

# Errata

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. To reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product number/name was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648 is now model number Agilent 8648.

Ce manuel peut contenir des références à <<HP>> ou <<Hewlett-Packard.>> Veuillez noter que les produits de test et mesure, de semi-conducteur et d'analyse chimique qui avaient fait partie de la société Hewlett-Packard sont maintenant une partie de la société Agilent Technologies. Pour réduire la confusion potentielle, le seul changement aux noms de référence a été dans le préfixe de nom de société : là où un nom de référence était HP XXXX, le nouveau nom de référence est maintenant Agilent XXXX. Par exemple, le HP 8648 s'appelle maintenant Agilent 8648.

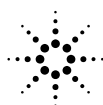
Diese Gebrauchsanweisung kann Bezug nehmen auf die Namen HP oder Hewlett-Packard. Bitte beachten Sie, dass ehemalige Betriebsbereiche von Hewlett-Packard wie HP-Halbleiterprodukte, HP-chemische Analysen oder HP-Test- und Messwesen nun zu der Firma Agilent Technology gehören. Um Verwirrung zu vermeiden wurde lediglich bei Produktname und - Nummer der vor laufende Firmenname geändert: Produkte mit dem Namen/Nummer HP XXXX lauten nun mehr Agilent XXXX. Z.B, das Modell HP 8648 heißt nun Agilent 8648.

Questo manuale potrebbe contenere riferimenti ad HP o Hewlett-Packard. Si noti che le attività precedentemente gestite da Hewlett-Packard nel campo di Test & Misura, Semiconduttori, ed Analisi Chimica sono ora diventate parte di Agilent Technologies. Al fine di ridurre il rischio di confusione, l'unica modifica effettuata sui numeri di prodotto e sui nomi ha riguardato il prefisso con il nome dell'azienda : dove precedentemente compariva "HP XXXX" compare ora "Agilent XXXX". Ad esempio: il modello HP8648 è ora indicato come Agilent 8648.

Este manual puede hacer referencias a HP o Hewlett Packard. Las organizaciones de Prueba y Medición (Test and Measurement), Semiconductores (Semiconductor Products) y Análisis Químico (Chemical Analysis) que pertenecían a Hewlett Packard, ahora forman parte de Agilent Technologies. Para reducir una potencial confusión, el único cambio en el número de producto y nombre, es el prefijo de la compañía: Si el producto solía ser HP XXXX, ahora pasa a ser Agilent XXXX. Por ejemplo, el modelo HP8648 es ahora Agilent 8648.

这个手册里面可能含有惠普公司的资料。请注意惠普公司以前的测试, 半导体产品, 化学分析部门现在属于安捷伦公司。为了减少可能的误解, 产品号码和名字只改变最前面的公司名字。如果一个产品的号码/名字以前是HP XXXX, 现在的号码/名字是安捷伦 XXXX。例如模型号码是惠普 8648。现在是模型号码安捷伦 8648。

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**Agilent Technologies**

## マニュアル・チェンジ

### 変更

本文中の「HP (YHP)」、または「(横河)ヒューレット・パッカー株式会社」という語句を、「Agilent」、または「アジレント・テクノロジー株式会社」と変更してください。

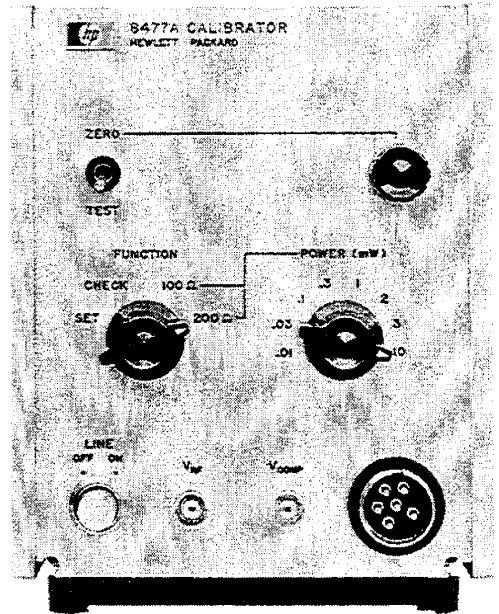
ヒューレット・パッカー社の電子計測、半導体製品、化学分析ビジネス部門は分離独立し、アジレント・テクノロジー社となりました。

社名変更に伴うお客様の混乱を避けるため、製品番号の接頭部のみ変更しております。

(例: 旧製品名 HP 4294A は、現在 Agilent 4294A として販売いたしております。)

# OPERATING AND SERVICE MANUAL

# CALIBRATOR 8477A



<b>Declaration of Conformity</b> according to ISO/IEC Guide 22 and EN45014	
<b>Manufacturer's Name:</b>	<b>Hewlett-Packard Ltd.</b>
<b>Manufacturer's Address:</b>	Queensferry Microwave Division South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom
Declares that the product	
<b>Product Name:</b>	Power Meter Calibrator for HP 432A
<b>Model Numbers:</b>	HP 8477A
<b>Product Options:</b>	This declaration covers all options of the above products as detailed in TCF A-5951-9852-02.
Conforms with the protection requirements of European Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic compatibility.	
Against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992	
<b>As Detailed in:</b>	Electromagnetic Compatibility (EMC) Technical Construction File (TCF) No. A-5951-9852-02
<b>Assessed by:</b>	DTI Appointed Competent Body EMC Test Centre, GEC-Marconi Avionics Ltd., Maxwell Building, Donibristle Industrial Park, KY11 5LB Scotland, United Kingdom
Technical Report Number:6893/2200/CBR, dated 23 September 1997	
<b>Supplementary Information:</b>	
The product conforms to the following safety standards:	
EN 61010-1(1993) / IEC 1010-1(1990) +A1(1992) CSA-C22.2 No. 1010.1-92	
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and carries the CE-marking accordingly.	
<b>South Queensferry, Scotland</b>	<b>17 November 1997</b>
<i>Location</i>	<i>Date</i>
	<i>R.M. Evans</i>
	<b>R.M. Evans / Quality Manager</b>

Europe Contact:  
Your Local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department 2Q / Standards Europe  
Herrenberger Strasse 130, D7030 Boblinger (Fax: +49-7031-143143)

## Warranty

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

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

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

## Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from:

- 1 Improper or inadequate maintenance, adjustment, calibration, or operation by Buyer;
- 2 Buyer-supplied software, hardware, interfacing or consumables;
- 3 Unauthorized modification or misuse;
- 4 Operation outside of the environmental and electrical specifications for the product;
- 5 Improper site preparation and maintenance; or
- 6 Customer induced contamination or leaks.

