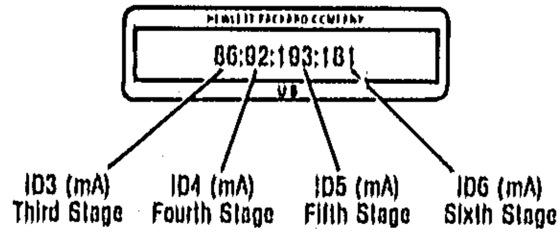


Figure 8-12. A2 Amplifier's Bias Currents Label

Verify that the amplifier's bias currents are correct by measuring across the test points listed below.

ID3 – A3J1 pin 9 to A3J1 pin 33
ID4 – A3J1 pin 25 to A3J1 pin 31
ID5 – A3J1 pin 23 to A3J1 pin 37
ID6 – A3J1 pin 3 to A3J1 pin 21

If the bias currents are found to be incorrect, further troubleshooting will be required to determine if the bias circuitry or amplifier is at fault. If Q3, Q4, Q5, or Q6 is found to be defective, follow the replacement procedure given below.

Q3, Q4, Q5, and Q6 Replacement Procedure

Upon replacement of Q3, Q4, Q5, or Q6, verify that the bias current for stage in which the transistor was replaced is correct (see Bias Checks above). If the bias current is incorrect, remove the appropriate resistor (see below).

ID3 – Remove R21
ID4 – Remove R22
ID5 – Remove R23
ID6 – Remove R24

Determine the value of the resistor removed and replace the resistor with a potentiometer set to the same resistance. Slowly adjust the potentiometer while monitoring the bias current. When the bias current given on the label is achieved, remove the potentiometer, measure its resistance, and install a 1%, 0.25 W fixed resistor of the same value in its place. Verify that the bias current is now correct.

Service Position Installation Procedure

1. Turn the HP 8349A LINE switch off and disconnect the line cord.
2. Remove the top and bottom covers (only the rear screw on the top needs to be removed to remove the top cover).
3. Remove the four screws securing the heat sink on which the A2 amplifier and A3 bias board are mounted (see Figure 8-13a).

4. Remove the rear two screws securing the heat sink on which the A5 regulator board is mounted (see Figure 8-13b).

5. Loosen the two screws securing the center support of the HP 8349A (see Figure 8-13c). Slide the rear panel away from the front panel.

6. Disengage the A3 bias board from the motherboard. Remove the A2 amplifier, A3 bias board and heat sink from the instrument. Disconnect the detector cable, W2, from the A2 amplifier.

NOTE

When sliding the rear panel forward in step 7, ensure that the LINE switch is reinserted through the front panel.

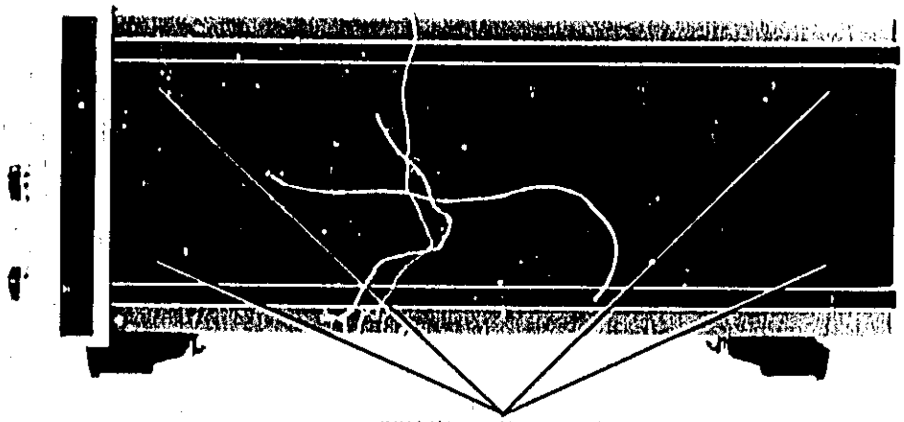
7. Slide the rear panel toward the front panel and reinstall the rear two screws which secure the heat sink on which the A5 regulator board is mounted. Securing this heat sink to the rear panel reconnects chassis ground.

8. Connect the extender board, HP P/N 08349-60017, to A6J1.

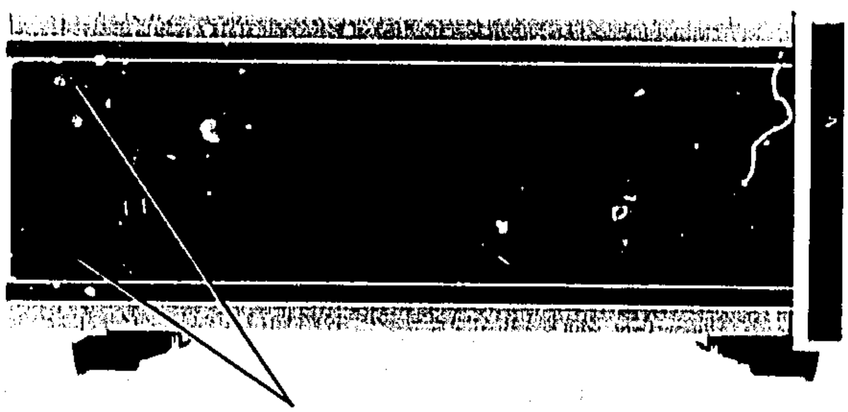
9. Mount the extender bracket (HP P/N 08349-00005) to the front panel using two of the screws removed in step 3. Connect the A3 bias board to the extender board installed in step 8 and mount the heat sink to the extender bracket (see Figure 8-13d). Reconnect the detector cable, W2, to the A2 assembly.

10. Ensure the LINE switch is off before reconnecting the LINE cord.

11. Reverse this procedure when reinstalling the A2 amplifier, A3 bias board and heat sink.

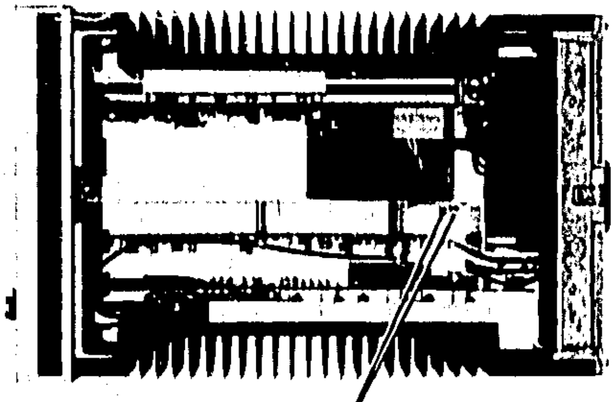


a) HP 8349A – Right Side

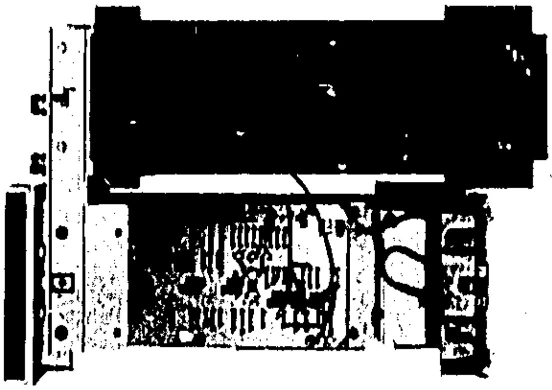


b) HP 8349A – Left Side

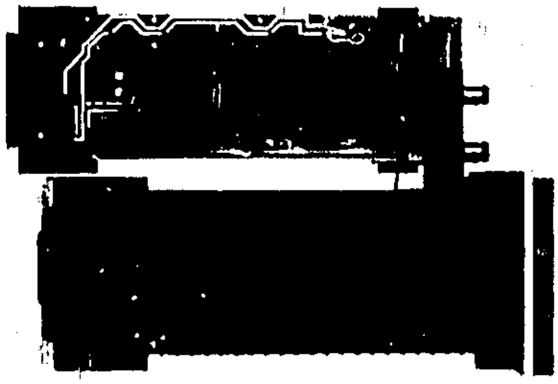
Figure 8-13. Service Position Installation Diagrams (1 of 2)



c) HP 8349A — Top View



VIEW OF RIGHT SIDE



VIEW OF LEFT SIDE

d) A2 Amplifier, A3 Bias Board, and Heat Sink in Service Position

Figure 8-13. Service Position Installation Diagrams (2 of 2)

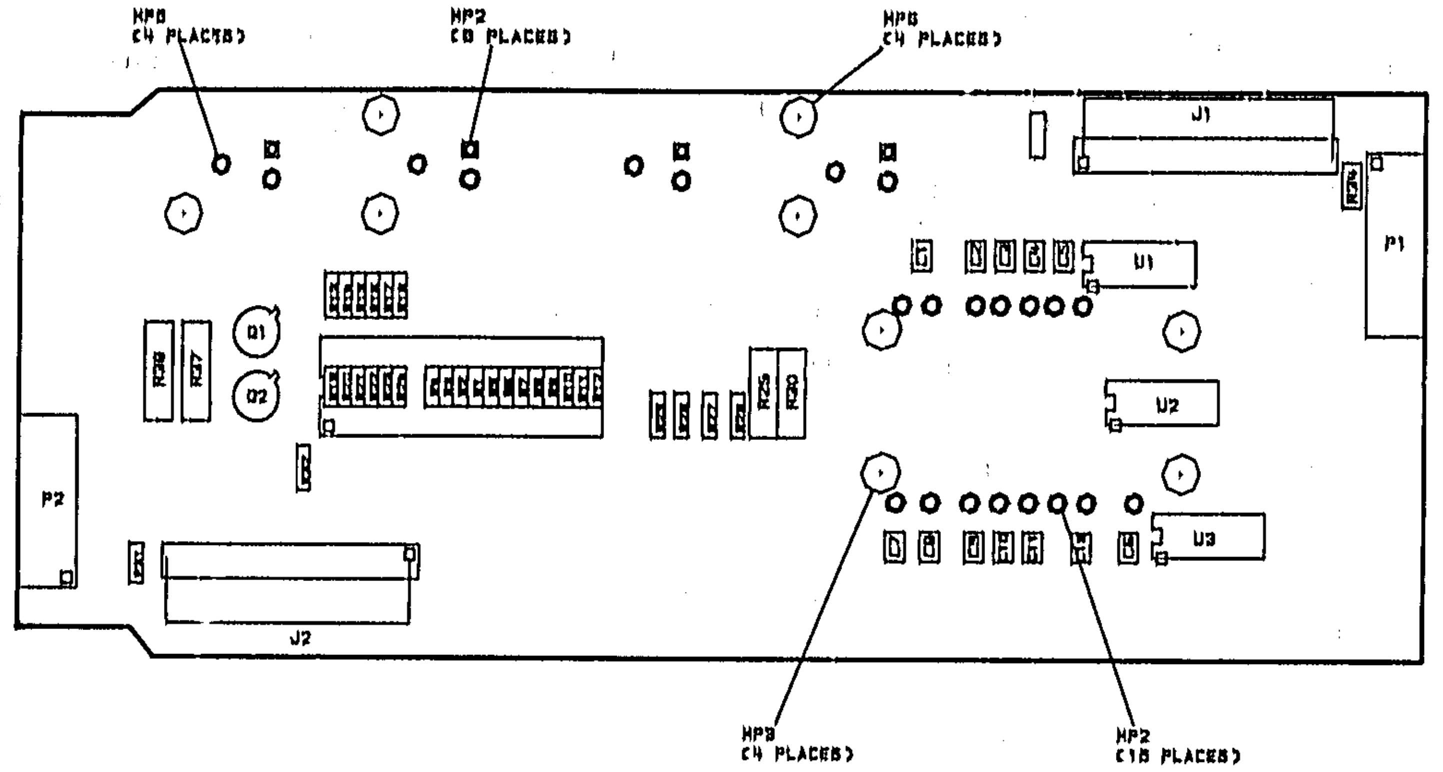


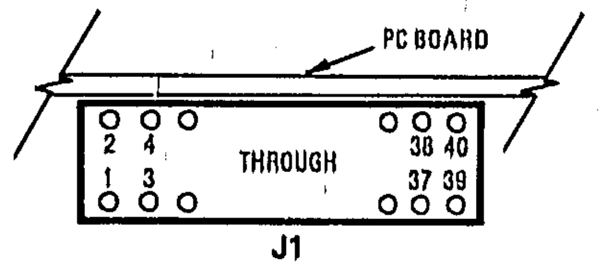
Figure 8-14. A3 Bias Board, Component Locations

NOTES

1. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

2. PIN CONFIGURATION FOR A3J1:



3. THE A2 AMPLIFIER IS EXTREMELY STATIC SENSITIVE. CARE SHOULD BE TAKEN WHEN PROBING THE A3 BIAS BOARD. TROUBLESHOOTING OF BIAS TO A2 AMPLIFIER SHOULD BE DONE AT CONNECTOR J1. SEE A2 AMPLIFIER AND A3 BIAS BOARD TROUBLESHOOTING FOR MORE INFORMATION.

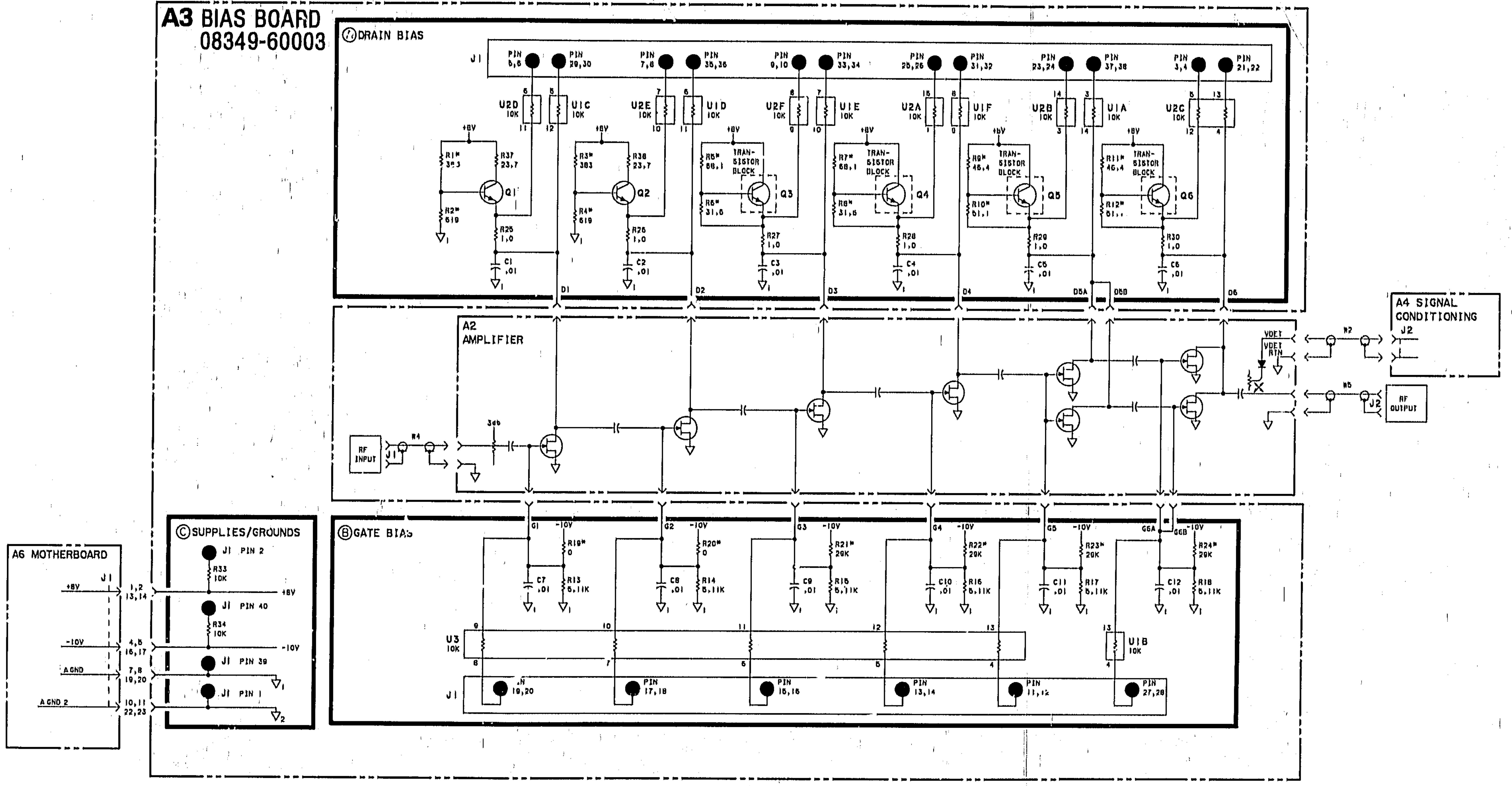


Figure 8-15. A2 Amplifier/A3 Bias Board, Schematic Diagram

A4 SIGNAL CONDITIONING BOARD, CIRCUIT DESCRIPTION

The two output signals generated by the signal conditioning board are VDISP and DET OUT. VDISP is used by the A1 display board to drive the POWER LEVEL display which displays the HP 8349A's RF output in dBm. DET OUT is connected directly to a rear panel BNC **(DETECTOR OUTPUT)**, which can be used to drive the external automatic leveling control circuit (ALC) of an RF source in order to level the HP 8349A's RF output.

