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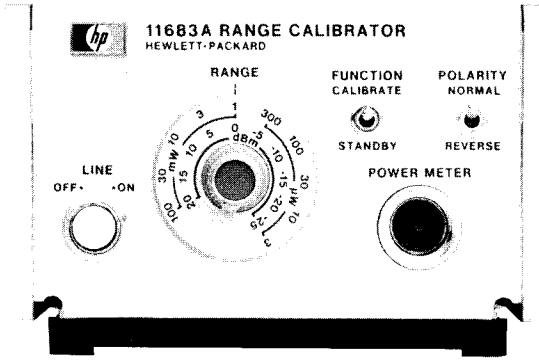
OPERATING AND SERVICE MANUAL

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# RANGE CALIBRATOR

## 11683A

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HEWLETT  PACKARD

OPERATING AND SERVICE MANUAL

# RANGE CALIBRATOR

## 11683A

### SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1312A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL.

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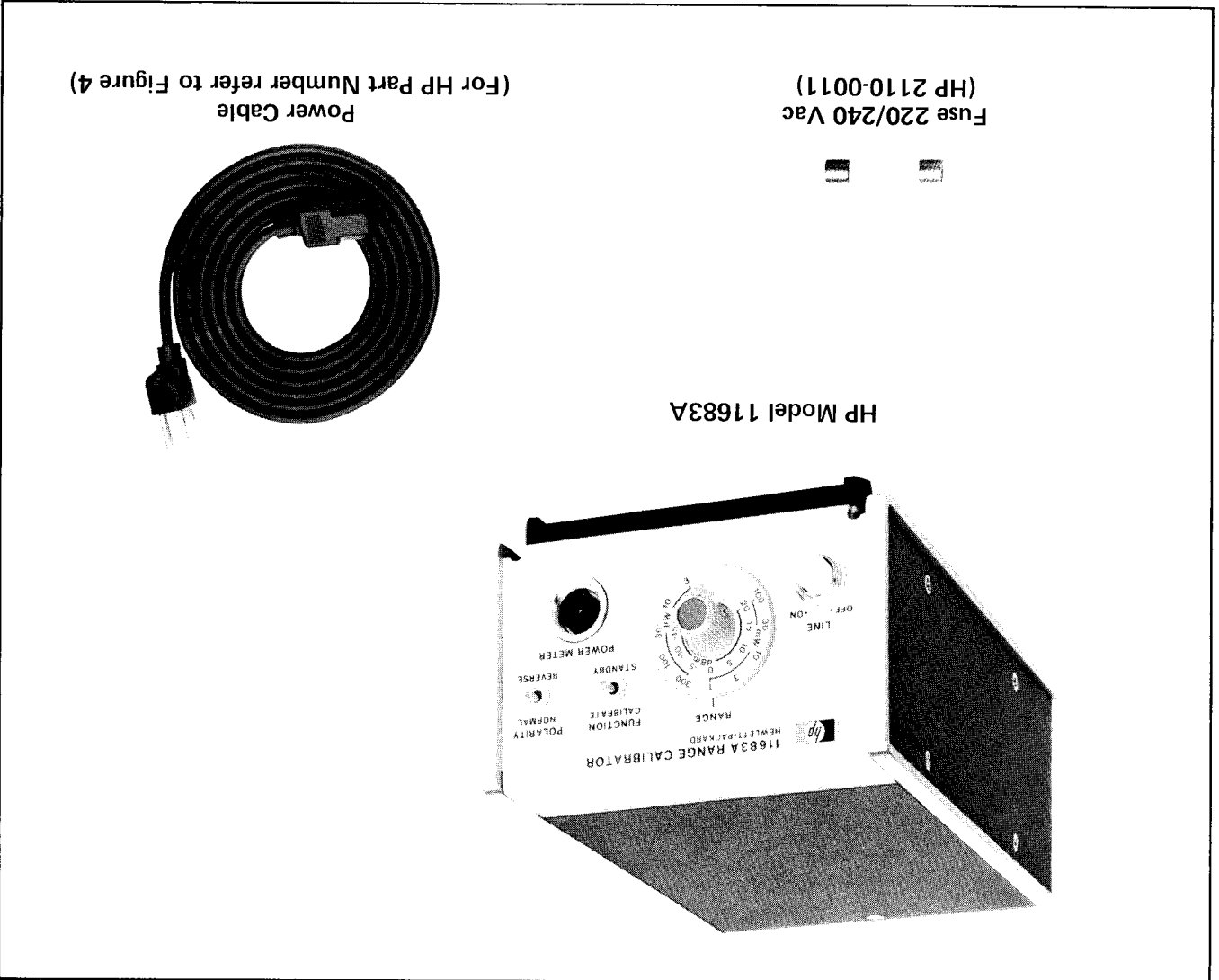
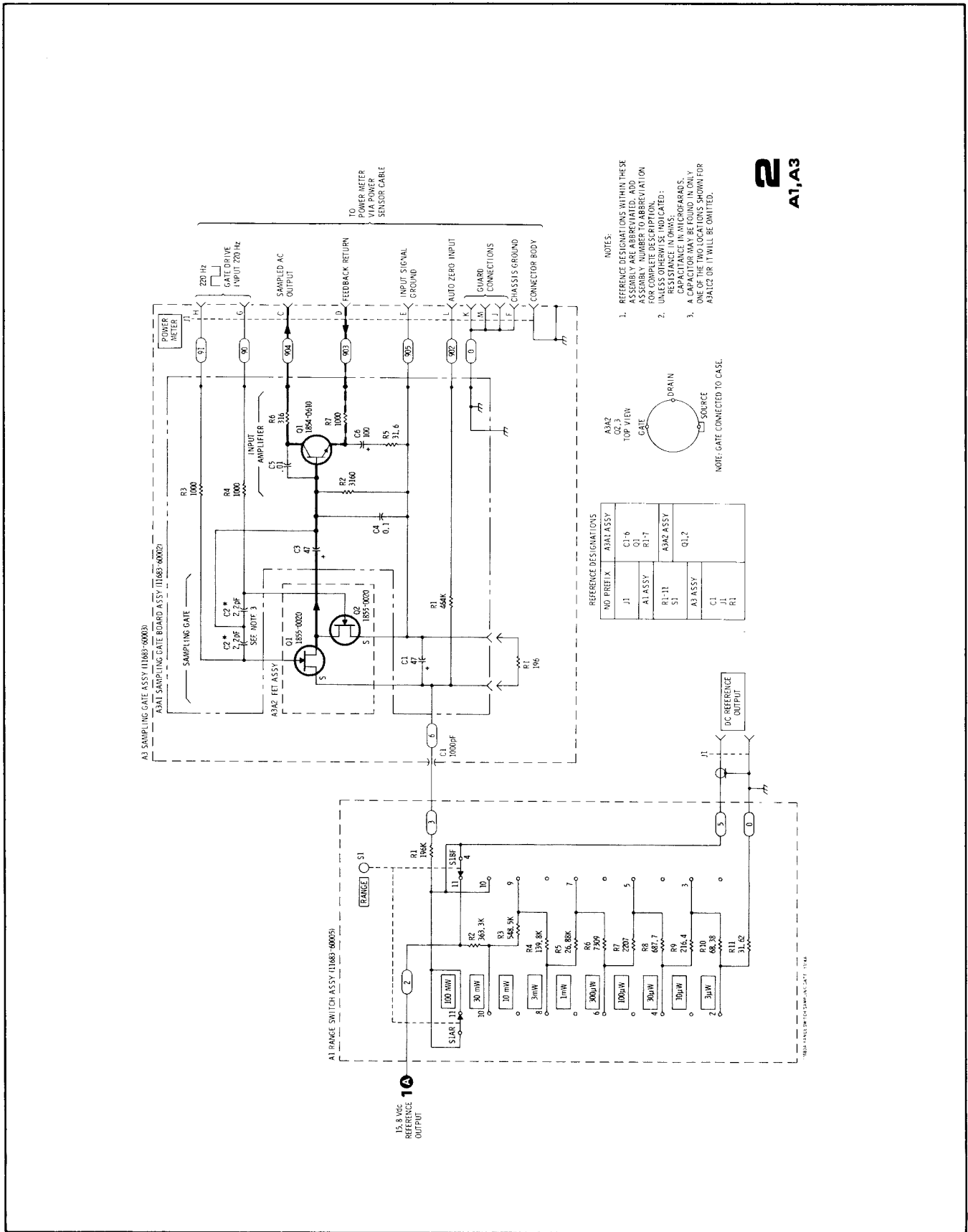


Figure 1. HP Model 11683A Calibrator and Accessories Supplied

Table 1. Specifications

<b>Calibration Functions:</b> Output voltage corresponding to meter readings at 3, 10, 30, 100, and 300 $\mu$ W; 1, 3, 10, 30, and 100 mW.
<b>Range-to-Range Calibration Uncertainty:</b> $\pm 0.25\%$ in all ranges.
<b>Dimensions:</b> 8-1/2" (215,9 mm) deep; 3-1/2" (88,9 mm) high; 5-1/4" (133,35 mm) wide.
<b>Weight:</b> Net, 2 lb, 8 oz. (1,13 kg).