THE WARRANTY SET FORTH IS EXCLUSIVE AND NO OTHER WARRANTY, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

## Limitation of Remedies and Liability

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL HP BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFITS) WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY.

## Responsibilities of the Customer

The customer shall provide:

- 1 Access to the products during the specified periods of coverage to perform maintenance.
- 2 Adequate working space around the products for servicing by Hewlett-Packard personnel.
- 3 Access to and use of all information and facilities determined necessary by Hewlett-Packard to service and/or maintain the products. (Insofar as these items may contain proprietary or classified information, the customer shall assume full responsibility for safeguarding and protection from wrongful use.)
- 4 Routine operator maintenance and cleaning as specified in this manual.
- 5 Consumables such as paper, disks, magnetic tapes, ribbons, inks, pens, gases, solvents, lamps, filters, fuses, seals, etc.

## 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.

## assistance

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

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

## disclaimer

The information contained in this document is subject to change without notice.

Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

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Use, duplication, or disclosure by the government is subject to restrictions as set forth in subdivision (b)(3)(ii) of the Rights in Technical Data and Computer Software clause at 52.227-7013. Hewlett-Packard Company; 3000 Hanover Street; Palo Alto, California 94304.

## Statement of Compliance

**Electromagnetic Compatibility (EMC) Information** This product has been designed to meet the protection requirements of the European Communities Electromagnetic Compatibility (EMC) directives:

EN55011:1991 (Group 1, Class A)  
 EN50082-1:1992  
 - IEC 1000-4-2 (1995) ESD  
 - IEC 1000-4-3 (1995) Radiated Susceptibility  
 - IEC 1000-4-4 (1995) EFT

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

**Safety Information** This instrument has been designed and tested in accordance with publication EN61010-1(1993) / IEC 1010-1(1990) +A1(1992) +A2(1994) / CSA C22.2 No. 1010.1(1993) Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

## General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

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**WARNING**

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**This is a Safety Class I instrument (provided with a protective earthing ground, incorporated in the powercord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.**

**DO NOT** operate the product in an explosive atmosphere or in the presence of flammable gasses or fumes.

**DO NOT** use repaired fuses or short-circuited fuseholders: For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.

**DO NOT** perform procedures involving cover or shield removal unless you are qualified to do so: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only.



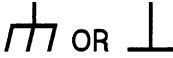

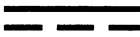



**DO NOT** service or adjust alone: Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, service personnel must not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

**DO NOT** operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

**DO NOT** substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

## Safety Symbols

The following symbols on the instrument and in the manual indicate precautions which must be taken to maintain safe operation of the instrument.

Safety Symbols	
	The Instruction Documentation Symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the supplied documentation.
	Indicates the field wiring terminal that must be connected to earth ground before operating the equipment - protects against electrical shock in case of fault.
	Frame or chassis ground terminal - typically connects to the equipment's metal frame.
	Alternating current (AC)
	Direct current (DC)
	Indicates hazardous voltages
WARNING	Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.
CAUTION	Caution denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution note until the indicated conditions are fully understood and met.
	The CE mark shows that the product complies with all relevant European Legal Directives.
ISM 1-A	This is a symbol of an Industrial, Scientific, and Medical Group 1 Class A product.
	The CSA mark is a registered trademark of the Canadian Standards Association, and indicates compliance to the standards laid out by them.



## Noise Declaration

LpA<70dB

am Arbeitsplatz (operator position)

normaler Betrieb (normal position)

nach DIN 45635 pt.19 (per ISO 7779)

## Operating Environment

This instrument is designed for Indoor use only.

The instrument may be operated at temperatures from 0°C to +55°C at altitudes up to 4600m (15,000 ft.). The instrument may be operated in environments up to 95% relative humidity to 40°C, but it should be protected from temperature extremes which may cause condensation.

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### Installation

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This instrument is designed for use in Installation Category II and Pollution Degree 2 per IEC1010 and 644 respectively.

### Cleaning

**To clean the instrument:** Use a soft, clean damp cloth to clean the front-panel and side covers.

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### Warnings

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Mains supply voltage fluctuations should not exceed  $\pm 10\%$  of the nominal selected line voltage.

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### Warnings

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Before switching on this instrument, make sure that the line voltage slide switch is set to the voltage of the power supply, and the correct fuse is installed (see Figure 1). Ensure the power supply voltage is in the specified range.

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### Warnings

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**Appliance coupler (mains input powercord) is the power disconnect device. Do not position the instrument such that access to the coupler is impaired.**

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### Warnings

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**For continued protection against fire hazard, replace the line fuse only with the same type and line rating (T125 mA 250 V). The use of other fuses or materials is prohibited.**

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### Warnings

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**If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in a normal condition only (in which all means for protection are intact).**

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### Warnings

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**No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

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# CALIBRATOR 8477A



**Agilent Technologies**

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1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

Manual Part No. 08477-90007

Printed: April 1998

**1. DESCRIPTION**

2. The HP Model 8477A Calibrator is a precision instrument designed to calibrate HP 432 series Power Meters. It supplies voltages to check and adjust the power meter bridge circuits; provision is made to calibrate a 432 for operation with either 100 ohm or 200 ohm thermistor mount resistances.

**3. INSTRUMENT IDENTIFICATION**

4. Each instrument carries a two-section serial number. The first section is a prefix. Revisions required to adapt this manual to instruments with particular serial number prefixes are contained in a yellow "Manual Changes" insert supplied with the manual, if applicable. If uncertain whether this manual applies to the serial prefix for your instrument, contact the nearest Hewlett-Packard office.

**5. INITIAL INSPECTION**

**6. Mechanical Check**

7. If damage to the shipping carton is evident, ask the carrier's agent to be present when the

instrument is unpacked. Inspect the instrument for mechanical damage. Also check the cushioning material for signs of severe stress.

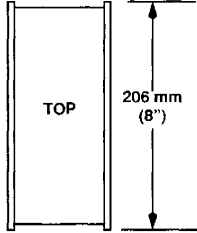
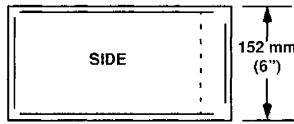

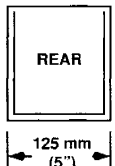
**8. Performance Check**

9. The electrical performance of the instrument should be verified upon receipt. Performance checks suitable for incoming inspection are given in paragraphs 41 through 44.

**10. Claims for Damage**

11. If the instrument is mechanically damaged in transit, notify the carrier and the nearest Hewlett-Packard field office immediately. A list of field offices is contained in the back of this manual. Retain the shipping carton and padding material for the carrier's inspection. The field office will arrange for replacement or repair of your instrument without delay for claim settlements against the carrier. Before shipment, this instrument was inspected and found free of mechanical and electrical defects. If there is any deficiency, or if electrical performance is not within specifications, notify your nearest Hewlett-Packard Sales and Service office.