VDET from the A2 amplifier is split into two paths on the signal conditioning board. The first path is to the Detector Output (Block E) where VDET is divided by two, buffered, and then sent to the rear panel. The second path is through a scaling circuit, a dual slope logger, a gain and temperature compensation circuit, and finally a peak detector circuit. The resultant signal, VDISP, is proportional to the RF output.

A – SCALING

U2 senses the detector voltage, VDET, differentially inverts VDET, and divides it by three. This is done to set the output (TP1) within the range of the Dual Slope Logger.

B – DUAL SLOPE LOGGER

R14, 0 DBM ADJ, adjusts the input of the logger to match the detector diode's sensitivity in the "square" law region. CR1 clamps the positive output voltage of U3 to 0.3V to prevent destructive reverse base-to-emitter voltages on the logging transistors.

Q3 and Q4 are configured in adjustable current source circuits which generate Ib1 and Ib2 (see Log Converter Description below). Q5 is also configured in a current source circuit which sets the zero output voltage of the circuit. This current is set so that an output voltage of zero volts equals an output power of 0 dBm.

Log Converter Description

Diode detectors characteristically exhibit two distinct regions of operation. At low power levels (<0 dBm), the detectors are in their "square law region". In this region, the detector's output voltage is proportional to RF power. At high power levels, the detector output voltage is proportional to the square root of the RF power. The purpose of the log converter is to convert the detector's output voltage into a dc voltage which corresponds to RF power in dBm. For the log converter to accomplish this, the log converter outputs, over its entire range, a voltage proportional to the logarithm of the input voltage. However, when the detector is operating in its "linear" region, the log converter's gain is twice that of when the detector is operating in its "square law" region. This doubling of gain in the "linear" region ensures that the log converter output is logarithmically related to its input over the entire range.

Figure 8-16 illustrates a simplified single slope log converter. The "log" function is accomplished by Q2a using the transistor characteristic that the collector current is the exponential of the base-to-emitter voltage. U3 amplifies the detector voltage, sinking the collector current of Q2a until it equals the input current developed by Vin across R7. Q2a's emitter voltage is then the log of the input voltage which passes through Q2b (wired as a diode) to the output.

To implement a "dual-slope" log converter, a second pair of transistors with bias currents is added as in Figure 8-17. Bias currents Ib1 and Ib2 are constant and nearly equal. Q2a and Q2b carry the logging current Iin, and Q1a and Q1b carry Ib1 and Ib2. For low power levels (square law region) assume Iin << Ib1 and Io (offset current) << Ib2. Q1a and Q1b are then carrying essentially identical currents and their base-to-emitter voltages are identical. Also, the emitter of Q2a is at the same voltage as the emitter of Q2b and the circuit acts like the single-slope logger of Figure 8-16. For high power levels (linear region), Iin >> Ib1. Q2a and Q1a now carry the same current, Iin (Ib1 can be ignored), and the base voltage of Q1a varies twice as much as the emitter of Q2a. Thus, the gain of the logger is doubled when the detector is in its linear region, and the log converter outputs a voltage proportional to detected RF power over a wide range of power levels.

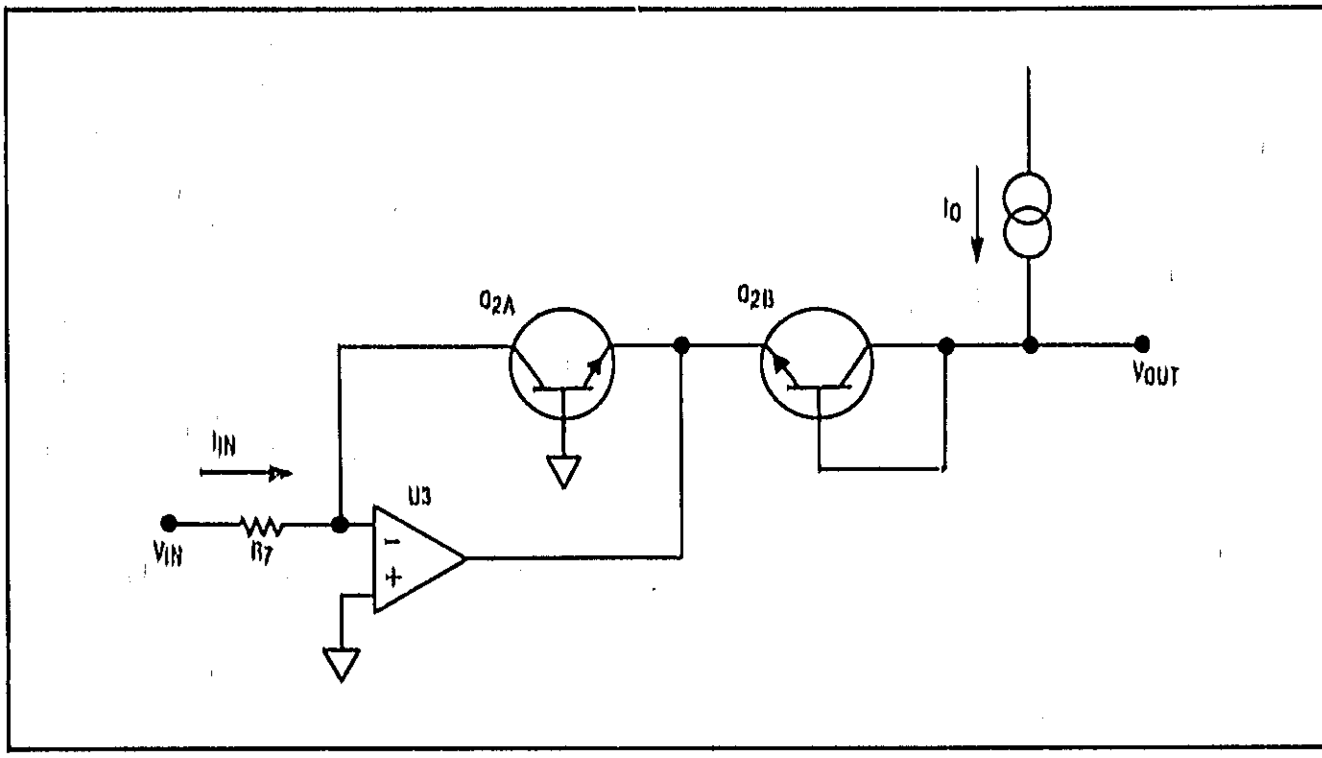


Figure 8-16. Single Slope Log Converter Diagram

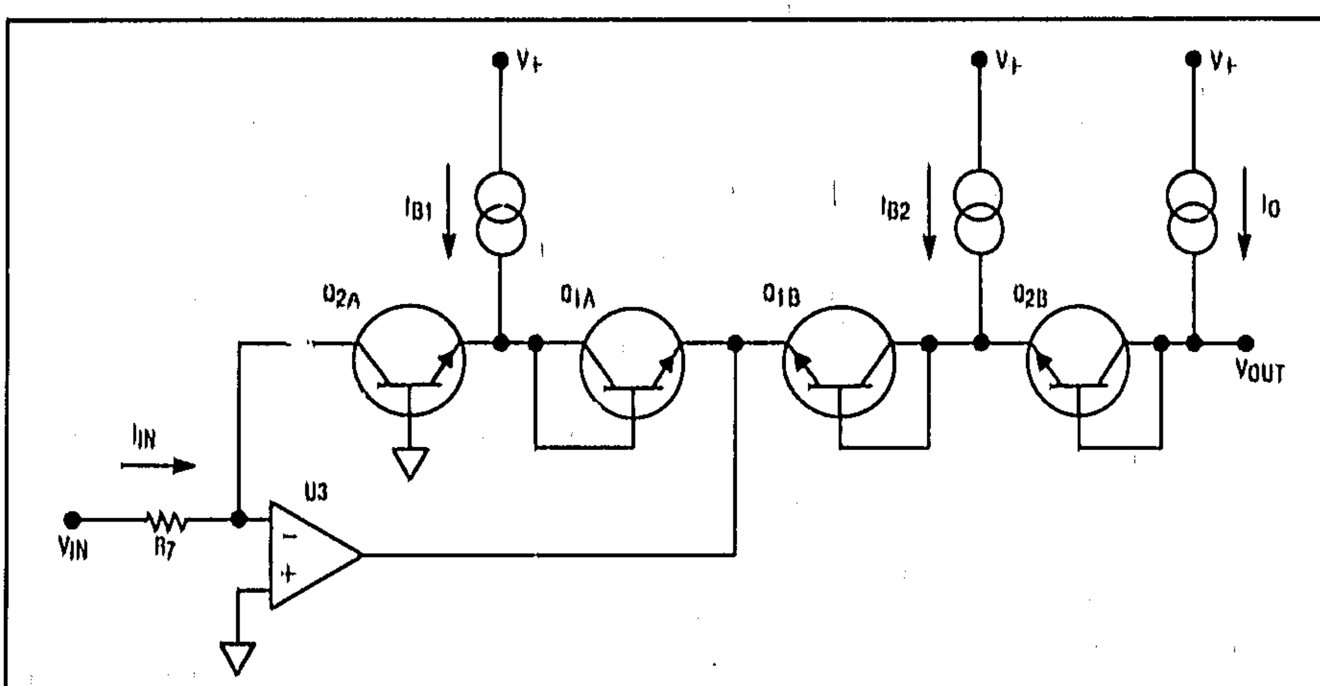


Figure 8-17. Dual Slope Log Converter Diagram

C – TEMPERATURE COMPENSATION/AMPLIFIER

U4 buffers the high impedance output of the Dual Slope Logger and has a temperature sensitive gain to compensate for the temperature drift of the logger. A gain stage U5 follows the temperature compensation stage to raise the output voltage (TP3) to 250 mV/dBm. CR2 and R51 clamp the negative output voltage of U5 to −6V to prevent U5 from saturating when the output of U4 (TP2) is zero volts. R22 (10 DBM ADJ) adjusts the gain of U5 to obtain the 250 mV/DBM output at TP3.

D – PEAK DETECTOR

The Peak Detector is incorporated onto this assembly to maintain a constant display of peak RF power on the front panel POWER LEVEL display during square wave modulation of the RF input. It also maintains a constant display during the RF source's retrace and bandswitch points if the HP 8349A's rear panel POS Z BLANK connector is connected to the RF source's positive z-axis blanking output.

When the input voltage of U6 is higher than the voltage across C1, the output of U6 goes high, turning Q6 on and charging up C1. When the voltage across C1 equals the input voltage, the output of U6 goes low, turning Q6 off. When the input voltage goes lower than the voltage across C1, the loop stays open until the input again rises above the output.

CR4 is a low leakage diode which minimizes leakage current. R27 determines the decay rate of the peak detector (discharge time of C1) and can be switched in or out of the circuit by the Display Hold circuitry. U7 is set up as a buffer and has high slew rate and low input current to minimize the leakage and improve the response of the circuit. The Guard Trace is connected to the negative input of U7 to keep its potential the same as C1. This minimizes the leakage of C1 when R27 is switched out of the circuit.

The Display Hold circuitry is used to maintain a constant display on the front panel POWER LEVEL display during retrace and bandswitch points of an RF source (only if POS Z BLANK is connected). With zero volts or no connection at the HP 8349A's rear panel POS Z BLANK BNC, Q8 is forward biased, FET switch Q7 is closed, and R27 is in the circuit. This allows C1 to discharge through R27. With +5V at the POS Z BLANK input, Q8 is reversed biased, Q7 is open, and R27 is out of the circuit. This reduces the decay rate of C1 and maintains a stable POWER LEVEL display.

A4 SIGNAL CONDITIONING BOARD, TROUBLESHOOTING

Description

In this troubleshooting procedure, the A4 signal conditioning board is isolated from the A1 display board by disconnecting ribbon cable W1 from the motherboard. The voltage between VDET and VDET RTN is set to 300 mV and then various points on the A4 board are probed to determine if the dc voltage at the probed points is correct.

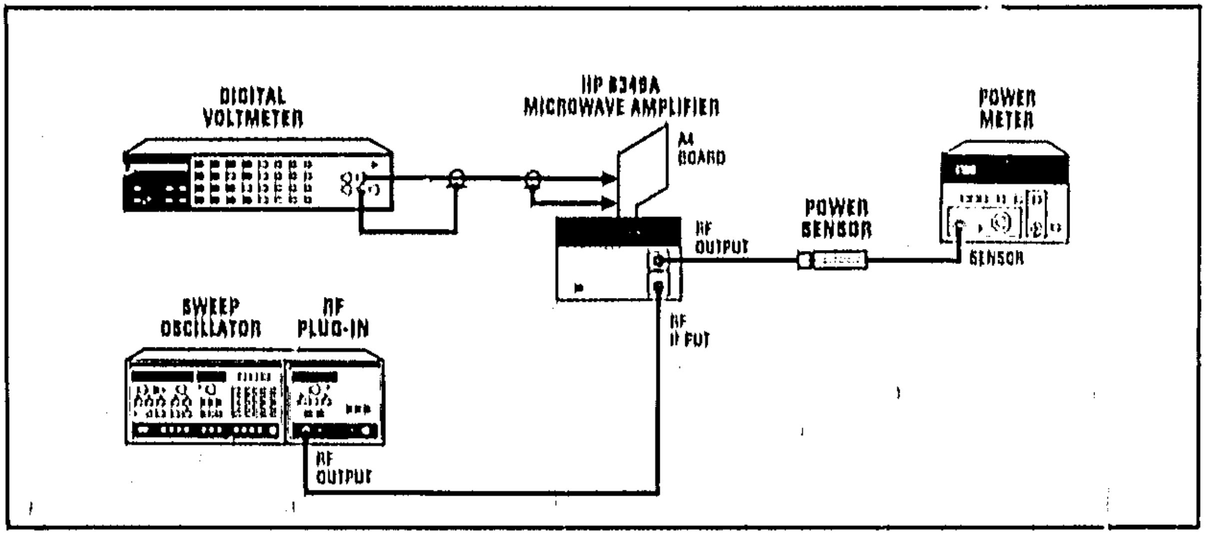


Figure 8-18. Troubleshooting Test Setup

Equipment Required

Sweep Oscillator	HP 8350B
RF Plug-in	HP 83595A
Digital Voltmeter	HP 3456A
Power Meter	HP 436A
Power Sensor	HP 8481A
Extender Board	HP P/N 08349-60023

Procedure

1. Remove top and bottom covers from the HP 8349A. Disconnect W1 from the motherboard. Before switching the HP 8349A on, make sure that W1 is not making contact with anything.

2. Connect the equipment as shown in Figure 8-18 (refer to the Service Position Installation Procedure for extending the A4 board). Set the sweep oscillator to CW, 10.0 GHz, internal leveling, and a power level of −5.0 dBm.

3. Press the HP 8349A LINE switch on and allow the equipment to warm up for 30 minutes.

4. Connect the DVM's positive lead to VDET at R5 and ground lead to VDET RTN at R6 (refer to the Component Location Diagram and Schematic for the A4 board).

5. Adjust the output power of the RF plug-in until the DVM reads −300 mV ±1 mV.

6. Connect the DVM to the rear panel DETECTOR OUTPUT. The DVM should measure −150 mV ±5 mV (one-half the voltage set in step 5).

7. Connect the DVM's ground lead to TP5 (A GND 2). Connect the DVM's positive lead TP1. The DVM should read 100 mV ±5 mV (one-third of the voltage set in step 5).

8. Calibrate the power meter and then adjust the power of the RF plug-in until the power meter reads 20.00 dBm.

9. Probe the points listed in Table 8-2 and verify that the measured voltages correspond to voltages given in the table. Note that the voltages at the points probed are affected by the adjustments on the A4 board. Refer to paragraph 5-11, Displayed Power Level Adjustments, if the measured voltages do not correspond to the voltages given.