- NOTES:
1. REFERENCE DESIGNATIONS WITHIN THESE ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
  2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN MICROFARADS.
  3. A CAPACITOR MAY BE FOUND IN ONLY ONE OF THE TWO LOCATIONS SHOWN FOR A3A1C2 OR IT WILL BE OMITTED.

REFERENCE DESIGNATIONS

NO PREFIX	A3A1 ASSY
J1	C1-6
A1 ASSY	O1
R1-11	R1-7
S1	A3A2 ASSY
A3 ASSY	O1,2
C1	
J1	
R1	

A3A2 O2,3 TOP VIEW

GATE

DRAIN

SOURCE

NOTE: GATE CONNECTED TO CASE.

**2**  
A1,A3

Figure 17. Range Switch/Sampling Gate Schematic Diagram



**1. GENERAL INFORMATION**

2. This operating and service manual contains information pertaining to incoming inspection, operation, performance tests, adjustments, and service for the HP Model 11683A Range Calibrator.

3. Equipment recommended for use in performance tests, adjustments, and service to the 11683A is listed in Table 2. Test equipment which meets or exceeds the critical specifications of Table 2 must be used for calibration if the 11683A is expected to conform to the published specifications.

4. The 11683A and all supplied accessories are shown in Figure 1. The published specifications are listed in Table 1.

**5. Instruments Covered by Manual**

6. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

7. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

8. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

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

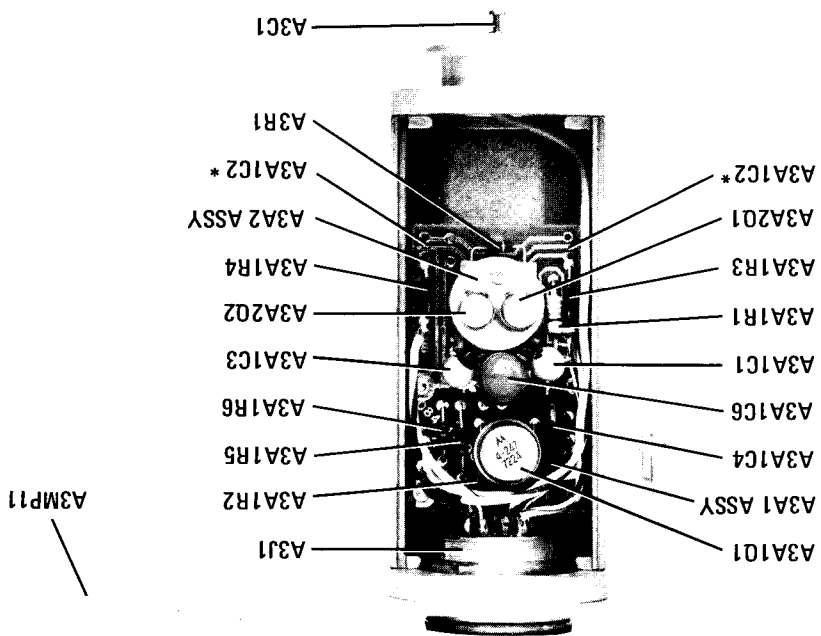
**10. Description**

11. The 11683A Range Calibrator is used to verify proper operation of compatible Power Meters such

*Table 2. Recommended Test Equipment*

Instrument	Critical Specifications	Model	Use*
Digital Voltmeter	Readout: 5 digits DC Measurements Ranges: 100 mV to 100 V full-scale Accuracy: ± 0.02% Resistance Measurements (four-wire measurement capability) Ranges: 100 Ω to 10 kΩ full-scale Sensitivity: 1 mΩ Accuracy: ± 0.02%	HP 3450B Option 002	P, A, T
Oscilloscope	Vertical Amplifier Bandwidth: DC to 5 MHz Deflection Factor: 50 mV/division minimum Attenuator Accuracy: ± 2% Time Base Time Span/division: 1 ms to 1 s Time base accuracy: ± 3%	HP 180C/ 1801A/ 1821A	A, T
Four-Wire Cable	Recommended Length: 5 feet maximum	(see Figure 2)	P
*P = performance; A = adjustment; T = troubleshooting			

Figure 16. A3 Assembly Component Locations



A3 ASSEMBLY COMPONENT LOCATIONS

as the HP Model 435A. The Power Meter's range-to-range accuracy and proper auto-zero operation can be easily verified. The 11683A can supply a full-scale test signal to the Power Meter for each Range Switch setting.

12. When set to CALIBRATE, the FUNCTION switch applies a dc voltage to the Power Meter; the input is grounded in STANDBY. The POLARITY switch increases ease of testing and adjusting the Power Meter auto-zero feedback circuit.

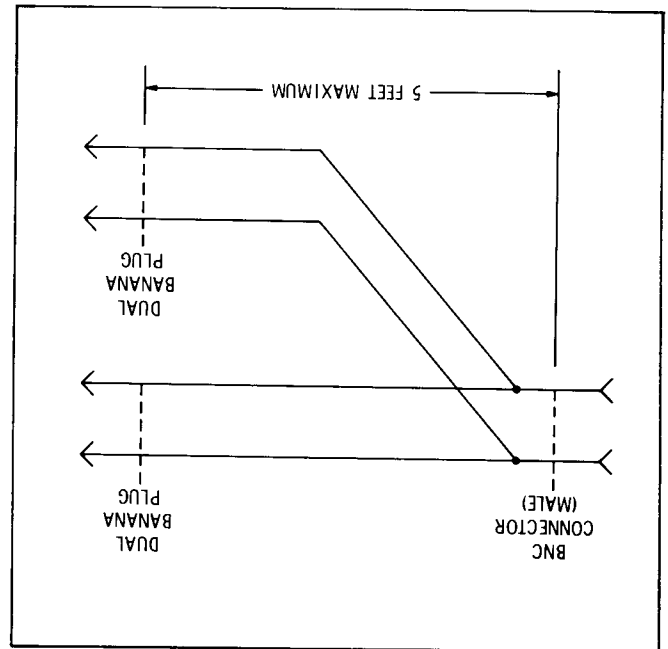


Figure 2. Four-Wire Cable

13. INSTALLATION

14. Initial Inspection

15. Inspect the shipping container for damage. If the shipping container or packing material is damaged it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is mechanical damage or if the instrument does not pass the performance tests, notify the nearest Hewlett-Packard office. Keep the damaged shipping materials (if any) for the carrier and a Hewlett-Packard representative to inspect. The HP office will arrange for repair or replacement without waiting for claim settlement.

16. Power Requirements

17. The 11683A Range Calibrator requires a power source with an output of 100, 120, 220, or 240 Vac +5% -10%, 48 to 440 Hz single phase. Power consumption is less than 10 VA.

18. Line Voltage Selection

19. Figure 3 provides instruction for line voltage and fuse selection. The Line Voltage Selection Card and fuse are factory installed for 120 Vac operation.

20. Power Cable

21. In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 4 for the part numbers of the power cable plugs available.

**WARNING**

The protection provided by grounding the instrument cabinet may be lost if any power cable other than the three-pronged type supplied is used to couple the ac line voltage to the instrument.

22. Interconnections

23. Refer to the Power Meter's operating and service manual for hookup instructions.

24. Operating Environment

25. The Operating environment should be within the following limitations:

- Temperature . . . . . 0 to 55°C
- Humidity . . . . . < 95% relative
- Altitude . . . . . > 15,000 feet

26. Bench Operation

27. The instrument is equipped with plastic feet and a tilt stand for use on a bench.

28. Rack Mounting

29. The instrument can be rack mounted by using an adapter frame. The adapter frame is a rack frame that accepts several combinations of sub-modular units. For additional information, address inquiries to your nearest Hewlett-Packard office.

30. Storage and Shipment

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

- Temperature . . . . . -40 to +75°C
- Humidity . . . . . < 95% relative
- Altitude . . . . . > 25,000 feet