*Table 1. Specifications, HP 8477A Calibrator*

<p><b>Calibration Function:</b> Output voltages corresponding to meter readings of: 0.01, 0.03, 0.1, 0.3, 1, 3, and 10 milliwatts.</p>	<p><b>Dimensions:</b> (nominal)</p>
<p><b>Calibration Uncertainty:</b> <math>\pm 0.5\%</math> on 0.01 and 0.03 mW ranges (+20°C to +30°C). <math>\pm 0.2\%</math> on 0.1 to 10 mW ranges (+20°C to +30°C).</p>	<p><b>NOTE</b> DIMENSIONS IN MILLIMETERS AND (INCHES) (A) FOR TOTAL LENGTH INCLUDING NOBS ADD 25 MM (1 IN) (B) FOR HEIGHT INCLUDING FEET ADD 11 MM (7/16 IN)</p>
<p><b>RFI:</b> Meets all conditions specified in MIL-I-6181D.</p>	<p><b>Depth:</b> </p>
<p><b>NOTE</b> The following Power Requirements are for mains connected equipment, unless stated otherwise.</p>	<p><b>Height:</b> </p>
<p> <b>Power:</b> 115 or 230 V, 50 to 400 Hz, 13 VA (max).</p>	<p><b>Width:</b> </p>
<p><b>Accessories Furnished:</b> 7-1/2 ft. (2.29 m) power cable.</p>	<p><b>Weight:</b> Net 2.04 kg (4 lb 8 oz) nominal.</p>
<p><b>Combining Cases:</b> 1051A, 11-1/4 in. (286 mm) deep 1052A, 16-3/8 in. (416 mm) deep</p>	<p><b>Environmental:</b> Operating Temperature: 0 to +55°C. Storage Temperature: -40 to +70°C. Humidity: Up to 95% Relative Humidity at 40°C. EMC: Meets EN55011:1991 (Group 1, Class A), and EN55082-1:1992.</p>
<p>The combining cases accept the 1/3-module HP instruments for bench use or rack mounting. See 1051A Data Sheet for details.</p>	

## 12. PREPARATION FOR USE

### 13. Power Requirements

14. The Model 8447A operates from 115 or 230 volts ac line voltage. Line frequency may vary from 50 to 400 Hz. A slide switch on the rear panel is moved to the correct position for the line voltage available. Before operating the equipment, ensure that the fuse installed in the instrument corresponds to the value marked on the panel for the line voltage available.

### 15. Power Cable

16. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. All Hewlett-Packard instruments are equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

17. To preserve the protection feature when operating the instrument from a two-connector outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

18. The power cord and power input connector meet the specifications established by the International Electrotechnical Commission (IEC).

### 19. Bench Mounting

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

### 21. Rack Mounting

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

## 23. STORAGE AND SHIPMENT

### 24. Original Packaging

25. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard Sales and Service offices listed at the rear of this manual.

26. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indi-

cating the type of service required, return address, model number and full serial number. Also mark the container FRAGILE to assure careful handling.

27. In any correspondence refer to the instrument by model number and full serial number.

### 28. Other Packaging Materials

29. The following general instructions should be used for repackaging with commercially available materials.

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard Service Office or center, attach a tag indicating the type of service required, return address, model number and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 200 pound test material is adequate.

c. Use enough shock-absorbing material (three to four inch layer) around all sides of the instrument to provide 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.

## 30. OPERATING INSTRUCTIONS

31. The front and rear panel controls, connectors and indicators are explained in Figure 1. The descriptions are keyed to corresponding items indicated on the figure. For further information regarding the various settings and uses of the controls and connectors, see the performance tests and adjustment procedures in the appropriate 432 manual.