Table 8-2. A4 Signal Conditioning Board Troubleshooting Voltages

Measurement Point	Typical Voltage
A4U3 pin 6	≥8V
A4U4 pin 3	−110 mV ±10 mV
A4TP2	−220 mV ±20 mV
A4TP3	4.7V ±0.4V
A4TP4	A4TP3 voltage

Service Position Installation Procedure

1. Remove the four screws that secure the A4 signal conditioning board to the HP 8349A's center support.

2. Using one of the screws removed in step 1, attach the extender bracket, HP P/N 08349-00011, to the standoff as shown in Figure 8-19.

3. Connect extender board, HP P/N 08349-60023, to the A4 board and then connect the extender board and A4 board to the motherboard.

4. Using one of the screws and two of the fiber washers removed in step 1, attach the A4 board to the extender bracket as shown in Figure 8-19. One fiber washer should be placed between the head of the screw and the A4 board and the other one should be between the extender bracket and the A4 board to ensure that the bracket or screw is not shorted to the board.

5. Reverse this procedure for disassembly.

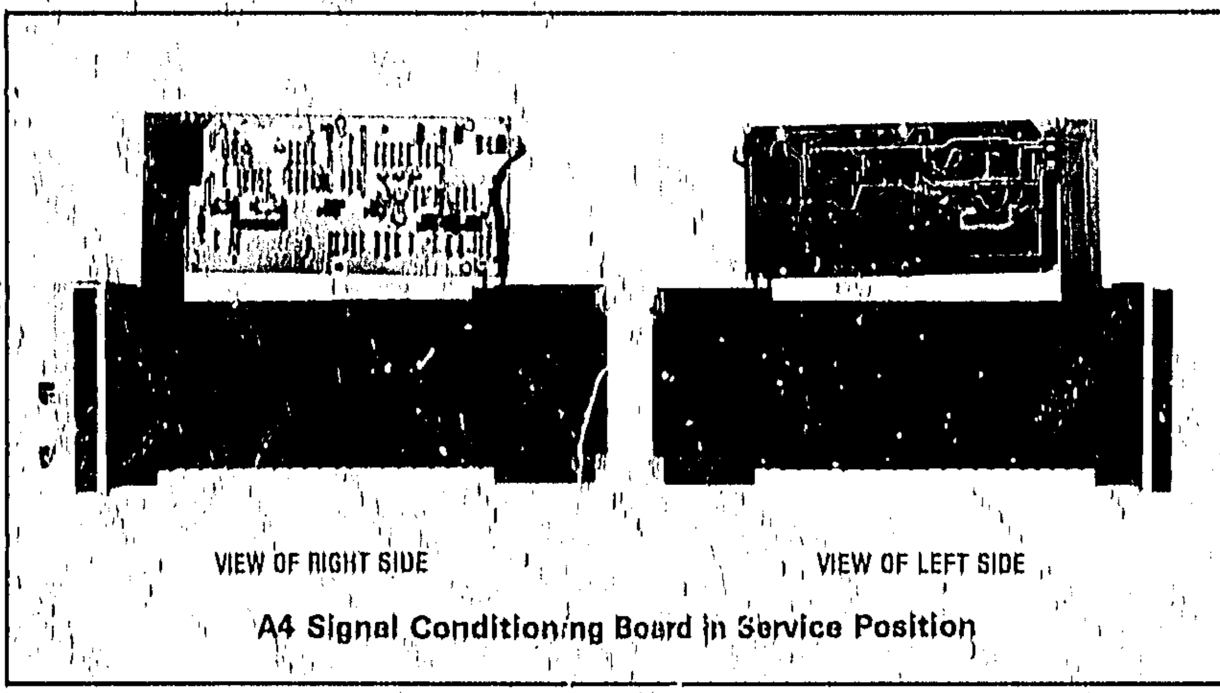


Figure 8-19. Service Position Installation Diagrams

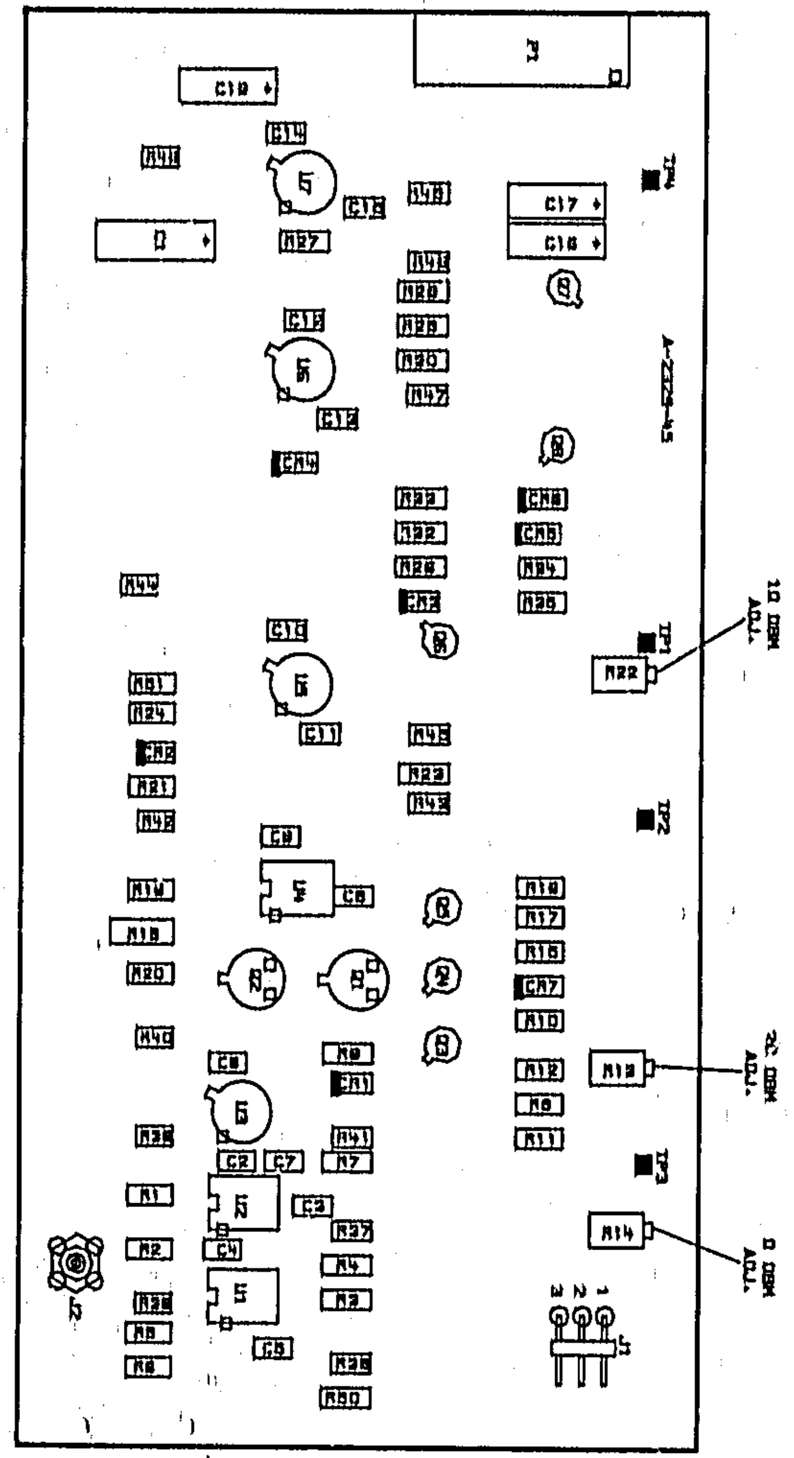


Figure 8-20. A4 Signal Conditioning Board, Component Locations

NOTE

UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

Figure 8-21. A4 Signal Conditioning Board, Schematic Diagram

A5 REGULATOR BOARD, CIRCUIT DESCRIPTION

NOTE

The A5 regulator board schematic documents the power line module, front panel line switch, and transformer, in addition to the A5 assembly itself. The following section applies to chassis mounted parts (not part of A5) associated with the line power circuits.

FL1 POWER LINE MODULE, S1 LINE SWITCH, T1 TRANSFORMER

The Power Line Module includes the primary fuse, line filter, and voltage selector. The fuse, F1, protects the primary side of the transformer against drawing too much current. F1 is accessible from the rear panel. The line filter reduces noise and transients on the power line.

The front panel LINE on/off switch, S1, controls power to the transformer primary. The LINE switch is a plunger style switch with the pushbutton on the front panel and a plunger running back to the rear panel where the switch is located. This type of switch is used to keep the line voltages at the rear panel.

The voltage selector in the Power Line Module configures the instrument to run on 100Vac, 120Vac, 220Vac, or 240Vac line power. The position of the voltage selector determines which of the various taps of the transformer primary windings are switched in or out. For the procedure on selecting the line voltage and fuse, see Figure 2-1, paragraph 2-8.

NOTE

The following sections apply to the A5 regulator board assembly. All reference designators are assumed to be part of A5.

The A5 regulator board provides the regulated power supply voltages for all assemblies in the instrument. There are four independent regulated voltages in all.

NOTE

All four rectifier circuits on the A5 regulator board assembly are of the same design. While component values change slightly for different voltages, and diode and capacitor polarities change for different polarities, the circuits are essentially identical. The +20V Rectifier is described in detail. For other rectifier description details, refer back to the +20V Rectifier description.

A– +20V RECTIFIER

CR9, CR10, CR11, and CR12 form a full-wave rectifier for the +20Vdc supply. C3 filters the full-wave ripple from the rectifier. C22 is a low impedance path for high frequency pulses. The +20V Rectifier output is nominally +29Vdc before regulation.

B – OVER VOLTAGE PROTECTION

The Over Voltage Protection blows line fuse F1 to protect the instrument from excessive line voltages. If the voltage from the +20V Rectifier exceeds +44.2 V, Zener diode VR5 conducts, turning SCR Q5 on through R29. Q5 causes excessive current to flow in the transformer and blows line fuse F1. R34 holds Q5 off unless VR5 conducts. C28 prevents fast transients or noise from firing Q5.

C – +8V RECTIFIER
D – +5V RECTIFIER
E – −10V RECTIFIER

The +8V Rectifier, +5V Rectifier, and −10V Rectifier provide the unregulated voltages for the +8V Regulator, +5V Regulator, and −10V Regulator respectively. Their nominal output voltages are as follows: +8V Rectifier – +13V, +5V Rectifier – +13V, and −10V Rectifier – −14V.

NOTE

All four regulator circuits on the A5 regulator board assembly are of the same design. While component values change slightly for different voltages, and diode and capacitor polarities change for different polarities, the circuits are essentially identical. The +20V Regulator is described in detail. For other regulator description details, refer back to the +20V Regulator description.

F – +20V REGULATOR

The +20V Regulator regulates the +20Vdc from the +20V Rectifier to produce the +20Vdc power supply voltage. U3 is an adjustable three terminal regulator. Its output voltage is nominally 1.25Vdc above the voltage on reference terminal U3 pin 1. R11 and R12 determine the regulated output voltage. C17 improves power line ripple and noise rejection, and also causes the power supply voltage to rise slowly and without overshoot. Input bypass capacitor C9 reduces high frequency noise or transients into the regulator. C10 reduces noise at the output. CR21 prevents the regulator's output voltage from becoming >0.7V above the input voltage. CR22 prevents the adjustable terminal voltage from becoming >0.7V above the regulator's output voltage. CR27 protects the regulator from negative voltages at the output.

The Crowbar circuit provides over voltage protection for circuits driven by the +20V Regulator if U3 or CR21 short. If the output voltage rises above 23.7Vdc, Zener diode VR3 conducts and fires SCR Q3 through R27. This shorts the output to ground and blows fuse F3 (Block A), shutting down the power supply. R32 holds Q3 off unless VR3 conducts. C26 prevents fast transients or noise from firing Q3.

Test point TP3 (+20V) is available to monitor the output voltage. R23 limits the current if the test point is shorted. LED DS3 turns on when the output voltage is about 16V or greater. VR6 sets the voltage at which DS3 lights. R3 limits the current through DS3. Note that the LED and test point are physically located near each other on the board.

G – +8V REGULATOR

The +8V Regulator provides the +8Vdc regulated power supply voltage for the instrument. Besides the change in voltage, there are only three differences between the +8V Regulator and the +20V Regulator. The differences are as follows. In the event that U1 or CR17 short, fuse A5F1 will blow, shutting down this supply. When troubleshooting the +8V power supply, this fuse may be removed to isolate the +8V Rectifier from the +8V Regulator. R6, R35, and R7 determine the regulated output voltage. R35 (+8V ADJ) allows adjustment of the regulated output to exactly +8V. LED DS1 turns on when the output voltage is approximately 2.5V or greater.

H – +5V REGULATOR

The +5V Regulator provides the +5Vdc power supply voltage for the instrument. Besides the change in voltage, there are only two differences between this regulator and the +20V Regulator. The differences are as follows. In the event that U2 or CR19 short, fuse F2 will blow, shutting down this supply. When troubleshooting the +5V power supply, this fuse may be removed to isolate the +5V Rectifier from the +5V Regulator. LED DS2 turns on when the output voltage is approximately 2.0V or greater.

I – −10V REGULATOR

The −10V Regulator provides the −10Vdc power supply voltage for the instrument. Besides the change in voltage and polarity, there are only two differences between this regulator and the +20V Regulator. The differences are as follows. R13, R36, and R14 determine the regulated output voltage. R36 (−10V ADJ) allows adjustment of the regulated output to exactly −10V. LED DS4 turns on when the output voltage is approximately 3.2V or greater.

J – GROUNDS

A GND (analog ground) and D GND (digital ground) are referenced to chassis ground through 10 ohm resistors R19 and R20 respectively. The chassis ground connection is made through the standoffs and screws which mount the A5 assembly to the Regulator Block and the Regulator Block to the heat sink. When troubleshooting the A5 regulator board, A2 amplifier assembly, or A3 bias assembly, it is critical that chassis ground be connected.

A GND (analog ground) and A GND 2 are used as the ground for the +20V, +8V, and −10V supplies. These supplies power all the analog circuitry in the instrument. D GND (digital ground) and D GND 4 are used as the ground for the +5V supply which powers all the digital circuitry. Both A GND and D GND are used for high current applications while A GND 2 and D GND 4 are used for low current. Having independent paths for several grounds improves power supply regulation.

A5 REGULATOR BOARD, TROUBLESHOOTING

NOTE

The A5 regulator board schematic documents the power line module, front panel line switch, and transformer, in addition to the A5 assembly itself.

NOTE

While troubleshooting the A5 regulator board, the chassis ground connection must be maintained. If this assembly needs to be removed from the instrument for troubleshooting, it should be placed into its service position. Refer to the Service Position Installation Procedure below.

Basic Checks

Check that the rear panel line voltage selector is set for the correct line voltage. Verify that line fuse F1 is not blown and that it is correct for the line voltage selected. Check all fuses on the A5 regulator board.

Transformer

Remove transformer secondary leads connector (P1) from the A5 regulator board. Probe the following pins and verify that the corresponding signal is present.

P1 pins 5 and 6 - ±20V p-p
P1 pins 1 and 2 - ±8V p-p
P1 pins 3 and 4 - ±5V p-p
P1 pins 7 and 8 - ±10V p-p

Rectifiers

Check rectifier outputs for the required voltages. If the voltages are missing or incorrect, suspect the rectifiers. A5F1 and F2 may be removed to isolate the +8V Rectifier and the +5V Rectifier, respectively, from the regulators for troubleshooting. Check that the Over Voltage Protection is not firing.

Regulators

Check that the voltage difference between the output and regulation (REG) terminals is approximately 1.25V. These terminals are available at feedthrough holes (not test points) on the A5 regulator board. Verify that Crowbar circuitry has not fired.

To eliminate the possibility of other assemblies in the HP 8349A loading down the supply voltages, remove major assemblies from their connectors, or disconnect the A5 regulator board from A6J3 (physical connection of A5 board to heat sink to rear panel must be maintained to ensure chassis ground connection).

