

# HP 8347A RF Amplifier

## SERIAL NUMBERS

This manual applies to HP 8347A RF Amplifiers having  
serial number prefixes 2816A, 2834A, and 3307A.

For additional information concerning serial numbers, see "Instruments  
Covered by the Manual" in the "General Information" section of this manual.

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1400 Fountaingrove Parkway, Santa Rosa, CA 95403 U.S.A.



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## **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 delivery. 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.*

By internet, phone, or fax, get assistance with all your test and measurement needs.

**Table 1-1 Contacting Agilent**

**Online assistance:** [www.agilent.com/find/assist](http://www.agilent.com/find/assist)

**United States**  
(tel) 1 800 452 4844

**Latin America**  
(tel) (305) 269 7500  
(fax) (305) 269 7599

**Canada**  
(tel) 1 877 894 4414  
(fax) (905) 282-6495

**Europe**  
(tel) (+31) 20 547 2323  
(fax) (+31) 20 547 2390

**New Zealand**  
(tel) 0 800 738 378  
(fax) (+64) 4 495 8950

**Japan**  
(tel) (+81) 426 56 7832  
(fax) (+81) 426 56 7840

**Australia**  
(tel) 1 800 629 485  
(fax) (+61) 3 9210 5947

**Asia Call Center Numbers**

Country	Phone Number	Fax Number
Singapore	1-800-375-8100	(65) 836-0252
Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

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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).



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 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 auto-transformer make sure the common terminal is connected to the neutral (grounded side of the 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 their 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.*

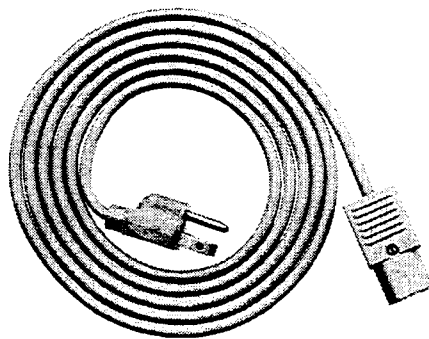


Figure 1-1. HP 8347A Amplifier With Power Cable

# Section 1. General Information

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## CONTENTS

1-1	Introduction
1-1	Manual Organization
1-2	Instruments Covered by the Manual
1-3	Instrument Description
1-3	Specifications
1-4	Supplemental Characteristics
1-5	Options
1-6	Recommended Test Equipment

## INTRODUCTION

This manual contains operating and service information for the Hewlett-Packard 8347A RF amplifier. Figure 1-1 shows the standard instrument and accessories supplied.

## MANUAL ORGANIZATION

This manual contains the following information:

<b>General Information:</b>	See <i>Contents</i> , above.
<b>Installation:</b>	Mechanical Inspection Preparation for Use Operating Environment Packaging and Shipping.
<b>Operation:</b>	Operation Operators Check Applications
<b>Performance Tests:</b>	This section contains the tests to verify that the electrical performance of the instrument meets the published specifications.
<b>Replaceable Parts:</b>	Ordering Information Parts Lists and Illustrations
<b>Service:</b>	Theory of Operation Troubleshooting Component Location Diagrams Schematic Diagrams



# INSTRUMENTS COVERED BY MANUAL

## Serial Numbers

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 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 prefixes listed under SERIAL NUMBERS on the title page.

## Manual Change Supplement

An instrument manufactured after the printing of this manual may have a serial number prefix not listed on the title page. This unlisted serial prefix indicates the instrument is different from those described in this manual. A yellow manual change supplement contains the information necessary to adapt the manual to a newer instrument.

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 obtain the latest manual change supplement.

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.

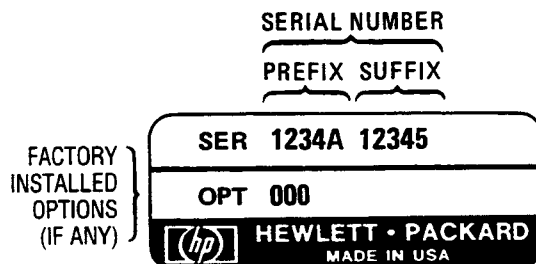


Figure 1-2. Typical Serial Number Tag

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## INSTRUMENT DESCRIPTION

The HP 8347A is a compact broadband instrumentation amplifier that provides:

- 100 kHz to 3 GHz frequency range
- +2 to +20 dBm internally leveled output power range
- $\geq 25$  dB gain
- Low harmonics

The HP 8347A can provide gain and power to overcome RF path losses, drive high-power devices, or improve measurement system performance. The flat, leveled output allows the HP 8347A to drive level-sensitive devices. In signal analysis or frequency counting applications, the HP 8347A can improve sensitivity by 15 to 20 dB.

### Increasing HP 8753 Dynamic Range or Sweep Speed

A special HP 8347A BNC (EXT AM OUT) connects to the HP 8753 network analyzer and can improve the network analyzer's dynamic range. The amount of dynamic range improvement is determined by the type of test set used. An HP 85044 or 85046 test set allows a 15 dB increase in dynamic range, while an HP 85047A allows +22 dB. Alternatively, the analyzer can sweep much faster if used with the standard dynamic range.

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## SPECIFICATIONS

Specifications for the HP 8347A are listed in Table 1-1. These are the performance standards against which the amplifier is tested. Table 1-2 lists typical or nominal values. They are included as additional information only and are not warranted.

**Table 1-1. Specifications**

The following specifications describe the instrument's warranted performance over the temperature range 0 to 55 °C (except where noted).
<b>Frequency Range:</b> 100 kHz to 3.0 GHz <b>Maximum Leveled Output Power:</b> $\geq +20$ dBm <b>Output Power Leveling Range*:</b> +2 to +20 dBm <b>Power Flatness* (internally leveled):</b> $\pm 1.5$ dB <b>Gain:</b> $\geq 25$ dB
<b>Harmonics (at +20 dBm output) 100 kHz to 10 MHz</b> Internal Leveling Off (ALC Off): $\leq -20$ dBc Internal Leveling On (ALC On): $\leq -15$ dBc
<b>Harmonics (at +20 dBm output) 10 MHz to 3 GHz</b> Internal Leveling Off (ALC Off): $\leq -25$ dBc Internal Leveling On (ALC On): $\leq -20$ dBc
* Specification only applies from 300 kHz to 3.0 GHz

**Table 1-2. Supplemental Characteristics**

<p>Supplemental Characteristics are intended to provide information useful in applying the instrument by giving typical but not warranted performance parameters.</p>
<p><b>Maximum Input for Minimum Internally-Leveled Output:</b>* -14 dBm</p>
<p><b>1 dB Compression Point:</b> +22 dBm</p>
<p><b>Third-Order Intercept:</b> +30 dBm</p>
<p><b>Impedance (input and output):</b> 50 ohm, nominal</p>
<p><b>VSWR</b>  <b>Input:</b> 2.0:1  <b>Output</b>              <b>Internally Leveled:</b> 1.5:1              <b>Unleveled</b>                  <b>Below 2 GHz:</b> 2.0:1                  <b>2 to 3 GHz:</b> 3.0:1</p>
<p><b>Reverse Isolation:</b> 60 dB</p>
<p><b>Noise Figure:</b>              Below 10 MHz: 20 dB              10 MHz to 3 GHz: 15 dB</p>
<p><b>GENERAL</b>  <b>RF Input/Output Connectors:</b> Type N Female</p>
<p><b>Power Requirements:</b> 50 to 400 Hz, 100, 120, 200, or 240 Volts (<math>\pm 10\%</math>); 45 VA maximum.</p>
<p><b>Weight:</b> Net 4 kg (8 lb). Shipping 5 kg (11 lb).  <b>Dimensions:</b> 102 High x 213 Wide x 298 mm Deep (4.0" x 8.4" x 11.8")</p>

\*This is the highest input level allowable when the output power is set to minimum (+2 dBm).

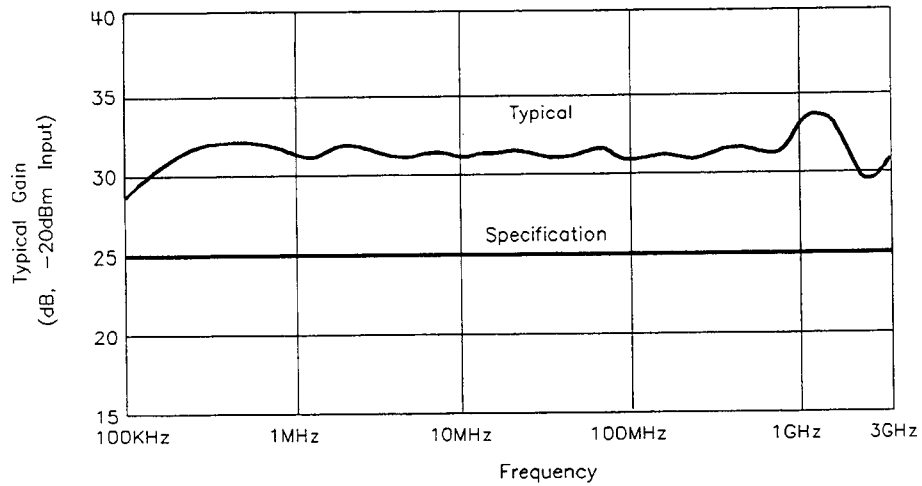


Figure 1-3. Typical Gain

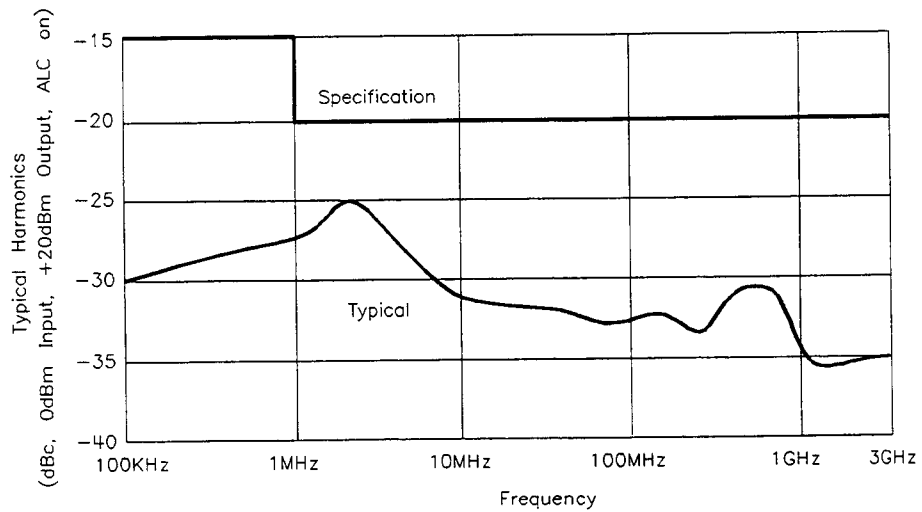


Figure 1-4. Typical Harmonics

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## OPTIONS

### Option 910, Additional Operation and Service Manual

Instruments ordered with Option 910 are supplied with two operation and service manuals. Additional manuals are also available through your nearest Hewlett-Packard sales or service office by ordering the HP part number listed on the title page.

## RECOMMENDED TEST EQUIPMENT AND ACCESSORIES

Test equipment and accessories recommended for servicing and testing the HP 8347A RF amplifier are listed in Table 1-3. If substitute equipment is used, it must meet the minimum specifications shown in the table.

Table 1-3. Recommended Test Equipment (1 of 2)

Instrument	Critical Specifications	Recommended Model	Use
RF Source	-10 to 0 dBm, 100 kHz to 10 MHz	HP 3325A	P
RF Source	-10 to +20 dBm, 10 MHz to 3 GHz	HP 8753B, HP 8340/41, or HP 8350 w/plug in	P, OC
Spectrum Analyzer	100 kHz to 3 GHz, +20 dBm input	HP 8566B	P
Power Meter		HP 436A	P, OC
Power Sensor	100 kHz to 3 GHz, 300 mW (+25 dBm)	HP 8482H	P, OC
Power Splitter	100 kHz to 3 GHz (up to two required)	HP 11667A	P, OC
Adapter, BNC (m) to Type N (f)		HP P/N 1250-1477	P

P = Performance Tests OC = Operator's Check P/N = Part Number

### 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 HP 8347A

#### 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.

## Section 2. Installation

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### CONTENTS

2-1	Introduction
2-1	Initial Inspection
2-2	Safety Considerations
2-2	Preparation for Use
2-5	Storage and Shipment

### INTRODUCTION

This section contains information on initial inspection, preparation for use, storage and packaging.

### INITIAL INSPECTION

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 both mechanically and electrically. Perform the following steps:

1. Check for completeness. Figure A-1 depicts all items you should receive.
2. Check connectors and body for mechanical damage.
3. Test the amplifier electrically by either making measurements or testing to the specifications. Refer to *Operation or Performance Tests* in this manual.

Notify your nearest Hewlett-Packard office, if any of the following conditions exists:

- a. Shipping contents are incomplete.
- b. There is mechanical damage or defect.
- c. The instrument does not pass electrical tests.

Also, notify the carrier if the shipping container is damaged or the cushioning material shows signs of stress. Keep all shipping materials for the carrier's inspection. Hewlett-Packard will arrange for repair or replacement without waiting for a claim settlement.

## SAFETY CONSIDERATIONS

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 manufactured and tested according to international safety standards. However, to ensure safe operation of the instrument, the cautions and warnings in this manual must be followed. Refer to the summary of safety notations near the front of this manual.

## PREPARATION FOR USE

**THE MICROCIRCUIT ASSEMBLY IN THIS PRODUCT MAY BE DAMAGED IF THE EARTH GROUND TERMINAL IS NOT CONNECTED TO EARTH GROUND DURING OPERATION.**

### Power Requirements

The HP 8347A requires a power source of 100, 120, 220, or 240 volts, +10%; 50 to 400 Hz. Maximum power consumption is less than 45VA.



**WARNING**

**BEFORE THIS INSTRUMENT IS SWITCHED ON, its protective earth terminal must be connected to earth ground. DO NOT negate the earth grounding 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.**



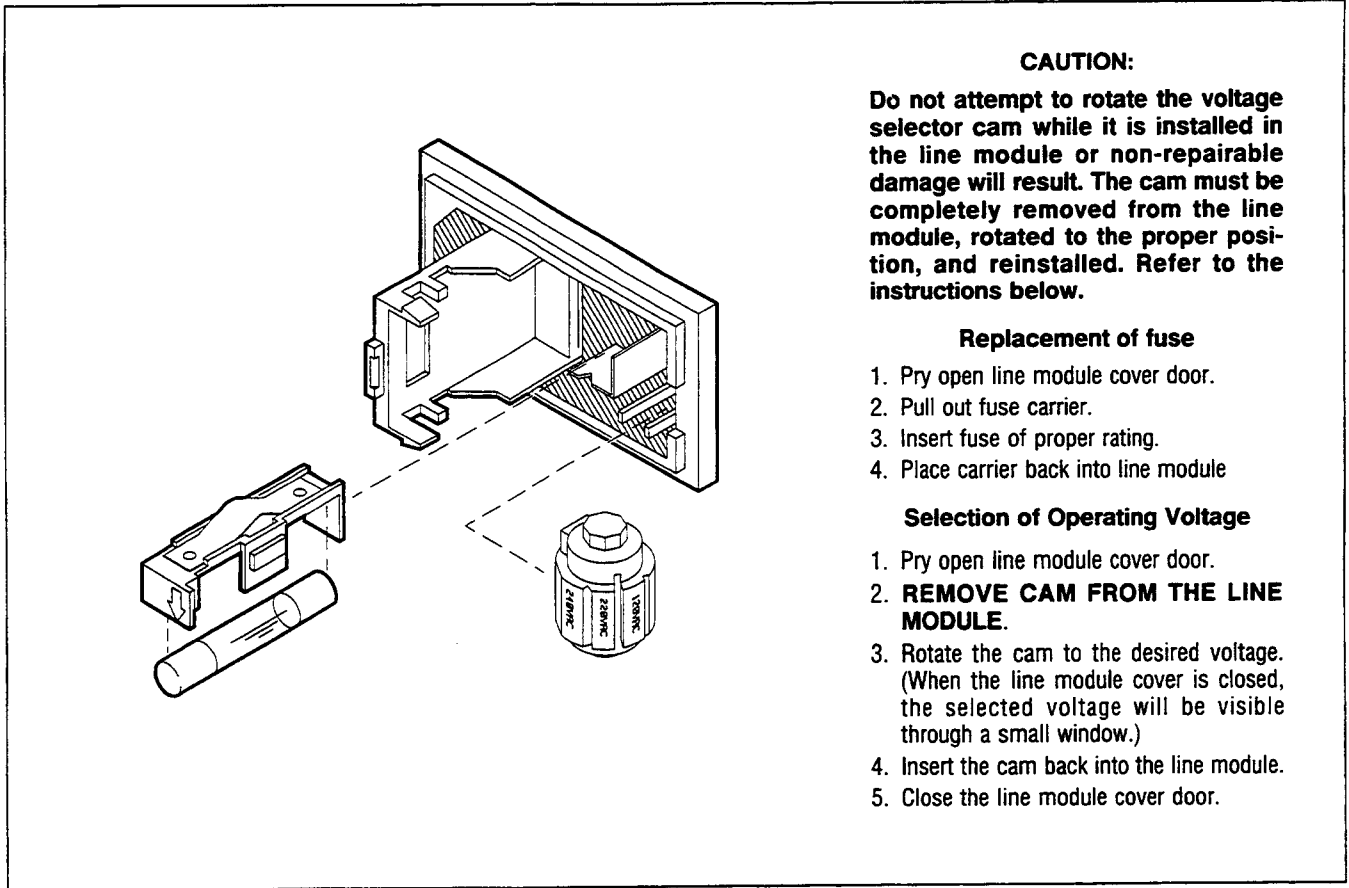
**CAUTION**

**BEFORE SWITCHING ON THIS INSTRUMENT, make sure it is adapted to the voltage of the AC power source. Make sure the rear panel power line module indicates the voltage of the AC power source. Connecting this product to AC power with the line voltage selector in the wrong position can result in damage to the instrument.**

### Line Voltage and Fuse Selection

Set the line voltage selector to the proper AC line voltage as described in the following steps.

1. Determine the AC line voltage. It must be within  $\pm 10\%$  of the four allowable voltage ranges or the product must be operated with an autotransformer.
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.
3. The rated fuse for all AC line voltages is shown on the rear panel of the HP 8347A.



**CAUTION:**

Do not attempt to rotate the voltage selector cam while it is installed in the line module or non-repairable damage will result. The cam must be completely removed from the line module, rotated to the proper position, and reinstalled. Refer to the instructions below.

**Replacement of fuse**

1. Pry open line module cover door.
2. Pull out fuse carrier.
3. Insert fuse of proper rating.
4. Place carrier back into line module

**Selection of Operating Voltage**

1. Pry open line module cover door.
2. **REMOVE CAM FROM THE LINE MODULE.**
3. Rotate the cam to the desired voltage. (When the line module cover is closed, the selected voltage will be visible through a small window.)
4. Insert the cam back into the line module.
5. Close the line module cover door.

Figure 2-1. Line Voltage Selection Cam and Fuse Position

**Power Cable**

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. Table 2-1 depicts the various plug types and their respective HP part number.

**WARNING**

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

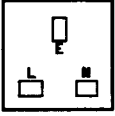
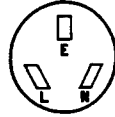
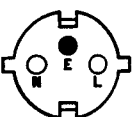


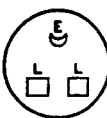
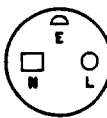
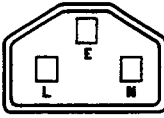
**Operating Environment**

This instrument should be operated within the following limits:

- Temperature ..... 0°C to 55°C
- Altitude ..... <4500 metres (15,000 feet)
- Humidity ..... 5% to 80% relative at +25°C to +40°C



Table 2-1. AC Power Cables and Plugs

Plug Type <sup>1</sup>	Cable HP Part Number <sup>2</sup>	CD <sup>3</sup>	Plug Description <sup>2</sup>	Cable Length (inches)	Cable Color	For Use in Country
<b>250V</b> 	8120-1351 8120-1703	0 6	Straight BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
<b>250V</b> 	8120-1369 8120-0696	0 4	Straight ZNSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
<b>250V</b> 	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)
<b>125V</b> 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 5 1 6 2	Straight NEMA5-15P 90° Straight NEMA5-15P 90° 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
<b>250V</b> 	8120-2104	3	Straight SEV1011.1959 24507, Type 12	79	Gray	Switzerland
<b>250V</b> 	8120-0698	6	Straight NEMA6-15P			United States, Canada
<b>220V</b> 	8120-1957 8120-2956	2 3	Straight DHCK 107 90°	79 79	Gray Gray	Denmark
<b>250V</b> 	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.

## STORAGE AND SHIPMENT

### Environment

The instrument may be stored or shipped in environments within the following limits:

Temperature	.....	-40°C to +75°C
Altitude	.....	<7600 metres (25,000 feet)
Humidity	.....	5% to 95% relative at 0°C to +40°C

### Packaging

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If you choose to package the instrument with commercially available materials, follow these instructions.

1. Wrap the instrument in heavy paper.
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**.

### Returning for Service

If you are shipping the instrument to a Hewlett-Packard office or Service Center please include the following information:

1. Company name and address (do not give a post office box).
2. Technical contact person with complete phone number.
3. Complete model and serial number of the instrument.
4. Type of service required (calibration vs. repair).
5. Any other information that may expedite service.

A page of preprinted fill-in tags are provided for your convenience at the end of this manual. When making inquiries, either by correspondence or by telephone, please refer to the instrument by model number and full serial number.



## Section 3. Operation

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### CONTENTS

- 3-1 Introduction
- 3-2 Operation
- 3-3 Panel Features
- 3-5 Operator's Check
- 3-6 Applications
- 3-6 Extending the Dynamic Range of the HP 8753A/B
- 3-7 Dynamic Range Extension Procedures



**THE MICROCIRCUIT ASSEMBLY IN THIS PRODUCT MAY BE DAMAGED IF THE EARTH GROUND TERMINAL IS NOT CONNECTED TO EARTH GROUND DURING OPERATION.**

### INTRODUCTION

This section explains the use of the HP 8347A microwave amplifier.

#### **Operator's Check**

Figure 3-2 is the operator's check of the HP 8347A. It's purpose is to verify that the HP 8347A is functioning. If the HP 8347A fails the operator's check it requires service.

#### **Rack Mounted Operation**

The physical configuration of the HP 8347A makes it compatible with EIA and IEC racking standards. The half rack configuration of the HP 8347A allows for mounting in a rack by itself, or closely alongside another instrument. Mounted either way, the HP 8347A's effective convection cooling system allows it to operate within 10°C above the ambient temperature of the rack environment.

## OPERATION

### Automatic Leveling Control (ALC) Operation

**ALC Description.** When the input power is within acceptable limits, the HP 8347A is able to maintain a leveled output power across its frequency range. The amplifier has a fixed gain that is typically +30 dB. A built-in variable attenuator (0 to 35 dB attenuation) levels the output.

**Power Surges.** A low input power level followed by a sudden rise in power causes a power surge from the HP 8347A's output. This low-to-high power condition commonly exists in the following applications:

- A swept source is used that has power drops during bandcrossings or retrace.
- Any use during which input power drops or is disconnected, followed by a sudden increase in power.

**Why power surges occur:** When the incoming signal level is very low, the attenuator goes to 0 dB and the incoming signal is amplified by the gain of the amplifier (typically 30 dB). A sudden power increase will be amplified as much as possible before the attenuator has time to engage. Any power level greater than -10 dBm is likely to cause a +20 dBm or higher output power pulse.

**Inhibiting Power Surges.** The rear panel RF BLANKING (-TTL) input BNC, when pulled TTL low, fully engages the attenuator. Thus the high power pulse can not occur. Refer to the description of the RF BLANKING (-TTL) in the *Panel Features* description.