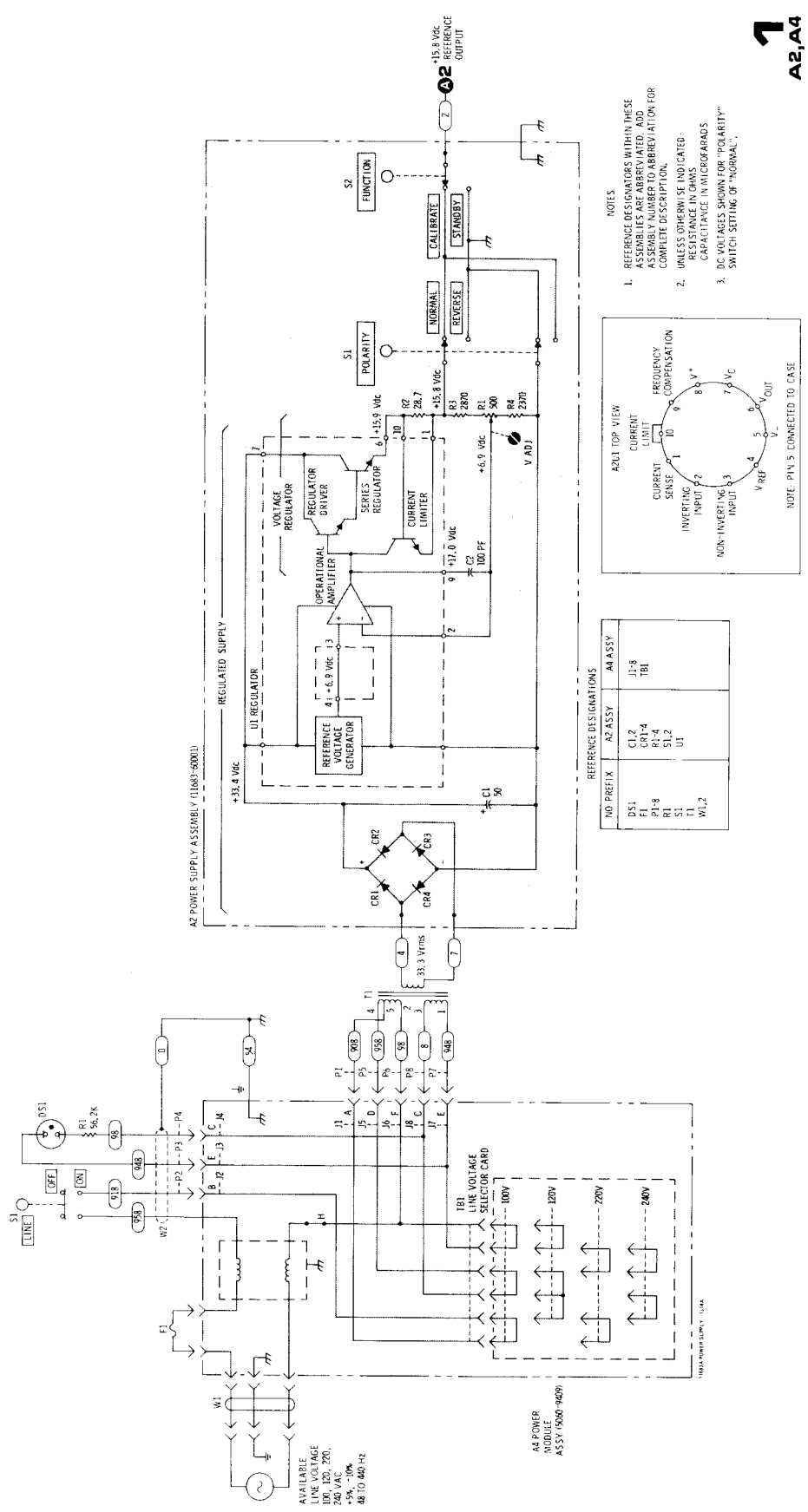


Figure 15. Power Supply Schematic Diagram

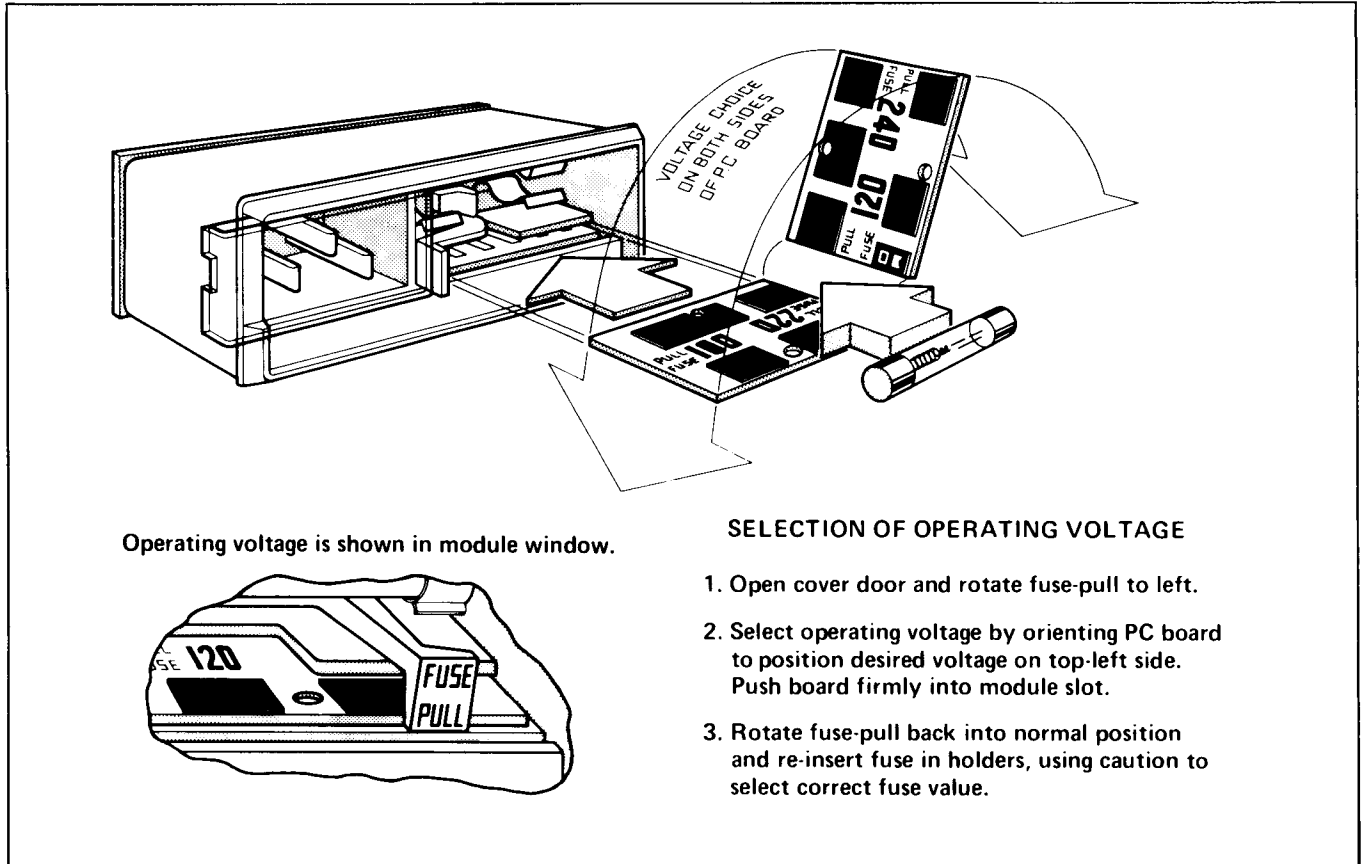


Figure 3. Line Voltage Selection

**32. Original Packaging.** Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number,

and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

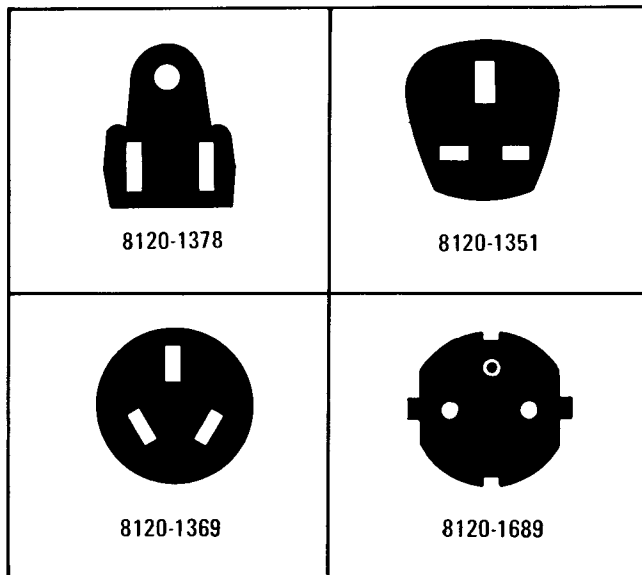


Figure 4. Power Cable HP Part Numbers Versus Mains Plugs Available

**33. Other Packaging.** The following general instructions should be used for re-packaging with commercially available materials:

- a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)
- b. Use a strong shipping container.
- c. 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.
- d. Seal the shipping container securely.
- e. Mark the shipping container FRAGILE to assure careful handling.

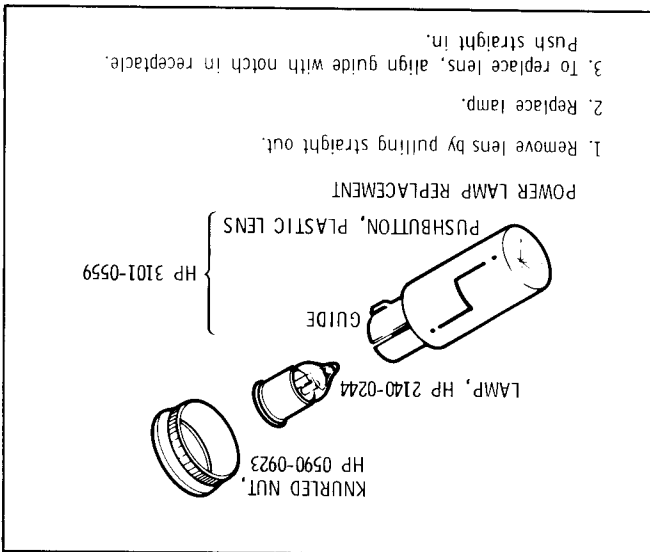


### 34. OPERATING AND MAINTENANCE INSTRUCTIONS

35. Operation of the controls of the 11683A is explained in Figure 6; Figure 7 provides operating and hookup instructions with a compatible Power Meter.