Table 8-3. Power Supply Voltages and Tolerances

Block	Power Supply Output	Nominal Voltage (V)	Allowable Range (V)	Maximum Current Drain (A)	Assemblies Where Used
A	+20V UNREG	29	23–31	—	A5
C	+8V UNREG	13	11–15.7	—	A5
D	+5V UNREG	13	8–11.2	—	A5
E	−10V UNREG	14	12–16.9	—	A5
F	+20V	20	19.9–20.9	0.1	A4, A5
G	+8V	8	7.9–9.3	1.0	A1, A2, A3, A4, A5
H	+5V	5	5–5.6	0.3	A1, A5
I	−10V	−10	9.9–10.6	0.1	A1, A2, A3, A4, A5

Service Position Installation Procedure

1. Turn the HP 8349A LINE switch off and disconnect the line cord.
2. Remove the top and bottom covers (only the rear screw on the top needs to be removed to remove the top cover).
3. Remove the four screws securing the heat sink on which the A5 regulator board is mounted (see Figure 8-22a).
4. Remove the rear two screws securing the heat sink on which the A2 amplifier and A3 bias board are mounted (see Figure 8-22b).
5. Loosen the two screws securing the center support of the HP 8349A (see Figure 8-22c). Slide the rear panel away from the front panel.
6. Disengage the A5 regulator board from the motherboard and disconnect the transformer's secondary leads connector P1 from A5J1. Remove the A5 assembly and heat sink from the instrument.

NOTE

When sliding the rear panel forward in step 7, ensure that the LINE switch is reinserted through the front panel.

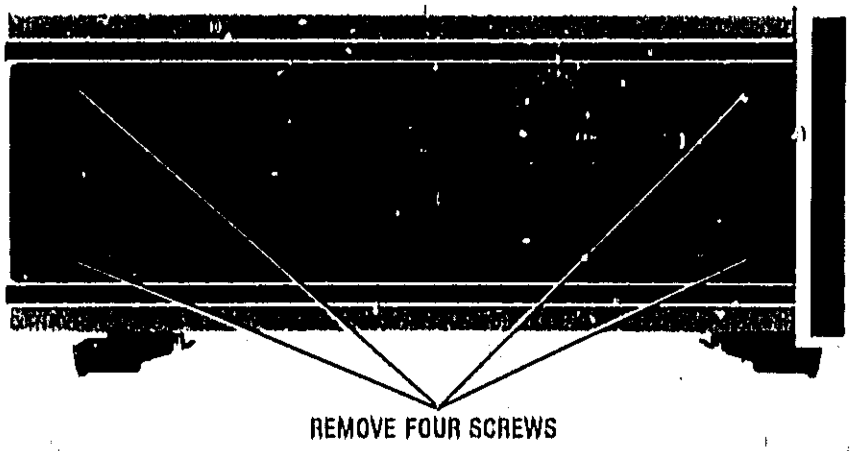
7. Slide the rear panel toward the front panel and reinstall the rear two screws which secure the heat sink on which the A2 and A3 assemblies are mounted. Securing this heat sink to the rear panel reconnects chassis ground.

8. Connect the extender board, HP P/N 08349-60023, to A6J3.

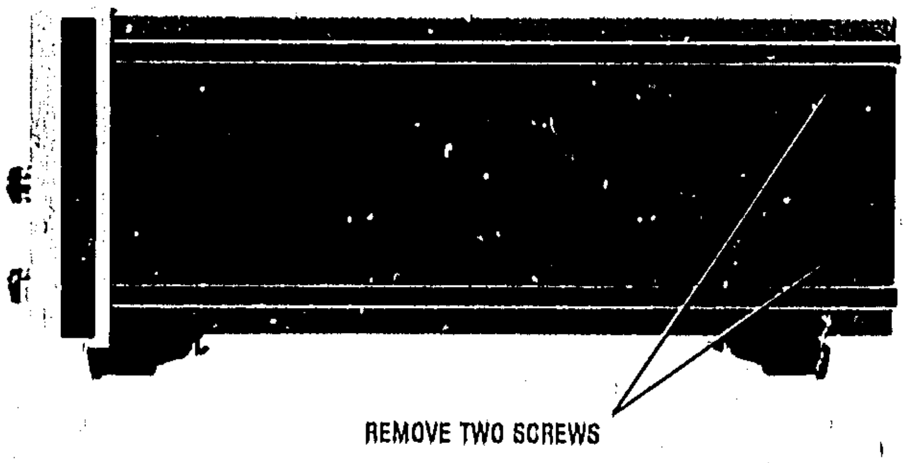
9. Mount the extender bracket (HP P/N 08349-00005) to the front panel using two of the screws removed in step 3. Connect the A5 regulator board to the extender board installed in step 8 and mount the heat sink to the extender bracket (see Figure 8-22d).

10. Reinstall the transformer's secondary leads connector P1 to A5J1. Ensure the LINE switch is off before reconnecting the LINE cord.

11. Reverse this procedure when reinstalling the A5 regulator board and heat sink.

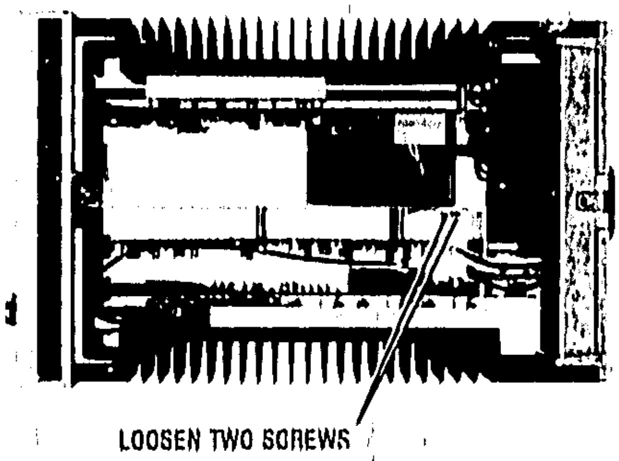


a) HP 8349A - Left Side

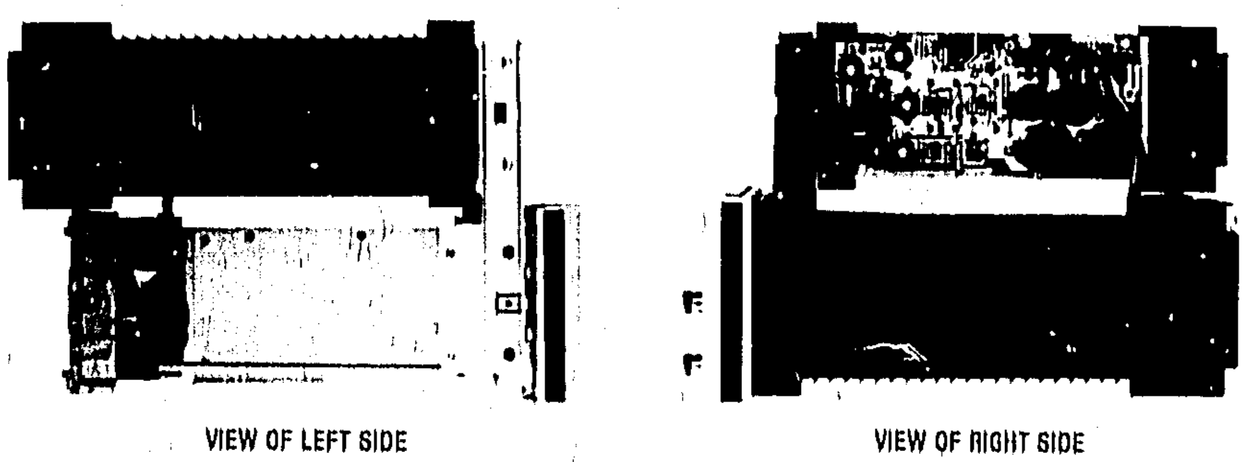


b) HP 8349A - Right Side

Figure 8-22. Service Position Installation Diagrams (1 of 2)



c) HP 8349A - Top View



d) A5 Regulator Board and Heat Sink in Service Position

Figure 8-22. Service Position Installation Diagrams (2 of 2)

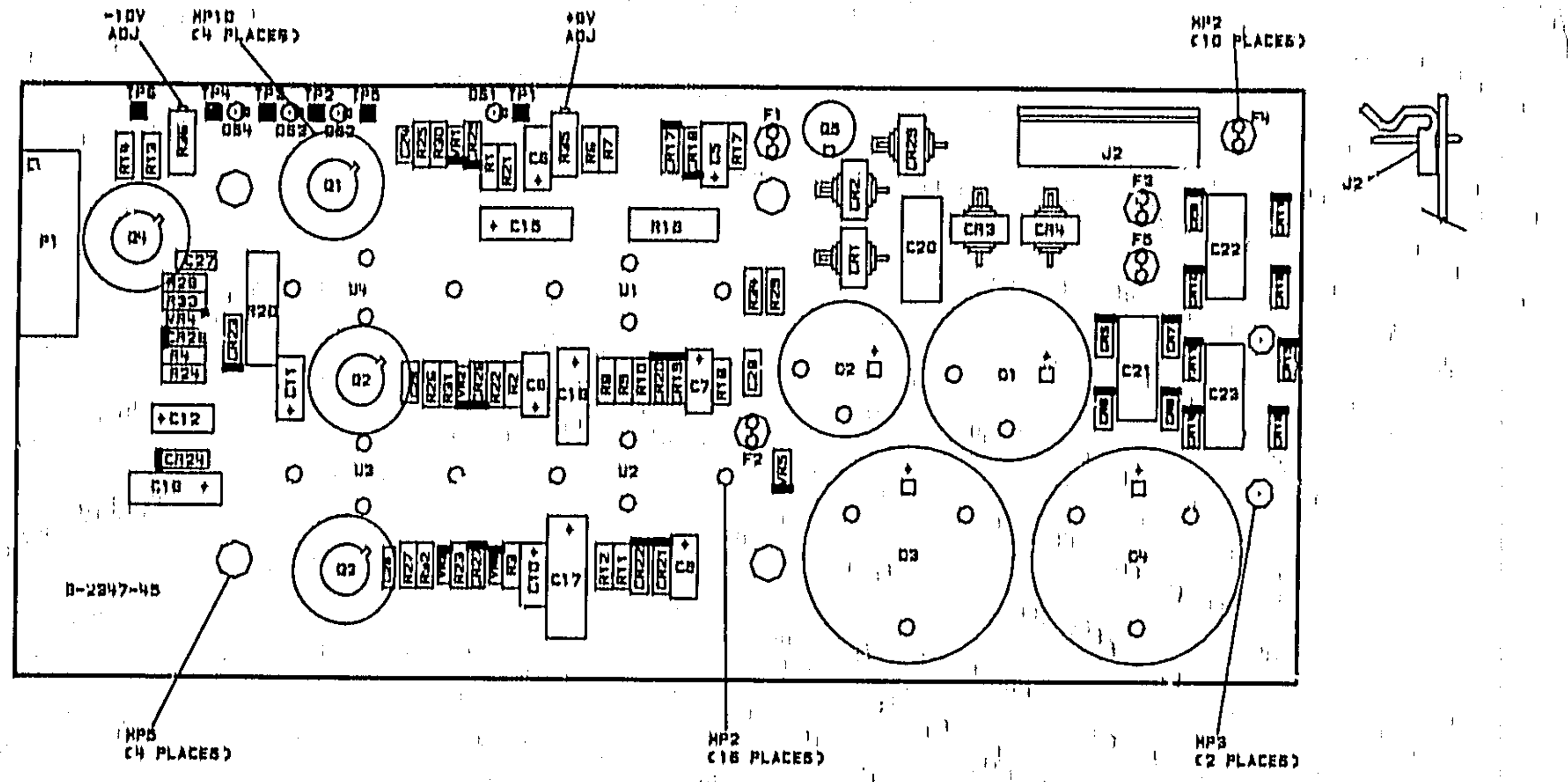
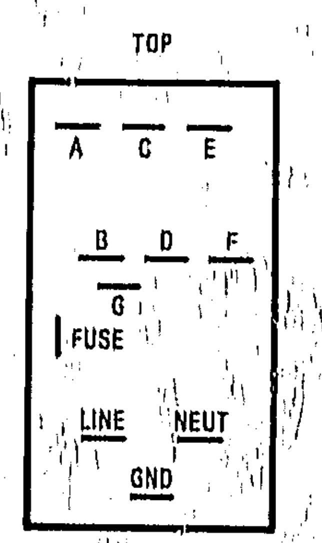


Figure 8-23. A5 Regulator Board, Component Locations

NOTES

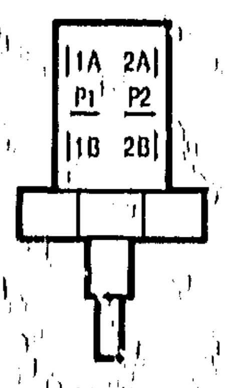
1. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
2. CHASSIS GROUND CONNECTION SHOWN IN BLOCK J IS MADE THROUGH THE MOUNTING SCREWS AND STANDOFFS WHICH SECURE THE A5 ASSEMBLY TO THE TRANSISTOR BLOCK.
3. FL1 POWER LINE MODULE PIN CONFIGURATION:

FRONT VIEW



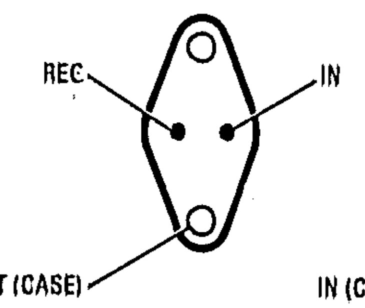
4. S1 LINE SWITCH PIN CONFIGURATION:

TOP VIEW

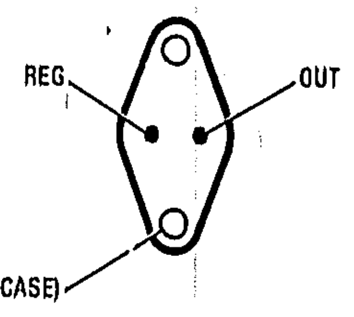


5. U1, U2, U3, AND U4 ARE MOUNTED ON THE REGULATOR BLOCK. THE CASE OF EACH DEVICE IS ONE OF THREE ACTIVE TERMINALS. THE CASE AND OTHER TWO PINS CONNECT THROUGH HOLES IN THE REGULATOR BLOCK TO PIN SOCKETS ON THE A5 ASSEMBLY. THE CASE AND OTHER TWO PINS MAY BE PROBED AT THE PIN SOCKETS.

BOTTOM VIEW U1, U2, U3

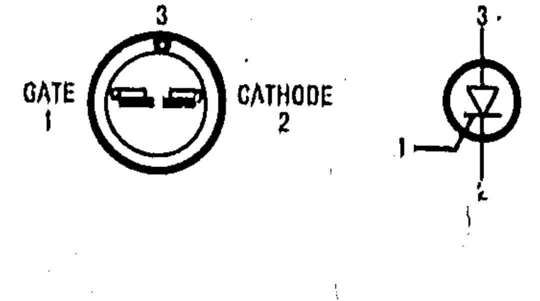


BOTTOM VIEW U4



6. Q1, Q2, Q3, Q4, AND Q5 SCR:

BOTTOM VIEW



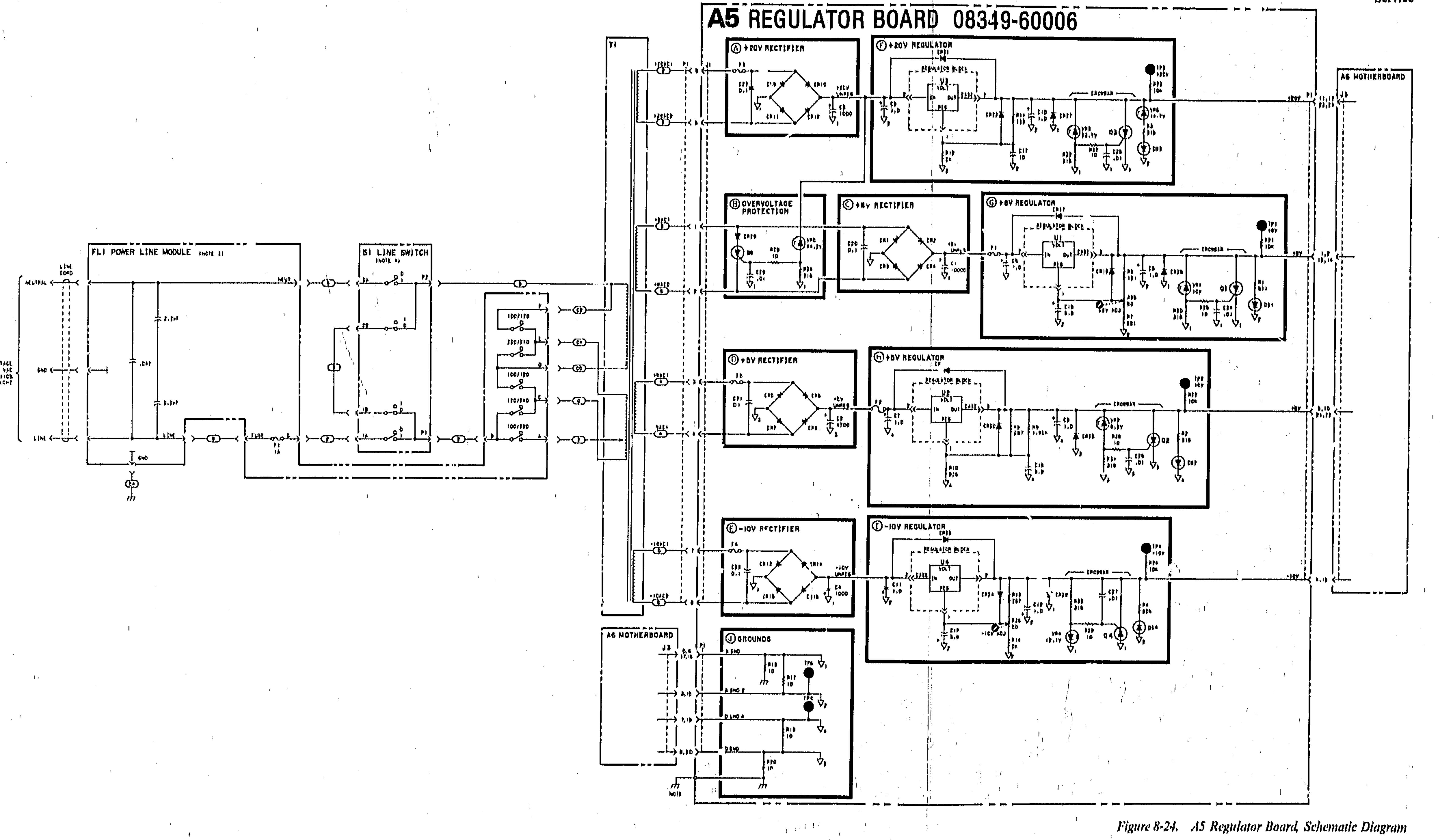


Figure 8-24. A5 Regulator Board, Schematic Diagram

A6 MOTHERBOARD

The A6 motherboard interconnects all the major assemblies in the HP 8349A. Refer to the Overall Block Diagram for a diagram of the connections between the motherboard and the rest of the instrument.