Another way of eliminating power surges is to increase the HP 8347A's output power to +20 dBm and use external attenuators to achieve the desired output power.

### Unleveled Operation

When the HP 8347A ALC switch is turned off, output power = Input Power (dBm) + Gain (typically +30 dB) up to the maximum unleveled output power.

## PANEL FEATURES

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

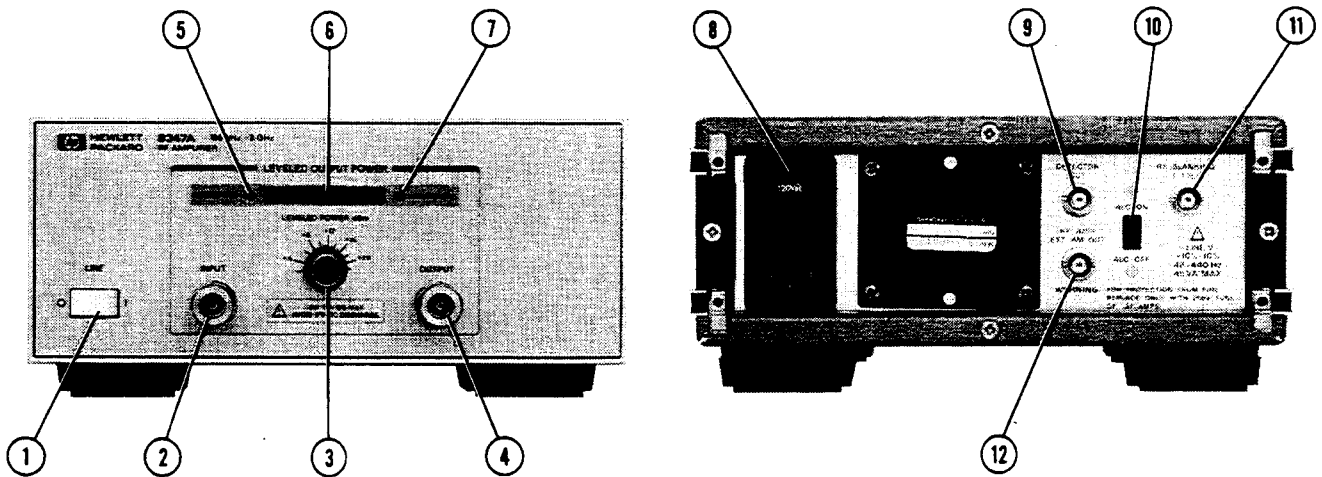


Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators

1. **Power Switch.** Turns AC mains power on or off.
2. **Input Connector.** A Type-N (female) connector supplies RF input power to the amplifier. Damage level is 0.5 watts and  $\pm 10$  VDC.
3. **Power Control Knob.** The power control knob controls the output power of the amplifier. When automatic leveling control is on, the power knob sets the output power to a fixed leveled value. The values on the graticule surrounding the knob are approximate values.
4. **Output Connector.** A Type-N (female) connector supplies amplified RF output power.
5. **OVERDRIVEN Lamp.** In leveled operation, this lamp indicates that too much power is being input given the selected output power. Reduce the input power.
6. **Power Output Bar Display.** The power output bar display is a row of light emitting diodes (LEDs) which shows the relative power level coming out of the HP 8347A amplifier. When power is turned down, only the LED next to "MIN" will be on. As power is increased, successive LEDs light. All LEDs are on when the output power is approximately +22 dBm.

The bar display does not quantify the output power. It shows that power is present on the output connector, and the relative signal strength with respect to minimum and maximum output.

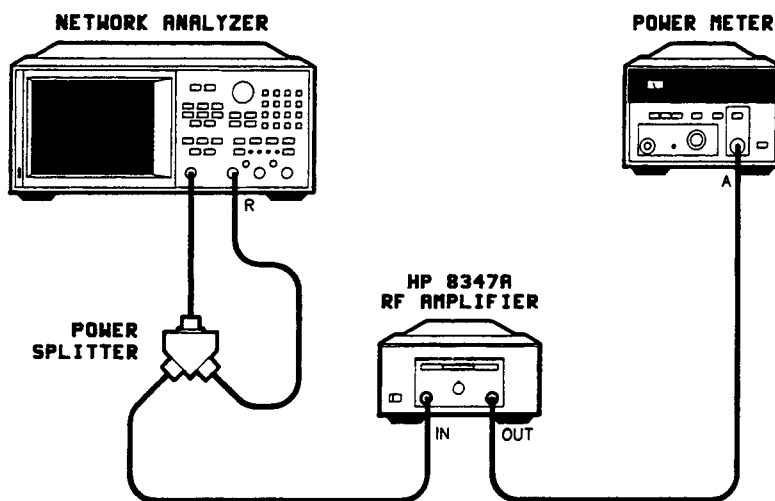
7. **UNLEVELED Lamp.** Indicates that insufficient power is being input to the HP 8347A given the selected output power. Increase input power or reduce the selected power output.
8. **AC Power Module.** Contains the three-wire AC power receptacle, line voltage selector (100, 120, 220, and 240 volts), line fuse, and line filter.
9. **DETECTOR OUT.** This BNC allows the DC output voltage of the ALC detector to be measured by a high impedance device. The voltage out of this connector is approximately  $-2$  mV/mW of output power. This ratio applies at  $+15$  dBm, and changes with output power level. The DETECTOR OUT output can be used for user-configured external leveling applications.
10. **ALC ON/OFF SWITCH.** Turns the Automatic (power) Leveling Control on or off. When on, the ALC maintains a fixed output power across the frequency range of the HP 8347A.
11. **RF BLANKING ( $-$ TTL).** When the ALC is on, a sudden transition from low to high power on the input will cause a brief power surge on the output. This surge can be suppressed by pulling the RF BLANKING ( $-$ TTL) BNC low before the power transition occurs. When at TTL low potential, the RF BLANKING ( $-$ TTL) input causes the built-in attenuator to provide maximum attenuation.

If using an HP 8350 source, J13 pin 7 (L RFB on the programming connector) can automatically pull the HP 8347A's RF BLANKING ( $-$ TTL) line low during bandswitching and retrace. To use the L RFB line, obtain the mating connector to J13, HP part number 1251-7902. Connect a wire from J13 pin 7 to the center pin of a male BNC connector. Connect a second wire from J13 pin 19 (digital ground) to the BNC's outer shield with a high-power soldering iron. Connect this BNC between J13 and the RF BLANKING ( $-$ TTL) connector on the back of the HP 8347A.

A simpler way to avoid surges is to set the amplifier to  $+20$  dBm output and use attenuator(s) to obtain the desired power at the DUT.

12. **HP 8753 EXT AM OUT.** This line is used to extend the dynamic range of an HP 8753. Refer to *Extending the Dynamic Range of the HP 8753*, later in this operating section.

## HP 8347A OPERATOR'S CHECK



### DESCRIPTION

The operator's check is intended to verify that the HP 8347A is operational. It is not intended to verify all specifications. This Operator's Check verifies basic operation by measuring the gain of the HP 8347A.

There are no adjustments in the HP 8347A, if the operator's check fails the amplifier requires service.

**SPECIFICATION** Gain:  $\geq 25$  dB

**EQUIPMENT**

RF Signal Source	HP 8753A/B*
Power Splitter	HP 11667A
Power Meter	HP 436A, 437A, or 438A
Power Sensor	HP 8482H

\* Or any other source that can produce  $-10$  dBm over a large portion of the amplifier's frequency range.

### PROCEDURE

1. Connect the equipment as shown in the figure above. Make sure the HP 8347A ALC switch is on.
2. Connect the power sensor to the output of the splitter. Set the source to any desired CW frequency within 100 kHz to 3 GHz. Set source power so  $-10$  dBm is present at the output of the splitter.
3. Remove the power sensor from the splitter. Place the power sensor on the amplifier's output. Connect the output of the power splitter to the amplifier's input.
4. Turn the HP 8347A's power knob clockwise until the UNLEVELED lamp comes on, then slowly turn it counter-clockwise until the UNLEVELED lamp goes out. The output of the amplifier should be  $\geq 15$  dBm.

If the amplifier fails this test it requires service. There are no adjustments. For more comprehensive tests, refer to *Performance Tests*.

Figure 3-2. Operator's Check



## APPLICATIONS

The HP 8347A RF amplifier may be used in a wide range of applications such as wide band amplification or preamplification. In addition, the HP 8347A can extend the dynamic range of the HP 8753 network analyzer.

Remember that the HP 8347A is a portable extension of the source. The spectral purity of the amplifier output can be limited by 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 8347A during high power inputs. These spurious signals are specified to be below the power level of the fundamental input signal by an amount shown in the specifications table.

## EXTENDING THE DYNAMIC RANGE OF THE HP 8753

**Compatible Instruments and Test Sets.** The HP 8347A may be used with an HP 8753 in conjunction with test sets HP 85044A, 85046A, or 85047A.

**Amount of Dynamic Range Increase with the HP 8347A.** The typical increase in dynamic range is determined by the test set used:

Test Set	Increase
HP 85044A	15 dB
HP 85046A	15 dB
HP 85047A	22 dB

**How the HP 8347A Increases Dynamic Range.** When making non-extended measurements, the HP 8753's RF output and reference power remain fixed and the instrument's dynamic range is based solely on the range of the A or B input. With an IF Bandwidth of 10 Hz selected, these inputs have a range of 0 to  $-100$  dBm.

The HP 8347A extends dynamic range by moving the reference power level during the measurement. The amount of reference power change adds directly to dynamic range. So, in addition to the 100 dB dynamic range of the input channel, the HP 8347A allows as much as 22 dB of additional dynamic range.

**How Reference Power is Controlled by the HP 8347A.** The HP 8347A amplifier controls the reference power by changing the RF output power. The RF output is changed by applying a DC voltage into the HP 8753's EXT AM input.

**The Power at the DUT is Higher than Shown on the HP 8753's Display.** In the procedures below, the operator is instructed to set the HP 8753's RF power level to  $-10$  dBm. This value will be displayed by the HP 8753 at all times. However, this is NOT the actual output power of the analyzer.

The HP 8347A forces the HP 8753 to increase power by sending an offset voltage into the instrument's EXT AM input. The HP 8753 does not display any changes in power caused by external amplitude modulation. For this reason, the HP 8753 will not display changes in power caused by the HP 8347A.

The insertion loss of the DUT directly affects the power output of the analyzer during dynamic range extension. An open causes the highest power output, a through (no power loss) causes the least amount of power. Refer to the following chart for maximum power levels.

<b>Test Set</b>	<b>Maximum Power At DUT (High Impedance)</b>
HP 85044A or HP 8546A	+5 dBm
HP 85047A	+10 dBm

Power to the DUT will change as its impedance changes. A filter DUT, for example, will see highest power levels while in its signal rejection range.

## **DYNAMIC RANGE EXTENSION PROCEDURES**

There are only three types of calibration available in extended dynamic range; response, response-and-isolation, and one-path 2-port. There are two procedures for extending dynamic range:

- A. Extended dynamic range with response or response-and-isolation calibration.
- B. Extended dynamic range with one-path 2-port calibration

Regardless of which procedure is used, four basic steps are performed:

1. Assemble equipment and set desired measurement parameters.
2. Set initial analyzer power level
3. Perform calibration
4. Make desired measurements

## EXTENDED DYNAMIC RANGE PROCEDURE FOR USE WITH RESPONSE OR RESPONSE-AND-ISOLATION CALIBRATIONS

1. Set up equipment as shown in Figure 3-3. Initially, the output of port 1 should be connected directly to the input of the amplifier.

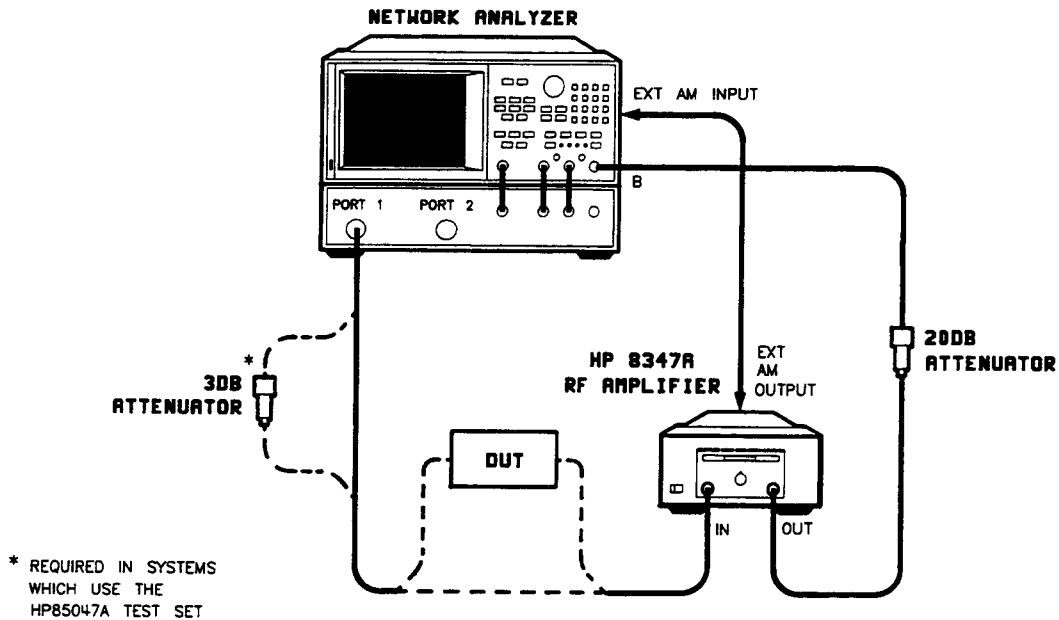


Figure 3-3. Extended Dynamic Range Setup

2. On the HP 8753, set RF power to  $-10$  dBm.

Only perform step 2a when using an HP 85044A or 85046A test set.

- 2a. Disconnect the cable going to the input of the HP 8347A. Display the R input. Increase RF power until the highest power on the displayed trace is just under 0 dBm.
3. Reconnect the cable to the HP 8347A's input. Select B/R measurements.
4. This completes the setup and initial power adjustment. Now choose either a response or response-and-isolation calibration. Calibration allows the HP 8753 to properly interpret measurement data as the reference power changes. After the calibration procedure is performed, the instrument will show the extended dynamic range as a reduced noise floor. For example: A system achieving a dynamic range increase of 22 dB has an effective noise floor of  $-122$  dBm (with an IF bandwidth of 10 Hz), or  $-112$  dBm (with an IF bandwidth of 3 kHz).

## **Response Calibration**

1. Select the appropriate calibration kit with the HP 8753's calibration kit selection command.
2. Perform a response calibration with Port 1 connected directly to the input of the amplifier. Proceed to *Making a Measurement after a Response or Response & Isolation Calibration*.

## **Response-and-Isolation Calibration**

1. Select the appropriate calibration kit with the HP 8753's calibration kit selection command.
2. Perform a response-and-isolation calibration to Port 1 and input channel B.

## **Making a Measurement after a Response or Response-and-Isolation Calibration**

1. Insert the DUT and observe the displayed measurement data.

## **EXTENDED DYNAMIC RANGE PROCEDURE FOR USE WITH ONE-PATH 2-PORT CALIBRATION**

**NOTE:** Perform step 1 EXACTLY as stated.

1. Turn line power off. Disconnect the test set interconnect cable. Turn line power on. Set the output power of the HP 8753 to  $-10$  dBm.
2. Set up the equipment as shown in Figure 3-3. The output of Port 1 should be connected directly to the input of the amplifier.

Only perform step 3 when using an HP 85044A or 85046A test set.

3. Disconnect the cable going to the HP 8347A's input. Display the R input and increase RF power until the highest power on the displayed trace is just under 0 dBm.
4. Reconnect the cable to the HP 8347A's input. Select B/R measurements.
5. This completes the setup and initial power adjustment. Now perform a One-Path 2-Port calibration. Calibration allows the HP 8753 to properly interpret measurement data as the reference power changes. After the calibration procedure is performed, the instrument will show the extended dynamic range as a reduced noise floor. For example: A system achieving a dynamic range increase of 22 dB has an effective noise floor of  $-122$  dBm (with an IF bandwidth of 10 Hz), or  $-112$  dBm (with an IF bandwidth of 3 kHz).

## **One-Path 2-Port Calibration**

1. Select the appropriate calibration kit with the HP 8753's calibration kit selection command. Perform the reflection, transmission, and isolation portions of the calibration.
2. Connect a typical DUT for a reverse measurement, press **[PRESS to CONTINUE]**.
3. Turn the DUT around for a forward measurement and press **[PRESS to CONTINUE]**.

## **Making a Measurement after a One-Port 2-Path Calibration**

The instrument will display S11 for the specific DUT used in the above calibration procedure. If you change the DUT, perform an HP 8753 measure restart command and follow the instructions shown on the display.

# Section 4. Performance Tests

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## CONTENTS

4-1	Introduction
4-1	Equipment Required
4-1	Recording Results
4-2	Output Power Leveling Range and Maximum Leveled Output Power
4-5	Gain
4-9	Flatness
4-11	Harmonics
4-17	Test Record

## INTRODUCTION

The performance tests allow the user to verify that the HP 8347A meets published specifications. All tests may be performed without access to the interior of the amplifier. An operators check is supplied in the *Operation* section. The operator's check simply verifies that the amplifier is functional – it does not verify all specifications.

There are no adjustments in this product. HP 8347A amplifiers that fail a performance test require service.

## EQUIPMENT REQUIRED

A list of required test equipment is given in Table A-3 at the end of the *General Information* section of this manual. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models.

## RECORDING RESULTS

Results of the performance tests may be recorded in the Test Record at the end of these 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.

Some of the test procedures contain spaces to write in the results of measurements. Use one of the following recommendations when recording data.

- Photocopy the test pages and/or Test Record and write on the copies.
- Write the results into the manual using a pencil only.

# OUTPUT POWER LEVELING RANGE AND MAXIMUM LEVELED OUTPUT POWER

## SPECIFICATIONS

Output Power Leveling Range: +2 to +20 dBm  
(300 kHz to 3 GHz)

Maximum Leveled Output Power:  $\geq +20$  dBm  
(100 kHz to 3 GHz)

## DESCRIPTION

This test verifies both output power leveling range and maximum leveled output power. The worst case output power performance of the HP 8347A is at its highest frequency, 3 GHz. This test verifies output power performance at this frequency. Leveling range is tested at 300 kHz and 3 GHz.

## EQUIPMENT REQUIRED

Descriptions	Critical Specifications	Suggested HP Model or Part Number
RF Source	+20 dBm output from 300 kHz to 3 GHz	HP 8753B* or HP 8340/41 and 3325A
Power Meter	None	HP 436A, 437A, or 438A
Power Sensor	300 kHz to 3 GHz	HP 8482H
Power Splitter	(Only needed if HP 8753A/B is used as the source)	HP 11667A
Adapter BNC (m) to type N (f)	(Only needed for HP 3325A)	1250-1477

\* The HP 8753A/B is a convenient RF source for this frequency range. Other sources may be used, such as the HP 8340/41 in conjunction with the HP 3325A.

## Output Power Leveling Range and Maximum Leveled Output Power (Cont'd)

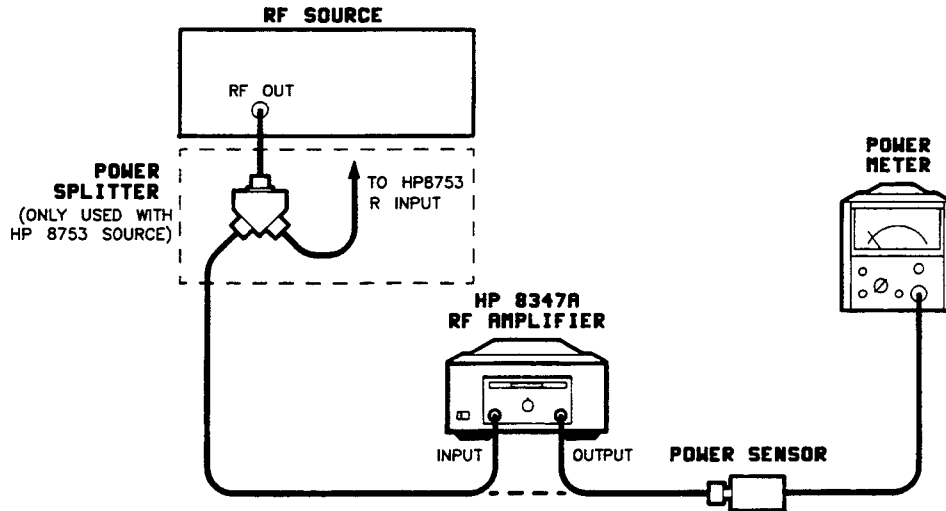


Figure 4-1. Output Power Leveling Range and Maximum Leveled Output Power Test Setup

### PROCEDURE

1. Turn on the equipment and allow to warm up for at least a half hour.
2. Set the power meter to dBm mode.

**NOTE:** Steps 3 through 9 are repeated twice in this procedure. When performing steps 3 through 9 for the first time, set the source to 300 kHz. When performing them the second time, set the source to 3 GHz.

3. Set the power meter's cal factor switch for the source frequency in use. Disconnect the power sensor from any test equipment and zero the power meter.

Connect the power sensor to the output of the RF source. (If using the HP 8753, place the power sensor on the output of the power splitter.)



## **Output Power Leveling Range and Maximum Leveled Output Power (Cont'd)**

4. Make sure the HP 8347A's rear panel ALC switch is on. Set the source to the proper CW frequency (300 kHz or 3 GHz). Adjust the source output until the power meter displays  $-14$  dBm.
5. Connect the power sensor to the output of the HP 8347A. Connect the output of the source to the input of the HP 8347A.
6. Set the HP 8347A power knob to  $+2$  dBm. Adjust the knob so  $+2$  dBm is displayed on the power meter.

If the UNLEVELED and OVERDRIVEN lamps are off, the HP 8347A passes the Output Power Leveling Range specification at  $+2$  dBm at the selected frequency. Fill out the Test Record accordingly.

If the UNLEVELED or OVERDRIVEN lamps come on after the output power is set, check the cable between the source and the HP 8347A. If the cable is good, the HP 8347A requires service.

7. Disconnect the power sensor from the HP 8347A.

Connect the power sensor to the output of the source. (If using the HP 8753, place the power sensor on the output of the power splitter.) Adjust the source until the power meter displays 0 dBm.

8. Connect the power sensor to the output of the HP 8347A. Connect the output of the source to the input of the HP 8347A.
9. Set the HP 8347A power knob to  $+20$  dBm. Adjust the knob so  $+20$  dBm is displayed on the power meter.

If the UNLEVELED and OVERDRIVEN lamps are off, the HP 8347A passes the Output Power Leveling Range specification at  $+20$  dBm at the selected frequency. Fill out the Test Record accordingly.

If the UNLEVELED or OVERDRIVEN lamps come on after the output power is set, check the cable between the source and the HP 8347A. If the cable is good, the HP 8347A requires service.

10. Repeat steps 3 through 9 at a CW frequency of 3 GHz. If using the HP 8340/41 and 3325A sources, use the HP 8340/41 when repeating the steps.

If the amplifier is capable of producing  $+20$  dBm at 3 GHz it passes the maximum leveled output power specification. Mark the Test Record (located after these tests) appropriately.

## GAIN

### SPECIFICATIONS

Gain:  $\geq 25$  dB  
(100 kHz to 3 GHz)

### DESCRIPTION

The gain specification is checked with the automatic leveling control (ALC) turned off.