36. Maintenance by the operator consists of changing the fuse (refer to Figure 3), and LINE switch lamp replacement (refer to Figure 5).

Figure 5. Line Switch Lamp Replacement



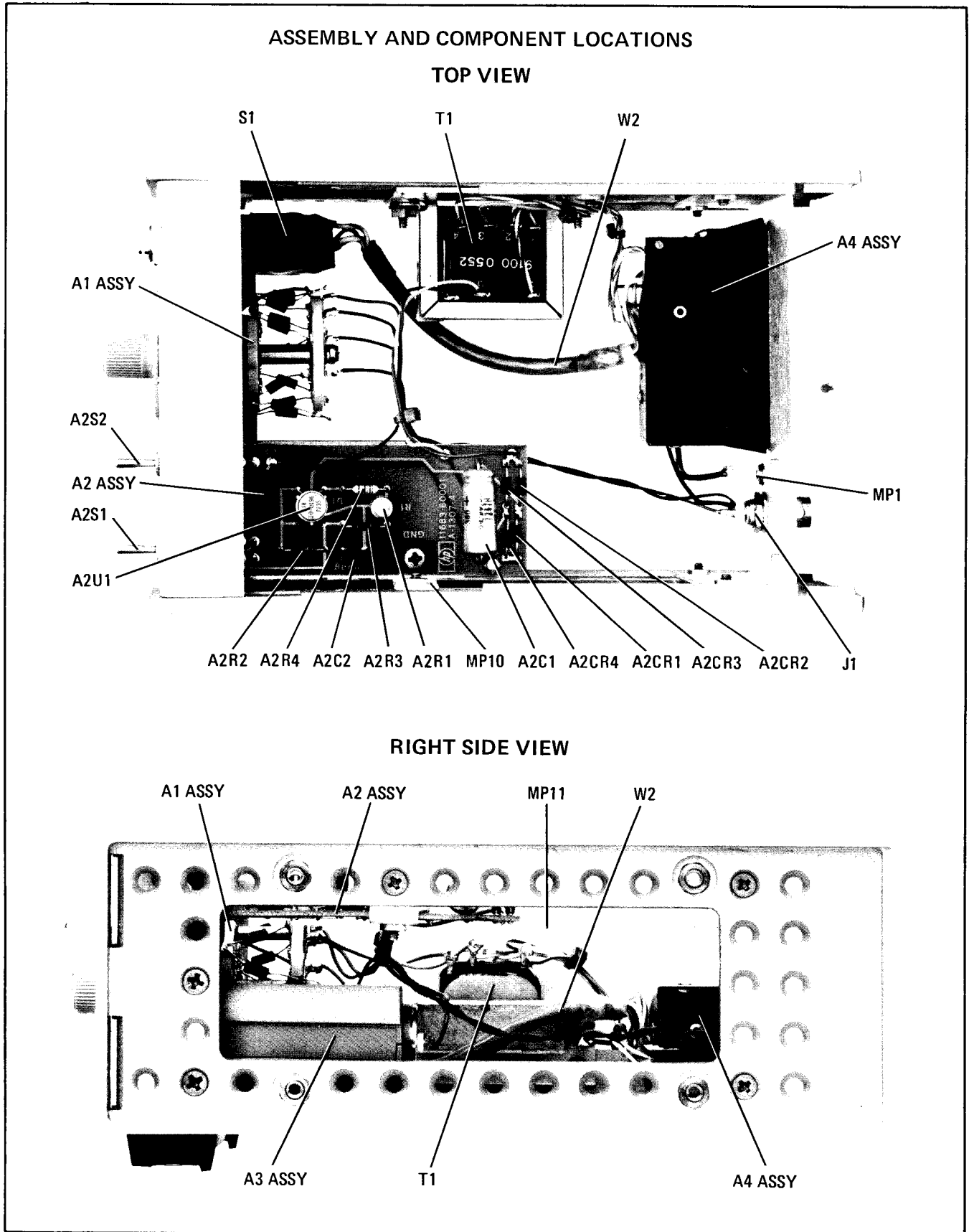
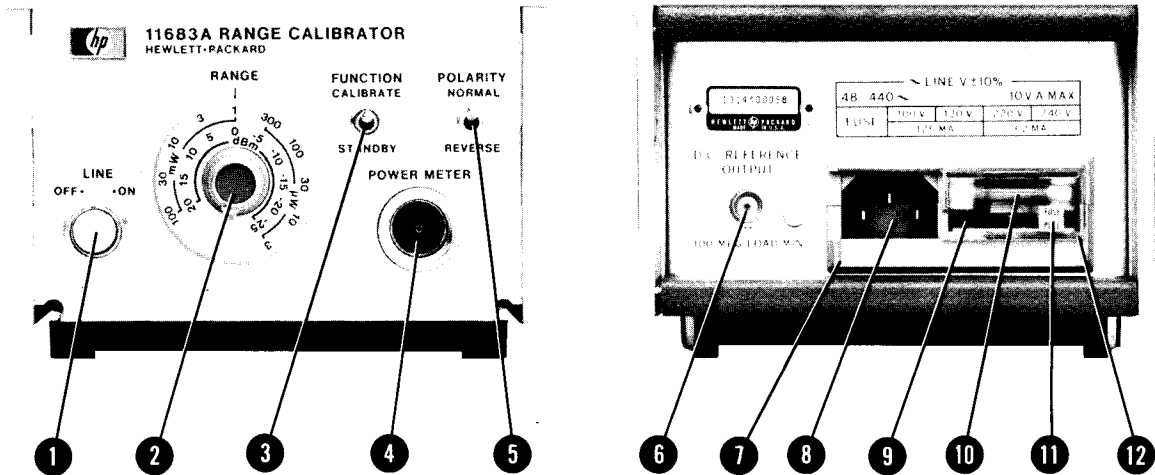


Figure 14. 11683A Assembly and Component Locations



FRONT AND REAR PANEL FEATURES



- 1 **LINE Switch.** Controls primary power. Illuminated when instrument is ON.
- 2 **RANGE Switch.** Equivalent to compatible Power Meter's Range Switch; produces a full scale Power Meter reading when 11683A and Power Meter Range switches are set to same scale.
- 3 **FUNCTION Switch.** When the switch is set to CALIBRATE an output dependent on the RANGE switch setting is coupled to the Power Meter. In STANDBY mode the output is grounded.
- 4 **POWER METER Connector.** Connects the output to, and control signals from, compatible Power Meter via Power Sensor Cable.
- 5 **POLARITY Switch.** An upscale reading is obtained on the Power Meter when the switch is set to NORMAL. The REVERSE setting produces a down-scale reading.

- 6 **D.C. REFERENCE OUTPUT Connector.** DC reference voltage output from RANGE Switch. Load resistance must be  $\geq 100 \text{ M}\Omega$  for proper operation of the 11683A.
- 7 **Power Module Assembly.**
- 8 **Receptacle.** Couples transformer primary to line voltage via power cable.
- 9 **Line Voltage Selection Card.** Matches transformer primary to line voltage. Refer to Figure 3.
- 10 **Fuse.** A 1/8 A fuse is used at 100/120 Vac; 1/16 A fuse at 220/240 Vac.
- 11 **Fuse Pull Handle.** Mechanical interlock; fuse must be removed before extraction of Line Voltage Selection Card.
- 12 **Window.** Safety interlock; fuse cannot be removed while power cable is coupled to Power Module Receptacle.

Figure 6. Front and Rear Panel Controls, Connectors, and Indicators

**NOTE**

The following instructions apply after the A3A1 Circuit Board Assembly has been exposed. Refer to Disassembly of A3 Sampling Gate Assembly.

The multivibrator drive from the Power Meter to the FET Sampling Gate circuit may be checked on the FET metal case. This drive voltage is a 220 Hz square wave whose most positive level is  $-0.05 \pm 0.05$  Vdc with the most negative level  $> 9$  V more negative.

In most cases it may be assumed that the operational amplifier, made up of the Input Amplifier and the first amplifier in the Power Meter, is operating correctly if the dc voltage found on the metal cover of A3A1Q1 is  $-70 \pm 30$  mVdc.

The FET's (A3A2Q1/A3A2Q2) may be checked by the following procedure.

a. Remove the power sensor cable from the 11683A.

b. Set the output of a dc power supply to 10 V.

c. Connect the positive lead of the power supply to the positive side of A3A1C3.

d. Connect one lead from an ohmmeter to the power supply positive lead and the other to chassis ground. Verify the resistance is less than 40 ohms.

e. Connect the negative power supply lead to BOTH FET metal covers. If the resistance increases:

1)  $< 20$  ohms, A3A2Q2 is probably defective.

2) 100 to 200 ohms, A3A2Q1 is probably defective.

3) Several hundred times, both FET's are functioning properly.

If either FET is defective, the entire FET Assembly must be replaced.

If the FET's are replaced it is recommended that the FET BALANCE ADJUSTMENT be performed to ensure the 11683A is operating at maximum capability.