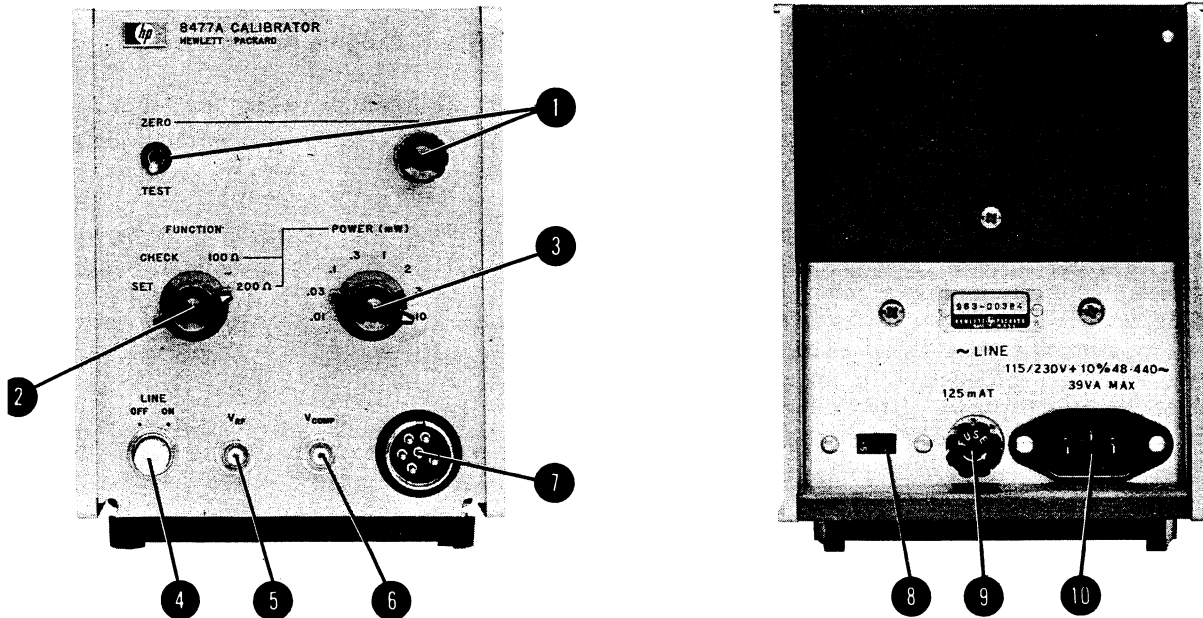
## 32. OPERATOR MAINTENANCE

33. Operator maintenance is limited to replacement of the front panel LINE switch light and the rear panel fuse.

### 34. Fuse Replacement

35. To replace the rear panel fuse, remove the rear panel fuse knob and replace the fuse with a 0.25 amp slo-blow fuse.

## CONTROLS AND CONNECTORS



### ZERO-TEST

**ZERO** — Adjust 8477A output so 432 meter reads zero.

**TEST** — Applies correct dc voltages to 432.

### FUNCTION — Controls 8477 mount resistance and the operation for checking gain of the 432 bridge amplifiers.

**SET** — Used to adjust offset of 432 bridge amplifiers to zero.

**CHECK** — Applies dc voltage to 432 bridge amplifiers to check gain.

**100Ω** — Provides 100Ω to complete 432 bridges.

**200Ω** — Provides 200Ω to complete 432 bridges.

### POWER (mW) — Sets output voltage levels that correspond to the 432 Power Meter ranges.

**4** **LINE** — Lamp lights when switch is in **LINE ON** position.

**5** **V<sub>RF</sub>** — Connects **V<sub>RF</sub>** from 432 to 8477A.

**6** **V<sub>COMP</sub>** — Connects **V<sub>COMP</sub>** from 432 to 8477A.

**7** Connects 8477A to 432 through thermistor cable; completes 432 bridge circuits through 8477A.

**8** **Line voltage** — Selects 115- or 230-volt line operation.

**9** **FUSE** — Use value shown (mA means milliamp slo-blow).

**10** **AC power** — Power cable receptacle (offset pin connected to 8477A Calibrator chassis).

Figure 1. 8477A Front and Rear Panel Controls and Connectors

**36. Lamp Replacement**

37. To replace the front panel line switch lamp (DS1), proceed as follows:

- a. Disconnect cord from rear panel receptacle.
- b. Pull the white cover portion of this switch from the instrument and then remove the lamp from inside the cover.
- c. Replace old lamp with a new lamp (see parts list for part number of DS1).
- d. Place white cover into switch receptacle.

e. Align tab on white cover with socket and push in.

**38. MAINTENANCE**

39. Test equipment and accessories required to perform maintenance are listed in Table 2. Equipment other than recommended models can be used provided the critical specifications are satisfied. Figure 10 on Service Sheet 1 shows the location of the test points and adjustments referred to in the following procedures. In the Calibrator, Test Point 3 is equivalent to the V<sub>RF</sub> jack and Test Point 7 is equivalent to the V<sub>comp</sub> jack. The instrument can be checked and adjusted using either the test points or the front panel connectors.

*Table 2. Recommended Test Equipment and Accessories*

Instrument Type	Critical Specifications	Recommended HP Model	Use (See Note)
Oscilloscope	Bandwidth: dc to 400 kHz Sensitivity: 1 mV/cm	140A with 1400A and 1422A Plug-in units	A
DC Standard Differential Voltmeter	Accuracy: ±0.0005% of reading ±0.004% of range ±1 μV	740B	P
Input Cable Assembly	Supplied with 740B	11054A	P
Digital Voltmeter	Range: 0.5 to 50 Vdc Accuracy: ±0.05% Input Impedance: 10 megohm floating Resolution: Three or more digits	3440 with 3443 Plug-in Unit	P,A,T
Power Meter		432 Series	P,A,T
Thermistor Mount Cable	Supplied with power meter	8120-1082	P,A,T
Cable Assemblies	Male BNC — 48 inches long	10503A	P,A,T
Cable Assemblies	BNC Male to dual banana	11001A	P,A,T
Isolation Resistors	1K 1% 1/8 watt	0757-0280	P
Cable Assembly	Dual Banana to test clips	11002A	P,A,T
<p>Note</p> <p>P = Performance Test; A = Adjustments; T = Troubleshooting</p>			

40. PERFORMANCE TESTS

41. Zero Range

- a. After at least one-half hour warmup, remove top cover of the 8477A.
- b. Connect the equipment as shown in Figure 2. Connect the low side of the digital voltmeter to Test Point 7 with a 1K resistor in series with the test lead. The high side of the DVM is connected to TP3. TP7 is also available at the  $V_{comp}$  BNC jack on the front panel of the 8477A and TP3 at the  $V_{RF}$  jack. Use BNC tees on these connectors to monitor the test point voltages there, if desired. Except for the different voltmeters used, the equipment setup is identical to Figure 4.
- c. Make the following equipment settings:

8477A:  
 POWER (mW) . . . . . .01 mW  
 FUNCTION . . . . . .200  
 ZERO/TEST . . . . . .ZERO

432:  
 RANGE . . . . . .10.0 mW  
 CALIBRATION FACTOR . . . . .100%  
 MOUNT RESISTANCE . . . . .200  
 A2S1 OPERATE/CALIBRATE SWITCH  
 (on A2 logic board of 432 with  
 Serial 931-01751  
 and above) . . . . . CALIBRATE

3440A/3443A:  
 RANGE . . . . . .AUTO

- d. Rotate the 8477A ZERO control full counterclockwise. The DVM should indicate greater than +500  $\mu V$ .
- e. Rotate the 8477A ZERO control full clockwise. The DVM should indicate less than -500  $\mu V$ .

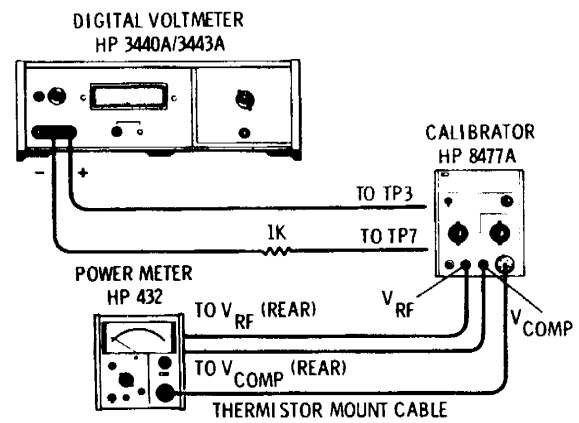


Figure 2. Zero Range Test Setup

42.  $V_{comp}$

- a. Make the following equipment settings:

8477A:  
 POWER (mW) . . . . . .01 mW  
 FUNCTION . . . . . .200 ohms  
 ZERO/TEST . . . . . .TEST

740B:  
 FUNCTION . . . . .  $\Delta VM$   
 RANGE . . . . . 1V  
 VOLTMETER SENSITIVITY . . . . . X10  
 VOLTAGE SET . . . . . 0 (all set ccw)

- b. Connect Input Cable Assembly (HP 11054A) to the INPUT receptacle of the 740B. Set INPUT Z switch to  $\infty$ .