### EQUIPMENT REQUIRED

Descriptions	Critical Specifications	Suggested HP Model or Part Number
RF Source #1	– 10 dBm output power from 100 kHz to 10 MHz	HP 3325A
RF Source #2	– 10 dBm output from 10 MHz to 3 GHz	HP 8753A/B* or HP 8340/41 or HP 8350 w/Plug-in
Power Meter	None	HP 436A, 437A, or 438A
Power Sensor	100 kHz to 3 GHz	HP 8482H
Power Splitter	(Only needed if HP 8753A/B is used as a source)	HP 11667A
Adapter BNC (m) to type N (f)	(Needed for HP 3325A source)	1250-1477

### PROCEDURE

1. Turn on the equipment and allow it to warm up for at least one half hour. Turn the HP 8347A rear panel ALC switch off.
2. Set the power meter to dBm mode, zero it, and set the cal factor switch as required for 100 kHz.

## Gain (Cont'd)

3. Connect the power sensor to the output of the HP 3325A with the cal factor chart visible. Set the frequency of the HP 3325A to 100 kHz.
4. Adjust the output of the HP 3325A until the power meter displays  $-10$  dBm.
5. Set the HP 3325A to each of the frequencies shown below. Write down the actual power output at each frequency. Change the power meter cal factor as required for each frequency measured.

Frequency	Actual Power (dBm)
100 kHz	$-10$
300 kHz	_____
500 kHz	_____
1 MHz	_____
3 MHz	_____
5 MHz	_____
10 MHz	_____

6. Set up the equipment as shown in Figure 4-2, making sure the power sensor's cal factor chart is visible.

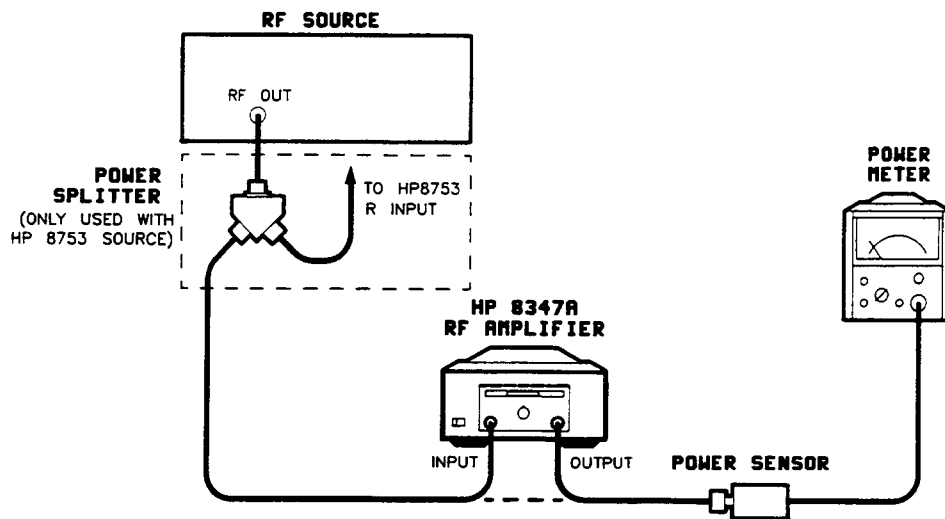


Figure 4-2. Gain Test Setup

## Gain (Cont'd)

**NOTE:** The position of the HP 8347A's front panel knob is not important, and does not affect the measurement.

- Set the power meter cal factor switch as required for 100 kHz. Set the source frequency to 100 kHz. Measure the output of the HP 8347A at each of the frequencies shown below. Change the power meter cal factor as required for each frequency measured.

Frequency	Actual Input Power (dBm) (from step 5)	Output Power (dBm)	Gain (dB)
100 kHz	-10	_____	_____
300 kHz	_____	_____	_____
500 kHz	_____	_____	_____
1 MHz	_____	_____	_____
3 MHz	_____	_____	_____
5 MHz	_____	_____	_____
10 MHz	_____	_____	_____

- Gain is equal to the difference between actual input power and output power. Calculate gain at each frequency. Write the gain value here and in the test record (located at the end of these tests).

- Disconnect the power sensor and zero the power meter. Connect the power sensor to the output of the 10 MHz to 3 GHz source, making sure that the cal factor chart is visible.

Set the power meter cal factor switch as required for 30 MHz. Set the source frequency to 30 MHz.

- Set the source such that -10 dBm is displayed by the power meter. (if using an HP 8753 as a source, measure at the output of the splitter.)

- Set the source to each of the frequencies shown below. Write down the actual power output at each frequency. Change the power meter cal factor as required for each frequency measured.

Frequency	Actual Power (dBm)
30 MHz	-10
50 MHz	_____
100 MHz	_____
300 MHz	_____
500 MHz	_____
1 GHz	_____
3 GHz	_____

## Gain (Cont'd)

12. Set up the equipment as shown in Figure 4-2, making sure the power sensor's cal factor chart is visible.
13. Set the power meter cal factor switch as required for 30 MHz. Set the source frequency to 30 MHz. Measure the output of the HP 8347A at each of the frequencies shown below. Change the power meter cal factor as required for each frequency measured.

Frequency	Actual Input Power (dBm) (from step 11)	Output Power (dBm)	Gain (dB)
30 MHz	-10	_____	_____
50 MHz	_____	_____	_____
100 MHz	_____	_____	_____
300 MHz	_____	_____	_____
500 MHz	_____	_____	_____
1 GHz	_____	_____	_____
3 GHz	_____	_____	_____

14. Gain is equal to the difference between actual input power and output power. Calculate gain at each frequency. Write the gain value here and in the test record (located at the end of these tests).

# FLATNESS

## SPECIFICATION

Flatness:  $\pm 1.5$  dB  
(300 kHz to 3 GHz)

## EQUIPMENT REQUIRED

Descriptions	Critical Specifications	Suggested HP Model or Part Number
RF Source	0 dBm output from 300 kHz to 3 GHz	HP 8753A/B* or HP 8340/41 and 3325A
Power Meter	None	HP 436A, 437A, or 438A
Power Sensor	300 kHz to 3 GHz	HP 8482H
Power Splitter	(Only needed if HP 8753A/B is used as the source)	HP 11667A
Adapter BNC (m) to type N (f)	(Only needed for HP 3325A source)	1250-1477

\* The HP 8753A/B is a convenient RF source for this frequency range. Other sources may be used, such as the HP 8340/41 in conjunction with the HP 3325A.

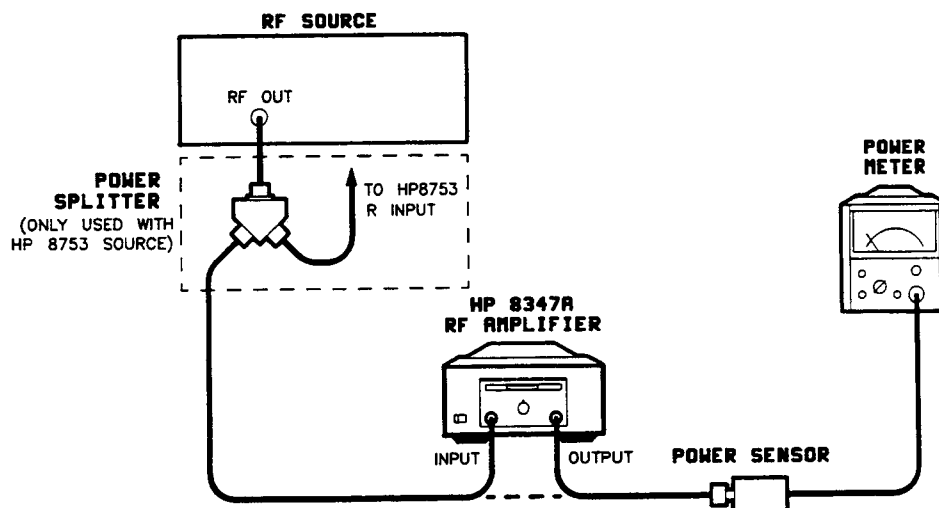


Figure 4-3. Flatness Test Setup

## Flatness (Cont'd)

### PROCEDURE

1. Turn on the equipment and allow to warm up for at least a half hour.
2. Set the power meter to dBm mode and set its cal factor switch as appropriate for 1.25 GHz. Zero the power meter.
3. Make sure the HP 8347A's rear panel ALC switch is on. Set the source to a CW frequency of 1.25 GHz. Connect the power sensor to the output of the source (if using an HP 8753, place the power sensor on the output of the power splitter). Adjust the source output power until the power meter displays approximately 0 dBm.
4. Connect the power sensor to the output of the HP 8347A. Connect the output of the source to the input of the HP 8347A.
5. Adjust the output of the HP 8347A so exactly +20 dBm is displayed on the power meter.
6. Set the power meter cal factor as appropriate for 300 kHz. Set the source to 300 kHz. Record the measured output power of the HP 8347A below:

Frequency	Output Power (dBm)
300 kHz	_____
5 MHz	_____
50 MHz*	_____
500 MHz*	_____
1 GHz*	_____
3 GHz*	_____

\* If using an HP 3325A in conjunction with a higher frequency source, use the higher frequency source for these frequencies. Set the output of the source to 0 dBm.

7. Measure each of the other frequencies shown by changing the frequency of the source and, as necessary, the power meter cal factor. Write the measured results in the spaces provided above.
8. Find the maximum and minimum power values and write them in the spaces provided below. The difference between these values must not exceed 3 dBm. Write the difference value in the Test Record.

Maximum Value  
(dBm)

\_\_\_\_\_

Minimum Value  
(dBm)

\_\_\_\_\_

---

# HARMONICS

## SPECIFICATION

Harmonics (at +20 dBm output, 100 kHz to 10 MHz)

With ALC Off:  $\leq -20$  dBc

With ALC On:  $\leq -15$  dBc

Harmonics (at +20 dBm output, 10 MHz to 3 GHz)

With ALC Off:  $\leq -25$  dBc

With ALC On:  $\leq -20$  dBc

## DESCRIPTION

The harmonics test is performed both with the ALC off and with the ALC on. The power output of the HP 8347A must be set precisely to +20 dBm at each test frequency. Harmonics are measured using a spectrum analyzer.

## EQUIPMENT REQUIRED

Descriptions	Critical Specifications	Suggested HP Model or Part Number
RF Source #1	0 dBm output from 100 kHz to 10 MHz	HP 3325A
RF Source #2	0 dBm output from 10 MHz to 3 GHz	HP 8753A/B or HP 8340/41 or HP 8350 with Plug-in
Spectrum Analyzer	100 kHz to 9 GHz +20 dBm input capability	HP 8566B
Power Meter	None	HP 436A, 437B, or 438A
Power Sensor	100 kHz to 3 GHz	HP 8482H
Power Splitter	(2 required if the HP 8753A/B is used as a source)	HP 11667A
Adapter BNC (m) to type N (f)	(Needed for HP 3325A source)	1250-1477



## Harmonics (Cont'd)

### PROCEDURE

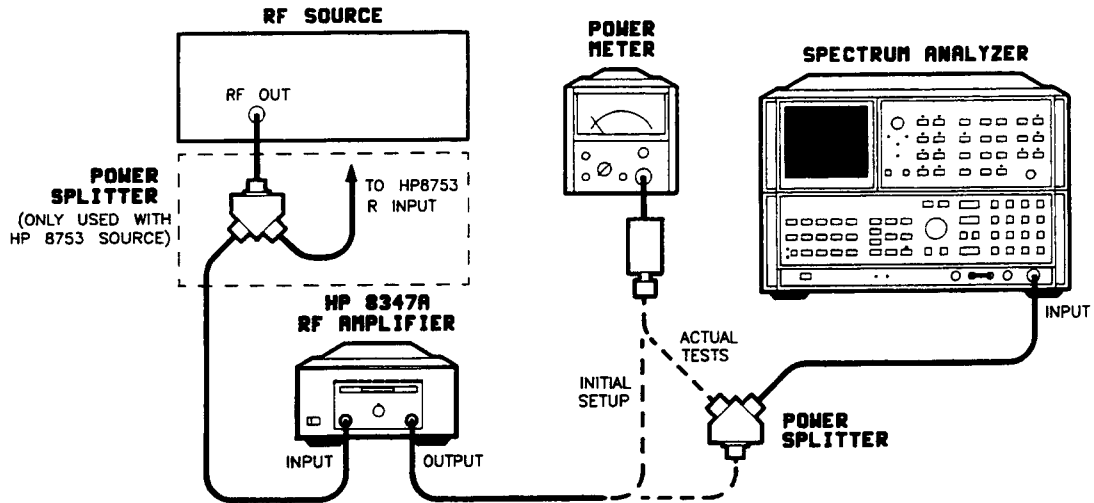


Figure 4-4. Harmonics Test Setup

### Initial Setup

1. Turn on the equipment and allow it to warm up for at least one half hour. Make sure the HP 8347A rear panel ALC switch is on.
2. Set the spectrum analyzer to the following settings:  
Resolution BW = 1 kHz  
Video BW = 100 Hz  
Reference Level = + 20 dBm  
Frequency Span = 100 kHz
3. Set the power meter to dBm mode. Set the cal factor as required for 100 kHz.

## Harmonics (Cont'd)

**NOTE:** When testing frequencies at or below 10 MHz, use the HP 3325A RF source. For frequencies above 10 MHz, use either the HP 8340/41, HP 8753A/B network analyzer source, or HP 8350A/B with RF plug-in.

**NOTE:** If using the HP 8753 network analyzer as a source, the RF output must be split and connected to the HP 8753's R input.

4. Set the source to a 100 kHz CW sine wave output. The output power of the source doesn't need to be exact.
5. Perform the "Harmonics Test with ALC On" and "Harmonics Test with ALC Off" tests provided below. When finished with these tests, write the results of second and third harmonic measurements in the Test Record if desired.

### Harmonics Test with ALC On

1. Connect the equipment as shown in Figure 4-4, with the power sensor connected directly to the output of the HP 8347A. Set the source to a nominal output power shown in the table below:

HP 3325A, 8340/41, 8350:	-5 dBm
HP 8753B	+1 dBm

Adjust the output of the HP 8347A until the power meter reads exactly +20 dBm.

2. Connect the power splitter to the output of the HP 8347A. Place the power sensor on one splitter output, and the spectrum analyzer cable on the other. Write down the displayed power meter reading here:

**Displayed power meter reading on splitter output:** \_\_\_\_\_ dBm

This value will have to be maintained throughout the test.

**NOTE:** The value measured in step 2 is the power output of the DUT minus loss from the power splitter. This loss may change slightly as frequency increases, and you will likely notice a small change when you introduce the high frequency source.

3. Initially perform the following steps at a frequency of 100 kHz. When repeating steps 3 through 9, use the next frequency listed in Table 4-1.
4. Make sure the power meter cal factor is set properly for the test frequency. Readjust the output power of the HP 8347A if necessary for the power level recorded in step 2.
5. Set the spectrum analyzer center frequency to the output frequency of the source.

## Harmonics (Cont'd)

Table 4-1. Measured Harmonics (with ALC On) at Recommended Test Frequencies

	Fundamental Power (dBm)	Measured 2nd Harmonic Power (dBm)	Calculated 2nd Harmonic Power (dBc)	Measured 3rd Harmonic Power (dBm)	Calculated 3rd Harmonic Power (dBc)
100 kHz	_____	_____	_____	_____	_____
300 kHz	_____	_____	_____	_____	_____
500 kHz	_____	_____	_____	_____	_____
1 MHz	_____	_____	_____	_____	_____
3 MHz	_____	_____	_____	_____	_____
5 MHz	_____	_____	_____	_____	_____
10 MHz	_____	_____	_____	_____	_____
30 MHz*	_____	_____	_____	_____	_____
50 MHz*	_____	_____	_____	_____	_____
100 MHz*	_____	_____	_____	_____	_____
300 MHz*	_____	_____	_____	_____	_____
500 MHz*	_____	_____	_____	_____	_____
1 GHz*	_____	_____	_____	_____	_____
3 GHz*	_____	_____	_____	_____	_____

\*Change to the high frequency source after measuring 10 MHz and repeat steps 1 through 10.

6. Set the spectrum analyzer's center frequency step size to equal the frequency of the source.
  7. Make sure the power meter displays the value recorded in step 2, adjust the output of the HP 8347A if required.  
Perform a peak search and record the value of the fundamental in Table 4-1.
  8. Step the center frequency up. The display will show the second harmonic.  
Perform a peak search and write the value of the second harmonic under **Measured 2nd Harmonic Power (dBm)**.
  9. Step the center frequency up again. The display will show the third harmonic.  
Perform a peak search and write the value of the third harmonic under **Measured 3rd Harmonic Power (dBm)**.
  10. Repeat steps 3 through 9 for the next frequency shown in Table 4-1.
- NOTE:** Change the source after measuring 10 MHz and repeat steps 1 through 10 with the high-frequency source.
11. Calculate the dBc values of the second and third harmonics in relation to the fundamental (dBc) and enter the values in Table 4-1 and/or the test record.

## Harmonics Test with ALC Off

**NOTE:** The last frequency used in the “Harmonics Test with ALC On” is the first frequency used in the following test.

1. Turn the HP 8347A rear panel ALC switch off.

Connect the power sensor directly to the output of the HP 8347A. Set the source's output power as shown in the table below:

HP 3325A, 8340/41, 8350:	–10 dBm
HP 8753B	–4 dBm

Adjust the power output of the SOURCE until the power meter reads exactly +20 dBm.

2. Connect the power splitter to the output of the HP 8347A. Place the power sensor on one splitter output, and the spectrum analyzer cable on the other. Write down the displayed power meter reading here:

**Displayed power meter reading on splitter output:** \_\_\_\_\_ dBm

This value will have to be maintained throughout the test.

**NOTE:** The value measured in step 2 is the power output of the DUT minus loss from the power splitter. This loss may change slightly as frequency decreases, and you will likely notice a small change when you introduce the low frequency source.

3. Initially, perform the following steps at a frequency of 3 GHz. When repeating steps 3 through 9, use the next frequency listed in Table 4-2.
4. Make sure the power meter cal factor is set properly for the test frequency. Readjust the output power of the SOURCE if necessary for the power level recorded in step 2.
5. Set the spectrum analyzer center frequency to the output frequency of the source.

Table 4-2. Measured Harmonics (with ALC Off) at Recommended Test Frequencies

	Fundamental Power (dBm)	Measured 2nd Harmonic Power (dBm)	Calculated 2nd Harmonic Power (dBc)	Measured 3rd Harmonic Power (dBm)	Calculated 3rd Harmonic Power (dBc)
3 GHz	_____	_____	_____	_____	_____
1 GHz	_____	_____	_____	_____	_____
500 MHz	_____	_____	_____	_____	_____
300 MHz	_____	_____	_____	_____	_____
100 MHz	_____	_____	_____	_____	_____
50 MHz	_____	_____	_____	_____	_____
30 MHz	_____	_____	_____	_____	_____
10 MHz*	_____	_____	_____	_____	_____
5 MHz*	_____	_____	_____	_____	_____
3 MHz*	_____	_____	_____	_____	_____
1 MHz*	_____	_____	_____	_____	_____
300 kHz*	_____	_____	_____	_____	_____
300 kHz*	_____	_____	_____	_____	_____
100 kHz*	_____	_____	_____	_____	_____

\*Change to the low frequency source after measuring 30 MHz and repeat steps 1 through 10.

6. Set the spectrum analyzer's center frequency step size to equal the frequency of the source.
7. Make sure the power meter displays the value recorded in step 2, adjust the output of the SOURCE if required.

Perform a peak search and record the value of the fundamental in Table 4-1.

8. Step the center frequency up. The display will show the second harmonic.

Perform a peak search and write the value of the second harmonic under **Measured 2nd Harmonic Power (dBm)**.

9. Step the center frequency up again. The display will show the third harmonic.

Perform a peak search and write the value of the third harmonic under **Measured 3rd Harmonic Power (dBm)**.

10. Repeat steps 3 through 9 for the next frequency shown in Table 4-2.

**NOTE:** Change the source after measuring 30 MHz and repeat steps 1 through 10 with the low-frequency source.

11. Calculate the dBc values of the second and third harmonics in relation to the fundamental (dBc) and enter the values in Table 4-2 and/or the test record.

### If The HP 8347A Fails This Test

Make sure the RF source harmonics are  $-40$  dBc or less. If the source is good, the A3 microcircuit assembly must be replaced.

Table 4-3. HP 8347A Test Record (1 of 3)

<b>Hewlett-Packard Model 8347A Amplifier</b>		<b>Date:</b> _____			
<b>Serial Number</b> _____		<b>Temperature</b> _____			
<b>Tested By</b> _____		<b>Humidity</b> _____			
<b>Performance Test</b>	<b>Test Conditions</b>	<b>Step</b>	<b>Lower Limit</b>	<b>Measured Value</b>	<b>Upper Limit</b>
<b>Output Power Leveling Range</b>					
Frequency = 300 kHz Input Power = -14 dBm Output Power = +2 dBm	OVERDRIVEN AND UNLEVELED lamps	6	OFF	_____	
Frequency = 300 kHz Input Power = 0 dBm Output Power = +20 dBm	OVERDRIVEN AND UNLEVELED lamps	9	OFF	_____	
Frequency = 3 GHz Input Power = -14 dBm Output Power = +2 dBm	OVERDRIVEN AND UNLEVELED lamps	6	OFF	_____	
Frequency = 3 GHz Input Power = 0 dBm Output Power = +20 dBm	OVERDRIVEN AND UNLEVELED lamps	9	OFF	_____	
<b>Maximum Leveled Output Power</b>		10	+20 dBm	_____	
<b>Gain</b>					
	100 kHz	8	25 dB	_____	
	300 kHz	8	25 dB	_____	
	500 kHz	8	25 dB	_____	
	1 MHz	8	25 dB	_____	
	3 MHz	8	25 dB	_____	
	5 MHz	8	25 dB	_____	
	10 MHz	8	25 dB	_____	
	30 MHz	14	25 dB	_____	
	50 MHz	14	25 dB	_____	
	100 MHz	14	25 dB	_____	
	300 MHz	14	25 dB	_____	
	500 MHz	14	25 dB	_____	
	1 GHz	14	25 dB	_____	
	3 GHz	14	25 dB	_____	
<b>Flatness</b>	Difference between Maximum and Minimum Power Readings	8		_____	3 dBm

**Table 4-3. HP 8347A Test Record (2 of 3)**

Performance Test	Test conditions	Step	Lower Limit	Measured Value	Upper Limit
<b>Harmonics</b>	<b>ALC ON</b>				
100 kHz	2nd Harmonic	11	-15 dBc	_____	
	3rd Harmonic		-15 dBc	_____	
300 kHz	2nd Harmonic	11	-15 dBc	_____	
	3rd Harmonic		-15 dBc	_____	
500 kHz	2nd Harmonic	11	-15 dBc	_____	
	3rd Harmonic		-15 dBc	_____	
1 MHz	2nd Harmonic	11	-15 dBc	_____	
	3rd Harmonic		-15 dBc	_____	
3 MHz	2nd Harmonic	11	-15 dBc	_____	
	3rd Harmonic		-15 dBc	_____	
5 MHz	2nd Harmonic	11	-15 dBc	_____	
	3rd Harmonic		-15 dBc	_____	
10 MHz	2nd Harmonic	11	-15 dBc	_____	
	3rd Harmonic		-15 dBc	_____	
30 MHz	2nd Harmonic	11	-20 dBc	_____	
	3rd Harmonic		-20 dBc	_____	
50 MHz	2nd Harmonic	11	-20 dBc	_____	
	3rd Harmonic		-20 dBc	_____	
100 MHz	2nd Harmonic	11	-20 dBc	_____	
	3rd Harmonic		-20 dBc	_____	
300 MHz	2nd Harmonic	11	-20 dBc	_____	
	3rd Harmonic		-20 dBc	_____	
500 MHz	2nd Harmonic	11	-20 dBc	_____	
	3rd Harmonic		-20 dBc	_____	
1 GHz	2nd Harmonic	11	-20 dBc	_____	
	3rd Harmonic		-20 dBc	_____	
3 GHz	2nd Harmonic	11	-20 dBc	_____	
	3rd Harmonic		-20 dBc	_____	

**Table 4-3. HP 8347A Test Record (3 of 3)**

Performance Test	Test conditions	Step	Lower Limit	Measured Value	Upper Limit
<b>Harmonics</b>	<b>ALC OFF</b>				
100 kHz	2nd Harmonic 3rd Harmonic	11	-20 dBc -20 dBc	_____ _____	
300 kHz	2nd Harmonic 3rd Harmonic	11	-20 dBc -20 dBc	_____ _____	
500 kHz	2nd Harmonic 3rd Harmonic	11	-20 dBc -20 dBc	_____ _____	
1 MHz	2nd Harmonic 3rd Harmonic	11	-20 dBc -20 dBc	_____ _____	
3 MHz	2nd Harmonic 3rd Harmonic	11	-20 dBc -20 dBc	_____ _____	
5 MHz	2nd Harmonic 3rd Harmonic	11	-20 dBc -20 dBc	_____ _____	
10 MHz	2nd Harmonic 3rd Harmonic	11	-20 dBc -20 dBc	_____ _____	
30 MHz	2nd Harmonic 3rd Harmonic	11	-25 dBc -25 dBc	_____ _____	
50 MHz	2nd Harmonic 3rd Harmonic	11	-25 dBc -25 dBc	_____ _____	
100 MHz	2nd Harmonic 3rd Harmonic	11	-25 dBc -25 dBc	_____ _____	
300 MHz	2nd Harmonic 3rd Harmonic	11	-25 dBc -25 dBc	_____ _____	
500 MHz	2nd Harmonic 3rd Harmonic	11	-25 dBc -25 dBc	_____ _____	
1 GHz	2nd Harmonic 3rd Harmonic	11	-25 dBc -25 dBc	_____ _____	
3 GHz	2nd Harmonic 3rd Harmonic	11	-25 dBc -25 dBc	_____ _____	





# Section 5. Replaceable Parts and Replacement Procedures

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- 5-2 Replaceable Parts List Description
- 5-2 Ordering Information
- 5-2 Line Fuse Part Numbers

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- 5-7 A2 Front Panel

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- 5-9 Removing the Front Panel
  
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- 5-23 Removing the Rear Panel Frame
- 5-23 Removing a Side Strut
  
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- 5-29 Knob, Covers, Feet, and Trim Hardware Replaceable Parts
  
- 5-31 Cable Replaceable Parts
  
- 5-31 Manufacturer's Code Cross Reference

## REPLACEABLE PARTS LIST DESCRIPTION

### Information

The following information is given for each part:

- The Hewlett-Packard part number.
- The part number check digit (CD).
- The total quantity (Qty) used in the product.
- The description of the part.
- The five digit code of the typical manufacturer of the part.
- The manufacturer's part number for the part.