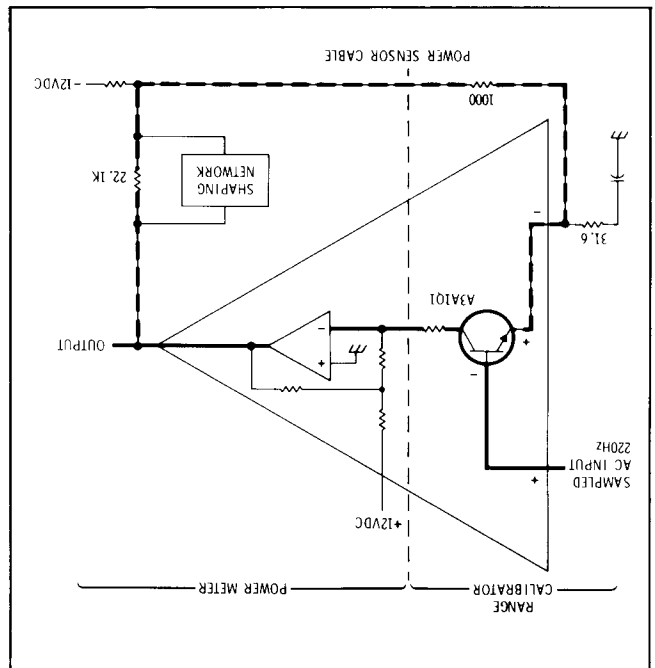


Figure 13. Hybrid Operational Amplifier

**76. Power Supplies.** If the output noise level has increased and the dc voltage at A2U1 pin 8 has decreased slightly, one of the bridge rectifier diodes or A2C1 may be defective.

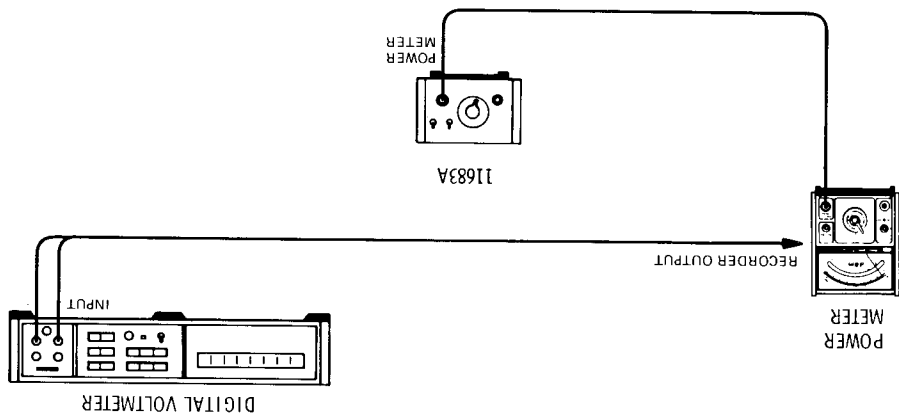
If the output voltage has decreased, 0.6 Vdc measured across A2R2 indicates the current limiter is operating.

Measure the voltage on A2U1 pins 2 and 3. If the voltage difference is  $> 10$  mVdc, verify that the regulated output has correctly followed the change in input levels. The regulated output's relative change from normal should follow the non-inverting input change and be opposite to the inverting input change. If the preceding statement is not true, the integrated circuit is probably defective, otherwise, the problem is probably with the associated components of A2U1.

**77. A1 Range Switch Assembly.** Voltages and/or resistance measurements, taken while performing the Range Switch Performance Test, may be out of the specified tolerances. This may be due to a definite change-in-resistance of one of the resistors mounted on the switch, high resistance contacts on the FUNCTION or RANGE switches, or a soldered connection which exhibits high resistance.

**78. A3 Sampling Gate Assembly.** The input to the A3 assembly is normally  $+15.8$  mVdc with the RANGE switch set to a 100 mW.

### OPERATING INSTRUCTIONS



### TURN ON

- a. Verify that the power transformer primary of the 11683A is matched to the line voltage. See Figure 3.
- b. Check the fuse, contained in the Power Module Assembly, for the correct rating. The voltage and amperage are shown on the rear panel. If necessary, change the fuse. See Figure 3.
- c. Connect the equipment together as shown above.
- d. Connect the Power Cable to the power outlet and Power Module receptacles. Press the LINE switch and release. The switch should remain in, the lamp within the plastic lens should be illuminated, and the cursor on the curved portion of the switch should indicate ON.

### POWER METER TROUBLESHOOTING

- f. The 11683A may be used as a test signal source which is capable of a full scale meter reading in any range. The POLARITY switch increases the ease of Auto-Zero circuit troubleshooting, and the 11683A may be substituted for the Power Sensor in order to isolate a malfunction to the Power Meter/Power Sensor Cable or the Power Sensor. Troubleshooting information is found in Section VIII of the Power Meter Operating and Service Manual.
- e. Refer to the Power Meter manual for Performance Test and Adjustment Procedures.

Figure 7. 11683A Operating Instructions

## 68. FET Assembly Installation.

a. Insert the FET Assembly leads through the spacer and printed circuit board. Refer to Figure 12.

b. Insert the clamp and cap screw to hold the spacer and assembly in place against the printed circuit boards.

c. Quickly solder the FET leads to the circuit board.

d. With hypodermic needle place RTV\* into the hollow portion of the spacer. For this purpose the needle is inserted into the hole in the circuit board directly beneath the FET Assembly.

e. Cover the soldered connections from the FET Assembly with RTV\*.

f. Cover the rest of the circuit side of the A2 assembly circuit board with Krylon\*\*.

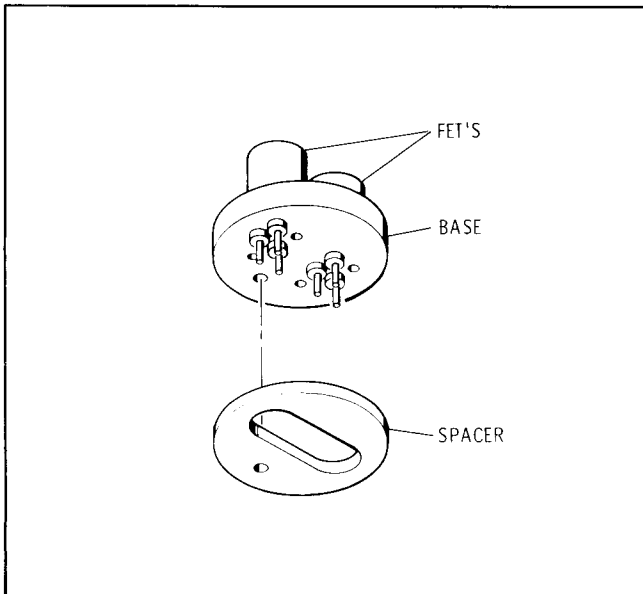


Figure 12. FET Assembly and Spacer

## 69. Principles of Operation

70. The principles of operation are intended to give the user a basic understanding of circuit operation and is, therefore, the most important troubleshooting aid available.

**71. Power Supply.** The A4 Power Module Assembly contains the Line Voltage Selector Card which matches the line voltage to power transformer primary. A line filter reduces line surge and transients.

\*RTV - 732 RTV Silicone Rubber Adhesive/Sealant by Dow Corning Corp., Midland, Michigan, 48640.

\*\*Krylon - No. 1302 Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp., Woodside 77, New York  
Krylon Inc., Norristown, Pennsylvania

The A2 Power Supply Assembly contains a bridge rectifier A2CR1-4, filter capacitor A2C1, a packaged voltage regulator circuit A2U1, and its associated components.

Within the IC package is a reference voltage generator, an operational amplifier, regulator driver, series regulator, and current limiting transistors. The reference voltage output, pin 4, is coupled to the non-inverting operational amplifier input, pin 3. The amplifier output drives the regulator driver and series regulator transistors and the regulated output is coupled from the emitter, through the current sense resistor A2R2, to the POLARITY switch A2S1. A2R3, R1, and R4 form a voltage divider through which the feedback bias is coupled to A2U1 pin 2, the inverting input.

If the current flow through A2R2 exceeds 20 mA, the current limiting transistor is turned-on and the drive voltage to the regulator driver is reduced which drops the regulated voltage toward zero.

A2C2 provides high frequency rolloff which reduces the feedback loop tendency to support spurious oscillations.

**72. A1 Range Switch Assembly.** The Range switch is a voltage divider which changes the output voltage by a factor of approximately  $\sqrt{10}$  for each sequential range change.

**73. A3 Sampling Gate Assembly.** The dc input from the Range Switch assembly is divided by one thousand and is coupled to the A3A2 Sampling Gate circuit. A 220 Hz squarewave drive signal from the Power Meter is coupled to the FET gates. When A3A2Q1 is conducting, the dc input is coupled to the Input Amplifier A3A1Q1. When A3A2Q2 is conducting, the input to the amplifier is essentially ground. The signal coupled to the Input Amplifier is 220 Hz ac, with the amplitude directly proportional to the dc input level.

The Input Amplifier and the first amplifier in the Power Meter are the component parts of a Hybrid Operational Amplifier. The Amplifier, which has a gain of approximately 730, is shown in Figure 13.

## 74. Troubleshooting

75. The Troubleshooting information is intended to supplement the principles of operation and schematics. This information should reduce troubleshooting time and increase the ease of solving problems that do not have obvious answers.