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**PERFORMANCE TESTS**


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**42.  $V_{comp}$  (Cont)**

c. Short the + and - inputs of the 11504A with a shorting wire. Carefully zero the 740B as follows:

1. Ensure that all VOLTAGE SET controls are set to zero (fully ccw).
2. Depress  $X10^4$  SENSITIVITY.
3. Adjust ZERO control for zero meter indication.

d. Remove the shorting wire from the input terminals of the 11054A. Change the 740B RANGE to 10V.

e. Connect the equipment as shown in Figure 3.

f. Check the +5.9V (200 ohm) reference as follows:

1. Depress the  $X1$  SENSITIVITY and adjust its VOLTAGE SET to 5.
2. Push the  $X10$  VOLTMETER SENSITIVITY and adjust its VOLTAGE SET to 9.
3. Push the  $X10^2$  VOLTMETER SENSITIVITY and adjust the VOLTAGE SET to zero.
4. Push the  $X10^3$  VOLTMETER SENSITIVITY and adjust the VOLTAGE SET to zero. The 740B meter should indicate within plus-minus three major divisions of zero.

g. Remove the voltmeter lead from TP7; set 3.100 volts on the 740B using the VOLTAGE SET controls (VOLTMETER SENSITIVITY set to  $X10^2$ ).

h. Turn the POWER (mW) control on the 8477A to 10 mW position.

i. Return the test lead from the differential voltmeter to TP7 in the calibrator. It should indicate zero plus-minus three major divisions (3 mV).

j. Again remove the test lead from TP7 in the 8477A. Using the VOLTAGE SET controls, set 2.200 volts on the 740B.

k. Set the 8477B FUNCTION switch and the 432A MOUNT RESISTANCE switch to 100 ohms; replace the voltmeter test lead on TP7. The 740B meter should indicate zero plus-minus three major divisions (3 mV).

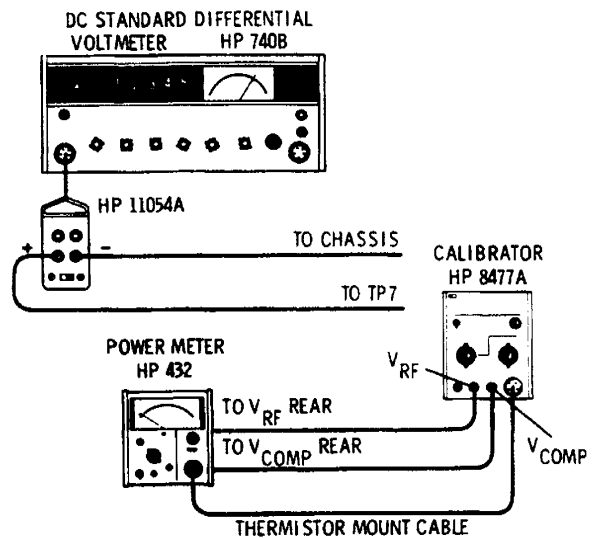


Figure 3.  $V_{comp}$  Check Test Setup

PERFORMANCE TESTS

Range Accuracy

After making the following instrument settings, connect equipment as shown in Figure 4.

32:		MOUNT RESISTANCE . . . . .	200 ohms
RANGE . . . . .	10 mW	CAL FACTOR . . . . .	100%
8477A:		ZERO/TEST . . . . .	ZERO
FUNCTION . . . . .	200 ohms	POWER (mW) . . . . .	.01 mW
740B:		VOLTMETER SENSITIVITY . . . . .	X1
FUNCTION . . . . .	$\Delta$ VM	VOLTAGE SET . . . . .	0
RANGE . . . . .	1 mV		

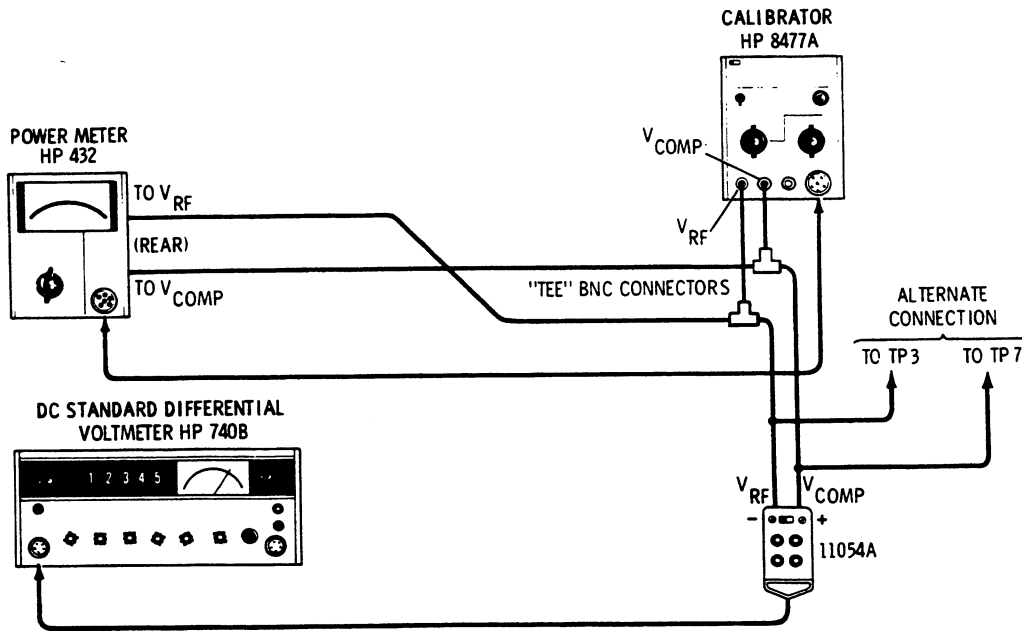


Figure 4. Range Accuracy Test Setup

Note

The heavy capacitive loading of the differential voltmeter may cause the 8477A-432 bridge loops to oscillate. An off-scale meter reading on the 432 is an indication of loop oscillations and can be verified by observing the signal inside the loop with an oscilloscope. If oscillations occur, connect a 1K resistor in series with the low side of the 740B Differential Voltmeter.

- b. Set the 740B VOLTMETER SENSITIVITY to  $X10^2$  and adjust the 8477A ZERO control for  $0.000 \pm 0.2$  major division on the 740B meter.

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**PERFORMANCE TESTS**


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**43. Range Accuracy (Cont)**

c. Set the 740B VOLTMETER SENSITIVITY to X1 and the 8477A ZERO/TEST control to TEST. Measure the calibrator voltage as follows:

1. Turn X1 VOLTAGE SET knob to 6.
2. Push X10 VOLTMETER SENSITIVITY and adjust its VOLTAGE SET to 7.
3. Push X10<sup>2</sup> VOLTMETER SENSITIVITY and adjust its VOLTAGE SET to 8. The 740B meter should indicate within plus-minus three major divisions of zero ( $\pm 3$  mV).

d. Return the 740B VOLTMETER SENSITIVITY to X1 and change its RANGE to 10 mV. Set the 8477A POWER (mW) switch to .03. Referring to Table 3 and using the procedures given in steps b and c, set the correct voltages and check the remaining 200 ohm ranges.