**NOTE:** The total quantity for each part is given only once, at the first appearance of the part in the list.

### ORDERING INFORMATION

To order a part listed in the replaceable parts list, indicate the Hewlett-Packard part number (with check digit to ensure efficient processing) and the quantity desired. Address the order to the nearest Hewlett-Packard office.

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

### LINE FUSE PART NUMBERS

Early versions of the HP 8347A used a 0.37 amp line fuse. Later versions use a 0.5 amp fuse. Use the fuse type shown on the rear panel of your HP 8347A. Fuse part numbers are:

0.37 amp 250 volt normal-blow	HP Part Number 2110-0421	CD 1
0.5 amp 250 volt normal-blow	HP Part Number 2110-0012	CD6

Table 5-1. Motherboard Assembly Replaceable Parts (1 of 3)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08347-60001	7	1	MOTHERBOARD ASSEMBLY	28480	08347-60001
A1C1	0160-0159	0	1	CAPACITOR-FXD 6800PF ±10% 200VDC POLYE	19701	708D1CC682PK201AX
A1C2	0160-0162	5	1	CAPACITOR-FXD .022UF ±10% 200VDC POLYE	19701	708D1HH223PK201AX
A1C3	0180-3587	6	3	CAPACITOR-FXD 1000UF ±20% 50VDC AL	00494	KM50VB1000M
A1C4	0180-3587	6	6	CAPACITOR-FXD 1000UF ±20% 50VDC AL	00494	KM50VB1000M
A1C5	0180-0183	2	1	CAPACITOR-FXD 10UF +75-10% 50VDC AL	56289	30D106G050CB2
A1C6	0180-3831	3	1	CAPACITOR-FXD 10UF ±10% 35VDC TA	56289	299D106X9035BB1
A1C7	0160-0575	4	1	CAPACITOR-FXD .047UF ±20% 50VDC CER	12474	SR205C473MAA
A1C8	0180-4055	5	1	CAPACITOR-FXD 4700UF +30-10% 50VDC TA	56289	80D472P050KD2B
A1C9	0180-0301	6	1	CAPACITOR-FXD 5UF +75-10% 50VDC AL	56289	30D505G050BB2
A1C10	0180-3771	0	2	CAPACITOR-FXD 1UF ±10% 35VDC TA	56289	299D105X9035AB1
A1C11	0150-0121	5	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	09969	RPE112-149Z5U104Z50V
A1C12				NOT ASSIGNED		
A1C13	0160-4535	4	4	CAPACITOR-FXD 1UF ±10% 50VDC CER	12474	SR305C105KAA
A1C14	0180-3587	6		CAPACITOR-FXD 1000UF ±20% 50VDC AL	00494	KM50VB1000M
A1C15				NOT ASSIGNED		
A1C16	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	12474	SR305C105KAA
A1C17	0180-4056	6	1	CAPACITOR-FXD 680UF +30-10% 100VDC AL	56289	80D681P100KA2B
A1C18				NOT ASSIGNED		
A1C19	0160-4005	3	1	CAPACITOR-FXD 1UF ±20% 100VDC CER	09969	RPE114-130Z5U105M100V
A1C20				NOT ASSIGNED		
A1C21	0160-3879	7	1	CAPACITOR-FXD .01UF ±20% 100VDC CER	12474	SR201C103MAA
A1C22				NOT ASSIGNED		
A1C23	0160-4535	4	4	CAPACITOR-FXD 1UF ±10% 50VDC CER	12474	SR305C105KAA
A1C24	0160-4535	4	4	CAPACITOR-FXD 1UF ±10% 50VDC CER	12474	SR305C105KAA
A1C25, C26				NOT ASSIGNED		
A1C27	0180-3771	0		CAPACITOR-FXD 1UF ±10% 35VDC TA	56289	299D105X9035AB1
A1CR1	1901-0050	3	5	DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1CR2	1901-0028	5	7	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR3	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR4	1901-0743	1	10	DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR5	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR6	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR7	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR8	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR9	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR10	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR11	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR12	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR13	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR14	1901-0376	6	1	DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1CR15	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1CR16	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1CR19	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR20	1901-0033	2	2	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1CR21	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1CR22	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR23	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR24	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1CR25	1901-0743	1		DIODE-PWR RECT 1N4004 400V 1A DO-41	11983	1N4004
A1F1	2110-0331	7	3	FUSE (INCH) .3A 125V NTD BI	16428	GMW 3/10
A1F2	2110-0047	2	1	FUSE (INCH) 1A 125V NTD BI	16428	GMW-1
A1F3	2110-0331	7	7	FUSE (INCH) .3A 125V NTD BI	16428	GMW 3/10
A1F4	2110-0331	7	7	FUSE (INCH) .3A 125V NTD BI	16428	GMW 3/10
A1J1	1251-8032	8	1	CONN-POST TYPE .156-PIN-SPCG 8-CONT	28480	1251-8032
A1J2	1251-7167	8	2	CONN-POST TYPE .100-PIN-SPCG 10-CONT	28480	1251-7167
A1J3	1251-7167	8		CONN-POST TYPE .100-PIN-SPCG 10-CONT	28480	1251-7167
A1MP1				NOT ASSIGNED		
A1MP2	0570-1358	2	4	STD-PRS-IN M3 X 0.5 5.000 CARB STL	46384	KBMS-7M3-50
A1MP3	08347-00004	4	1	HEATSINK-SUPPORT	28480	08347-00004
A1MP4	1200-0081	4	4	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
A1MP5	0340-0681	5	2	INSULATOR-XSTR THRM-CNDCT GRA	55285	7403-09FR-11

Table 5-1. A1 Motherboard Assembly Replaceable Parts (2 of 3)

Reference Designation	HP Part Number	C	D	Qty	Description	Mfr Code	Mfr Part Number
A1MP6	0535-0004	9		4	NUT-HEX DBL-CHAM M3 X 0.5 2.9MM-THK	00000	ORDER BY DESCRIPTION
A1MP7	1200-0173	5		2	INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A1MP8	1251-5595	2		2	POLARIZING KEY-POST CONN	18873	66423-002
A1Q1	1853-0594	7		2	TRANSISTOR-DUAL PNP 2N3808 TO-78	04713	2N3808
A1Q2					NOT ASSIGNED		
A1Q3	1853-0594	7			TRANSISTOR-DUAL PNP 2N3808 TO-78	04713	2N3808
A1Q4	1853-0281	9		1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1Q5	1854-0072	8		1	TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	04713	2N3054
A1Q6	1884-0073	2		2	THYRISTOR-SCR VRRM=100	9N171	CD1031
A1Q7	0853-0418	4		1	TRANSISTOR PNP 2N6317 SI TO-66 PD=90W	04716	2N6317
A1Q8	1884-0073	2			THYRISTOR-SCR VRRM=100	9N171	CD1031
A1Q9, Q10					NOT ASSIGNED		
A1Q11	1854-0477	7		1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1R1	0698-3453	2		2	RESISTOR 196K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1963-F
A1R2	0757-0416	7		6	RESISTOR 511 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-511R-F
A1R3	0757-0280	3		6	RESISTOR 1K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1001-F
A1R4	0698-3450	9		1	RESISTOR 42.2K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-4222-F
A1R5	0757-0416	7			RESISTOR 511 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-511R-F
A1R6	0757-1094	9		2	RESISTOR 1.47K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1471-F
A1R7					NOT ASSIGNED		
A1R8	0757-0401	0		4	RESISTOR 100 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-101-F
A1R9	0698-8827	4		3	RESISTOR 1M ± 1% .125W TF TC=0±100	12498	CT4
A1R10	0757-1078	9		1	RESISTOR 1.47K ± 1% .5W TF TC=0±100	K8479	H2
A1R11, R12					NOT ASSIGNED		
A1R13	0757-0438	3		7	RESISTOR 5.11K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-5111-F
A1R14	0811-3403	4		1	RESISTOR 1K ± 5% .25W PWN TC= +3400±300	01686	R2702
A1R15	0698-3151	7		2	RESISTOR 2.87K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-2871-F
A1R16, R17					NOT ASSIGNED		
A1R18	0757-0438	3			RESISTOR 5.11K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-5111-F
A1R19	0757-0401	0			RESISTOR 100 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-101-F
A1R20	0757-0416	7			RESISTOR 511 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-511R-F
A1R21	0757-1094	9			RESISTOR 1.47K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1471-F
A1R22	0757-0401	0			RESISTOR 100 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-101-F
A1R23	0698-8827	4			RESISTOR 1M ± 1% .125W TF TC=0±100	12498	CT4
A1R24	0757-0458	7		1	RESISTOR 51.1K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-5112-F
A1R25	0757-0438	3			RESISTOR 5.11K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-5111-F
A1R26	0698-0083	8		7	RESISTOR 1.96K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1961-F
A1R27	0757-0279	0		2	RESISTOR 3.16K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-3161-F
A1R28	0698-3440	7		2	RESISTOR 196 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-196R-F
A1R29	0698-3440	7			RESISTOR 196 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-196R-F
A1R30	0698-3453	2			RESISTOR 196K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1963-F
A1R31	0698-3159	5		2	RESISTOR 26.1K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-2612-F
A1R32	0757-0279	0			RESISTOR 3.16K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-3161-F
A1R33	0757-0459	8		3	RESISTOR 56.2K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-5622-F
A1R34	0698-6619	8		1	RESISTOR 15K ± 0.1% .125W TF TC=0±25	12498	NE55
A1R35	0698-6362	8		2	RESISTOR 1K ± 0.1% .125W TF TC=0±25	12498	NE55
A1R36	0698-6360	6		1	RESISTOR 10K ± 0.1% .125W TF TC=0±25	12498	NE55
A1R37	0757-0346	2		2	RESISTOR 10 ± 1% .125W TF TC=0±100	D8439	MK2
A1R38	0757-0416	7			RESISTOR 511 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-511R-F
A1R39	0757-0280	3			RESISTOR 1K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1001-F
A1R40	0698-3157	3		5	RESISTOR 19.6K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1962-F
A1R41	0757-0416	7			RESISTOR 511 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-511R-F
A1R42	0698-3153	9		1	RESISTOR 3.83K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-3831-F
A1R43	0757-0401	0			RESISTOR 100 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-101-F
A1R44	0698-3159	5			RESISTOR 26.1K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-2612-F
A1R45	0698-3151	7			RESISTOR 2.87K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-2871-F
A1R46	0811-1078	5		1	RESISTOR .22 ± 5% 3W PWI TC=0±90	91637	CW-2B-39
A1R47	0698-6343	5		1	RESISTOR 9K ± 0.1% .125W TF TC=0±25	12498	NE55
A1R48	0698-6362	8			RESISTOR 1K ± 0.1% .125W TF TC=0±25	12498	NE55
A1R49	0757-0416	7			RESISTOR 511 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-511R-F
A1R50	0757-0346	2			RESISTOR 10 ± 1% .125W TF TC=0±100	D8439	MK2
A1R51	0698-0083	8			RESISTOR 1.96K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-1961-F
A1R52	0757-0438	3			RESISTOR 5.11K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-5111-F
A1R53	0698-3132	4		1	RESISTOR 261 ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-2610-F
A1R54	0698-3154	0		1	RESISTOR 4.22K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-4221-F
A1R55	0757-0459	8			RESISTOR 56.2K ± 1% .125W TF TC=0±100	12498	CT4-1/8-T0-5622-F

Table 5-1. A1 Motherboard Assembly Replaceable Parts (3 of 3)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R56	0757-0459	8		RESISTOR 56.2K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-5622-F
A1R57	0757-0442	9	5	RESISTOR 10K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1002-F
A1R58	0757-0442	9		RESISTOR 10K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1002-F
A1R59	0757-0438	3		RESISTOR 5.11K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-5111-F
A1R60	0698-3403	2	1	RESISTOR 348 ±1% .5W TF TC=0±100	K8479	H2
A1R61-67				NOT ASSIGNED		
A1R68	0757-0438	3		RESISTOR 5.11K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-5111-F
A1R69				NOT ASSIGNED		
A1R70	0757-0280	3		RESISTOR 1K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1001-F
A1R71.72				NOT ASSIGNED		
A1R73	0698-3150	6	1	RESISTOR 2.37K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-2371-F
A1R74	0698-8827	4		RESISTOR 1M ±1% .125W TF TC=0±100	12498	CT4
A1R75.76				NOT ASSIGNED		
A1R77	0757-0438	3		RESISTOR 5.11K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-5111-F
A1R78	0698-3162	0	1	RESISTOR 46.4K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-4642-F
A1R79	0698-3457	6	1	RESISTOR 316K ±1% .125W TF TC=0±100	12498	CT4
A1R80	0698-4308	8	1	RESISTOR 16.9K ±1% .125W TF TC=0±100	09969	CT4-1/8-T0-1692-F
A1R81	0757-0280	3		RESISTOR 1K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1001-F
A1R82				NOT ASSIGNED		
A1R83	0698-3157	3		RESISTOR 19.6K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1962-F
A1R84	0698-3157	3		RESISTOR 19.6K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1962-F
A1R85	0698-3157	3		RESISTOR 19.6K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1962-F
A1R86	0757-0280	3		RESISTOR 1K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1001-F
A1R87	0757-0442	9		RESISTOR 10K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1002-F
A1R88	0757-0280	3		RESISTOR 1K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1001-F
A1R89	0757-0442	9		RESISTOR 10K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1002-F
A1R90	0757-0442	9		RESISTOR 10K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1002-F
A1R91.92				NOT ASSIGNED		
A1R93	0698-3157	3		RESISTOR 19.6K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1962-F
A1R94				NOT ASSIGNED		
A1R95	0698-0083	8		RESISTOR 1.96K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1961-F
A1R96	0698-0083	8		RESISTOR 1.96K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1961-F
A1R97	0698-0083	8		RESISTOR 1.96K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1961-F
A1R98	0698-0083	8		RESISTOR 1.96K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1961-F
A1R99	0698-0083	8		RESISTOR 1.96K ±1% .125W TF TC=0±100	12498	CT4-1/8-T0-1961-F
A1R100	0757-0294	9	1	RESISTOR 17.8 ±1% .125W TF TC=0±100	19701	5033R-1/8-T0-17R8-F
A1RT1	0837-0007	2	1	THERMISTOR DISC 10K-OHM TC=-4.4%/C-DEG	83186	41D2
A1TP1 - TP10	0360-2050	8	10	CONNECTOR-SGL CONT	28480	0360-2050
A1U1	1826-1048	1	5	IC OP AMP PRCN 8-DIP-C PKG	06665	OP-07CZ
A1U2	1826-1048	1		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-07CZ
A1U3	1826-0962	6	3	IC OP AMP LOW-BIAS-H-IMP DUAL 8-DIP-P	27014	LF412CN
A1U4	1826-1048	1		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-07CZ
A1U5	1826-0962	6		IC OP AMP LOW-BIAS-H-IMP DUAL 8-DIP-P	27014	LF412CN
A1U6	1826-1048	1		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-07CZ
A1U7	1826-1048	1		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-07CZ
A1U8	1826-0962	6		IC OP AMP LOW-BIAS-H-IMP DUAL 8-DIP-P	27014	LF412CN
A1U9				NOT ASSIGNED		
A1U10	1826-1308	6	2	IC V RGLTR-ADJ 5/35V 16-DIP-C PKG	9N171	UC2834J
A1U11	1826-1308	6		IC V RGLTR-ADJ 5/35V 16-DIP-C PKG	9N171	UC2834J
A1U12 - 16				NOT ASSIGNED		
A1U17	1858-0077	1	1	TRANSISTOR ARRAY 14-PIN PLSTC TO-116	04713	MPQ2222P
A1VR1				NOT ASSIGNED		
A1VR2	1902-3071	6	1	DIODE-ZNR 4.22V 2% DO-35 PD=.4W	28480	1902-3071
A1VR3	1902-0041	4	3	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A1VR4	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A1VR5	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A1VR6	1902-0025	4	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1X1	1251-5185	6	9	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	00779	380598-2
A1X2	1251-2313	6	8	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	00779	3-332070-5



Table 5-2. A2 Front Panel Assembly and A3 Microcircuit Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	08347-60002	8	1	FRONT PANEL ASSEMBLY	28480	08347-60002
A2CR1	1901-0050	3	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A2DS1	1990-0453	7	2	LED-LAMP LUM-INT=800UCD IF=50MA-MAX	28480	HLMP-1200
A2DS2	1990-0453	7		LED-LAMP LUM-INT=800UCD IF=50MA-MAX	28480	HLMP-1200
A2J1,2				NOT ASSIGNED		
A2J3	1251-7167	8	1	CONN-POST TYPE .100-PIN-SPCG 10-CONT	28480	1251-7167
A2MP1				NOT ASSIGNED		
A2MP2	5040-8858	3	1	LED STDF STRIP	28480	5040-8858
A2R1	0757-0289	2	1	RESISTOR 13.3K $\pm 1\%$ .125W TF TC=0 $\pm 100$	19701	5033R-1/8-T0-1332-F
A2R2	0698-0083	8	3	RESISTOR 1.96K $\pm 1\%$ .125W TF TC=0 $\pm 100$	12498	CT4-1/8-T0-1961-F
A2R3	0757-0458	7	1	RESISTOR 51.1K $\pm 1\%$ .125W TF TC=0 $\pm 100$	12498	CT4-1/8-T0-5112-F
A2R4	0698-0083	8		RESISTOR 1.96K $\pm 1\%$ .125W TF TC=0 $\pm 100$	12498	CT4-1/8-T0-1961-F
A2R5	2100-4002	6	1	RESISTOR-VAR CONTROL CCP 2K 10% LIN	12697	392
A2R6	0698-0083	8		RESISTOR 1.96K $\pm 1\%$ .125W TF TC=0 $\pm 100$	12498	CT4-1/8-T0-1961-F
A2R7	0698-3157	3	1	RESISTOR 19.6K $\pm 1\%$ .125W TF TC=0 $\pm 100$	12498	CT4-1/8-T0-1962-F
A2U1	1826-0915	9	1	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-C PKG	04713	MC34001BU
A2U2	1826-0655	4	1	IC MISC 18-DIP-P PKG	27014	LM3914N
A2U3	1990-1141	2	1	LED-LAMP ARRAY LUM-INT=600UCD	28480	1990-1141
A2X1	1200-0697	8	1	SOCKET-IC 20-CONT DIP W-WRAP	06776	ICN-203-WB-G



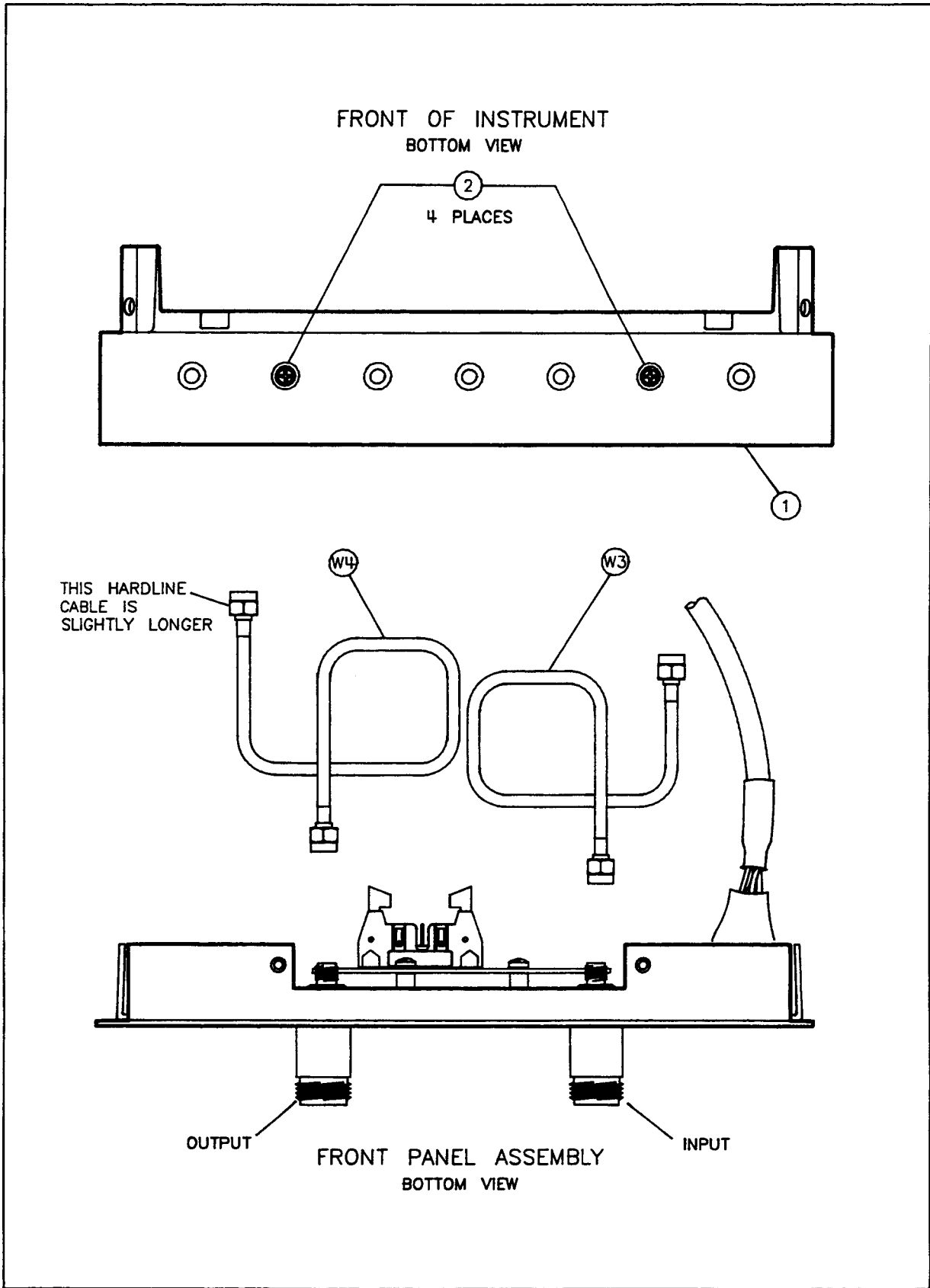


Figure 5-1. Front Panel Attaching Hardware and Hardline Cables

Table 5-3. Front Panel Attaching Hardware and Hardline Cable Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				FRONT PANEL ATTACHING HARDWARE AND HARDLINE CABLES		
W3	08347-20003	5	1	RF CABLE - J1 INPUT	28480	08347-20003
W4	08347-20004	6	1	RF CABLE - J2 INPUT	28480	08347-20004
1	5021-5813	4	1	FRAME, FRONT (SERIAL PREFIX 2816 ONLY)	28480	5021-5813
	5021-8413	6	1	FRAME, FRONT (SERIAL PREFIX 2834 AND ABOVE)	28480	5021-8413
2	0515-0219	6	4	SCREW-MACH M3 X 0.5 6MM-LG 90-DEG-FLH-HD	28480	0515-0219

## REMOVING THE FRONT PANEL

**Tools Required:**

- Large pozidriv screwdriver
- Small pozidriv screwdriver
- Flat blade screwdriver
- 5/16 inch open-end wrench
- Diagonal Cutter

### Procedure

1. Remove top and bottom covers with the large pozidriv screwdriver.
2. Remove the top trim strip (located above the front panel) with the flat blade screwdriver. Place the unit in its normal operating position.
3. Remove the two screws identified as item 2 in Figure 5-1 (identical screws are located on the top and bottom of the unit). Remove the ribbon cable connecting the motherboard to the front panel board.
4. Use the 5/16 inch wrench to loosen the hardline cable nuts at the back of the input and output connectors. Only loosen the nuts, do not remove them from the connector threads completely.
5. Turn the amplifier upside down. Remove the two screws identified as item 2 in Figure 5-1.
6. Using the 5/16 inch wrench, completely loosen the nuts holding the two hardline cables to the microcircuit. Slide the nuts away from the microcircuit threads.
7. Observe the cable going to the line power switch. This cable is tie-wrapped to the inner chassis and has a service connector. Cut the tie wrap and disconnect the service connector.
8. Turn the instrument on its side and push on the front panel from the back.
9. When reassembling, use care when connecting the hardline cables to the microcircuit. Reverse the above steps to reassemble the amplifier.