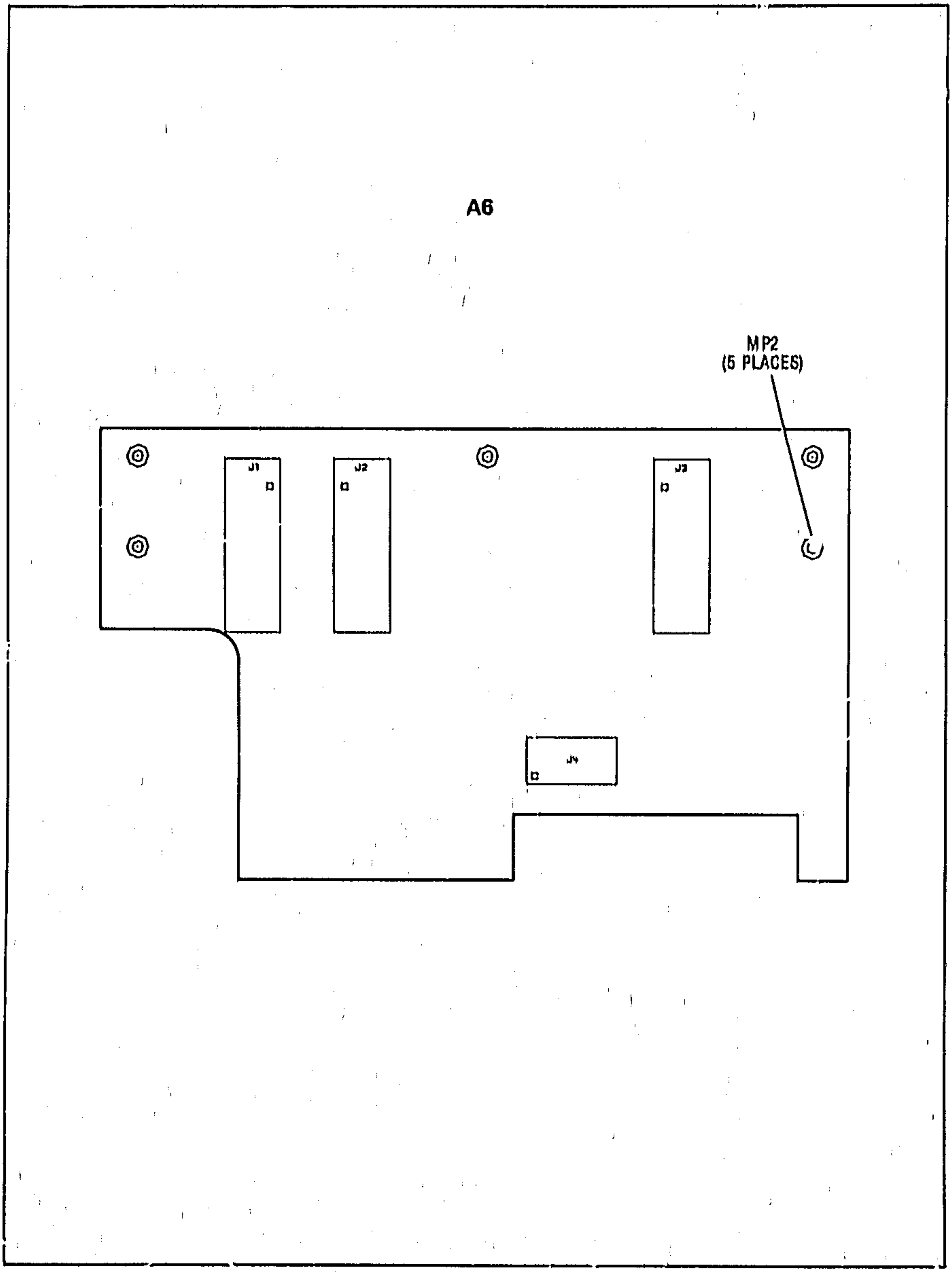


Figure 8-25. A6 Motherboard Component Locations

SERVICE INFORMATION CON'T

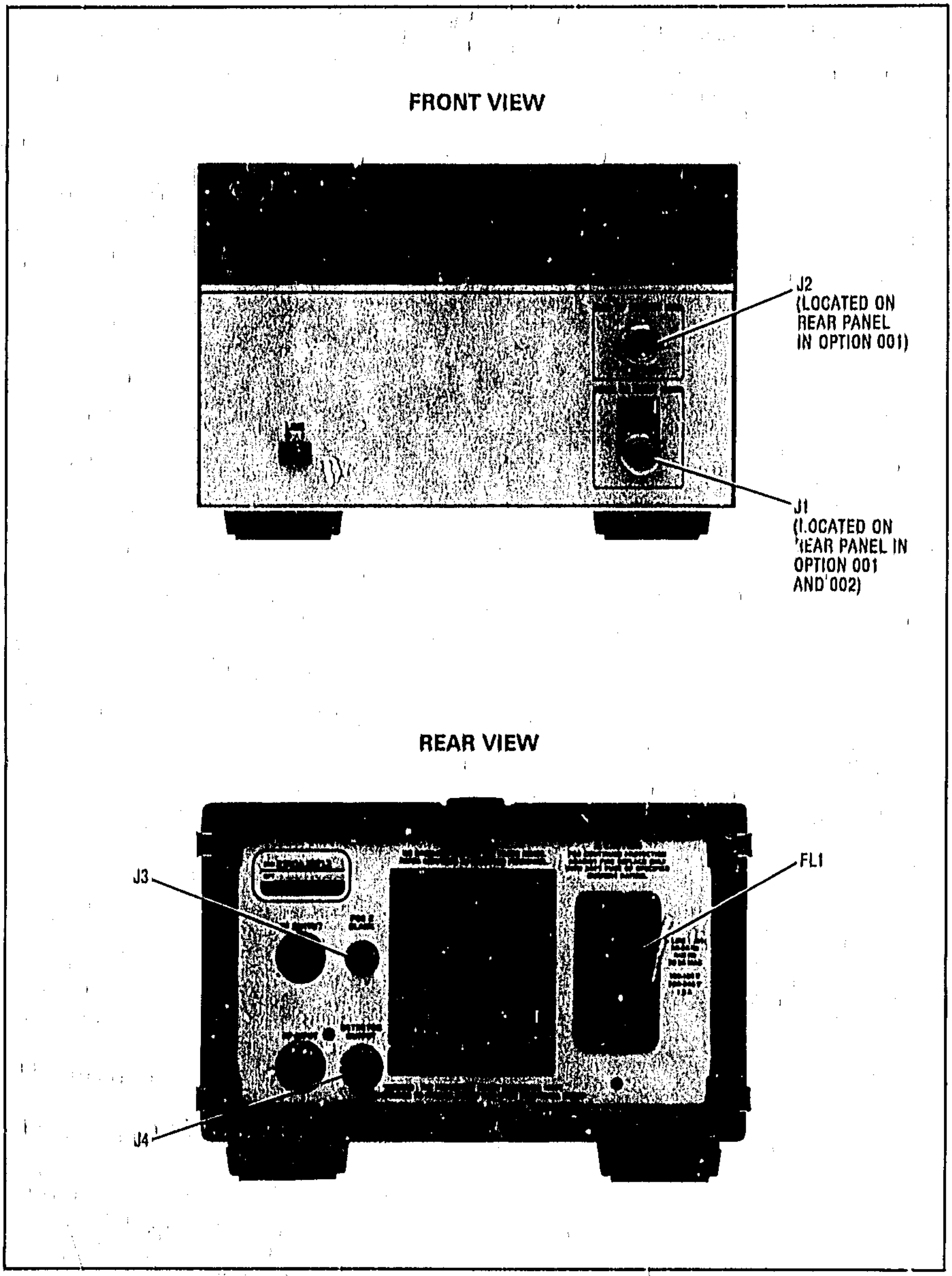
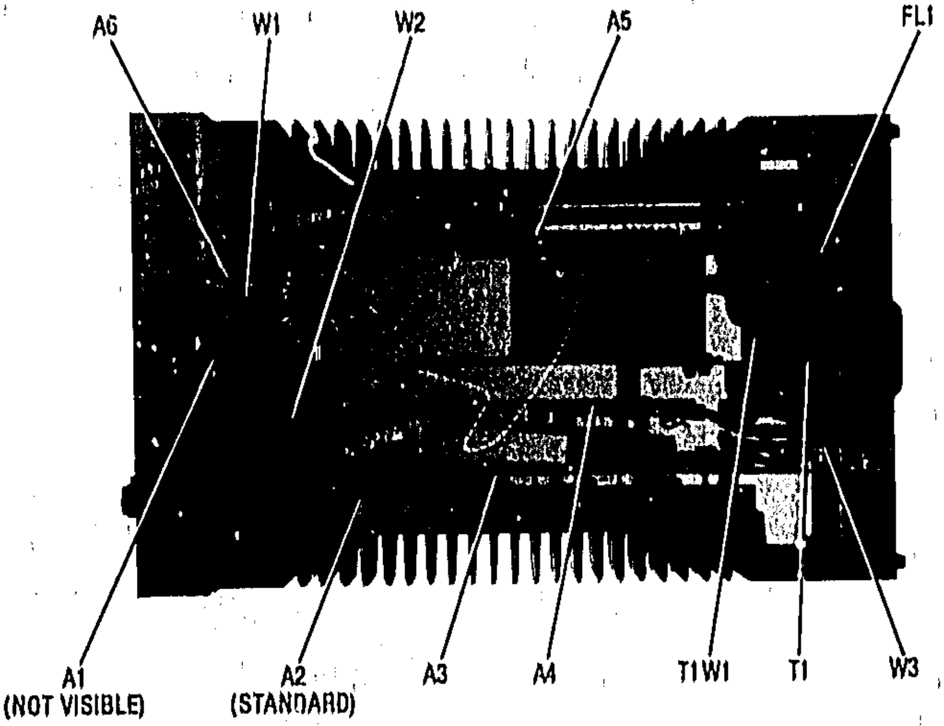


Figure 8-26. Major Assemblies (1 of 3)

TOP VIEW WITHOUT COVERS



BOTTOM VIEW WITHOUT COVERS
(A4 ASSEMBLY REMOVED)

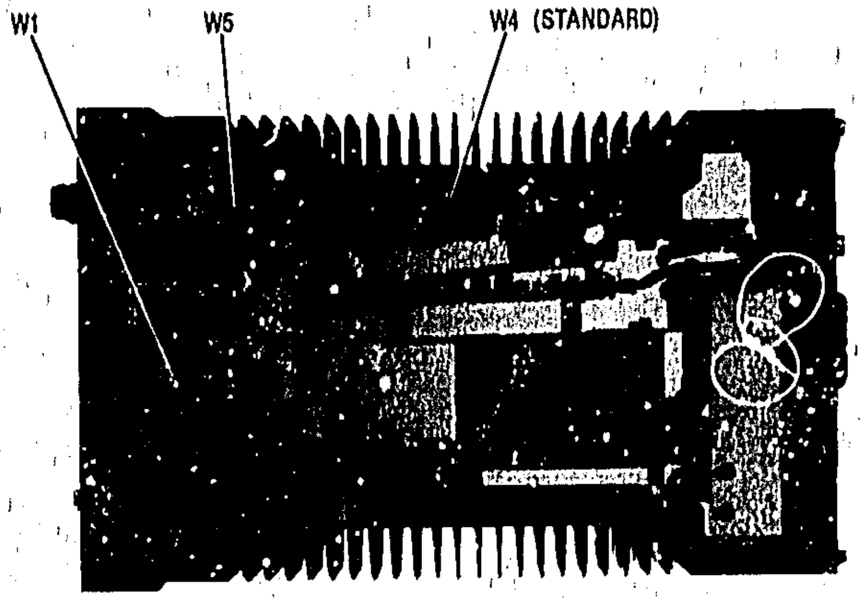


Figure 8-26. Major Assemblies (2 of 3)

INSIDE REAR PANEL

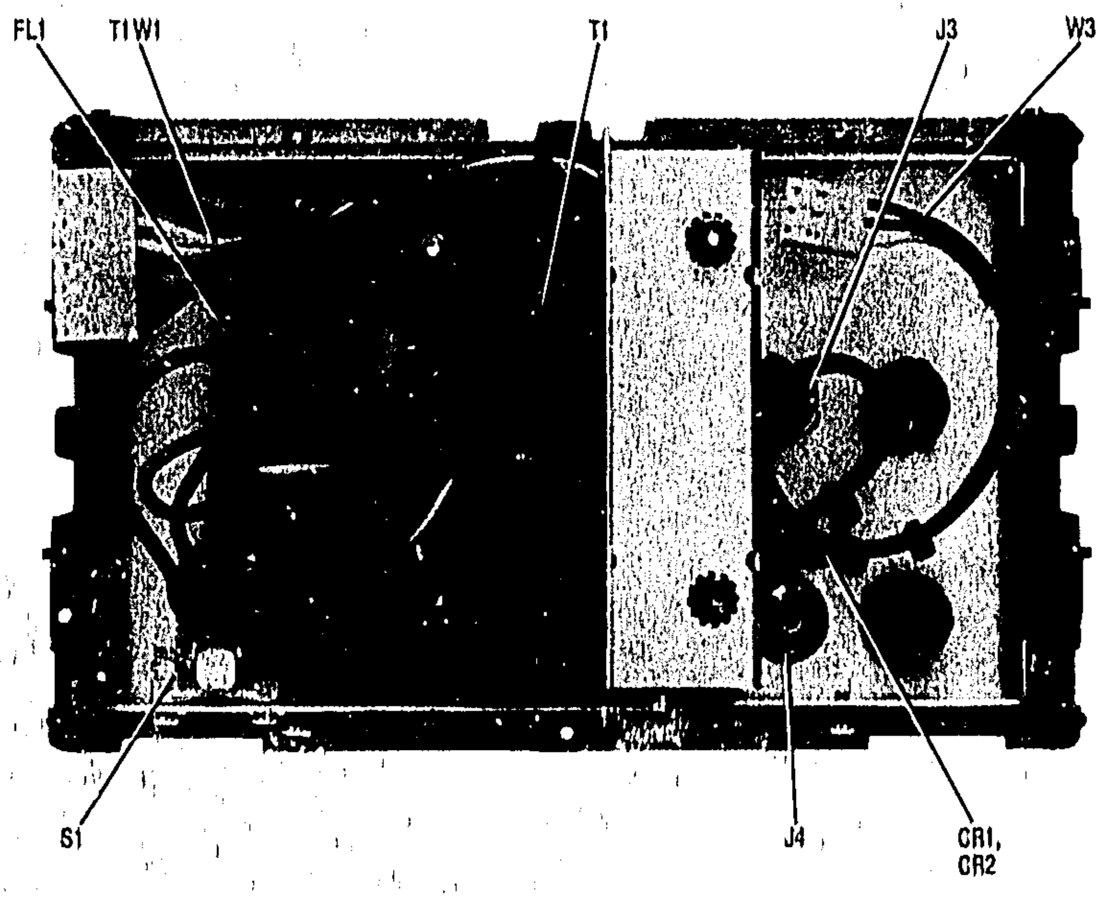


Figure 8-26. Major Assemblies (3 of 3)

MANUAL CHANGES

MANUAL CHANGES

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies, quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

MANUAL IDENTIFICATION

Model Number: 8349A
Date Printed: February 1984
Part Number: 08349-90001

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement, make all ERRATA corrections and all appropriate serial number related changes indicated in the tables below.