**37. RANGE SWITCH PERFORMANCE TEST**

38. The range-to-range accuracy of the 11683A Range Switch is checked to ensure a full-scale meter reading will be obtained when the 11683A and Power Meter Range Switches are set to the same scale.

39. **Description.** Voltage and resistance measurements are made at the rear panel output jack. Voltage measurements are made on the higher ranges. Because precise low voltage measurements are more difficult to make, resistance measurements are made at the lower RANGE switch settings. To achieve the needed accuracy, the four-wire resistance measurement technique is used.

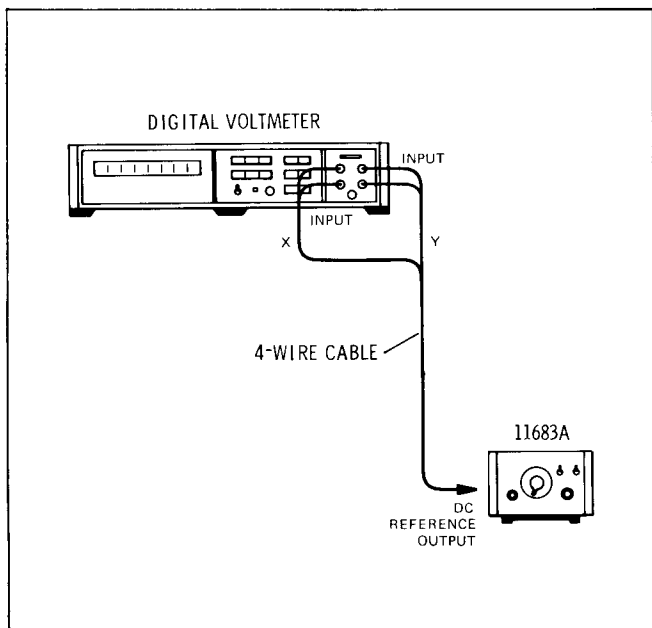


Figure 8. Range Switch Performance Test Setup

40. **Equipment.** Recommended equipment for performing these tests and adjustments are a digital voltmeter, HP 3450B (with option 002), and a 4-wire cable for performing the resistance measurements (refer to Table 2).

**NOTE**

The 4-wire cable must connect directly to the 11683A. Do not use connectors or adaptors because their series resistance will reduce measurement accuracy.

**41. Procedure.**

a. Set the 11683A controls as follows:

RANGE . . . . . 100 mW  
 FUNCTION . . . . . STANDBY  
 POLARITY . . . . . NORMAL

b. Set the DVM controls so measurements of up to +20 Vdc may be made. All measurements are to be 5-digit resolution.

c. Connect the equipment together as shown in Figure 8.

d. Set the 11683A FUNCTION control to CALIBRATE. On the table, record the dc voltage measured in each RANGE from 100 mW to 300 μW. If the voltage measured at the 1 mW range is beyond the limits shown on the table, when this procedure is completed, perform the Power Supply Adjustments. Calculate and record the ratio of the voltages using the formula shown in the table below.

Range	DVM Reading			Ratio ( $V_{100\text{ mW}} / V_{\text{range}}$ )		
	Min.	Actual	Max.	Min.	Actual	Max.
100 mW		_____		-----	1.0000	-----
30 mW		_____		3.3457	_____	3.3604
10 mW		_____		10.768	_____	10.815
3 mW		_____		34.394	_____	34.545
1 mW	143.00mVdc	_____	147.00mVdc	108.76	_____	109.23
300 mW		_____		343.95	_____	345.45

**60. SERVICE**

61. Service Information is composed of Repair, Principles of Operation, and Troubleshooting, followed by the assembly and component locations diagrams (Figure 14 and 16) and schematic diagrams (Figures 15 and 17).

62. Test equipment that meets or exceeds the critical specifications of Table 2 may be used in place of the recommended test instruments.

**WARNING**

The service information is often used with power supplied and protective covers removed from the instrument. Energy available at many points may, if contacted, result in personal injury or death.

**63. Repair**

64. The repair information includes instructions for removing and installing the A3 Sampling Gate Assembly, proper installation of the A3A1 Board Assembly, and the removal and installation of the A3A2 FET Assembly.

**65. Disassembly of A3 Sampling Gate Assembly.** For steps 1 through 3 see Figure 11. Refer to Figure 10 steps 4 through 8.

a. Remove the top, bottom, and side covers of the 11683A.

b. Remove the right-side frame which is adjacent to A2 and A3 assemblies after removing five 6-32 x 1/4" flat head machine screws.

c. Remove the RANGE switch knob after loosening the socket set screws. Remove the 3/8-32 x 7/16" hex nut from the RANGE switch; remove the RANGE SWITCH.

d. Remove the 1/2-32 knurled nut on the LINE switch and lift the A3 Assembly, which is attached only by the orange wire, from the 11683A chassis.

e. To remove the A3 Assembly plastic covers, insert the blade of a screwdriver into the seam on each side of the bulkhead feedthrough. Gently twist until the covers snap apart. Remove the covers and the magnetic shields.

Excessive heat from the soldering iron when installing or removing the assembly, may destroy the FET internal circuitry. Before removing the FET Assembly be sure that it must be replaced. The Troubleshooting information gives the correct procedures for verifying that the FET's are defective.

a. Remove the A3A1 Circuit Board Assembly. Refer to Disassembly of A3 Sampling Gate Assembly.

b. Remove the 0-80 x 0.500" cap screw, spring, clamp, and A3R1.

c. Remove the RTV coating which covers the FET pin connections to the printed circuit board.

d. With a desoldering tool, remove the solder from the six pins which hold the FET Assembly in place.

e. Carefully break each pin loose from the printed circuit board with a soldering aid tool.

f. Gently lift the FET Assembly and spacer from the circuit board. Refer to Figure 12.

**CAUTION****67. FET Assembly Removal.**

so they touch A3A1C6.

c. Bend the 100  $\mu$ F capacitor, A3A1C6, so it touches A3A1Q1. Position A3A1C1 and A3A1C3

the cap screws.

b. Center the circuit board so there is equal air gap between each side and the chassis. Tighten

screws.

a. Place the circuit board in the correct position and insert four 0-80 x 0.188" socket cap

operation.

**66. A3A1 Assembly Installation.** The relative position of the installed circuit board and some components on the board are critical for proper

the preceding instructions in reverse order.

h. To reassemble the A3 Assembly follow

remove the upper chassis.

upper chassis. Loosen the lower cap screws and

g. Remove the two 0-80 x 0.188" socket cap screws which secure the feedthrough endbell to the

upper chassis.

machine screws which attach the sub-panel to the

f. Remove the two 0-80 x 0.312" flat-head

e. Set the 11683A FUNCTION switch to STANDBY. Set the DVM controls to measure resistance.

f. Measure the resistance at each RANGE setting from 300 to 3  $\mu$ W to 5-digit resolution and record the reading on the table below. Verify that each reading falls within the limits shown.

Range	DVM Reading (Ohms)		
	Min.	Actual	Max.
300 $\mu$ W	31.43.3	_____	3157.1
100 $\mu$ W	995.90	_____	1000.2
30 $\mu$ W	315.14	_____	316.52
10 $\mu$ W	99.749	_____	100.18
3 $\mu$ W	31.580	_____	31.718

g. If any of the voltage ratio's or resistance readings are incorrect, refer to the troubleshooting information.

#### 42. ADJUSTMENTS

##### 43. Power Supply Adjustment

44. The dc output of the 11683A is set to a specified level to ensure Power Meter full-scale deflection occurs when the RANGE controls of the Calibrator and Power Meter are set to the same scale.

**45. Description.** The 11683A RANGE switch is set to the 1 mW scale and the dc voltage at the rear panel D.C. REFERENCE OUTPUT is set to a specified level.

**46. Equipment.** The HP Model 3450B is the recommended Digital Voltmeter used to set the power supply voltage. A DVM that meets or exceeds the critical specifications of Table 2 may be substituted.

##### 47. Procedure.

1. Connect the 11683A rear panel DC REFERENCE OUTPUT to the DVM INPUT.
2. Set the DVM controls to provide 5-digit resolution at 145 mVdc.
3. Remove the 11683A top cover.
4. Adjust A2R1 for a DVM reading of  $145.00 \pm 2.00$  mVdc.

This procedure normally will have to be performed only when the FET assembly is replaced or if the white/black or white/brown wires which connect A3A1 to A3d1 are moved since their relative position is critical. Minor adjustment of spike amplitude may be made by changing the position of these wires.

#### NOTE

**50. Description.** Adequate FET gate-to-drain capacitance balance is achieved when the transient spike amplitude is found to be  $< 1.0$  Vp-p at the appropriate test location (TP4 in the HP Model 435A). Solder the selected capacitor in place.

49. A characteristic of an FET Sampling Gate circuit is transient spikes caused by an imbalance in gate-to-drain capacitance. The imbalance can be corrected by making the effective junction capacitance equal. A capacitor of correct value is coupled across the gate-to-drain leads of the active component with the lower junction capacitance. Other factors keep the transient from being eliminated completely, therefore, the amplitude is reduced to a minimum.