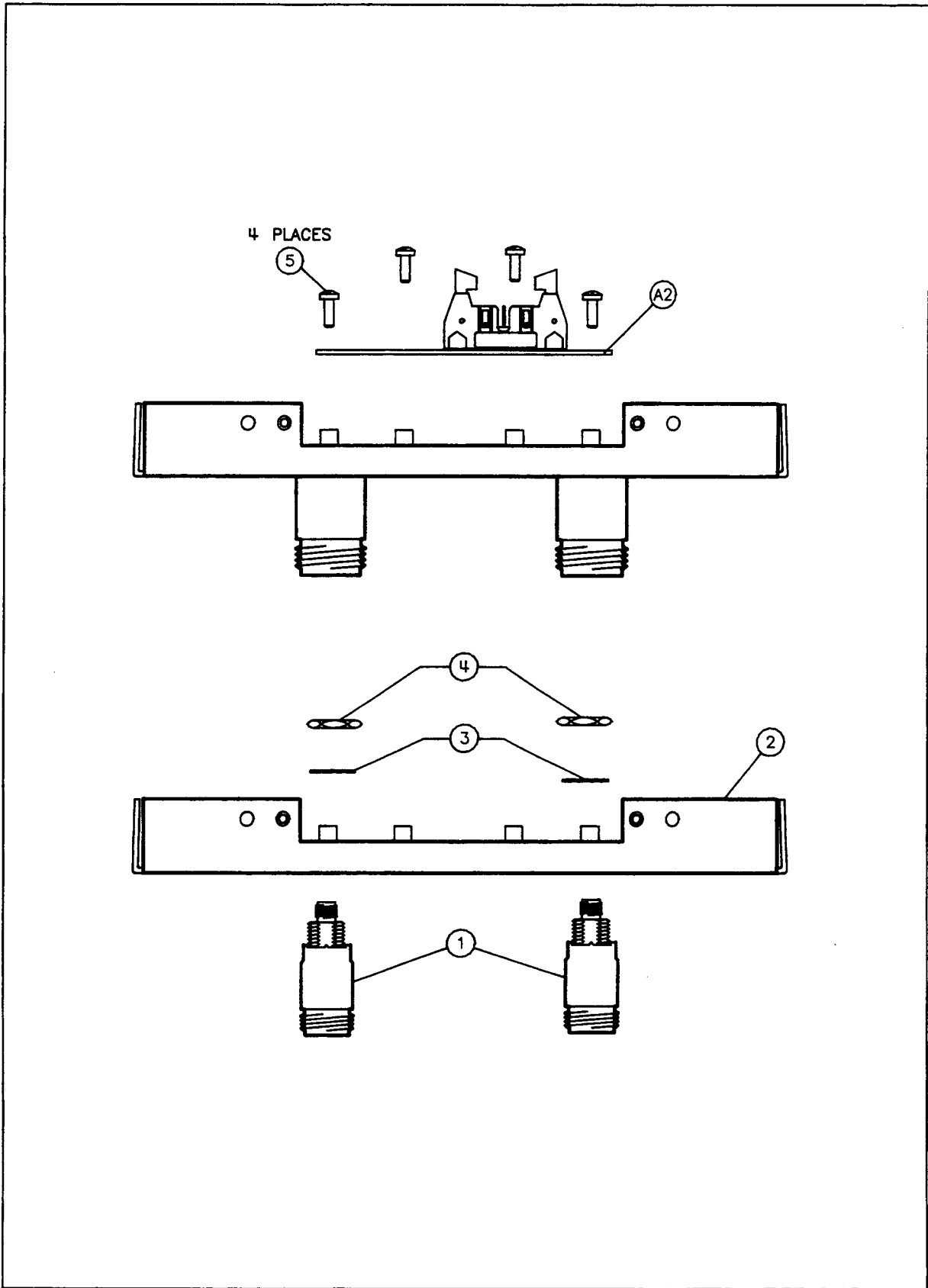


Figure 5-2. Front Panel Connector and A2 Front Panel Board Attaching Hardware

Table 5-4. Front Panel Type-N Connectors and A2 Front Panel Board Attaching Hardware Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				FRONT PANEL TYPE-N CONNECTORS AND A2 FRONT PANEL BOARD ATTACHING HARDWARE		
A2	08347-60002	8	1	BOARD ASSY. FRONT PANEL	28480	08347-60002
1	86290-60005	7	2	CONNECTOR ASSY - TYPE N (J1, J2)	28480	86290-60005
2	08347-00002	2	1	SUB-PANEL-FRONT	28480	08347-00002
3	2190-0104	0	2	WASHER-LK INTL T 7/16 IN .439-IN-ID	78189	1922-04
4	2950-0132	6	2	NUT-HEX-DBL-CHAM 7/16-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
5	0515-1079	8	4	SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION

## REMOVING THE A2 FRONT PANEL BOARD ASSEMBLY

**Tools Required:** 1/16 inch hex wrench  
All tools listed in *Removing the Front Panel*

1. Perform the *Removing the Front Panel* procedure.
2. Remove the front panel knob by loosening the two set screws with a 1/16 inch hex wrench.
3. Remove the four screws holding the A2 assembly to the front panel.

**NOTE:** If you replace one of the A2 assembly's light emitting diodes (LED's) make sure the new LED does not press outward on the vinyl dress panel when the front panel is reassembled.

## REMOVING A FRONT PANEL TYPE-N CONNECTOR

**Tools Required:** 9/16 inch wrench or nut driver  
All tools listed in *Removing the Front Panel*

1. Perform the *Removing the Front Panel* procedure.
2. Completely unscrew the nut which holds the hardline cable to the back of the type-N connector. Remove the hardline cable from the connectors by pulling **straight out**, away from the type-N connector. DO NOT twist or rotate the cable as this will damage its male pin.
3. Remove the type-N connector's nut with a 9/16 inch wrench or nut driver.
4. When replacing the connector, reverse these steps.

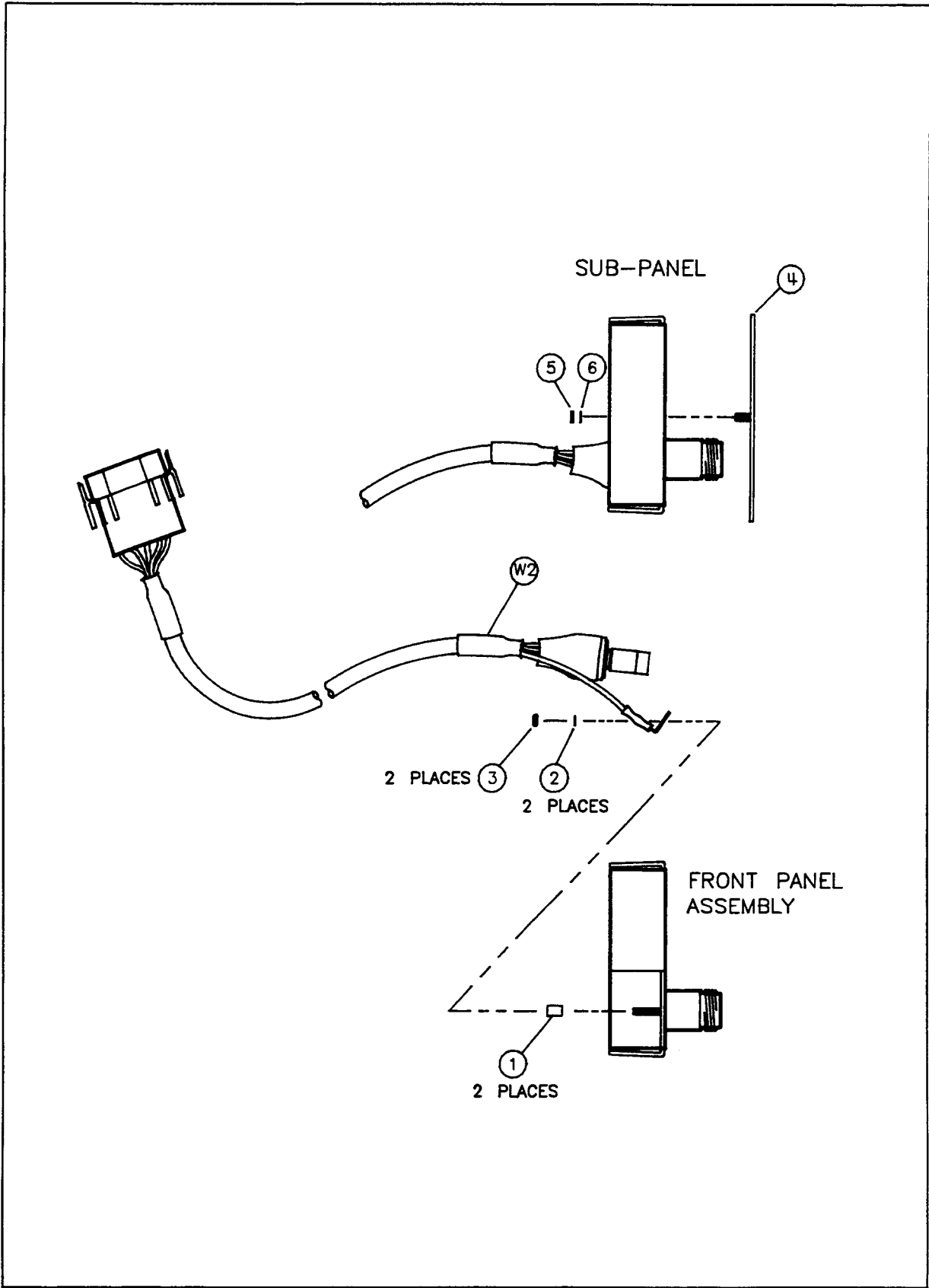


Figure 5-3. Dress Panel, Sub-panel, and Attaching Hardware

Table 5-5. Dress Panel, Sub-panel, and Attaching Hardware Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				DRESS PANEL, SUB-PANEL AND ATTACHING HARDWARE (TO FRONT PANEL)		
W2	08347-60004	0	1	CABLE ASSY - POWER (INCLUDES POWER SWITCH)	28480	08347-60004
1	0380-1400	2	2	SPACER-RND 4-MM-LG 3.4-MM-ID 6-MM-OD AL	28480	0380-1400
2	2190-0014	1	2	WASHER-LK INTL T NO. 2 .089-IN-ID	78189	1902-00-00-2580
3	0610-0001	6	2	NUT-HEX-DBL-CHAM 2-56-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
4	08347-80001	9	1	DRESS PANEL	28480	08347-80001
5	0535-0004	9	2	NUT-HEX DBL-CHAM M3 X 0.5 2.9MM-THK	00000	ORDER BY DESCRIPTION
6	2190-0638	5	2	WASHER-LK INTL T-B 3.0 MM 3.15-MM-ID	28480	2190-0638

## REPLACING THE DRESS PANEL

**Tools Required:** 5.5 mm wrench or nut driver  
 1/16 inch hex wrench  
 All tools required in *Removing the Front Panel*

1. Perform the *Removing the Front Panel* procedure.
2. Loosen the four nuts holding the A2 front panel board assembly in place.
3. Remove the two nuts and washers shown in Figure 5-3 (items 5 and 6).
4. Turn the front panel knob to any power graticule. Remove the knob by loosening the two set screws with a 1/16 inch hex wrench. Do not turn the knob when removing it.
5. Remove the old dress panel and replace it. Reverse the above steps to reassemble the amplifier. When replacing the knob, point it to the power graticule selected in step 3. After the unit is fully assembled, you can use a source and a power meter to roughly calibrate the knob's position.

## REPLACING W2 CABLE/POWER SWITCH ASSEMBLY

**Tools Required:** 3/16 inch wrench or nut driver  
 All tools required in *Removing the Front Panel*

1. Remove the front panel with the instructions in *Removing the Front Panel*.
2. Remove the two nuts and washers shown in Figure 5-3 (items 2 and 3) with the 3/16 inch wrench or nut driver.
3. Replace the cable/power switch assembly. The heat shrink tubing on the new power switch has a white dot on it. The dot should be on the bottom when installing the switch.
4. Reassemble the amplifier.

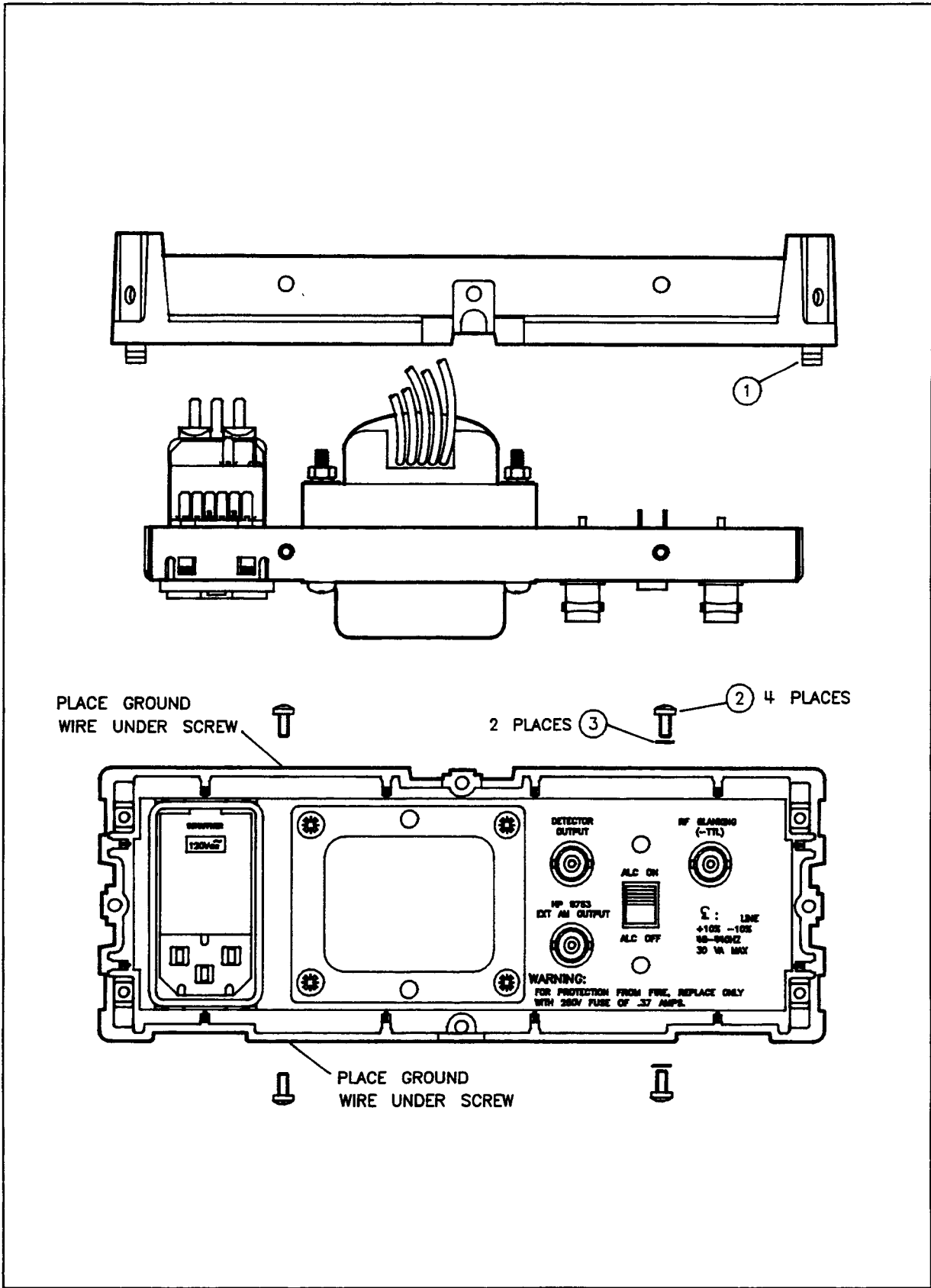


Figure 5-4. Rear Panel Attaching Hardware

Table 5-6. Rear Panel Attaching Hardware Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				REAR PANEL ATTACHING HARDWARE		
1	5021-5814	5	1	FRAMS-REAR	28480	5021-5814
2	0515-0924	0	4	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	28480	0515-0924
3	2190-0005	0	2	WASHER-LK EXT T NO. 4 .116-IN-ID	78189	1804-01

## REMOVING THE REAR PANEL

**Tools Required:** Small pozidriv screwdriver  
Diagonal cutters

1. Remove the top and bottom covers.
2. Remove the ribbon cable that connects the motherboard to the rear panel BNCs. Also remove the power cable that connects the motherboard to the transformer.
3. Remove the four screws and two washers shown as items 2 and 3 in Figure 5-4.
4. Remove both side-panels.
5. Turn the amplifier upside down. Observe the power cable connecting the line module to the front panel power switch. The cable is tie-wrapped to the inner chassis and has a service connector. Cut the tie wrap and separate the connector halves. Push the rear panel out.

**NOTE:** Major rear panel components are described on the next page, along with replacement procedures.



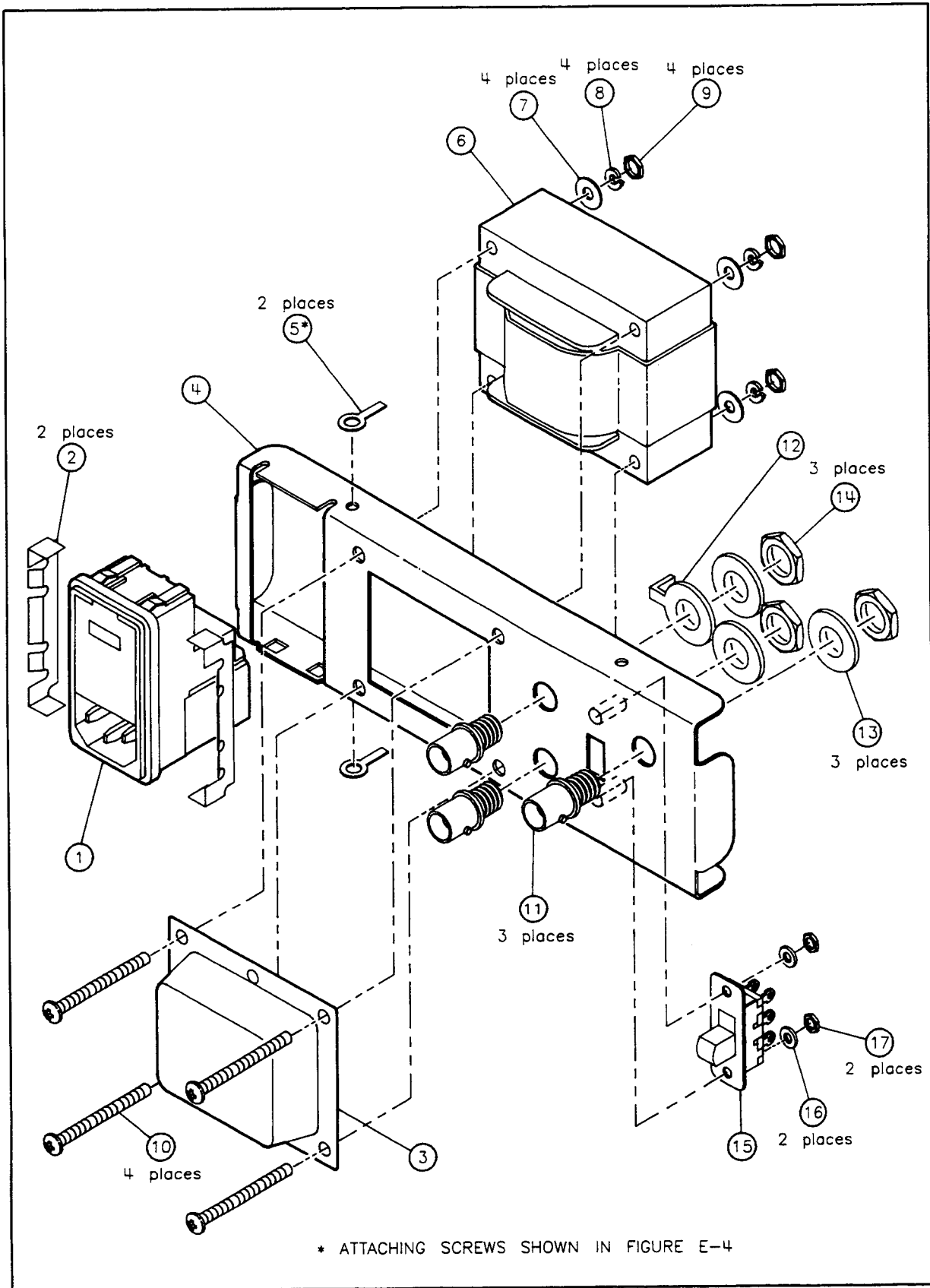


Figure 5-5. Rear Panel Major Components

Table 5-7. Rear Panel Major Component Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				REAR PANEL HARDWARE		
1	9135-0217	7	1	LINE MODULE-FILTERED AC WORKING VOLTAGE	S4307	FN 370-6/22
2	5001-3907	1	2	RETAINER-PWR MOD	28480	5001-3907
3	7100-0389	9	1	TRANSFORMER COVER .62-IN-DP	28480	7100-0389
4	08347-00003	3	1	PANEL-REAR	28480	08347-00003
5	0360-0016	2	2	TERMINAL-SLDR LUG LK-MTG FOR-#4-SCR	79963	523
6	9100-4738	2	1	XFMR-PWR 100/120/220/240V	28480	9100-4738
7	3050-0227	3	4	WASHER-FL MTLCL NO. 6 .149-IN-ID	80120	AN960C-6
8	2190-0586	2	4	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
9	2420-0002	6	4	NUT-HEX-DBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
10	2360-0135	8	4	SCREW-MACH 6-32 1.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
11	1250-0118	3	3	CONNECTOR-RF BNC FEM SGL-HOLS-FR 50-OHM	05876	31-2221-1022
12	0360-1190	5	1	TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	79963	720-380H
13	2190-0016	3	3	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
14	2950-0001	8	3	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
15	3101-0110	2	1	SWITCH-SL DPDT STD .5A 125VAC/DC	82389	11A-1039B
16	2190-0584	0	2	WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
17	0535-0004	9	2	NUT-HEX DBL-CHAM M3 X 0.5 2.9MM-THK	00000	ORDER BY DESCRIPTION

## REMOVING THE TRANSFORMER, ALC SWITCH, OR BNC CONNECTORS

Removing the transformer, ALC switch, or a BNC connector is easy and straightforward. Nuts hold each of these components in place. Here is a list of tools you will need to remove the different nut types:

- Transformer Nut — 5/16 inch wrench or nut driver
- BNC Nut — 1/2 inch wrench or nut driver
- ALC Switch Nut — 5.5 mm wrench

Replacement transformers are shipped with the 8-pin motherboard connector attached.