● – NEW ITEM

Serial Prefix or Number	Make Manual Changes
2424A	1
2441A	1, 2
● 2512A	1–3

Serial Prefix or Number	Make Manual Changes

HEWLETT PACKARD

20 MARCH 1985
22 pages plus 1 foldout

Printed in U.S.A.

ERRATA

- **Page 1-2, Paragraph 1-22:**
  Replace with the following:
  The HP 8349A is a general purpose, fully self-contained microwave amplifier with a frequency range of 2 to 20 GHz. It delivers a minimum of 100 milliwatts (+20 dBm) of unleveled power and 80 milliwatts (+19 dBm) of leveled power from 2 to 18.6 GHz. From 18.6 to 20 GHz, it delivers a minimum of 50 milliwatts (+17 dBm) of unleveled power and 40 milliwatts (+16 dBm) of leveled power. The amplifier may be used with either a fixed or swept frequency source. Leveled flatness is ±1.25 dB, and minimum small signal gain is 15 dB from 2 to 18.6 GHz and 12 dB from 18.6 to 20 GHz.

- **Page 1-3, Paragraph 1-36:**
  Add the following material:

Manufacturer's Declaration

NOTE

This is to certify that this product meets the radio frequency interference requirements of Directive FTZ 1046/1984. The German Bundespost has been notified that this equipment was put into circulation and has been granted the right to check the product type for compliance with these requirements.

Note: If test and measurement equipment is operated with unshielded cables and/or used for measurements on open set-ups, the user must insure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

Model ______________________

NOTE

Hiermit wird bescheinigt, dass dieses Gerät/System in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Mess- und Testgeräte:

Werden Mess- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Messaufbauten verwendet, so ist vom Betreiber sicherzustellen, dass die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

- **Page 1-4, Table 1-1:**
  Replace the specifications under **Minimum Output Power** with the following:

Frequency Range (GHz)	Input	Output	
		Leveled	Unleveled
2.0 to 18.6	5 dBm (3.2 mW)	19 dBm (80 mW)	20 dBm (100 mW)
18.6 to 20.0	5 dBm (3.2 mW)	16 dBm (40 mW)	17 dBm (50 mW)
2.0 to 20.0	5 dBm (3.2 mW)	16 dBm (40 mW)	17 dBm (50 mW)

ERRATA (Cont'd)

- **Page 1-4, Table 1-1 (Cont'd):**
  Replace the specifications for **Minimum Small Signal Gain** with the following:

Frequency Range (GHz)	Input	Gain
2.0 to 18.6	−5 dBm	15 dB
18.6 to 20.0	−5 dBm	12 dB

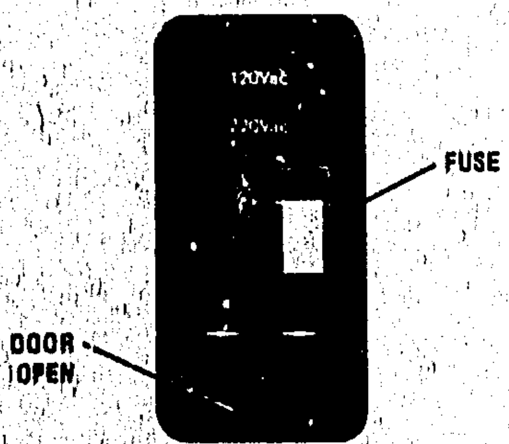
- **Page 2-1, Paragraph 2-9:**
  Replace the line voltage selection instructions given with the following steps:

CAUTION

BEFORE selecting a different line voltage READ all instructions. Improper procedure will result in instrument damage.

1. Determine the ac line voltage.
2. Refer to Figure 2-1. At the instrument's rear panel power line module, pry open the module door to reveal a rotating cam. **Do not rotate the cam in the module.** Remove the cam from the module, select the required voltage and replace it before power on. Note that the available line voltage must be within ± 10% of the line voltage selected on the rotating cam. If it is not, you must use an autotransformer between the ac source and the HP 8349A.
3. The rated fuse for all ac line voltage is 1 ampere.

- **Page 2-2, Figure 2-1:**
  Replace Figure 2-1 with the following *Figure 2-1, Line Voltage Selection with Power Module Rotating Cam (ERRATA)*



Replacement of Fuse

1. Pry open POWER MODULE cover door.
2. Pull out grey carrier.
3. Insert fuse of proper rating.
4. Replace carrier in POWER MODULE.

Selection of Operating Voltage

1. Pry open POWER MODULE cover door.
2. Remove the cam from the module.
3. Rotate cam to desired voltage so that the voltage is visible through window when door is closed.
4. Insert cam back into the module.
5. Close cover door.

Figure 2-1. Line Voltage Selection with Power Module Rotating Cam (ERRATA)

ERRATA (Cont'd)

- Page 3-6, Figure 3-3:
  Change "20 GHz" to "18.6 GHz."

- Page 4-2, Paragraph 4-10:
  Under "**OUTPUT POWER, GAIN, AND FLATNESS**" replace all of the information with Paragraph 4-10, "**OUTPUT POWER, GAIN, AND FLATNESS (ERRATA)** contained in this change sheet.

Page 4-9, Paragraph 4-11:
  Step 2: Change "20 GHz" to "18.6 GHz."

- Page 4-19/4-20, Table 4-3:
  Replace Table 4-3 with *Table 4-3. HP 8349A Test Record (ERRATA)* contained in this change sheet.

Page 6-7, Table 6-3:
  Change the reference designator A4R19 to A4RT1.

- Page 6-9, Table 6-3:
  Change A5MP3 to HP and Mfr. Part Number 0380-1718, CD5 (Recommended Replacement).

Page 6-10, Table 6-3:
  Change A5VR2 to HP and Mfr. Part Number 1902-0048, CD 1, DIODE-ZNR 6.81V, (Recommended Replacement).
  Change MP3 to HP and Mfr. Part Number 0370-3068, CD 1.
  Change MP22 to HP and Mfr. Part Numbers 08349-00017, CD 1, and 08349-00018, CD 2, (Recommended Replacement).

Page 6-11, Table 6-3:
  Change S1 to HP and Mfr. Part Number 3101-2779, CD3, (Recommended Replacement).
  OPTION 001. Add HP and Mfr. Part Number 08349-20035, CD 5, PLUG-HOLE (DELETE MP10; RF INPUT).
  OPTION 002. Add HP and Mfr. Part Number 08349-20035, CD 5, PLUG-HOLE (DELETE MP10 2 PLACES).

Page 8-31, Table 8-2:
  Directly across from "A4U3 pin 6," under "**Typical Voltage**," change the value to read: ≤ −8V.

Page 8-33/8-34, Figure 8-21 (A4 Schematic Diagram):
  Change the value of R8 to 5.11K ohms.
  Change the value of R17 to 237K ohms.
  Change the reference designator R19 to RT1.

Page 8-43/8-44, Figure 8-24 (A5 Schematic Diagram):
  Change the color-code wire connections as noted in *P/O Figure 8-24. A5 Regulator Board, Schematic Diagram (ERRATA)* shown in this change sheet.
  Change the value of A4VR2 to 6.81V.

CHANGE 1

This change modifies the A4 Signal Conditioning Board and replaces the +5V supply, crowbar diode, with a new value.

Page 6-7, Table 6-3:

Change A4 to HP and Mfr. Part Number 08349-60034, CD 8, SIGNAL CONDITIONING BOARD.
Add A4C19 HP and Mfr. Part Number 0160-0153, CD 4, CAPACITOR-FXD 10000 pF ±10% 200VDC POLYE.
Add A4R25, HP and Mfr. Part Number 0757-0346, CD 2, RESISTOR 10 1% .125W F TC=0±100, 28480.
Change A4R27 to HP and Mfr. Part Number 0698-3157, CD 3, RESISTOR 19.6K 1% .125W F TC=100, 28480.
Change A4R47 to HP and Mfr. Part Number 0757-0438, CD 3, RESISTOR 5.11K 1% .125W F TC=0±100, 28480.
Add A4R52-55, HP and Mfr. Part Number 057-0442, CD 9, RESISTOR 10K 1% .125W F TC=0±100, 28480.

Page 6-10, Table 6-3:

Change A5VR2 to HP and Mfr. Part Number 1902-0048, CD 1, DIODE-ZNR 6.81V.

Page 8-33/8-34, Figure 8-20 (A4 Component Locations):

Replace Figure 8-20 with *Figure 8-20. A4 Signal Conditioning Board, Component Locations (CHANGE 1)* from this change sheet.

Page 8-33/8-34 (A4 Schematic Diagram):

Change the A4 SIGNAL CONDITIONING BOARD part number in the top left-hand corner of the A4 Schematic to 08349-60034.
Add the SERIAL PREFIX 2424A to the bottom left-hand corner of the page.
Add TP5 to the A GND 2 line in Block F.
Insert a 10k ohm resistor, R52 in series with TP1.
Insert a 10k ohm resistor, R53, in series with TP2.
Insert a 10k ohm resistor, R54, in series with TP3.
Insert a 10k ohm resistor, R25, between C1 and ground number 2.
Place a 1000 pF capacitor, C19, in parallel with R26.
Connect one end of a 5.11k ohm resistor, R47, to the emitter of Q6. Connect the other end to the +20V supply.
Change the value of R27 to 19.6k ohms.
Change the value of R30 to 12.1k ohms.
Insert a 10k ohm resistor, R55, in series with TP4.

Page 8-43/-44, Figure 8-24 (A5 Schematic Diagram):

Change the value of A5VR2 to 6.81V.

CHANGE 2

This change modified the A3 Bias Board Assembly by replacing some of the factory selected resistors with fixed-value resistors and adding potentiometers for fine tuning of the bias currents.

Page 5-i:
Add the following to the bottom of the page:

NOTE

Although A3 contains potentiometers they should be adjusted ONLY IF THE BIAS ASSEMBLY REPLACED OR SERVICED. Do not perform any adjustments if A2 and A3 are replaced as a set. You can find repair and adjustment information in SECTION VIII under the title, A2 AMPLIFIER AND A3 BIAS BOARD, TROUBLESHOOTING.

Page 6-6, Table 6-3:
Change A3 to HP and Mfr. Part Number 08349-60029, CD 1, Bias Board.
Make the following changes to the previously factory selected component:
A3R1, R22, R23, and R24 to HP Part Number 0757-2088, CD 1, RESISTOR-FXD 9.09K 1% .125W.
Add A3R40, R41, R42, and R43 HP Part Number 2100-3094, CD 4, RESISTOR-VAR, 100K.
Delete the following:
A3J1
A3R31 and R32.
A3X1

Page 8-19:
Change **B-GATE BIAS** to read as follows:
The FET gate bias for stages 3−6 is developed by the divider network created by the combination of a fixed resistor and potentiometer, R21 through R24 and R40 through R43, respectively. The bias for stages 1 and 2 is fixed at about zero volts.

Page 8-21:
Change **Q3, Q4, and Q6 Replacement Procedure** to read as follows:

Upon replacement of Q3, Q4, Q5, or Q6, verify that the bias current for the stage in which the transistor was replaced is correct (See Bias Checks above). If the bias current is incorrect, adjust the appropriate potentiometer (see below).
ID3 . . . Adjust . . . R40
ID4 . . . Adjust . . . R41
ID5 . . . Adjust . . . R42
ID6 . . . Adjust . . . R43

Delete all references to hand-selecting and replacing resistors.

Page 8-25/26, Figure 8-14 and Figure 8-15:
Replace Figure 8-14 with *Figure 8-14. A3 Bias Board Component Locations (CHANGE 2)* from this change sheet.
Replace Figure 8-15 with *Figure 8-15. A2 Amplifier/A3 Bias Board Schematic Diagram (CHANGE 2)* from this change sheet.

• CHANGE 3

This change documents the replacement of some inch cabinet components with metric cabinet components.

Page 6-10, Table 6-3:
Under **MISCELLANEOUS PARTS**, change the following:

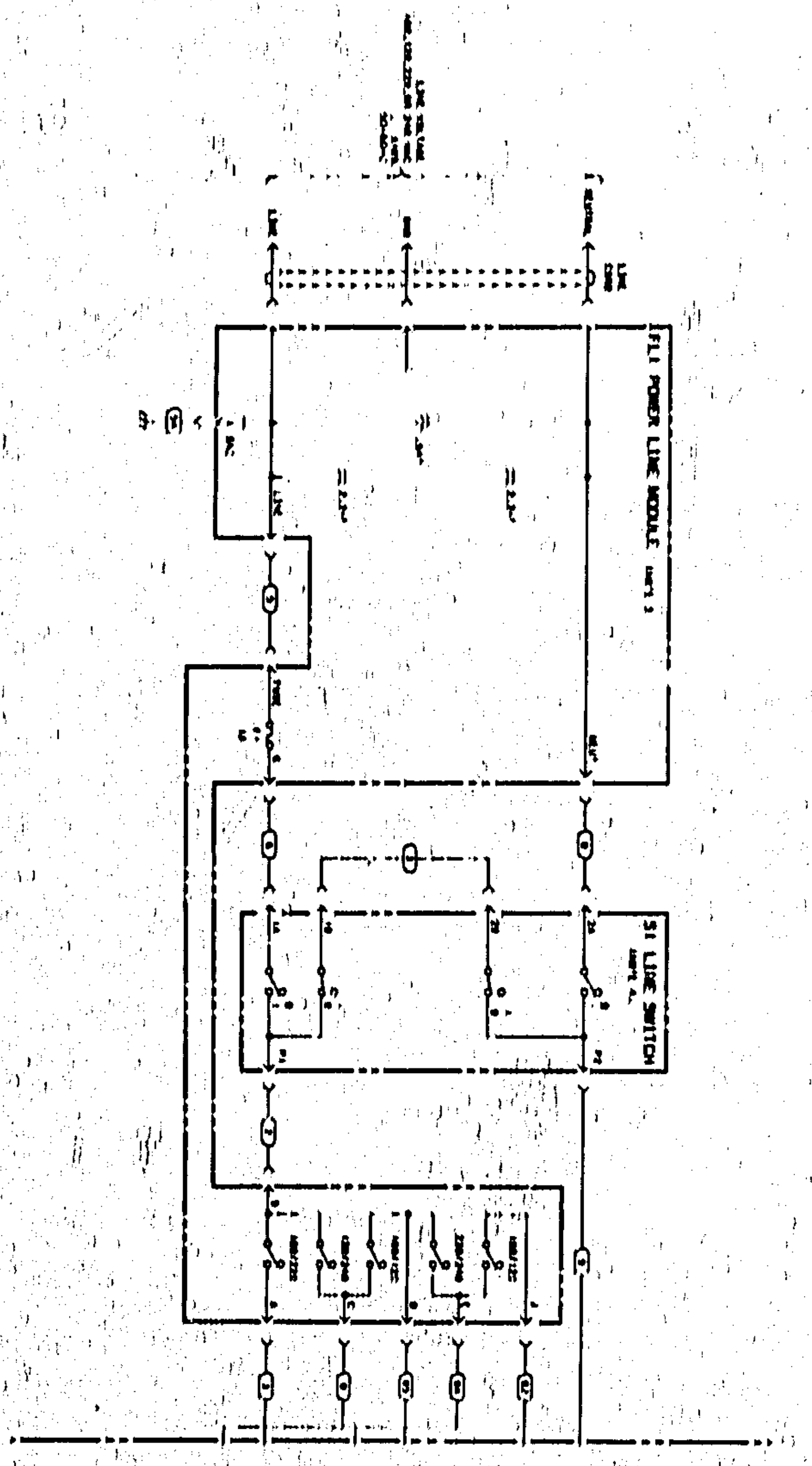
Reference Designator	HP and Mfr. Part Number	CD	Description
MP5	5021-5815	6	FRONT FRAME
MP14	5041-6819	4	COVER STRIP-HANDLE FRONT
MP15	5041-6820	7	COVER STRIP-HANDLE REAR
MP18	5061-8572	4	BOTTOM COVER-PERFORATED
MP29	5021-6815	7	REAR FRAME