##### 48. FET Balance Adjustment

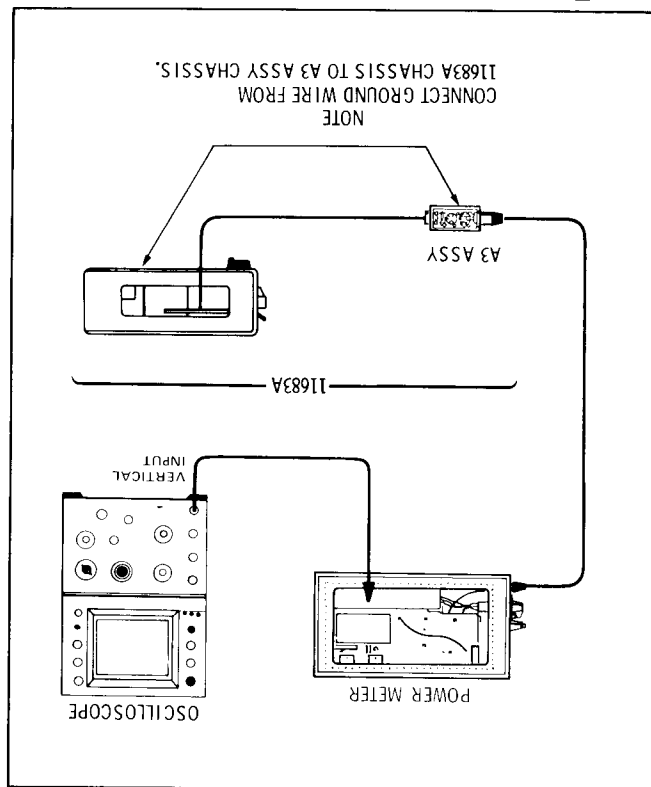


Figure 9. FET Balance Adjustment Setup

Table 3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
<p>The diagram shows an exploded view of various cabinet components. Part 1 is a top cover with a screw. Part 2 is a front panel. Part 3 is a side panel. Part 4 is a front bezel. Part 5 is a screw for the bezel. Part 6 is a rear panel. Part 7 is a main cabinet body. Part 8 is a small bracket. Part 9 is a wire. Part 10 is a connector. Part 11 is a side panel with a connector.</p>					
<p>FIGURE 11. CABINET PARTS EXPLODED VIEW</p>					

Table 4. Manufacturer's Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
02660	AMPHENOL CORP.	BROADVIEW, ILL.	60153
04009	ARROW, HART & HEGEMAN ELECT. CO.	HARTFORD, CONN.	06106
04713	MOTOROLA SEMICONDUCTOR PROD. INC.	PHOENIX, ARIZ.	85008
09353	C & K COMPONENTS INC.	NEWTON, MASS.	02158
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
70903	BELDEN CORP.	CHICAGO, ILL.	60644
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
74868	AMPHENOL CORP. RF DIV.	DANBURY, CONN	06810
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
76854	DAK MFG. CO. DIV. DAK ELECTRO/NETICS CORP.	CRYSTAL LAKE, ILL.	60014
79963	ZIERICK MFG. CO.	MT. KISCO, N.Y.	10549
87034	MARCOAK INDUSTRIES	ANAHEIM, CALIF.	92803



**51. Equipment.** The HP Model 180C/1801A/1821A is the recommended oscilloscope for use in the balance adjustment. An oscilloscope that meets or exceeds the critical specifications of Table 2 may be substituted.

## 52. Procedure.

a. Remove the A3 assembly (refer to the paragraph, Disassembly of the A3 Sampling Gate Assembly, under the heading Repair). Reinstall the LINE and A1 RANGE switch in the front panel before proceeding.

b. Connect the equipment as shown in Figure 9. (The oscilloscope probe will be coupled to TP4 if the HP 435A Power Meter is being used.)

c. Set the 11683A FUNCTION switch to STANDBY; the Power Meter RANGE switch to 3  $\mu$ W.

d. Press the 435A ZERO Switch and check the spike amplitude on the oscilloscope display. Remove A2C2 and replace it, in the same location, with the next higher value capacitor. (A2C2 may be located in one of the two positions or it may be omitted; see Figure 13.

### NOTE

The 435A ZERO switch must be pressed for the duration of this adjustment procedure.

e. If the spike amplitude decreases, continue to increase the capacitor value, in sequence, until the minimum spike amplitude (balance point) is found. The capacitor normally will not be  $>7$  pF. After two or three capacitors are tried, if the spike amplitude is constant or increases, a smaller value capacitor may be tried. If the lowest value capacitor is reached without finding the balance point, remove the capacitor and check the spike amplitude. Next begin to insert capacitors, in sequence, in the other A2C2 location. When the spike amplitude of  $<1.0$  Vp-p at the appropriate test point is found, the circuit is considered balanced and the capacitor may be soldered in place.

## 53. REPLACEABLE PARTS

54. Table 3 lists all replaceable parts in reference designator order. Table 4 contains the names and

addresses that correspond to manufacturer's code numbers.

## 55. Replaceable Parts List

56. Table 3 is the list of replaceable parts and is organized as follows:

- a. Electrical assemblies and their components in alphanumeric order by reference designation.
- b. Chassis-mounted parts in alpha-numerical order by reference designation.
- c. Miscellaneous parts.
- d. Illustrated parts breakdowns.

The information given for each part consists of the following:

- a. The Hewlett-Packard part number.
- b. The total quantity (Qty) in the instrument.
- c. The description of the part.
- d. A typical manufacturer of the part in a five-digit code.
- e. The manufacturer's number for the part.

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

## 57. Ordering Information

58. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

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

Table 3. Replaceable Parts

Item Number	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
-------------	----------------	-----	-------------	----------	-----------------

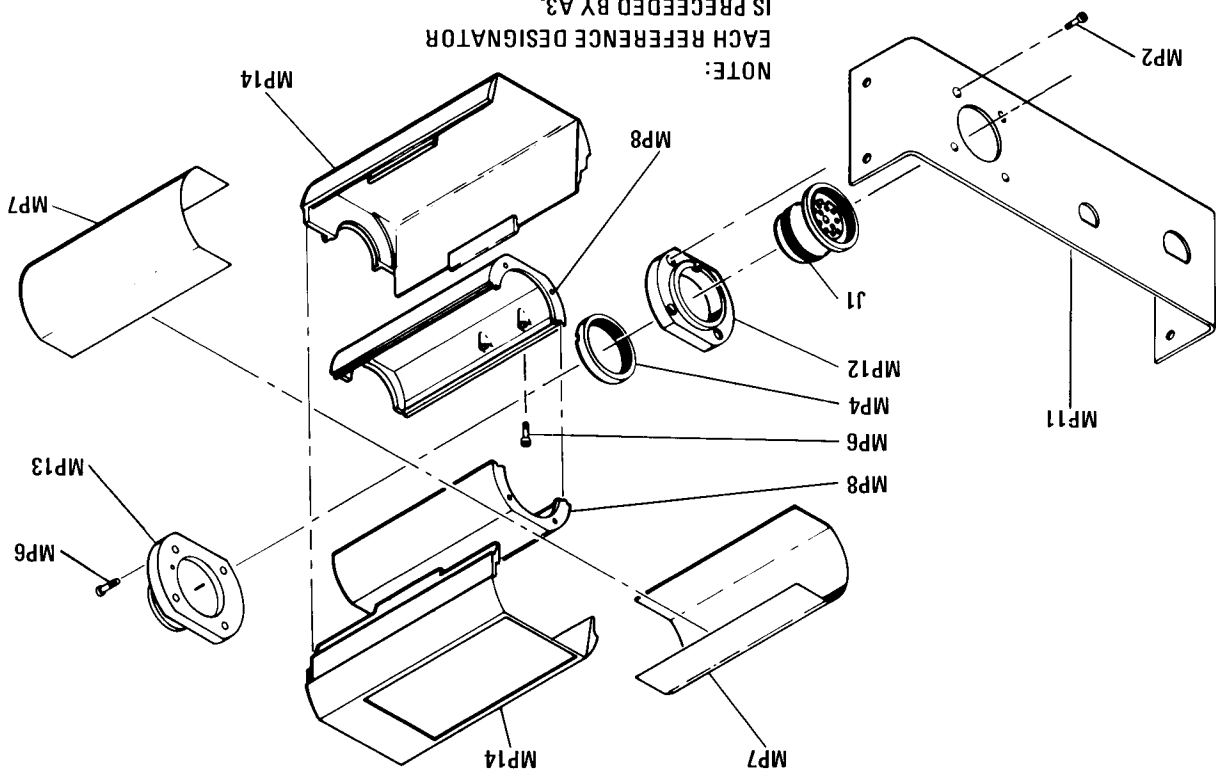


FIGURE 10. A3 ASSEMBLY EXPLODED VIEW

Item Number	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	2360-0182	2	SCREW:FLAT HD POZI DR 6-32 X 0.312" LG	00000	08D
2	5060-8553	2	COVER ASSY:TOP, 5 X 8	28480	5060-8553
3	11683-00001	1	PANEL:REAR	28480	11683-00001
4	5060-0247	2	FRAME ASSY	28480	5060-0247
5	2360-0180	8	SCREW:FLAT HD POZI DR 6-32 X 0.188" LG	00000	08D
6	5000-8766	2	COVER:SIDE 3 X 8	28480	5000-8766
7	5000-8569	1	COVER:BOTTOM, 5 X 8	28480	5000-8569
8	11683-00002	1	PANEL:FRONT	28480	11683-00002
9	5060-0727	2	FOOT ASSY	28480	5060-0727
10	1490-0031	1	STAND:TILT	28480	1490-0031
11	5040-0700	2	HINGE	28480	5040-0700