## REMOVING THE LINE MODULE

**Tools/Parts Required:**

- 5/16 inch wrench or nut driver (to remove transformer)
- Flat blade screwdriver
- Long nose pliers
- Razor knife
- Soldering Iron
- All tools required in *Removing the Rear Panel*

1. Perform the *Removing the Rear Panel* procedure.

2. Cut off the existing heat shrink tubing and desolder the wires going to the line module. If you look closely at the line module you will see letter designators next to most connectors. Use the following guide when later replacing the wires:

A = black/orange

B = gray

C = black

D = black/green

E = black/yellow

F = black/red and white/gray

G = brown/white/gray

P = white/gray/red

3. Remove the four transformer nuts with a 5/16 inch wrench. Remove the transformer screws, cover, and transformer.
4. With a flat blade screwdriver, pry the metal retainer clip away from the line module; lay them over at a 90° angle.
5. Place the screwdriver under one clip and pry up until the clip comes loose. Repeat for both clips.
6. Find the two rectangular holes in the rear panel under the line module. Press a flat blade screwdriver into each hole alternately while applying pressure to push the line module out. Continue until that end of the line module is free of the mounting hole.
7. Pry the other end of the line module out with the small screwdriver.

#### **IMPORTANT**

**When inserting a new line module, its power cord socket should be on the bottom of the rear panel.**

8. To install the new line module, press the retaining clips onto each side of the module and insert it through the mounting hole. Put new heat shrink tubing over each wire and resolder them using the above guide. Use a heat gun to shrink the tubing over the solder joints.
9. Reassemble the amplifier. Remember to mount the transformer cover before attaching the transformer.

**NOTE:** The transformer cover has the serial tag mounted to it.

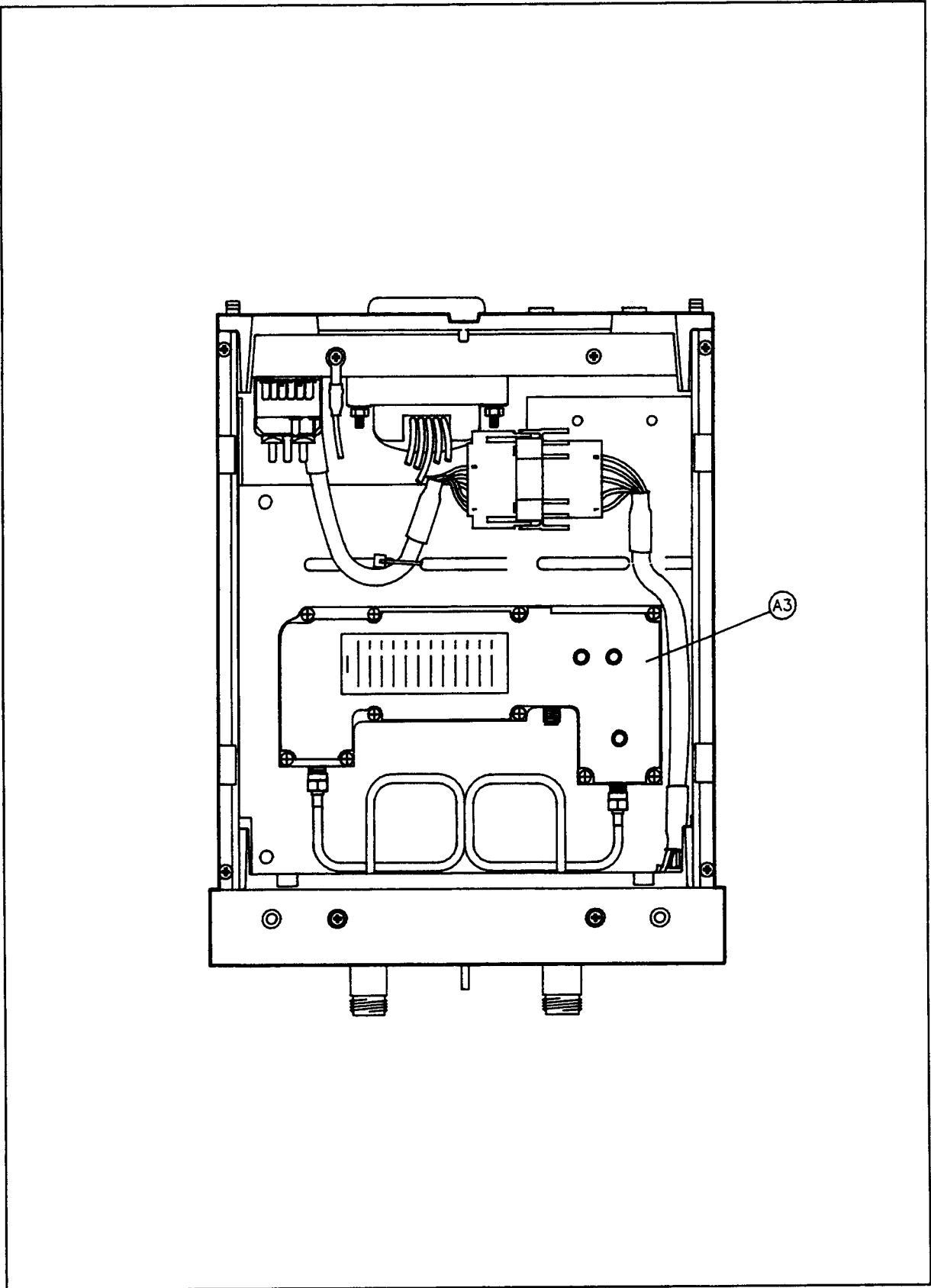


Figure 5-6. A3 Microcircuit Attaching Hardware (1 of 2)

A1 MOTHERBOARD  
TOP VIEW

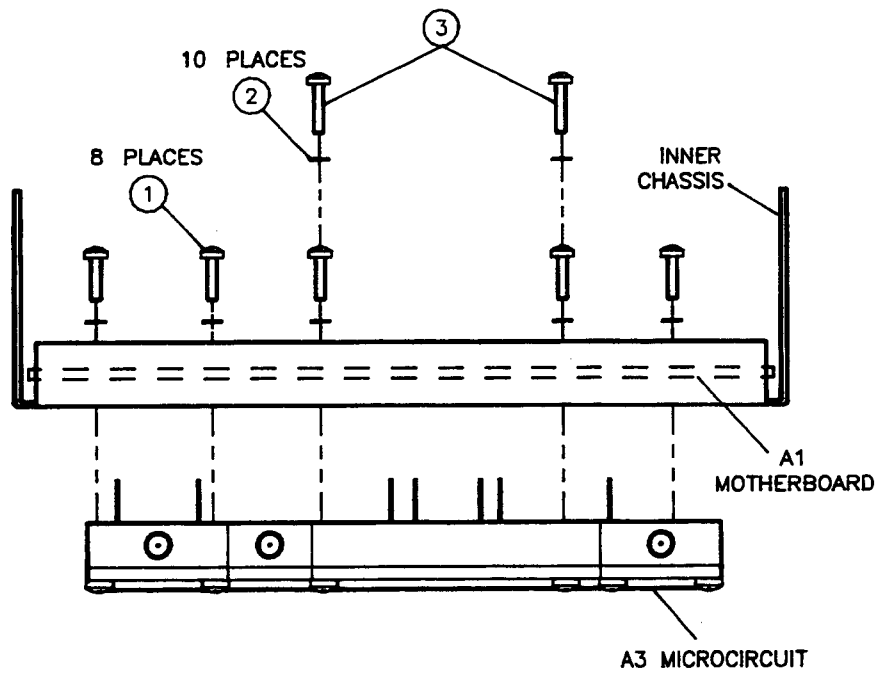
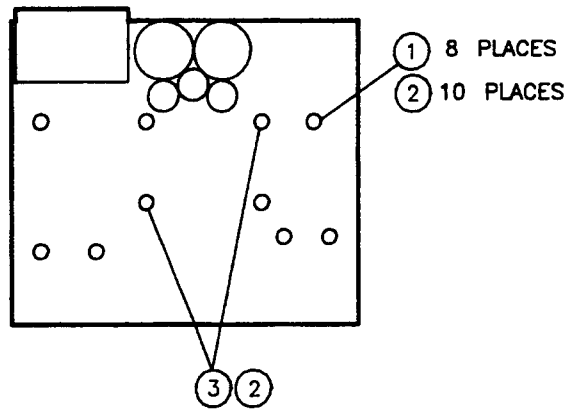


Figure 5-6. A3 Microcircuit Attaching Hardware (2 of 2)

**Table 5-8. A3 Microcircuit Attaching Hardware Replaceable Parts**

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	08347-60013		1	A3 MICROCIRCUIT AND ATTACHING HARDWARE AMPLIFIER KIT (NEW)	28480	08347-60013
	08347-60012			REBUILT EXCHANGE AMPLIFIER KIT	28480	08347-60012
1	0515-0925	1	8	SCREW-MACH M3 X 0.5 10MM-LG PAN-HD	82480	0515-0925
2	2190-0584	0	10	WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
3	0515-0911	5	2	SCREW-MACH M3 X 0.5 12MM-LG PAN-HD	28480	0515-0911

## REMOVING THE A3 MICROCIRCUIT

**Tools Required:**

- Small pozidriv screwdriver
- Long nose pliers
- 5/16 inch wrench
- Anti-static wrist strap and bench mat

**Caution** Use anti-static precautions when performing this procedure! A grounded anti-static wrist strap and bench mat are highly recommended.

1. Remove the top and bottom covers.
2. Remove the 10 screws shown in Figure 5-6. Pick up the screws and lock washers with the long nose pliers and set them aside. Place the two screws (item 3) in a separate location so they are not confused with the eight (item 1) screws.
3. Loosen the hardline cable nuts at the front panel type-N connectors.
4. Turn the amplifier upside down. Remove the microcircuit's input and output hardline cable nuts (with a 5/16 inch wrench) and slide them away from the microcircuit.
5. Carefully pull the hardline cables out of the microcircuit connectors. Gently lift up the microcircuit and set aside. Set the microcircuit with the connection pins facing up. Do *not* touch the connection pins!

**Note** If you are removing the A3 microcircuit as a sub-step of the *Removing the A1 Motherboard* procedure, return to that procedure now.

6. To install the new microcircuit, carefully align the connection pins with the sockets on the motherboard and press firmly. (Alignment may be better assured by removing the rear panel and looking between the motherboard and the A3 microcircuit.)
7. Hold the microcircuit in place with one hand and turn the amplifier over. While holding the microcircuit up, replace all of its screws.
8. Reattach the hardline cables and tighten all four hardline cable nuts. Reassemble the HP 8347A.

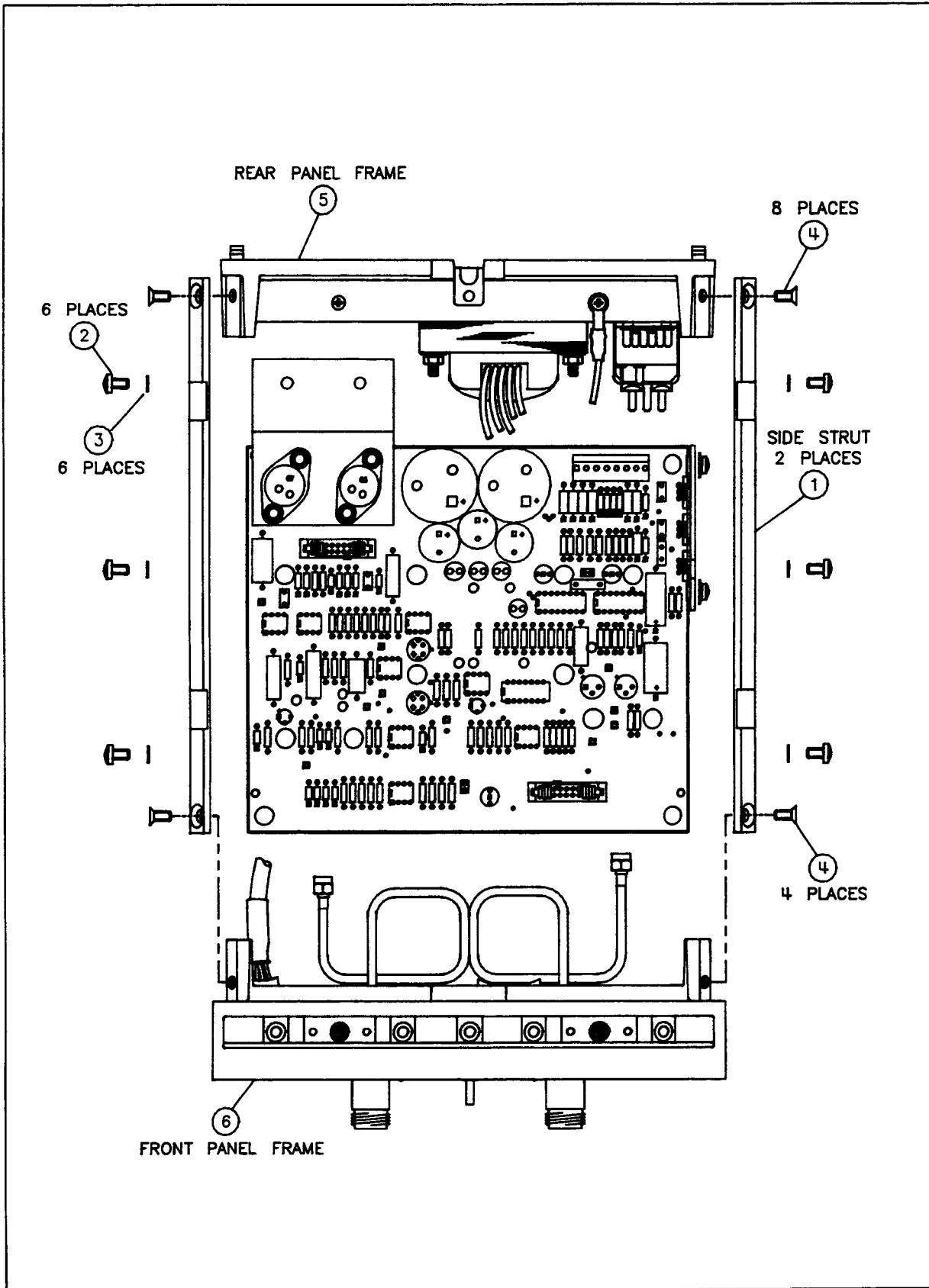


Figure 5-7. Chassis Frame Components and Attaching Hardware

Table 5-9. Chassis Frame Components and Attaching Hardware Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS FRAME AND ATTACHING HARDWARE		
1	5021-5829	2	1	SIDE STRUT	28480	5021-5829
2	0515-0915	9	6	SCREW-MACH M4 X 0.7 6MM-LG PAN-HD	28480	0515-0915
3	2190-0586	2	6	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
4	0515-1012	9	8	SCREW-MACH M4 X 0.7 8MM-LG 90-DEG-FLH-HD	28480	0515-1012
5	08347-60005	1	1	CABLE ASSY 10C FLAT RIBBON	28480	08347-60005
6				FRONT PANEL FRAME - SEE TABLE 5-3.		

## REMOVING THE FRONT PANEL FRAME

**Tools Required:** All tools required in *Removing the Front Panel*

1. Perform the *Removing the Front Panel* procedure. Also remove the outer side panels.
2. Refer to Figure 5-7. Remove the four (item 4) screws holding on the front panel. Push each corner of the front frame until it comes off. Reverse this procedure to attach the new frame.

## REMOVING THE REAR PANEL FRAME

**Tools Required:** All tools required in *Removing the Rear Panel*

1. Perform the *Removing the Rear Panel* procedure. Also remove the outer side panels.
2. Refer to Figure 5-7. Remove the four (item 4) screws holding on the rear panel frame. Push each corner of the rear frame until it comes off. Reverse this procedure to attach the new frame.

## REMOVING A SIDE STRUT

**Tools Required:** 2 Point Posidriv screwdriver

1. Remove top covers, bottom covers, and outer side panels. Remove all screws holding on the desired side panel. Each side panel has seven screws holding it in place —one in each corner (item 4) and three near the top edge (item 2). Refer to Figure 5-7.



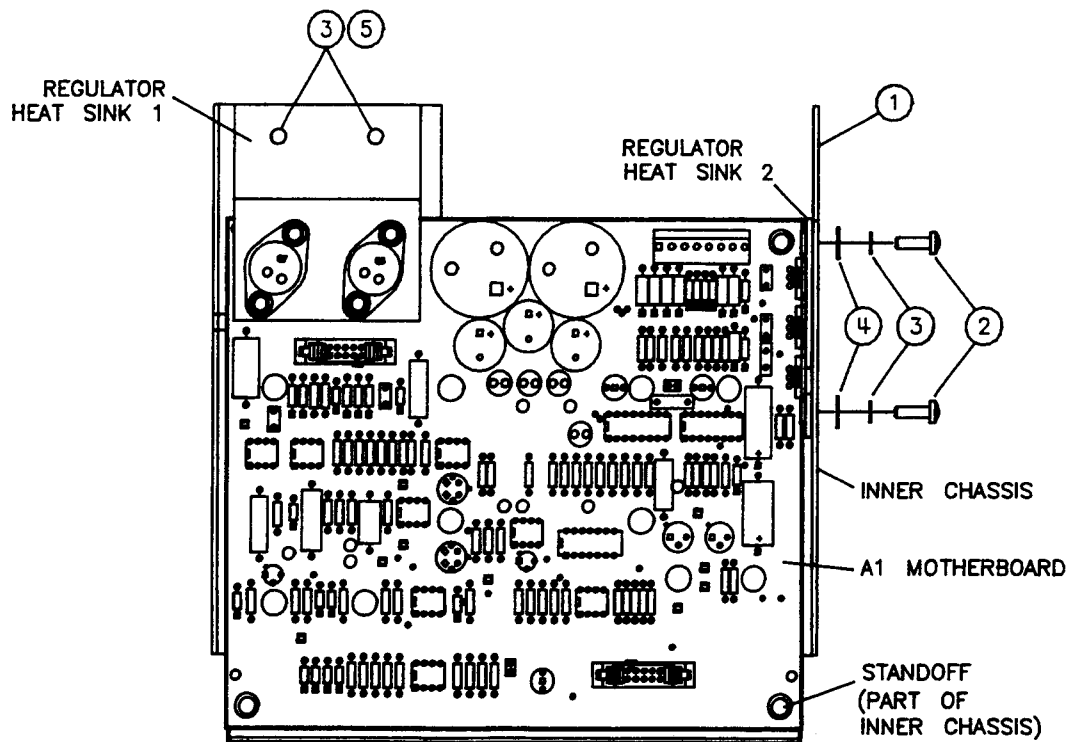


Figure 5-8. A1 Motherboard and Inner Chassis Attaching Hardware

Table 5-10. A1 Motherboard and Inner Chassis Attaching Hardware Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MOTHERBOARD AND INNER CHASSIS ATTACHING HARDWARE		
1	08347-00006	6	1	INNER CHASSIS	28480	08347-00006
2	0515-0917	1	2	SCREW-MACH M3.5 X 0.6 10MM-LG PAN-HD	28480	0515-0917
3	2190-0586	2	4	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
4	3050-0139	6	2	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
5	0515-0918	2	2	SCREW-MACH M3.5 X 0.6 6MM-LG PAN-HD	28480	0515-0918

## REMOVING THE A1 MOTHERBOARD

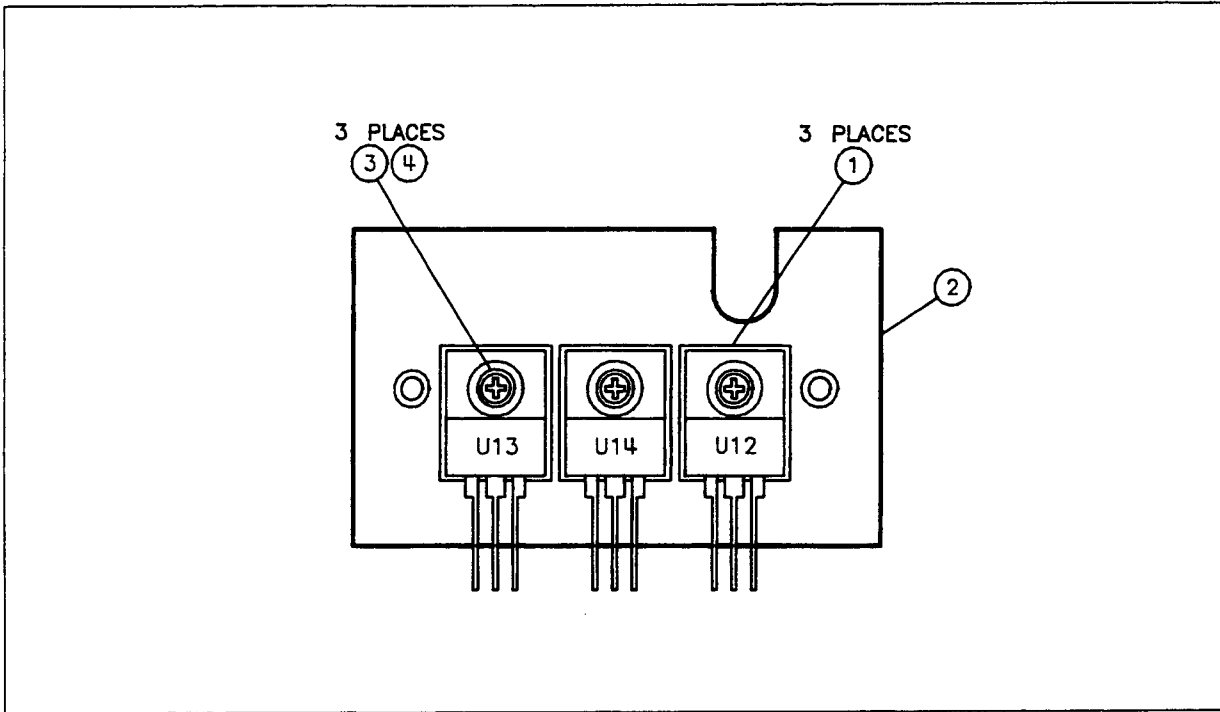
### Tools Required:

Large pozidriv screwdriver  
 All tools required in *Removing the A3 Microcircuit*  
 Small flat blade screwdriver  
 Soldering iron and anti-static solder removal tool



**Use anti-static precautions when performing this procedure!**

1. Perform the *Removing the A3 Microcircuit* procedure. Also remove the right side cover (as seen from the front).
2. Remove all cables attached to the motherboard.
3. Remove the four screws shown in Figure 5-8 as items 2 and 5.
4. Use the small flat blade screwdriver to pry regulator heat sink #2 about 10 degrees away from the side strut.
5. Remove the A1 motherboard. Pry the front-left corner up by inserting a small screwdriver through the hole in the front-left corner of the motherboard and pry upward. If replacing the Motherboard, desolder U12, U13, and U14 shown in Figure 5-9 (attached to regulator heat sink #2). Solder the U12, U13, U14 assembly to the new motherboard.
6. To reinstall the motherboard: Move all cables out of the way and press the motherboard firmly onto the inner chassis standoffs. Replace screws (items 2 and 5), along with related washers. Reattach all motherboard cables.
7. Turn the motherboard over. Carefully align the A3 microcircuit's connection pins with the sockets on the motherboard. Press firmly. (Alignment may be better ensured by removing the rear panel and looking between the motherboard and the A3 Microcircuit.)
8. Hold the microcircuit in place with one hand and turn the amplifier over. While holding the microcircuit up, replace all of its screws.
9. Reattach the hardline cables and tighten all four hardline cable nuts. Reassemble the amplifier.