Note

It is not necessary to vary the RANGE switch of the 432 in the steps of the 8477A RANGE accuracy steps.

e. Using the procedure outlined above, check the 100 ohm range accuracies to the specifications listed in Table 4.

*Table 3. Range Accuracy Readings (200 $\Omega$ )*

POWER (mW)	Voltage TP3 to TP7 (mV)	Tolerance ( $\pm$ )
0.01	0.678	0.003 mV
0.03	2.034	0.009
0.1	6.784	0.010
0.3	20.370	0.031
1.0	68.190	0.100
2.0	137.200	0.200
3.0	207.000	0.310
10.0	1831.000	2.700

*Table 4. Range Accuracy Readings (100 $\Omega$ )*

POWER (mW)	Voltage TP3 to TP7 (mV)	Tolerance ( $\pm$ )
0.01	0.909	0.004 mV
0.03	2.729	0.012
0.1	9.110	0.014
0.3	27.440	0.041
1.0	92.870	0.138
2.0	190.000	0.284
3.0	292.100	0.438
10.0	1283.500	1.920

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PERFORMANCE TESTS

44. SET and CHECK Functions

a. This check verifies that the 8477A is operating properly in the SET and CHECK functions. Connect the equipment as shown in Figure 5. Set the instrument controls as follows:

8477A:  
 FUNCTION . . . . . SET

432:  
 RANGE . . . . . 10 mW  
 MOUNT RESISTANCE . . . . 200 ohms

b. The voltmeter should indicate +5.9 volts  $\pm$ .01 volt.

c. Change the FUNCTION switch to CHECK. The voltmeter should now read 2.2 volts  $\pm$ .01 volt.

d. Connect the positive probe of the voltmeter to TP3 (negative lead to chassis).

e. Set the 8477A FUNCTION switch to SET. The voltmeter should read 5.9 volts  $\pm$ .01 volt.

f. Move the FUNCTION switch to the CHECK position. The voltmeter should read 2.2 volts  $\pm$ .01 volt.

g. Return the OPERATE/CALIBRATE switch A2S1 on the 432 A2 Logic Board to OPERATE if set in this position in step 41 c.

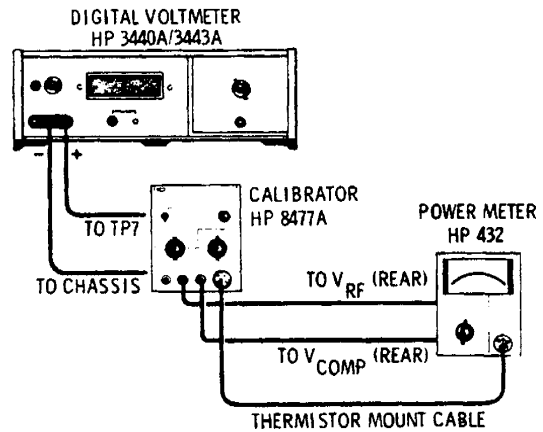


Figure 5. SET and CHECK Function Test Setup

Table 5. Performance Test Record

Para Ref.	Test	Measurement Unit	Min.	Actual	Max
41	<b>Zero Range</b>				
41d	Meter Indication	$\mu$ Vdc	+500	_____	
41e	Meter Indication	$\mu$ Vdc		_____	-500
42	<b>Vcomp Check</b>				
42f	Meter Indication	Vdc	5.897	_____	5.903
42i	Meter Indication	Vdc	3.097	_____	3.013
42k	Meter Indication	Vdc	2.197	_____	2.203
43	<b>Range Accuracy (200 ohms)</b>				
43d	0.01	mVdc	0.675	_____	0.681
	0.03	mVdc	2.025	_____	2.043
	0.1	mVdc	6.774	_____	6.794
	0.3	mVdc	20.339	_____	20.401
	1	mVdc	68.090	_____	68.290
	2	mVdc	137.000	_____	137.400
	3	mVdc	206.690	_____	207.310
	10	mVdc	1828.300	_____	1833.700
	<b>(100 ohms)</b>				
43e	0.01	mVdc	0.905	_____	0.913
	0.03	mVdc	2.717	_____	2.741
	0.1	mVdc	9.096	_____	9.124
	0.3	mVdc	27.399	_____	27.481
	1.	mVdc	92.732	_____	93.008
	2	mVdc	189.716	_____	190.284
	3	mVdc	291.662	_____	292.538
	10	mVdc	1281.580	_____	1285.420
44	<b>SET and CHECK Functions</b>				
44b	Meter Indication	Vdc	5.890	_____	5.910
44c	Meter Indication	Vdc	2.190	_____	2.210
44e	Meter Indication	Vdc	5.890	_____	5.910
44f	Meter Indication	Vdc	2.190	_____	2.210

## 45. CHECKS AND ADJUSTMENTS

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### 46. Power Supplies

- a. Connect the DVM and the oscilloscope in parallel to TP4. This power supply is nominally +18V; the voltage should be between +17V and +20V. Maximum ripple is 5.6 mV p-p (2 mVrms).
  - b. Connect the scope and DVM to TP5. This supply is nominally -7V; its value should fall between -5.8V and -7.8V. Maximum ripple is 2.8 mV p-p (1.0 mVrms).
  - c. Refer to the troubleshooting information on Service Sheets 1 thru 3 if either power supply fails to meet the above specifications.
- 

### 47. 5.900 Volt Adjustment

- a. Set up the test equipment as shown in Figure 3. Connect the positive lead of the voltmeter to TP13. Set the instrument controls as follows:

#### 8477A:

FUNCTION . . . . .	200 ohms	ZERO/TEST . . . . .	ZERO
POWER (mW) . . . . .	3 mW	ZERO CONTROL . . . . .	Centered

#### 432:

RANGE . . . . .	3 mW	MOUNT RESISTANCE . . . . .	200 ohms
		CAL FACTOR . . . . .	100%

#### 740B:

FUNCTION . . . . .	$\Delta$ V	VOLTMETER SENSITIVITY . . . . .	X1
RANGE . . . . .	10V	VOLTAGE SET . . . . .	0

- b. Zero the 740B meter (refer to  $V_{comp}$  check in Performance Test for procedure).
  - c. Set the 740B to 5.900 volts using its VOLTAGE SET controls and adjust A1R21 for a 740B meter indication of zero  $\pm 1$  major division. If A1R21 cannot be adjusted to the above value, the value of A1R22 should be changed to make the adjustment possible.
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### 48. Amplifier Balance Adjustment

- a. Connect a DVM between TP6 and TP7 with a 1K resistor in series with the negative lead and set R24 (OFFSET ADJUST) for a DVM reading of  $0.000 \pm 0.002V$ .
  - b. Move the DVM leads to TP2 and TP3 with the 1K resistor in series with the negative lead. Set R37 (ZERO ADJUST) for a DVM reading of  $0.000 \pm 0.002V$ .
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49. REPLACEABLE PARTS

50. Ordering Information

51. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard field office (see list at rear of this manual for addresses). Identify parts by their Hewlett-

Packard part numbers. To obtain a part that is not listed, include:

- a. Instrument model number.
- b. Instrument serial number.
- c. Description of the part.
- d. Function and location of the part.