CABINET PARTS (SEE FIGURE 11)

See introduction to this section for ordering information

Table 3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	11683-60005	1	RANGE SWITCH ASSY (SEE MP8)	28480	11683-60005
A1R1	0811-0570	1	R:FXD WM 196K OHM	28480	0811-0570
A1R2	0811-0571	1	R:FXD WM 363.3K OHM	28480	0811-0571
A1R3	0811-0572	1	R:FXD WM 548.5K OHM	28480	0811-0572
A1R4	0811-0573	1	R:FXD WM 139.8K OHM 0.1% 0.125M	28480	0811-0573
A1R5	0811-0574	1	R:FXD WM 26.88K OHM	28480	0811-0574
A1R6	0811-0575	1	R:FXD WM 7.309K OHM	28480	0811-0575
A1R7	0811-0576	1	R:FXD WM 2.207K OHM	28480	0811-0576
A1R8	0811-0578	1	R:FXD WM 687.7 OHM	28480	0811-0578
A1R9	0811-0579	1	R:FXD WM 216.4 OHM	28480	0811-0579
A1R10	0811-0577	1	R:FXD WM 68.38 OHM	28480	0811-0577
A1R11	0811-3214	1	R:FXD WM 31.62 OHM	28480	0811-3214
A1S1	3100-3211	1	SWITCH:ROTARY 2 SECTION,10 POSITION	76854	A-5950-5303-1
A2	11683-60001	1	POWER SUPPLY ASSY	28480	11683-60001
A2C1	0180-0141	1	C:FXD ELECT 50 UF +75-10% 50VDCM	56289	30050660500D2-DSM
A2C2	0160-2204	1	C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A2C3	1901-0159	4	DIODE:SILICON 0.75A 400PIV	04713	SRI358-4
A2R1	2100-1788	1	R:VAR FLW 500 OHM 10% LIN 1/2M	28480	2100-1788
A2R2	0688-4433	1	R:FXD MET FLW 28.7 OHM 1% 1/8M	28480	0688-4433
A2R3	0698-3151	1	R:FXD MET FLW 2.87K OHM 1% 1/8M	28480	0698-3151
A2R4	0698-3150	1	R:FXD MET FLW 2.37K OHM 1% 1/8M	28480	0698-3150
A2S1	0121-0594	1	SMITGH:TOGGLE DPDT, SUB-MINIATURE (SEE MP4, MP9)	09353	7101-AV25 W/BUSHING
A2S2	0101-0595	1	SMITGH:TOGGLE SPDT, SUB-MINIATURE (SEE MP4, MP9)	09353	7101-AV25 W/BUSHING
A201	1820-1196	1	IC:LINEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A3	11683-60003	1	SAMPLING GATE ASSY	28480	11683-60003
A3C1	0160-2527	1	C:FXD CER FEED-THRU 1000 PF +80-20%	28480	0160-2527
A3C2	1251-0226	1	CONNECTOR:AUDIO, 12 FEMALE CONTACT	74868	91-T-3638
A3R1	1470-0291	1	COMPOND:NUT LOCKING	28480	0470-C231
A3R2	0516-0096	4	SCREW:FLAT HD SLDT DR 0-80 X 0.312" LG	00000	080
A3R3	0180-4936	1	SCREW:SOCKET CAP 0-80 X 0.500" LG	00000	080
A3R4	1251-0363	1	NUT:CONNECTOR MOUNTING	00000	080
A3R5	1460-1500	1	SPRING:COMPRESSION 0.150" (USED WITH A3J1)	28480	1460-1330
A3R6	0848-4004	8	SCREW:SOCKET CAP 0-80 X 0.188" LG	00000	080
A3R7	0848-4002	2	SHIELD	28480	08481-0092
A3R8	08481-2011	2	CHASSIS	28480	08481-2011
A3R9	08481-4003	1	SPACER F.E.L.T.	28480	08481-4003
A3R10	08481-4004	1	CLAMP LEAD	28480	08481-4004
A3R11	11683-00505	1	PANEL:FRONT, SUB	28480	11683-0003
A3R12	11683-2003	1	ENDBELL:FRONT	28480	11683-2003
A3R13	11683-2004	1	ENDBELL:FEED THRU	28480	11683-2004
A3R14	11683-2005	2	SHELL:PLASTIC	28480	11683-2005
A3R15	0698-7219	1	R:FXD FLW 196 OHM 2% 1/6M	28480	0698-7219
A3A1	11683-60002	1	BOARD ASSY:SAMPLING GATE	28480	11683-60002
A3A2	0180-2515	2	C:FXD ELECT 47 UF	28480	0180-2515
A3A3	1180-2515	1	C:FXD ELECT 47 UF	28480	0180-2515
A3A4	0160-3094	1	C:FXD CER 0.1 UF 10% 100VDCM	56289	0160-3094
A3A5	0160-3879	1	C:FXD CER 0.01 UF 20% 100VDCM	72982	0160-3879
A3A6	0160-2549	1	C:FXD ELECT 100 UF	28480	0160-2549
A3A7	0698-3260	1	TRANSISTOR:SI NPN	28480	0698-3260
A3A8	0698-3261	1	R:FXD MET FLW 464K OHM 1% 1/8M	28480	0698-3261
A3A9	0698-7248	1	R:FXD FLW 3.16K OHM 2% 1/8M	28480	0698-7248

See Introduction to this section for ordering information

Table 3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3A1R3	0698-7236	3	R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A3A1R4	0698-7236		R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A3A1R5	0757-0180	1	R:FXD MET FLM 31.6 OHM 1% 1/8W	28480	0757-0180
A3A1R6	0698-7224	1	R:FXD FLM 316 OHM 2% 1/8W	28480	0698-7224
A3A1R7	0698-7236		R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A3A2	08481-60002	1	FET ASSEMBLY	28480	08481-60002
A4	5060-9409	1	POWER MODULE ASSEMBLY	28480	5060-9409
A4J1 THRU A4J8	0360-0514	8	TERMINAL	28480	0360-0514
A4T81	5020-8122	1	LINE VOLTAGE SELECTION CARD CHASSIS PARTS	28480	5020-8122
DS1	2140-0244	1	LAMP:GLOW MINIATURE 95V (PART OF S1).	87034	A1H
F1	2110-0027	1	FUSE:0.125A 250V (FOR 100/120 VAC OPERATION)	75915	312.125
F1	2110-0011	1	FUSE:CARTRIDGE 3 AG 1/16 AMP 250V MAX (FOR 220/240 VAC OPERATION)	75915	312062
J1	1250-0083	1	CONNECTOR:BNC (SEE MP8)	02660	31-221-1020
MP1	0360-1190	1	LUG:SOLDER B.N.C.	79963	720 SPEC
MP2	0370-2388	1	KNOB:BAR SKIRTED, JADE GRAY	28480	0370-2388
MP3	0590-0052	2	NUT:CAPTIVE 6-32 CLEAR CHROMATE	00000	080
MP4	0590-0765	2	NUT:KNURLED (USED WITH A2S1 AND A2S2).	00000	080
MP5	2190-0016	2	WASHER:LOCK PH BRZ NP	00000	080
MP6	2190-0067	2	WASHER:LOCK FOR 1/4" HDW	28480	2190-0067
MP7	2360-0113	1	SCREW:PAN HD POZI 6-32 X 1/4 W/LK	00000	080
MP8	2950-0043	2	NUT:HEX 3/8-32 X 7/16 X 3/32 (USED WITH A1 AND J1)	00000	080
MP9	2950-0052	2	NUT:HEX BRASS 1/4-40 (USED WITH A2S1 AND A2S2).	04009	080#
MP10	11683-00004	1	SUPPORT:P.C. BOARD	28480	11683-00004
MP11	11683-00005	1	BRACKET:TRANSFORMER MOUNTING	28480	11683-00005
MP12	0590-0923	1	NUT:KNURLED 1/2-32 THREAD (PART OF S1)	00000	080
MP13	3101-0559	1	CAP:PUSHBUTTON, WHITE PLASTIC (PART OF S1).	87034	67250-121
P1 THRU P8	0362-0063	8	TERMINATION:CRIMP LUG FOR 0.0465Q PIN	00000	080
R1	0757-0459	1	R:FXD MET FLM 56.2K OHM 1% 1/8W (PART OF W2).	28480	0757-0459
S1	3101-1394	1	SWITCH:PUSHBUTTON DPDT-08 (PART OF W2;INCLUDES DS1, MP12,13).	87034	53-67280-120/A1H
T1	9100-0552	1	TRANSFORMER:POWER 50-400 HZ	28480	9100-0552
W1	8120-1378	1	CABLE ASSY:AC POWER CORD	70903	KH-7081
W2	11683-60004	1	PRIMARY POWER CABLE (INCLUDES R1 AND S1).	28480	11683-60004

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