Add the following reference designator and part number:

MP34	7121-2527	5	CAUTION LABEL: MIXED HARDWARE

Page 6-11, Table 6-3:
Under **ATTACHING HARDWARE** change the following:

Reference Designator	HP and Mfr. Part Number	CD	Description
6	0535-0081	2	M 4 X 0,8 HEX NUT
7	0515-1132	4	M 5 X 0,8 X 10
8	0515-1388	2	M 4 X 0,7 FLHX



P/O Figure 8-24. A5 Regulator Board, Schematic Diagram (ERRATA)

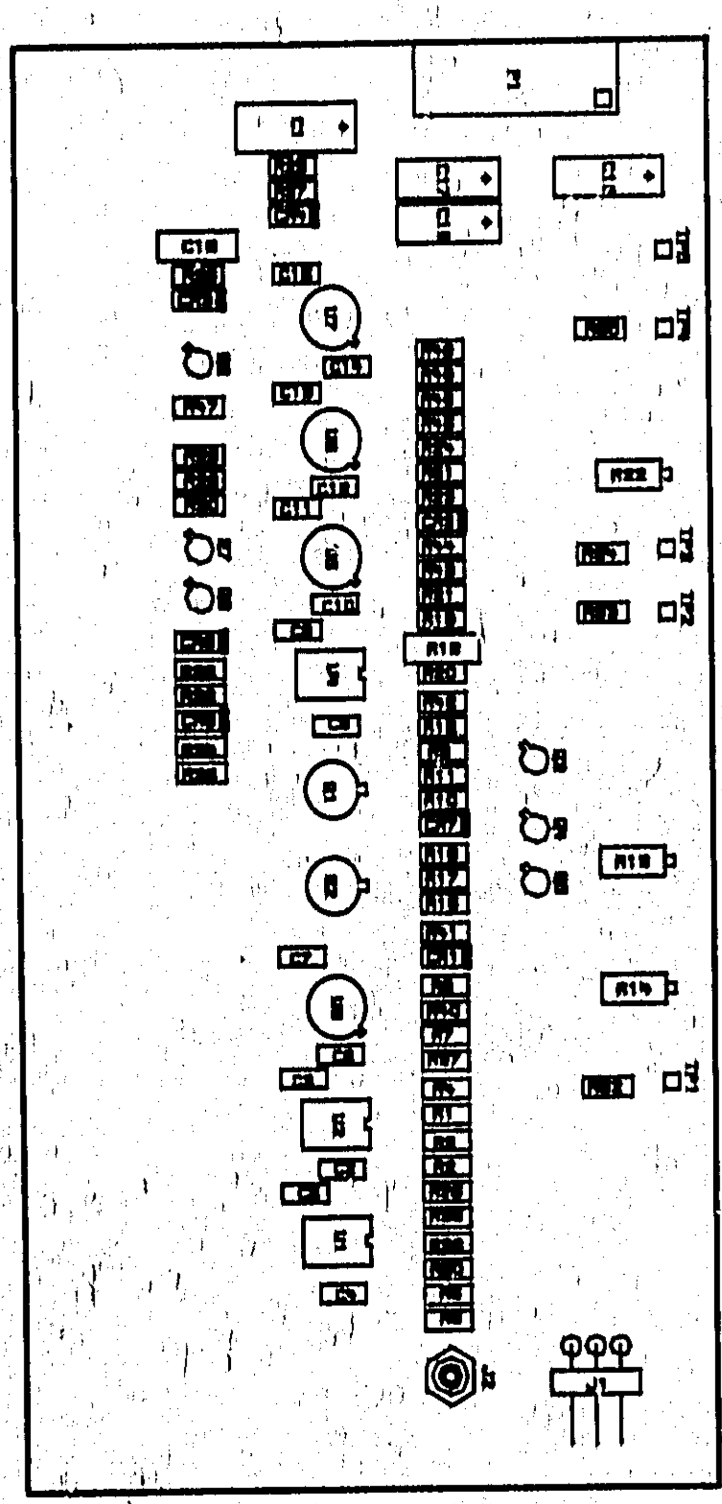


Figure 8-20. A4 Signal Conditioning Board, Component Locations (CHANGE 1)

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

SPECIFICATION:

Minimum Output Power (25°C ± 5°C):

Frequency Range (GHz)	Input	Output	
		Leveled	Unleveled
2.0 to 18.6	5 dBm (3.2 mW)	19 dBm (80 mW)	20 dBm (100 mW)
18.6 to 20.0	5 dBm (3.2 mW)	16 dBm (40 mW)	17 dBm (50 mW)
2.0 to 20.0	5 dBm (3.2 mW)	16 dBm (40 mW)	17 dBm (50 mW)

Power Flatness (Leveled): ± 1.25 dB

Minimum Small Signal Gain:

Frequency Range (GHz)	Input	Gain
2.0 to 18.6	−5 dBm	15 dB
18.6 to 20.0	−5 dBm	12 dB

DESCRIPTION:

The Small Signal Gain specification is measured in two parts.

Part 1. Sweep oscillator set for a 2.0 to 18.6 GHz sweep.

Part 2. Sweep oscillator set for an 18.6 to 20.0 GHz sweep.

In both tests, the sweep oscillator is externally leveled at −5 dBm and the output signal is stored into the network analyzer's memory. The output is then connected to the HP 8349A's RF INPUT and the network analyzer is connected to the RF OUTPUT. With the network analyzer set to the measurement minus memory mode, Minimum Small Signal Gain is read directly on the display.

Two separate tests are performed to measure Unleveled Output Power. The first is done for a frequency range of 2.0 to 18.6 GHz and the second for 18.6 to 20.0 GHz. In both, the HP 8349A's minimum output power frequency is determined by adjusting a frequency marker to the minimum power point on the network analyzer's swept display. The source is set up for CW at the marker frequency and then adjusted for exactly +5 dBm output power. The source is then connected to the HP 8349A's RF INPUT and the Unleveled Output Power is measured at the output with a power meter.

Leveled Output Power and Flatness are verified in the same test. The HP 8349A's DETECTOR OUTPUT is connected to the source's EXT ALC INPUT and leveling is selected. The amplifier's minimum power frequency is found by manually sweeping the source while observing the power meter. The output power is then set for either +19 dBm or +16 dBm depending on the frequency range. The maximum power point is found in the same manner as above and the difference between the maximum and minimum is calculated to verify the Flatness specification. Being able to level at +19 dBm for the 2 to 18.6 GHz range and +16 dBm for the 18.6 to 20 GHz range also verified the Leveled Output Power specification.

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

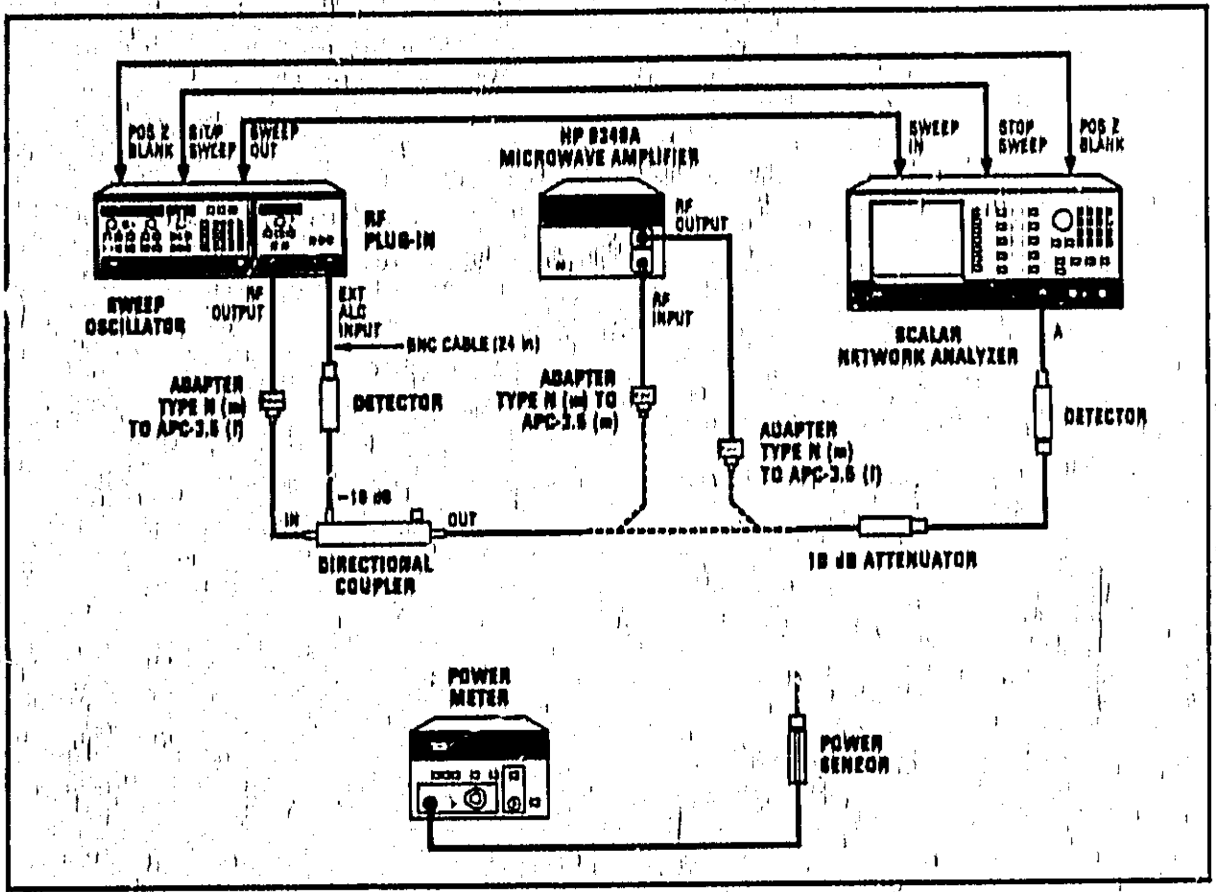


Figure 4-1. Small Signal Gain Test Setup

EQUIPMENT:

Sweep Oscillator .... HP 8350B
RF Plug-In .... HP 83590A
Scalar Network Analzyer .... HP 8756A
Detector .... HP 11664B
Power Meter .... HP 436A
Power Sensor .... HP 8485A
Attenuator .... HP 8493C Option 010
Detector .... HP 8473C
Directional Coupler .... HP P/N 0955-0125
Adapters:
- Type N (m) — APC-3.5 (f) (2 required) .... HP P/N 1250-1744
- Type N (m) — APC-3.5 (m) .... HP P/N 1250-1743

Cables:
- SMA (m) .... HP P/N 8120-3124
- BNC (m) (48 in., 3 required) .... HP 11170C
- BNC (m) (24 in.) .... HP 11170B

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

PROCEDURE:

Small Signal Gain 2.0 to 18.6 GHz

1. Connect the equipment as shown in Figure 4-1 with the coupler output connected to the 10 dB attenuator.

2. Set the network analyzer to display the power measured on the A input. Set the reference level to -15 dBm and scale to 10 dB/DIV. Place the reference line on the center graticule.

3. Set up the sweep oscillator as follows:

   Start Frequency: 2.0 GHz
   Stop Frequency: 18.6 GHz
   Sweep Time: 0.5 sec
   Sweep Trigger: Internal
   Power Level: -5 dBm
   ALC Mode: External
   27.8 kHz Square Wave Modulation: On
   Display Blanking: On

   Adjust the power level to center the waveform on the -15 dBm reference line.

4. Press the HP 8349A LINE switch on. Allow the equipment to warm up for 30 minutes.

5. Change the scale on the network analyzer to 1 dB/DIV and adjust the output power of the plug-in for the flattest waveform about the -15 dBm reference (use the slope feature of the plug-in if necessary).

6. Store the waveform into the network analyzer's memory.

7. Connect the coupler to the RF INPUT of the HP 8349A and the 10 dB attenuator to the RF OUTPUT.

8. Set the network analyzer to display measurement minus memory and set the reference to +20 dB. Adjust the reference to place the minmum point of the waveform on the display. Determine the dB value of the minimum point (HP 8349A's minimum small signal gain). The measured value should be $\geq$15 dB.

Small Signal Gain 18.6 to 20.0

9. Disconnect the HP 8349A's RF INPUT and RF OUTPUT from the test setup. Connect the coupler output directly to the 10 dB attenuator.

10. Set the network analyzer to display the power measured on the A input. Set the reference level to -15 dBm and scale to 10 dB/DIV. Place the reference line on the center graticule.

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

11. Set up the sweep oscillator as follows:

    Start Frequency: 18.6 GHz
    Stop Frequency: 20.0 GHz
    Sweep Time: 0.5 sec
    Sweep Trigger: Internal
    Power Level: -5 dBm
    ALC Mode: External
    27.8 kHz Square Wave Modulation: On
    Display Blanking: On

    Adjust the power level to center the waveform on the -15 dBm reference line.

12. Change the scale on the network analyzer to 1 dB/DIV and adjust the output power of the plug-in for the flattest waveform about the -15 dBm reference (use the slope feature of the plug-in if necessary).

13. Store the waveform into the network analyzer's memory.

14. Connect the coupler to the RF INPUT of the HP 8349A and the 10 dB attenuator to the RF OUTPUT.

15. Set the network analyzer to display measurement minus memory and set the reference to +20 dB. Adjust the reference to place the minimum point of the waveform on the display. Determine the dB value of the minimum point (HP 8349A's minimum small signal gain). The measured value should be ≥12 dB.

Unleveled Output Power (2.0 - 18.6 GHz)

16. Select dBm mode on the power meter and calibrate.

17. Reconnect the network analyzer to the output of the coupler as shown in Figure 4-1.

18. Set the network analyzer to display the power measured on the A input. Set the reference level to -5 dBm and scale to 10 dB/DIV.

19. Set the sweep oscillator's stop frequency to 18.6 GHz. Set the plug-in's output power to +5 dBm and then adjust it to center the waveform on the network analyzer's reference line.

20. Change the scale on the network analyzer to 1 dB/DIV and readjust the output power of the plug-in for the flattest waveform about the reference (use the slope feature of the plug-in if necessary).

21. Store the waveform into memory.

22. Reconnect the coupler to the HP 8349A's RF INPUT and the network analyzer to the RF OUTPUT.

23. Set the network analyzer to display measurement mminus memory and the reference to +15 dB. Adjust the reference to place the minimum point of the waveform on the display.

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

24. Set one of the sweep oscillator's frequency markers to lowest point of the waveform displayed on the network analyzer. Select marker to center frequency and then select CW mode. This should set the sweep oscillator output frequency to the marker frequency. Turn the square wave modulation off.

25. Adjust the CAL FACTOR % on the power meter to the value given on the sensor for the frequency selected.

26. Disconnect the coupler from the HP 8349A and connect the power sensor to the coupler output. Adjust the plug-in's output power until the power meter measures +5.0 dBm.

27. Disconnect the power sensor, connect the attenuator to the coupler output and connect the power sensor to the attenuator. Determine the amount of attenuation.

28. Reconnect the coupler to the RF INPUT of the HP 8349A and the attenuator and power sensor to the RF OUTPUT. Add the amount of attenuation determined in step 27 to the dBm value now displayed on the power meter. The sum is the minimum output power with a +5 dBm input over the 2.0 to 18.6 GHz range and should be ≥20 dBm.

Unleveled Output Power (18.6 - 20 GHz)

29. Reconnect the network analyzer to the output of the coupler as shown in Figure 4-1.

30. Set the network analyzer to display the power measured on the A input. Set the reference level to +5 dBm and scale to 10 dB/DIV.

31. Set the sweep oscillator's start frequency to 18.6 GHz and stop frequency to 20 GHz. Turn the 27.8 kHz square wave modulation on. Set the plug-in's output power to +5 dBm and then adjust it to center the waveform on the network analyzer's reference line.