**Figure 5-9. U12, U13, U14 and Attaching Hardware**

Table 5-11. U12, U13, U14 and Attaching Hardware Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				U12, U13, U14 AND ATTACHING HARDWARE		
U12	1826-0106	0	1	IC V RGLTR-FXD-POS 14.4/15.6V TO-220 PKG	07263	UA7815UC
U13	1826-0277	6	1	IC V RGLTR-FXD-NEG 14.4/15.6V TO-220 PKG	27014	LM320T-15
U14	1826-0393	7	1	IC V RGLTR-ADJ-POS 1.2/37V TO-220 PKG	27014	LM317T
1	0340-0949	8	3	INSULATOR-XSTR THRM-CNDCT	18565	60-11-5791-1674
2	08347-00005	5	1	HEATSINK-SIDE	28480	08347-00005
3	1200-0081	4	3	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
4	0515-0905	7	3	SCREW-MACH M2.5 X 0.45 6MM-LG PAN-HD	28480	0515-0905

## REPLACING U12, U13, or U14

### Tools Required

Diagonal cutters  
 Pozidrive screwdriver  
 Soldering iron and anti-static solder removal tool

1. Remove the top cover and right side cover (as seen from the front).
2. Cut the leads of the faulty regulator and remove the screw holding it in place.
3. Heat the solder pads and remove the cut regulator pins.
4. Clear the solder holes. Cut the lead lengths in the new regulator to precisely 12 mm and insert them into the motherboard holes.
5. Screw the regulator to the heat sink.
6. Solder the regulator leads in place.
7. Replace the side and top covers.

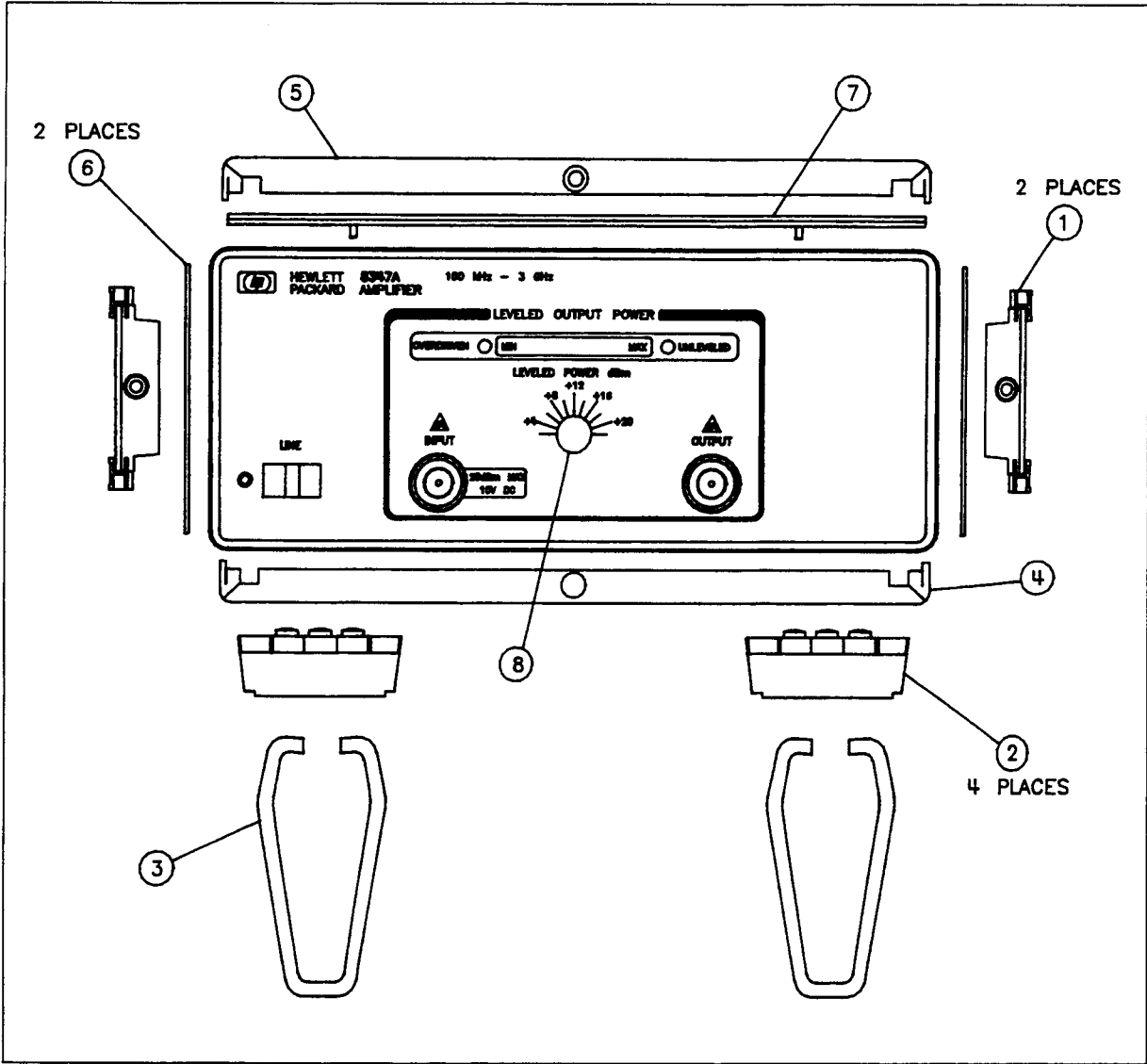


Figure 5-10. Knob, Covers, Feet, and Trim Hardware

Table 5-12. Knob, Covers, Feet, and Trim Hardware Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				COVERS, FEET, AND TRIM HARDWARE		
1	5061-9504	2	2	SIDE COVER (SERIAL PREFIX 2816 ONLY)	28480	5061-9504
	5062-3804	5	2	SIDE COVER (SERIAL PREFIX 2834 AND ABOVE)	28480	5062-3804
2	5040-7201	8	4	BOTTOM FOOT (SERIAL PREFIX 2816 ONLY)	28480	5040-7201
	5041-8801	8	4	BOTTOM FOOT (SERIAL PREFIX 2834 AND ABOVE)	28480	5041-8801
3	1460-1345	5	2	TILT STAND SST	28480	1460-1345
4	5061-9440	5	1	BOTTOM COVER (SERIAL PREFIX 2816 ONLY)	28480	5061-9440
	5062-3836	3	1	BOTTOM COVER (SERIAL PREFIX 2834 AND ABOVE)	28480	5062-3886
5	5061-9428	9	1	TOP COVER (SERIAL PREFIX 2816 ONLY)	28480	5061-9428
	5062-3728	2	1	TOP COVER (SERIAL PREFIX 2834 AND ABOVE)	28480	5062-3728
6	5001-0438	7	2	SIDE TRIM (SERIAL PREFIX 2816 ONLY)	28480	5001-0438
	5001-0538	8	2	SIDE TRIM (SERIAL PREFIX 2834 AND ABOVE)	28480	5001-0538
7	5040-7203	0	1	TOP TRIM (SERIAL PREFIX 2816 ONLY)	28480	5040-7203
	5041-8803	0	1	TOP TRIM (SERIAL PREFIX 2834 AND ABOVE)	28480	5041-8803
8	0370-1097	2	1	KNOB	28480	0370-1097

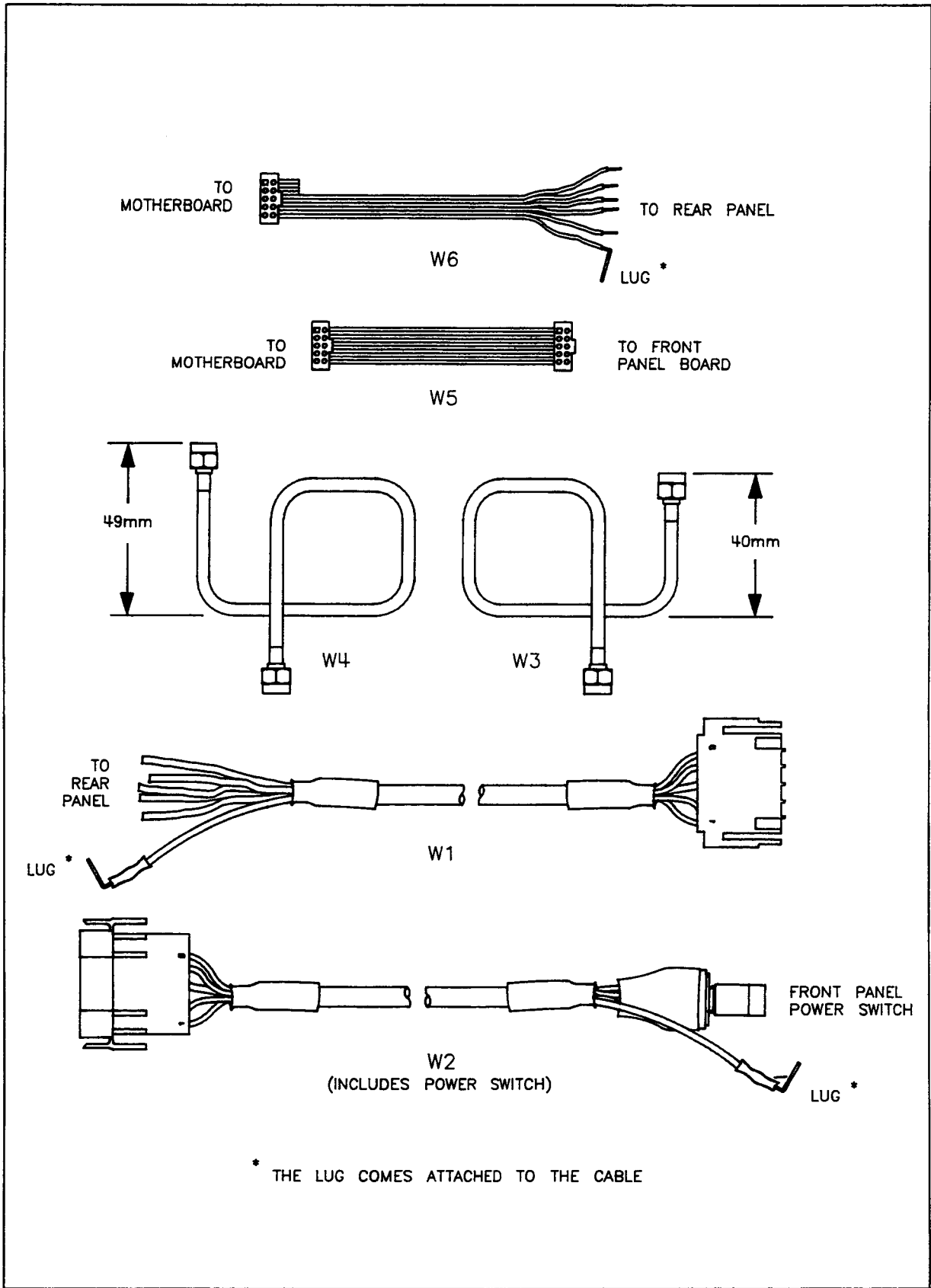


Figure 5-11. Instrument Cables

Table 5-13. Instrument Cable Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				INSTRUMENT CABLES		
W1	08347-60007	3	1	REAR PANEL AC POWER TO POWER DISCONNECT	28480	08347-60007
W2	08347-60004	0	1	POWER DISCONNECT TO FRONT PANEL AC SWITCH	28480	08347-60004
W3	08347-20003	5	1	RF CABLE - J1 INPUT	28480	08347-20003
W4	08347-20004	6	1	RF CABLE - J2 OUTPUT	28480	08347-20004
W5	08347-60005	1	1	RIBBON CABLE, A1J3 TO A2J3	28480	08347-60005
W6	08347-60008	4	1	RIBBON CABLE A1J2 TO REAR PANEL	28480	08347-60008

Table 5-14. Manufacturer's Code Cross Reference

Mfr's Code	Manufacturer	City	City/Country	Zip Code
D8439	ROEDERSTEIN/RESISTA GMBH	LANDSHUT	GM	8300
K8479	HOLSWORTHY ELECTRONICS LTD	HOLSWORTHY	EG	
S4307	SCHAFFNER AG	LUTERBACH	SW	
00000	ANY SATISFACTORY SUPPLIER			
00494	ADDRESSOGRAPH FARRINGTON	TREVOSE	PA	44117
00779	AMP INC	HARRISBURG	PA US	17111
01686	RCL ELECTRONICS INC	NORTHBROOK	IL US	60062
04713	MOTOROLA INC	ROSELLE	IL US	60195
05876	U S POLYMERIC INC	STAMFORD	CT	06904
06665	PRECISION MONOLITHICS INC	SANTA CLARA	CA US	95054
06776	ROBINSON NUGENT INC	NEW ALBANY	IN US	47150
07263	FAIRCHILD SEMICONDUCTOR CORP	CUPERTINO	CA US	95014
09969	DALE ELECTRONICS INC	YANKTON	SD US	57078
11983	NORTRONICS CO INC	MINNEAPOLIS	MN	55427
12474	BEL-RAY CO INC	FARMINGDALE	NJ	07727
12498	CRYSTALONICS, DIV TELEDYNE	CAMBRIDGE	MA	02140
12697	CLAROSTAT MFG CO INC	DOVER	NH US	03820
13103	THERMALLOY INC	DALLAS	TX US	75234
16428	COOPER INDUSTRIES INC	HOUSTON	TX US	77210
18565	CHOMERICS INC	WOBURN	MA	01801
18873	DUPONT E I DE NEMOURS & CO	WILMINGTON	DE US	19801
19701	MEPCO/CENTRALAB INC	WEST PALM BEACH	FL US	33407
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA US	95052
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
46384	PENN ENGINEERING & MFG CORP	DOYLESTOWN	PA US	18901
55285	BERGQUIST CO	MINNEAPOLIS	MN	55420
56289	SPRAGUE ELECTRIC CO	LEXINGTON	MA US	02173
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN	IL	60126
79963	ZIERICK MFG CO	MT KISCO	NY	10549
80120	SCHNITZER ALLOY PRODUCTS CO	ELIZABETH	NJ	07206
82389	SWITCHCRAFT INC	CHICAGO	IL US	60630
83186	VICTORY ENGINEERING CORP	SPRINGFIELD	NJ US	07081
9N171	UNITRODE CORP	LEXINGTON	MA US	02173
91637	DALE ELECTRONICS INC	COLUMBUS	NE US	68601





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- 6-1 When Disassembling the HP 8347A
- 6-2 Printed Circuit Board Markings
- 6-2 Theory of Operation
- 6-5 Initial Troubleshooting
- 6-6 Symptomatic Troubleshooting Procedures
- 6-9 Basic Component Symbology
- 6-10 A1 Component Location Diagram
- 6-11 A2 Component Location Diagram and Schematic
- 6-12 Instrument Wiring

### INTRODUCTION

This section provides instructions for troubleshooting the HP 8347A RF amplifier. Repair procedures are integrated into the Replaceable Parts section.

### WHEN DISASSEMBLING THE HP 8347A



**When working inside the amplifier, be very careful not to touch any of the exposed pins coming from the A3 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 ground strap. Never touch the center contacts of the RF connectors without static protection.**

**Always take antistatic precautions when servicing the HP 8347A. An anti-static wrist strap and bench mat are recommended. If replacing components on a circuit board, use an anti-static solder removal tool and a soldering iron with a grounded tip.**

## Semi-rigid Cables

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

## PRINTED CIRCUIT BOARD MARKINGS

A printed circuit board shows proper component polarity with a square pad. Table 6-1 shows the proper component terminal to place in the square pad.

*Table 6-1. Component Terminals to be Placed in Square PC Board Pads*

Component	Terminal	Component	Terminal
Diode	Cathode	I.C.	Pin 1
Transistor	Emitter	Connector	Pin 1
FET	Source	Capacitor	Positive Side

## THEORY OF OPERATION

Figure 6-1 shows the block diagram of the HP 8347A amplifier.

### Overview

HP 8347A internal leveling is controlled by a negative feedback loop. This loop contains a forward path, and feedback path, and a summing node where the two signals are compared.

The forward path includes the reference, integrator, shaping, variable attenuator, amplifier, and the coupler through arm.

The feedback path includes the coupled arm of the directional coupler, the diode detector, the A1 input buffer, and the A1 log amp.

The summing node detects any imbalance between the forward path and feedback path. When this occurs, the output of the integrator will change, changing the value of the variable attenuator. The variable attenuator changes the output power, bringing the loop back into balance.

### Main RF Path (A3 Microcircuit)

The main RF Path is through the A3 Microcircuit. This device is composed of the following devices:

- Variable Attenuator
- Amplifier
- Coupler/Diode Detector

The gain of the amplifier is fixed. The variable attenuator actually controls the output power by limiting the power sent to the amplifier.

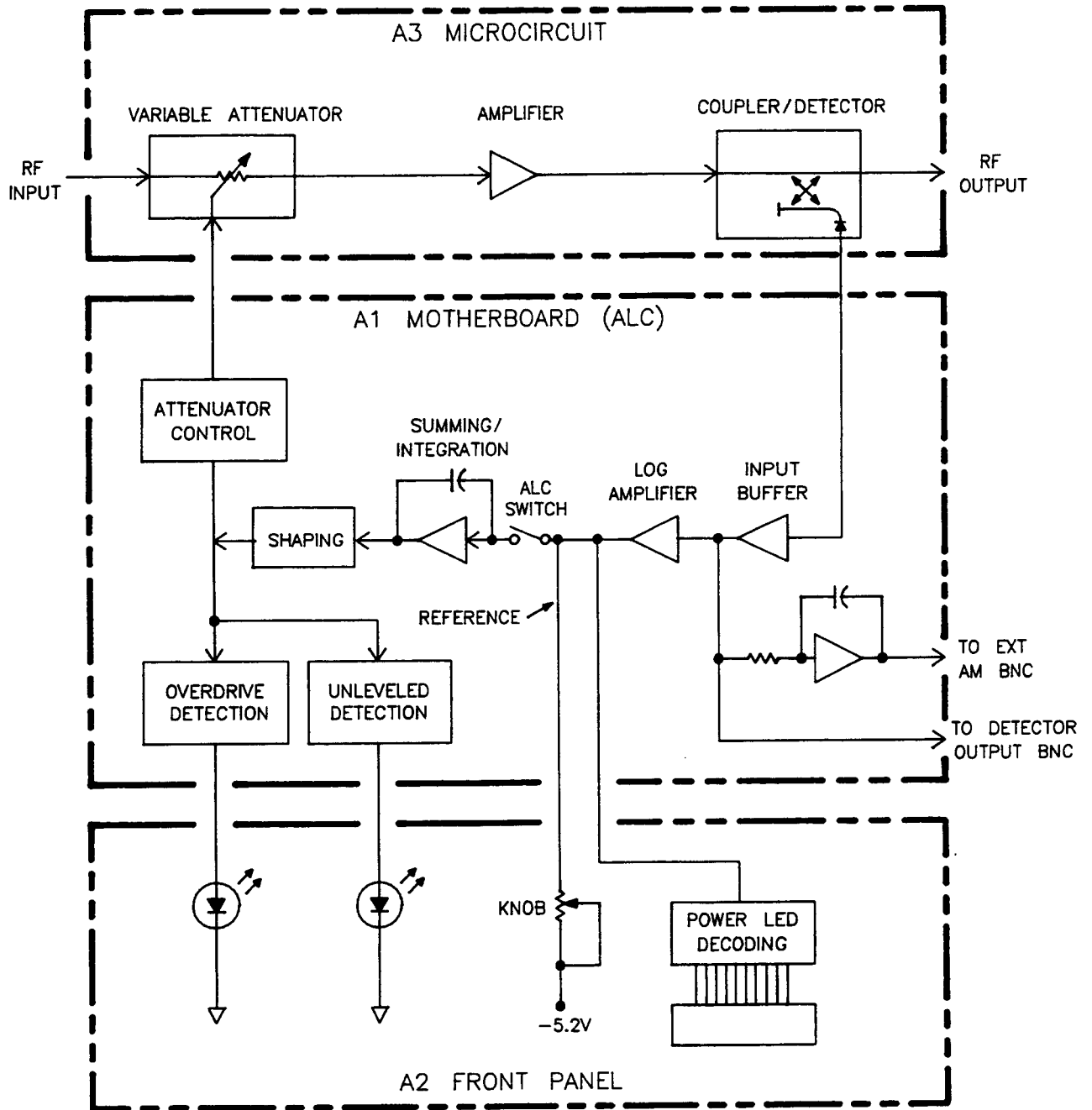


Figure 6-1. HP 8347A Block Diagram

**Variable Attenuator.** This device is driven by two DC control voltages and attenuates the RF signal accordingly.

**Amplifier.** Typical gain of the A3 microcircuit is approximately +37 dB. Due to losses throughout the A3 microcircuit, overall gain is typically +30 dB.

**Coupler/Detector.** The final stage of the A3 microcircuit is the coupler. This device samples the RF power output of the amplifier with a negative diode detector. The output of the detector is input to the A1 motherboard's Input Buffer block (Pin E1). Leveled power flatness is affected most by the characteristics of the coupler.

**NOTE:** The detector output signal is a nonlinear function of the HP 8347A output power. This signal is used by the ALC (automatic leveling control) to monitor and correct the output power. In later descriptions this signal is referred to as the "feedback signal".

## **Automatic Leveling Control (ALC) Path**

The automatic leveling control compares output power with a reference and changes the variable attenuator such that power remains leveled at a selected value. The reference circuit is controlled by the front panel knob. When reading the following theory, remember that the ALC works by controlling the variable attenuator.

**Input Buffer.** The microcircuit coupler/detector samples the output power and sends the power level signal to this buffer circuit. This circuit prevents circuit loading. The buffered feedback signal is sent to the log amp (main path), as well as to the external AM circuit. The external AM circuit creates a DC offset voltage which is sent to the external AM BNC. The external AM signal may be used to extend the dynamic range of an HP 8753A/B.

**Logarithmic Amplifier (log amp).** The feedback signal varies with output power, but it does so in a nonlinear way. This is because it is generated by a diode detector. The log amp provides the integrator with a current that tracks output power in a linear way. Log amp characteristics are set by the input resistor and the amount of current biased through the transistor. The output of the log amp is sent to the ALC switch (main feedback path), and to the front panel power level display circuitry.