Table 6. Reference Designations and Abbreviations

REFERENCE DESIGNATORS							
A	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor	FL	= Filter	Q	= transistor		
BT	= battery	J	= jack	R	= resistor		
C	= capacitor	K	= relay	RT	= thermistor	VR	= voltage regulator
CP	= coupler	L	= inductor	S	= switch		
CR	= diode	LS	= loud speaker	T	= transformer	W	= cable
DL	= delay line	M	= meter	TB	= terminal board	X	= socket
DS	= device signaling (lamp)	MK	= microphone	TP	= test point	Y	= crystal
E	= misc electronic part	MP	= mechanical part	U	= integrated circuit	Z	= tuned cavity, network

ABBREVIATIONS							
A	= amperes	H	= henries	N/O	= normally open	RMO	= rack mount only
AFC	= automatic frequency control	HDW	= hardware	NOM	= nominal	RMS	= root-mean square
AMPL	= amplifier	HEX	= hexagonal	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage
BFO	= beat frequency oscillator	HG	= mercury			S-B	= slow-blow
BE CU	= beryllium copper	HR	= hour(s)			SCR	= screw
BH	= binder head	Hz	= Hertz	NPN	= negative-positive-negative	SE	= selenium
BP	= bandpass	IF	= intermediate freq	NRFR	= not recommended for field replacement	SECT	= section(s)
BRS	= brass	IMPG	= impregnated			SEMICON	= semiconductor
BWO	= backward wave oscillator	INCL	= incandescent			SI	= silicon
		INCL	= include(s)	NSR	= not separately replaceable	SIL	= silver
		INS	= insulation(ed)			SL	= slide
		INT	= internal	OBD	= order by description	SPG	= spring
				OH	= oval head	SPL	= special
CCW	= counterclockwise	K	= kilo = 1000	OX	= oxide	SST	= Stainless steel
CER	= ceramic					SR	= split ring
CMO	= cabinet mount only	LH	= left hand			STL	= steel
COEF	= coefficient	LIN	= linear taper	P	= peak		
COM	= common	LK WASH	= lock washer	PC	= printed circuit	TA	= tantalum
COMP	= composition	LOG	= logarithmic taper	PF	= picofarads = 10 <sup>-12</sup> farads	TD	= time delay
COMPL	= complete	LPF	= low pass filter	PH BRZ	= phosphor bronze	TGL	= toggle
CONN	= connector			PHL	= Phillips	THD	= thread
CP	= cadmium plate	M	= milli = 10 <sup>-3</sup>	PIV	= peak inverse voltage	TI	= titanium
CRT	= cathode-ray tube	MEG	= meg = 10 <sup>6</sup>	PNP	= positive-negative-positive	TOL	= tolerance
CW	= clockwise	MET FLM	= metal film			TRIM	= trimmer
DEPC	= deposited carbon	MET OX	= metallic oxide			TWT	= traveling wave tube
DR	= drive	MFR	= manufacturer				
ELECT	= electrolytic	MHz	= mega Hertz	P/O	= part of	μ	= micro = 10 <sup>-6</sup>
ENCAP	= encapsulated	MINAT	= miniature	POLY	= polystyrene		
EXT	= external	MOM	= momentary	PORC	= porcelain	VAR	= variable
F	= farads	MOS	= metalized substrate	POS	= position(s)	VDCW	= dc working volts
FH	= flat head	MTG	= mounting	POT	= potentiometer		
FIL H	= Fillister head	MY	= "mylar"	PP	= peak-to-peak	W/	= with
FXD	= fixed			PT	= point	W	= watts
		N	= nano (10 <sup>-9</sup> )	PWV	= peak working voltage	WIV	= working inverse voltage
G	= giga (10 <sup>9</sup> )	N/C	= normally closed			WW	= wirewound
GE	= germanium	NE	= neon	RECT	= rectifier	W/O	= without
GL	= glass	NI PL	= nickel plate	RF	= radio frequency		
GRD	= ground(ed)			RH	= round head or right hand		

Table 7. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08477-60001	1	BOARD ASSY-CALIBRATOR	28480	08477-60001
A1C1	0180-1819	1	C:FXD ELECT 100 UF +75-10% 50VDCW	28480	0180-1819
A1C2	0180-0229	3	C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A1C3	0180-0116	1	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X903582-DYS
A1C4			NOT ASSIGNED		
A1C10			NOT ASSIGNED		
A1C11	0160-2930	5	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C12	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C13	0180-0197	1	C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A1C14	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A1C15	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C16	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C17	0180-0376	1	C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
A1C18	0180-0229		C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A1CR1	1901-0026	4	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR2	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR3	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR4	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A1CR5	1902-0048	1	DIODE:BREAKDOWN 6.81V 5%	04713	SZ10939-134
A1CR6	1902-0509	1	DIODE BREAKDOWN:6.20V 2%	04713	SZ50984
A1CR7			NOT ASSIGNED		
A1CR10			NOT ASSIGNED		
A1CR11	1901-0040	4	DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR13	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1Q1	1853-0020	8	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q2	1854-0039	1	TSTR:SI NPN	80131	2N3053
A1Q3	1854-0071	14	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q8	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q9	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q10			NOT ASSIGNED		
A1Q11	1854-0221	2	TSTR:SI NPN(REPL.BY 2N4044)	28480	1854-0221
A1Q12	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q13	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q15	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q16	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q17	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q18	1854-0221		TSTR:SI NPN(REPL.BY 2N4044)	28480	1854-0221
A1Q19	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q20	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q21	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q22	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q23	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q24	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1Q25	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1Q26	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1R1	0698-3160	2	R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1R2	0757-0465	4	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A1R3	0698-3157	1	R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157
A1R4	0757-0442	1	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A1R5	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A1R6	0698-3430	1	R:FXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-3430
A1R7	0757-0317	1	R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
A1R8	0757-0279	4	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A1R9	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A1R10	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A1R11	0698-3444	1	R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444
A1R12			NOT ASSIGNED		
A1R20			NOT ASSIGNED		
A1R21	2100-1770	1	R:VAR WW 100 OHM 5% TYPE H 1W	28480	2100-1770
A1R22	0757-0400	1	R:FXD MET FLM 90.9 OHM 1% 1/8W FACTORY SELECTED PART	28480	0757-0400
A1R23	0698-3260	6	R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A1R24	2100-1773	2	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A1R25	0698-3458	2	R:FXD MET FLM 348K OHM 1% 1/8W	28480	0698-3458
A1R26	0698-3260		R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A1R27	0757-0401	5	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R28	0698-3260		R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A1R29	0698-3454	2	R:FXD MET FLM 215K OHM 1% 1/8W	28480	0698-3454