32. Repeat steps 20 through 27.

33. Reconnect the coupler to the RF INPUT of the HP 8349A and the attenuator to the RF OUTPUT. Add the amount of attenuation determined in step 27 to the dBm value now displayed on the power meter. The sum is the minimum output power with a +5 dBm input over the 18.6 to 20 GHz range and should be ≥+17 dBm.

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

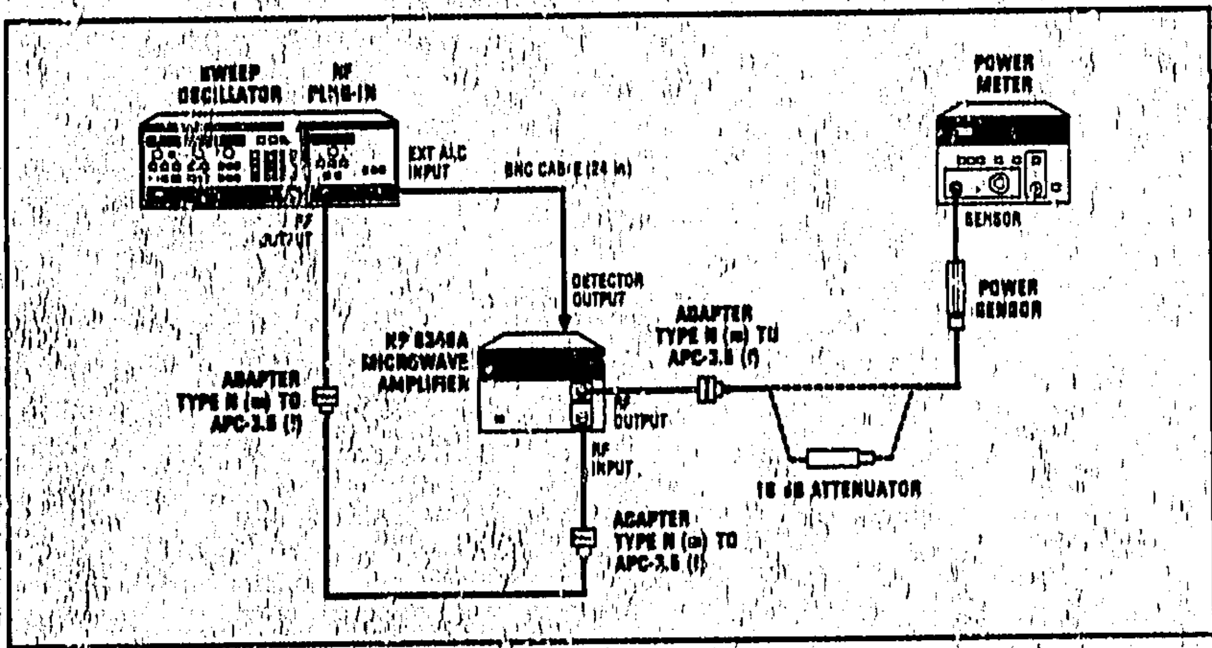


Figure 4-2. Leveled Output Power and Flatness Test Setup

Leveled Output Power and Flatness (2 - 18.6 GHz)

34. Connect the equipment as shown in Figure 4-2 with the power sensor connected to the HP 8349A's RF OUTPUT (attenuator not installed).

35. Set up the sweep oscillator as follows:

    Start Frequency: 2.0 GHz
    Stop Frequency: 20.0 GHz
    Sweep: Manual
    ALC Mode: External
    Power Level: 19 dBm
    Square Wave Modulation: Off

NOTE

In order to level the HP 8349A at +19 dBm, it may be necessary to adjust the RF plug-in's front panel EXT ALC CAL adjustment.

36. While monitoring the power meter, adjust the manual frequency from 18.6 GHz to 2 GHz and determine the frequency of the minimum power point (minimum point will typically occur at the higher frequencies). Return the sweep oscillator to the frequency of the minmum power point.

37. Adjust the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected and then adjust the output power of the plug-in for a +19 dBm power meter reading.

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

38. Connect the 10 dB attenuator between the adapter and the power sensor as shown in Figure 4-2. While monitoring the power meter, adjust the manual frequency from 2 to 18.6 GHz and determine the frequency of the maximum power point. Return the sweep oscillator to the frequency of the maximum power point.

39. Adjust the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected. Subtract 9 dBm from the value shown on the power meter to determine the leveling flatness of the HP 8349A. This value should be ≤2.5 dB.

40. To meet leveling requirements, the unleveled indicator on the RF plug-in should remain off during forward sweep. Set the sweep oscillator for a 5 second sweep from 2.0 to 18.6 GHz and verify that the unleveled indicator remains off during forward sweep.

Leveled Output Power and Flatness (18.6 - 20.0 GHz)

41. Connect the equipment as shown in Figure 4-2 with the power sensor connected to the HP 8349A's RF OUTPUT (attenuator not installed).

42. Set up the sweep oscillator as follows:

    Start Frequency: 18.6 GHz
    Stop Frequency: 20.0 GHz
    Sweep Time: Manual
    ALC Mode: External
    Power Level: +16 dBm
    Square Wave Modulation: Off

NOTE

In order to level the HP 8349A at +16 dBm, it may be necessary to adjust the RF plug-in's front panel EXT ALC CAL adjustment.

43. While monitoring the power meter, adjust the manual frequency from 20 GHz to 18.6 GHz and determine the frequency of the minimum power point (minimum point will typically occur at the higher frequencies). Return the sweep oscillator to the frequency of the minmum power point.

44. Adjust the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected and then adjust the output power of the plug-in for a +16 dBm power meter reading.

45. Connect the 10 dB attenuator between the adapter and the power sensor as shown in Figure 4-2. While monitoring the power meter, adjust the manual frequency from 18.6 to 20 GHz and determine the frequency of the maximum power point. Return the sweep oscillator to the frequency of the maximum power point.

4-10. OUTPUT POWER, GAIN, AND FLATNESS (ERRATA) (Cont'd)

46. Adjust the CAL FACTOR % on the power meter to the value given on the power sensor for the frequency selected. Subtract 9 dBm from the value shown on the power meter to determine the leveling flatness of the HP 8349A. This value should be ≤2.5 dB.

47. To meet leveling requirements, the unleveled indicator on the RF plug-in should remain off during forward sweep. Set the sweep oscillator for a 5 second sweep from 18.6 to 20.0 GHz and verify that the unleveled indicator remains off during forward sweep.

Table 4-3. HP 8349A Test Record (ERRATA)

Hewlett-Packard Model 8439A
Microwave Amplifier

Date: ____________

Serial Number: ____________

Tested by: ____________

Specification Tested	Step	Test Conditions	Specification	Measured Value
4-10. Small Signal Gain	8	Frequency Range: 2.0 to 18.6 GHz Input Power: 5 dBm	15 dB	________ dB
4-10. Small Signal Gain	15	Frequency Range: 18.6 to 20.0 GHz Input Power: −5 dBm	12 dB	________ dB
4-10. Unleveled Output Power	28	Frequency Range 2.0 to 18.6 GHz Input Power: −5 dBm	20 dBm	________ dBm
4-10. Unleveled Output Power	33	Frequency Range: 18.6 to 20.0 GHz Input Power: 5 dBm	17 dBm	________ dBm
4-10. Output Power Flatness, Leveled	39	Frequency Range: 2.0 to 18.6 GHz Minimum Output: 19 dBm	±1.25 dB	________ dB pk-pk
4-10. Output Power Flatness, Leveled	46	Frequency Range: 18.6 to 20 GHz Minimum Output: 16 dBm	±1.25 dB	________ dB pk-pk
4-11. Input SWR	8		≤2.8	________
4-11. Output SWR	22	Output Power 20 dBm, Leveled	≤2.5	________
4-12. Spectral Purity: Harmonics	14	Output Power: 20 dBm, Leveled	≤20 dBc	________ dBc
4-12. Spectral Purity: Non-Harmonic Spurious	25	Output Power: 20 dBm, Leveled	≤55 dBc	________ dBc

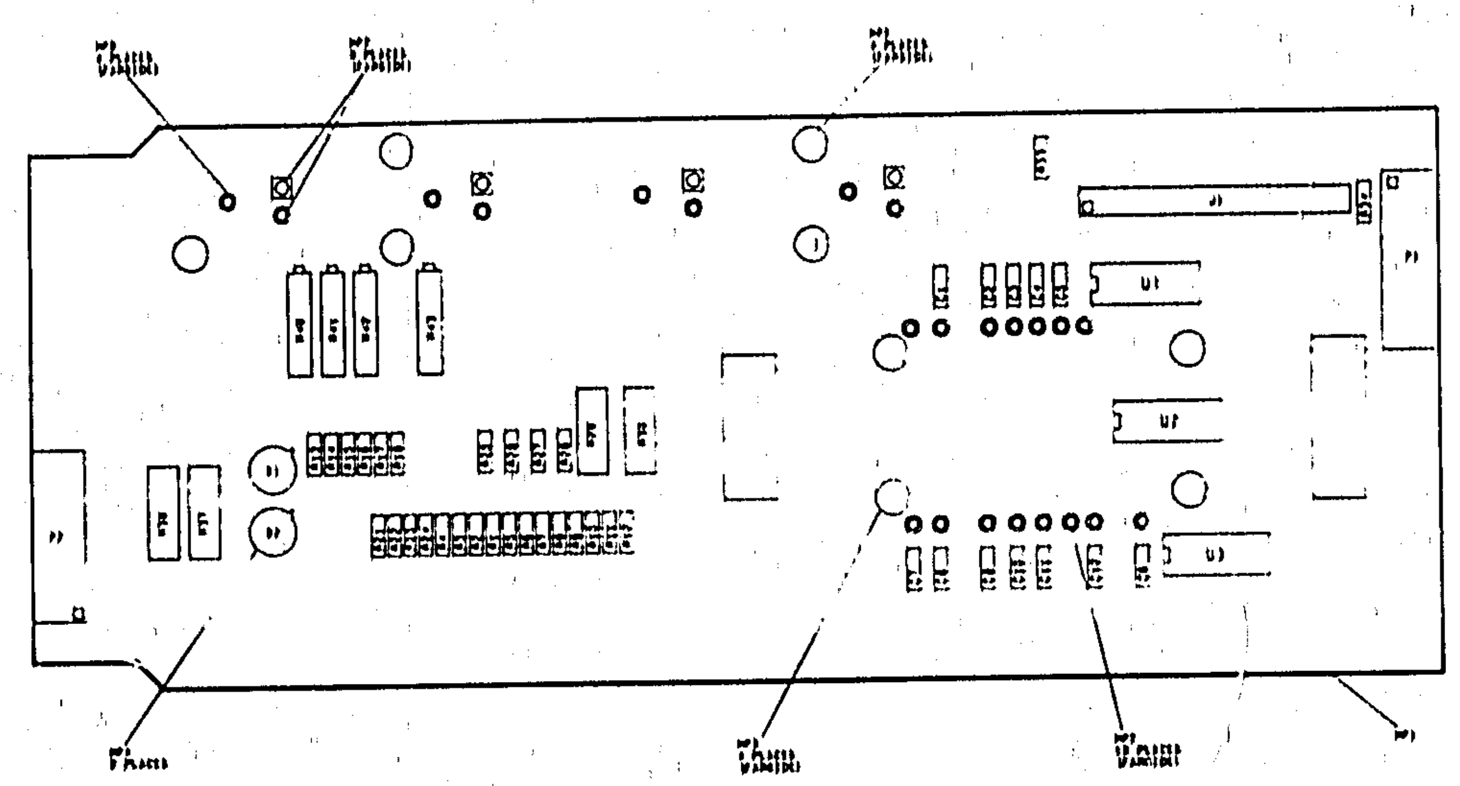


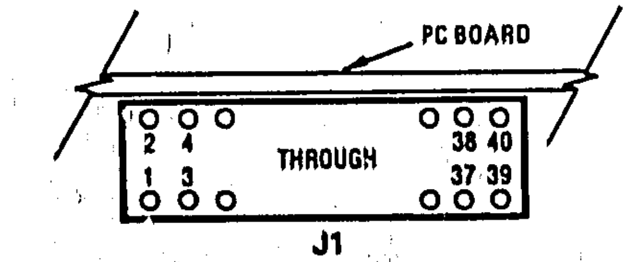
Figure 8-14. A3 Bias Board Component Locations (CHANGE 2)

NOTES

1. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

2. PIN CONFIGURATION FOR A3J1



3. THE A2 AMPLIFIER IS EXTREMELY STATIC SENSITIVE. CARE SHOULD BE TAKEN WHEN PROBING THE A3 BIAS BOARD. TROUBLESHOOTING OF BIAS TO A2 AMPLIFIER SHOULD BE DONE AT CONNECTOR J1. SEE A2 AMPLIFIER AND A3 BIAS BOARD TROUBLESHOOTING FOR MORE INFORMATION.

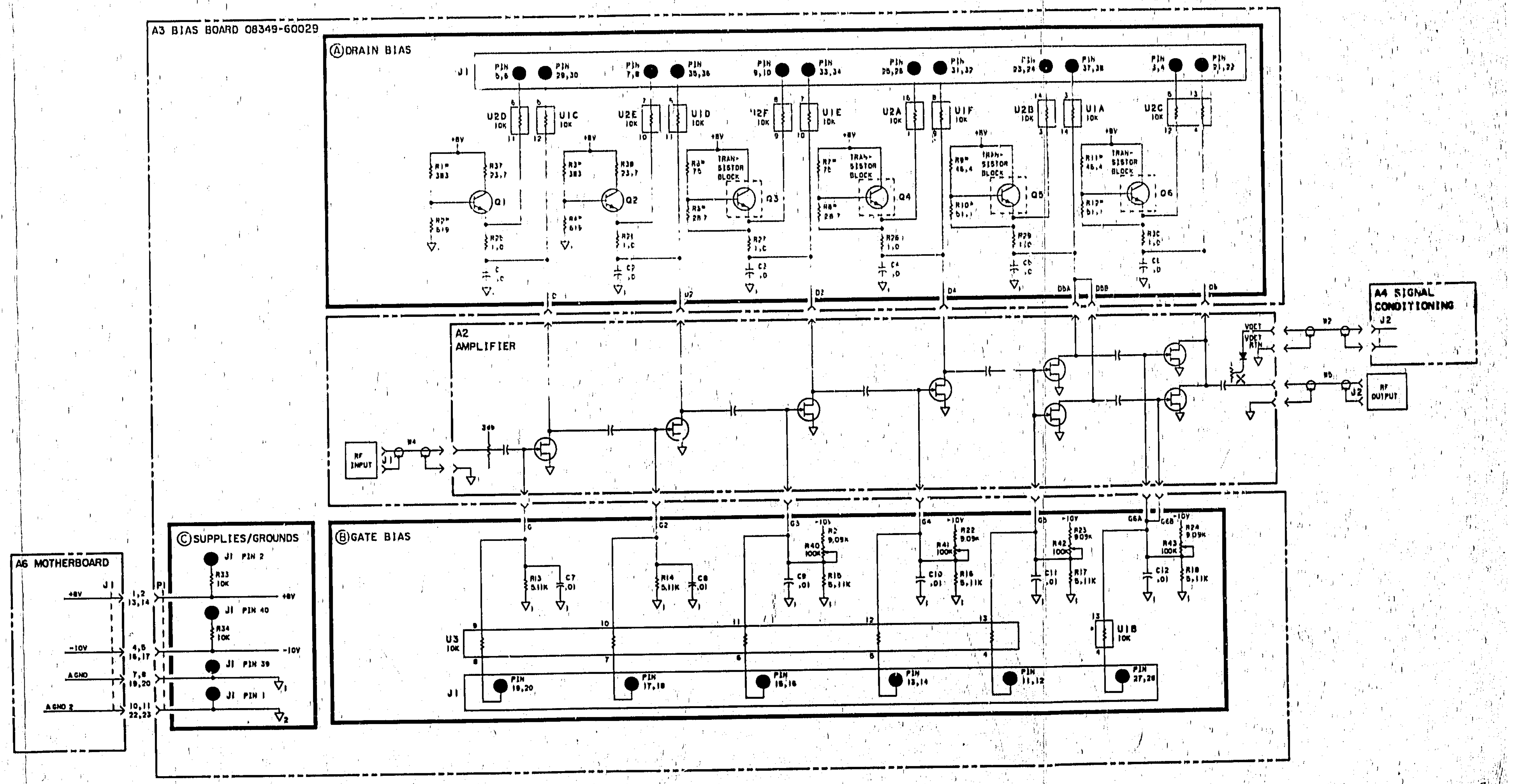


Figure 8-15. A2 Amplifier/A3 Bias Board Schematic Diagram (CHANGE 2)