**ALC Switch.** This switch turns automatic leveling on or off. When open, ALC operation is turned off and the variable attenuator is set to 5 dB (its minimum setting). When the ALC switch is closed ALC operation is on, and the feedback signal is sent to the Summing/Integration circuit (main feedback path).

**Summing/Integration.** The summing/integration circuit sums the negative feedback signal current with a positive current from the reference circuit. The reference circuit is controlled by the front panel knob. In a steady-state condition, the power feedback current and the reference current are equal and opposite. In this state no current flows to the integrator. When an imbalance occurs, current flows through the integrator, producing a DC voltage on its output. This voltage is sent to the shaping circuit and ultimately controls the variable attenuator.

**Shaping.** The variable attenuator requires drive voltages which are nonlinear. The shaping circuit modifies the output of the integrator as necessary. The output of this circuit is sent to the attenuator control circuit, and overdriven/unleveled detection circuits.

**Attenuator Control.** The shaped attenuator control voltage is converted to a pair of control voltages required by the variable attenuator.

## **Power Supply Interdependency**

To protect the microcircuit, the  $-5.2\text{V}$  supply must be on before the  $+15\text{VA}$  supply will operate.

## **Front Panel Circuitry**

The front panel contains a bar graph display, power control knob, unleveled LED, and overdriven LED.

**Bar Graph.** This display contains ten segments that show the relative RF output power of the HP 8347A. A custom I.C. on the A2 front panel board drives the bar graph.

**Overdriven LED.** Indicates that the requested output power can not be supplied because the input power is too high. The attenuator cannot reduce the incoming signal any further. This normally occurs when the input power exceeds the requested output power.

**Unleveled LED.** The unleveled LED will come on when the HP 8347A can not provide leveled power at the requested level. This normally occurs when a very low input power is supplied to the HP 8347A while the knob is set for a large output power. The difference between input power and requested output power should not exceed the gain specification.

## INITIAL TROUBLESHOOTING

Troubleshooting is primarily to assembly level. However, basic component-level information is also supplied.

### 1. Make Sure the AC Mains Power Cord Ground Terminal is Connected to Earth Ground

The HP 8347A can be damaged if the ground terminal is not connected to earth ground before use. If this has occurred, suspect a microcircuit failure. Refer to *Symptomatic Troubleshooting Procedures* to verify a failed microcircuit before replacing it.

### 2. Check the Line Voltage Selector and Main Fuse

Make sure the line voltage selector is set to the appropriate voltage and check the main fuse with an ohm meter.

### 3. Check the Power Supplies and Motherboard Fuses

Check the voltages in the following chart by measuring the A1 test points listed. If one has failed, check the motherboard fuse shown in the chart with an ohm meter. (Fuse position is shown in Figure 6-3, A1 Motherboard Component Location Diagram.)

A1 Test Point	Power Supply	Lower Limit	Upper Limit	Fuse
6	-5.2V	-5.0V	-5.4V	F1
7	+15VA*	+14.3V	+15.7V	F2
8	+15VB	+13.8V	+16.2V	F2
9	-15VB	-13.8	-16.2	F3
10	+22V	+24.0V	+20.0V	F4

\*The +15VA supply will not operate if the -5.2V supply is not functioning.

Assuming all fuses are good, a power supply failure could be caused by either the A1 motherboard or the U12, U13, and U14 heatsink assembly. U12, U13, and U14 may be replaced separately. Replacement A1 motherboard assemblies do not come with these three regulators, or the associated heat sink.

## SYMPTOMATIC TROUBLESHOOTING PROCEDURES

Perform *Initial Troubleshooting* before using a symptomatic troubleshooting procedure. This section assumes you have identified the failure symptom. Choose the appropriate symptom below and troubleshoot as directed.

### Test Setup

When troubleshooting, provide the HP 8347A with a +5 dBm input signal at any desired frequency. The position of the front panel knob is unimportant unless otherwise specified.

### Troubleshooting By Symptom

**Low Output Power.** Output power is between 0 and  $-60$  dBm. Refer to *Low Output Power Troubleshooting*.

**No Output Power.** Output power is less than  $-60$  dBm. Remove and check the semi-rigid power cables. If they are good, the A3 microcircuit is bad.

**Power Leveling Range is Out of Specification.** Output power can not be set properly over the entire +2 to +20 dBm range. Refer to *Power Leveling Range Troubleshooting*.

**Power Flatness is Out of Specification.** The HP 8347A can be set properly from +2 to +20 dBm, but does not meet the flatness specification. This type of failure is always caused by a bad A3 microcircuit.

**Harmonics is Out of Specification.** Output power meets all other specifications except harmonics. Make sure the harmonics of your RF source are less than  $-40$  dBc. If so, the A3 microcircuit is bad.

**Gain is Out of Specification.** A gain related failure should not be confused with a low power failure. If output power is low regardless of the input power, refer to either *Low Output Power* or *No Output Power* described above. A gain problem exists if the HP 8347A can produce normal output power levels, but does not provide the specified gain.

To check gain, turn the ALC switch off. Measure TP5 with a voltmeter. If it is less than 0V the A1 motherboard is bad. If is greater than 0V the A3 microcircuit is bad.

### Low Output Power Troubleshooting

1. Refer to figure 6-3, A1 Motherboard Component Location Diagram. Measure across A1R46 with a voltmeter. Make sure the rear panel ALC switch is on. Provide a +5 dBm signal to the HP 8347A input connector.
2. If the measured voltage is greater than 125 mV, the A3 microcircuit assembly is bad and must be replaced.
3. Assuming the measured voltage is less than 125 mV, measure A1TP5 with a voltmeter.
4. If the voltage at A1TP5 is less than 0V, the A1 motherboard is bad.
5. If the voltage at A1TP5 is greater than 0V, remove and check the semi-rigid cables. If the cables are good, the A3 microcircuit is bad and must be replaced.

## Power Leveling Range Troubleshooting

1. Make sure the input power level is sufficient for the output power requested. The input power cannot be less than:

Desired Output Power — Gain Specification.

Perform the following steps with an input power of at least +5 dBm.

2. Make sure the ALC switch is on. Assuming input power is acceptable, measure across A1R46 with a voltmeter. (Refer to Figure 6-3, A1 Motherboard Component Location Diagram.)
3. If the voltage across R46 is greater than 125 mV, the microcircuit is bad and must be replaced.
4. If the voltage across R46 is less than 125 mV, set the input power to +5 dBm and turn the HP 8347A's front panel knob fully clockwise.
5. Measure TP2 with a voltmeter. If the voltage is more positive than -300 mV, the front panel knob potentiometer or A1 motherboard is bad. Check the potentiometer by performing sub-step A. If TP2 is more negative than -300 mV, proceed to step 6.
  - a. Remove the ribbon connector from the A2 front panel board. Measure across the knob potentiometer either on the back of the A2 board or at pins 6 and 7 of the A2J3 connector. Make sure potentiometer resistance meets the following requirements:

Knob Fully Clockwise:                    2 kohms  $\pm$  20%  
 Knob Fully Counter-Clockwise:        0 ohms

If the knob potentiometer does not pass this check, replace it and recheck the operation of the HP 8347A. If the knob is good, the A1 motherboard is bad.

6. Measure E1, TP1, and TP5. Compare the measured voltages with the chart in Table 6-2. This chart determines which assembly has failed given measured voltage conditions.

*Table 6-2. E1, TP1, and TP5 Voltage Conditions and Related Assembly Failures*

E1		TP1		TP5		Failed Assembly
<-10 mV	>-10 mV	<0V	>0V	<0V	>0V	
✓		✓		X	X	A1 Motherboard
✓			✓	✓		A1 Motherboard
✓			✓		✓	Perform Steps 7 through 11
	✓		X	X	X	A3 Microcircuit

X = Don't Care

**NOTE:** Perform steps 7 through 11 only if directed by Table 6-2. If the HP 8347A passes all the tests given in steps 7 through 11, the A3 microcircuit is bad.



7. With the ALC switch on, measure the HP 8347A's output power with a power meter (equipped with an HP 8482H power sensor), or an HP 8753A/B. In the chart below, find the power level that is closest to the measured output power. Look in the "Expected E1 Voltage" column for the expected (approximate) value of E1.

Power Output (dBm)	Expected E1 Voltage
+2	-15 mV
+4	-25 mV
+7	-35 mV
+10	-60 mV
+13	-95 mV
+17	-170 mV
+20	-260 mV

8. Measure E1. If E1 differs more than 50% from the expected voltage the A3 microcircuit is bad.
9. If E1 is correct, measure TP1 and compare it to E1. These signals must approximately follow the relationship given below:

$$TP1 \cong 0.1 \ln(-210 \times E1) \quad \text{Where E1 is expressed in volts.}$$

If the relationship between E1 and TP1 is not correct, the A1 motherboard is bad.

10. If the relationship between E1 and TP1 is correct, measure TP2. If TP2 is more negative than -10 mV, proceed to step 11. If TP2 is more positive than -10 mV, perform the front panel potentiometer check given in step 5A.

If the potentiometer is bad, replace it. If the potentiometer is good, the A1 motherboard is bad.

11. Check to see that the following conditions are true with an input power of +5 dBm.
- With the front panel knob fully clockwise, the UNLEVELED lamp is on and the OVERDRIVEN lamp is off.
  - With the front panel knob fully counter-clockwise, the UNLEVELED lamp is off and the OVERDRIVEN lamp is on.

If the above statements are not true, the A1 motherboard is bad

If the HP 8347A passes all the tests given in steps 7 through 11, but does not level properly over its entire power range, the A3 microcircuit is bad.

## BASIC COMPONENT SYMBOLOGY

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

**Figure 6-2. Basic Component Symbolology**

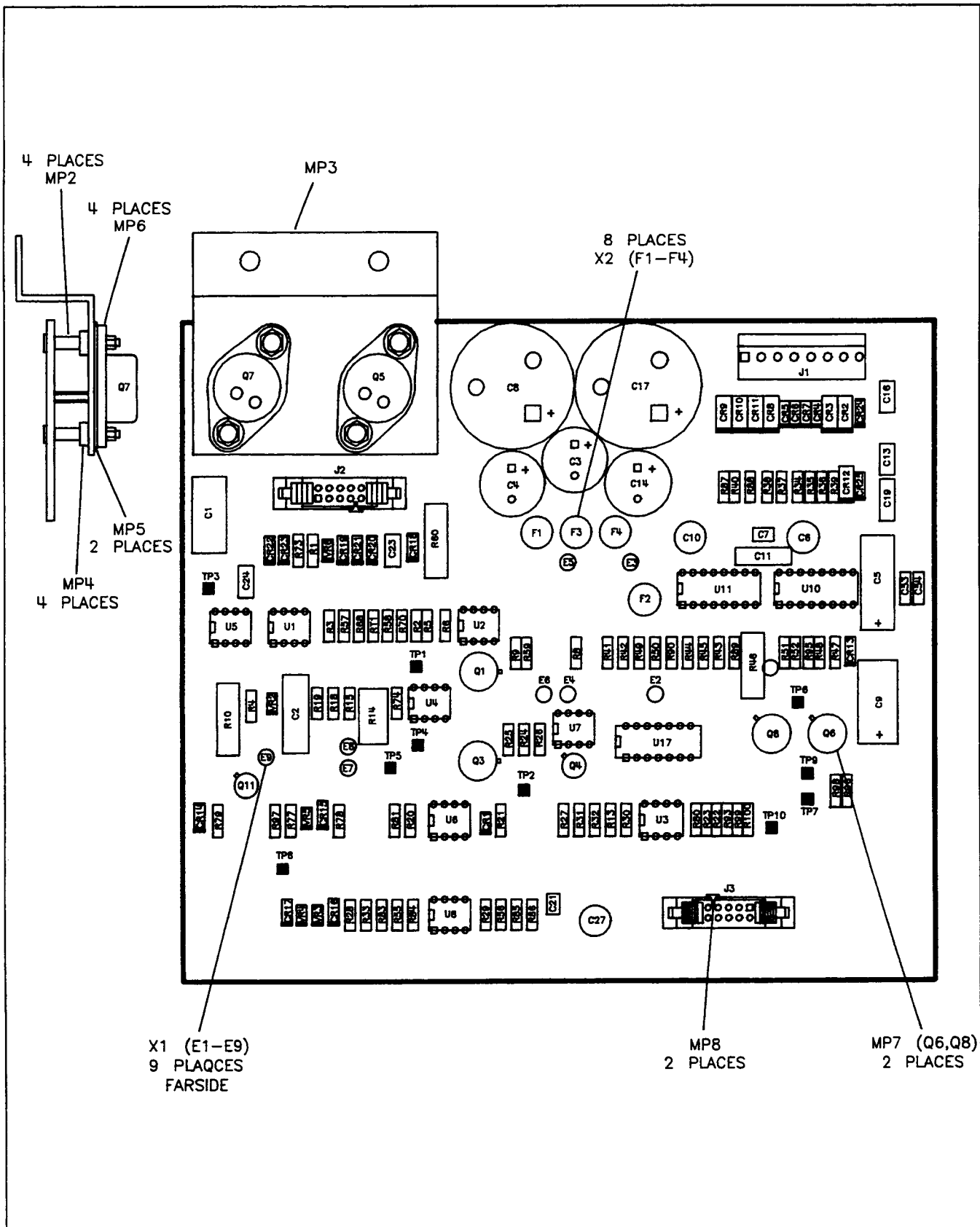


Figure 6-3. A1 Motherboard Component Location Diagram

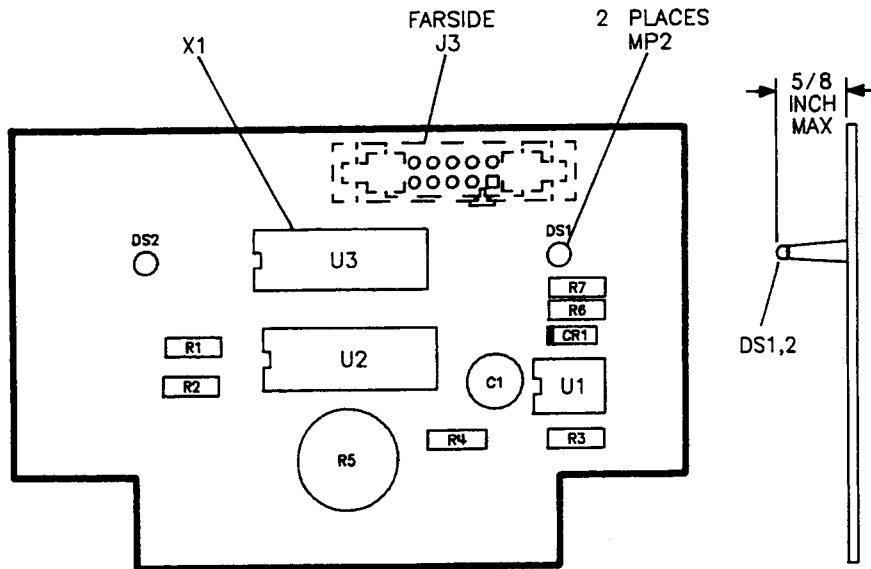


Figure 6-4. A2 Front Panel Assembly Component Location Diagram

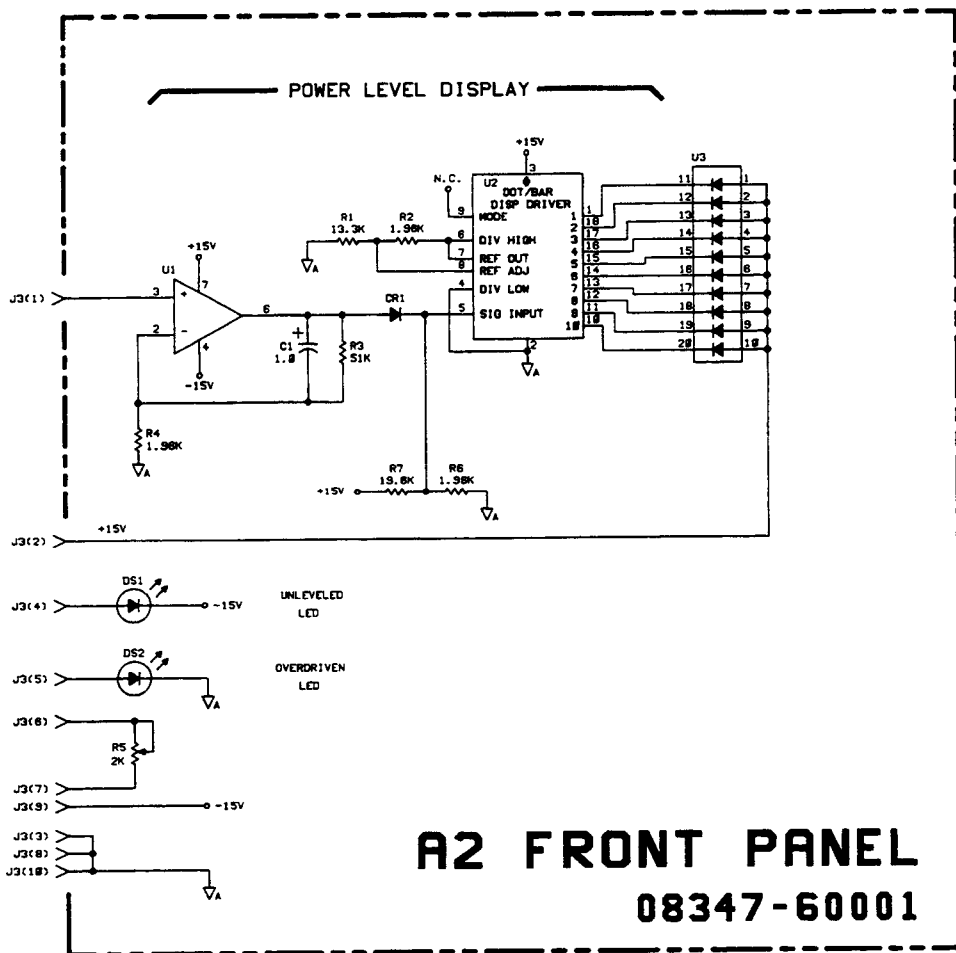


Figure 6-5. A2 Front Panel Assembly Schematic Diagram

## INSTRUMENT WIRING

The following tables provide wiring information. Refer to A1 and A2 component location diagrams for connector position information. Note that the A2 has only one connector, which is called A1J3.

*Table 6-3. A1J3 (Motherboard) to A2J3 (Front Panel Board)*

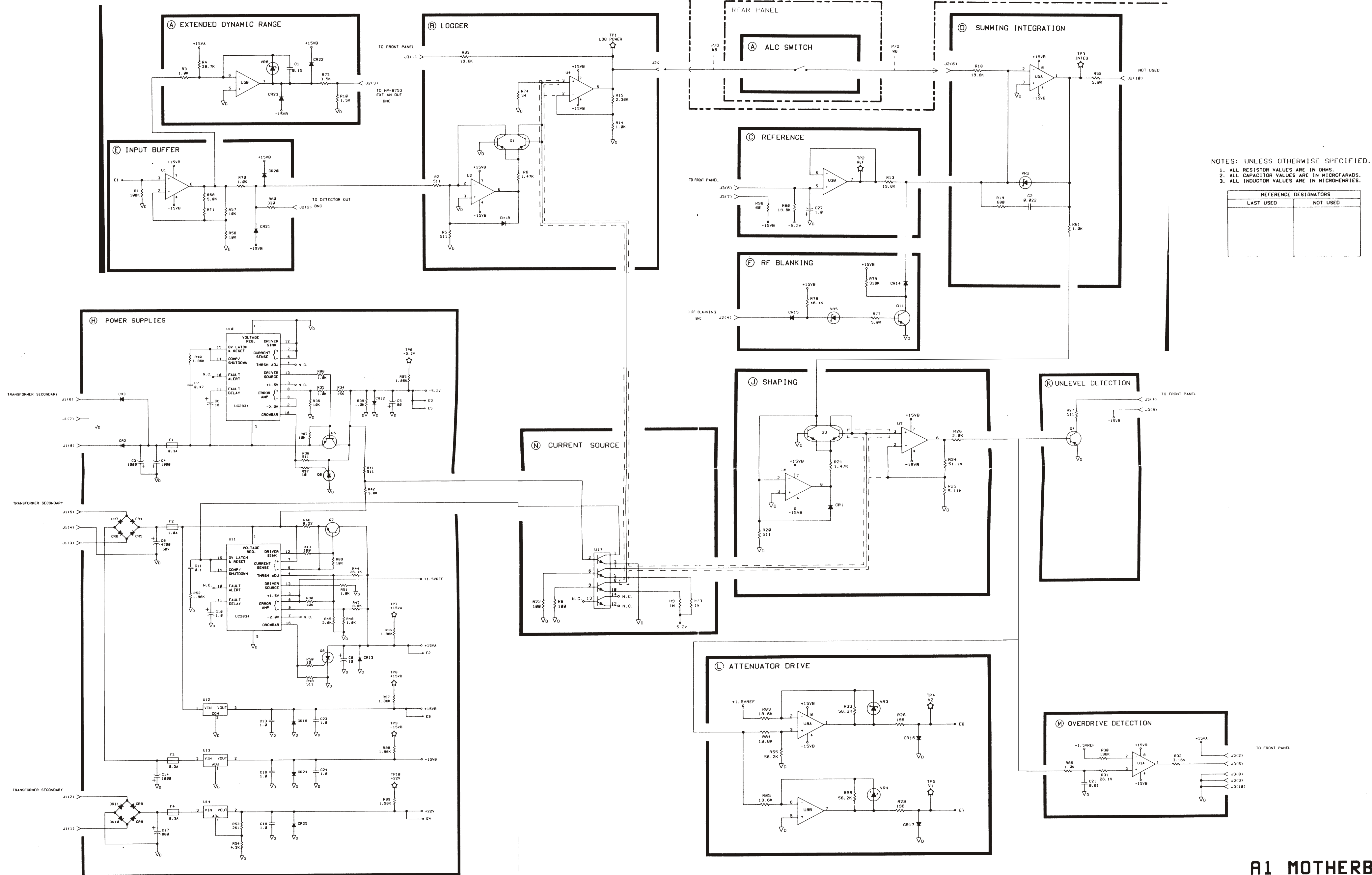
<b>A1J3 Pin Number</b>	<b>Signal Description</b>	<b>A2J3 Pin Number</b>
1	Bar Graph Display Drive	1
2	+15 VA	2
3	D Ground	3
4	UNLEVELED LED Drive	4
5	OVERDRIVEN LED Drive	5
6	To Knob Potentiometer	6
7	To Knob Potentiometer	7
8	D Ground	8
9	-15 VB	9
10	D Ground	10

*Table 6-4. A1J2 (Motherboard) to Rear Panel*

<b>A1J2 PIN Number</b>	<b>Rear Panel Connection</b>
1	Ground Lug
2	Detector Out BNC
3	HP 8753 EXT AM BNC
4	RF Blanking BNC
5	ALC Switch
6	ALC Switch

*Table 6-5. Line Module Wiring*

<b>Line Module Pin Letter</b>	<b>From Transformer</b>	<b>From W1</b>
A	Black/Orange	
B		Gray
C	Black	
D	Black/Green	
E	Black/Yellow	
F	Black/Red	White/Gray
G		White/Gray/Brown
P		White/Gray/Red



NOTES: UNLESS OTHERWISE SPECIFIED.  
 1. ALL RESISTOR VALUES ARE IN OHMS.  
 2. ALL CAPACITOR VALUES ARE IN MICROFARADS.  
 3. ALL INDUCTOR VALUES ARE IN MICRONERIES.

REFERENCE DESIGNATORS	
LAST USED	NOT USED

**A1 MOTHERBOARD**  
**08347-60001**

Figure 6-6. A1 Motherboard Schematic Diagram



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