See introduction to this section for ordering information



Table 7. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R30	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A1R31	0757-0199	2	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A1R32	0698-3156	1	R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A1R33	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A1R34	0757-0280	8	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R35	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R36	0698-3260		R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A1R37	2100-1773		R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773
A1R38	0698-3458		R:FXD MET FLM 348K OHM 1% 1/8W	28480	0698-3458
A1R39	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R40	0698-3260		R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A1R41	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A1R42	0698-3454		R:FXD MET FLM 215K OHM 1% 1/8W	28480	0698-3454
A1R43	0698-3260		R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
A1R44	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
A1R45	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A1R46	0698-3452	1	R:FXD MET FLM 147K OHM 1% 1/8W	28480	0698-3452
A1R47	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A1R48	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R49	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R50	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R51	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R52	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1R53	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A1	1205-0011	1	HEAT DISSIPATOR:FOR T0-5 AND TO-9 CASES	98978	TXBF-032-0258
A2	08477-60002	1	SWITCH ASSY:POWER	28480	08477-60002
A2R1	0811-2673	1	R:FXD WW 1273 OHM 0.02% 1/40W	28480	0811-2673
A2R2	0811-2674	1	R:FXD WW 409.1 OHM 0.02% 1/40W	28480	0811-2674
A2R3	0811-2675	2	R:FXD WW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R4	0811-2677	1	R:FXD WW 2.807 OHM 0.05% 1/40W	28480	0811-2677
A2R5	0811-2672	1	R:FXD WW 5.616 OHM 0.05% 1/40W	28480	0811-2672
A2R6	0811-2676	1	R:FXD WW 1.674 OHM 0.05% 1/40W	28480	0811-2676
A2R7	0811-2679	1	R:FXD WW 17.99 OHM 0.05% 1/40W	28480	0811-2679
A2R8	0811-2678	1	R:FXD WW 2.216 OHM 0.05% 1/40W	28480	0811-2678
A2R9	0811-2680	1	R:FXD WW 54.06 OHM 0.05% 1/40W	28480	0811-2680
A2R10	0811-2681	1	R:FXD WW 16.80 OHM 0.05% 1/40W	28480	0811-2681
A2R11	0811-2682	1	R:FXD WW 181.2 OHM 0.05% 1/40W	28480	0811-2682
A2K12	0811-2684	1	R:FXD WW 22.40 OHM 0.05% 1/40W	28480	0811-2684
A2R13	0811-2683	1	R:FXD WW 263.3 OHM 0.05% 1/40W	28480	0811-2683
A2R14	0811-2685	1	R:FXD WW 289.2 OHM 0.05% 1/40W	28480	0811-2685
A2R15	0811-2686	1	R:FXD WW 174.1 OHM 0.05% 1/40W	28480	0811-2686
A2R16	0811-2688	1	R:FXD WW 1079 OHM 0.05% 1/40W	28480	0811-2688
A2R17	0811-2689	1	R:FXD WW 1134 OHM 0.05% 1/40W	28480	0811-2689
A2R18	0811-2690	1	R:FXD WW 11.01K OHM 0.05% 1/40W	28480	0811-2690
A2R19	0811-2687	1	R:FXD WW 178.1 OHM 0.05% 1/40W	28480	0811-2687
A2R20	0811-2675		R:FXD WW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2S1	3100-2497	1	SWITCH:ROTARY	28480	3100-2497
A3R1	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A3R2	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A3R3	0811-2538	2	R:FXD WW 100 OHM 0.1% 1/10W	28480	0811-2538
A3R4	0811-2538		R:FXD WW 100 OHM 0.1% 1/10W	28480	0811-2538
A3S1	3100-2498	1	SWITCH:ROTARY	28480	3100-2498
C1	0180-0106	1	C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
C2	0160-3043	1	C:FXD CER 2 X 0.005 UF 20% 250VAC	56289	29C147A-CDH
DS1	2140-0244	1	LAMP:GLOW MINIATURE 95V	87034	A1H
F1	2110-0318	1	FUSE:0.125 AMP SLOW-BLOW	71400	MDL 108
J1	1251-0153	1	CONNECTOR:AUDIO 6 MALE CONTACT	28480	1251-0153
	00432-2003	1	NUT:DRESS	28480	00432-2003
J2	1250-0083	2	CONNECTOR:BNC	02660	31-221-1020
J3	1250-0083		CONNECTOR:BNC	02660	31-221-1020
J4	1251-2357	1	SOCKET:3-PIN MALE POWER RECEPTACLE (PART OF REAR PANEL)	82389	EAC-301
R1	2100-2746	1	R:VAR WW 200 OHM 3% LIN 1-1/2W	28480	2100-2746
R2	0757-0458	1	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R3	0757-0198	2	R:FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198
R4	0757-0198		R:FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198
S1	3101-1248	1	SWITCH:PUSHBUTTON SPDT ILLUMINATED (LINE)	87034	53-55480-121/A1H
S2	3101-1234	1	SWITCH:SLIDE DPDT 6A 250 VAC (PART OF REAR PANEL)	82389	11A-1242A
S3	00432-2005	1	NUT:CONNECTOR	28480	00432-2005
	3101-0163	1	SWITCH:TOGGLE SPDT (ZERO/TEST)	04009	MST-1050
T1	9100-2504	1	TRANSFORMER:28.4V SEC.	28480	9100-2504
W1	8120-1348	1	CABLE ASSY:POWER, DETACHABLE	70903	KHS-7041

Table 7. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
XA1 XF1	1251-0160	1	CONNECTOR:15 PIN	28480	1251-0160
	1400-0084	1	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
	0370-0077	3	MISCELLANEOUS KNOB:SKIRTED BAR FOR 0.250" DIA SHAFT (POWER)	28480	0370-0077
	0370-0077		KNOB:SKIRTED BAR FOR 0.250" DIA SHAFT (FUNCTION)	28480	0370-0077
	0370-0310	1	KNOB:ROUND BLK 0.625" DIA (ZERO)	28480	0370-0310

See introduction to this section for ordering information

Table 7. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CABINET PARTS		
1	5060-0702	1	FRAME ASSEMBLY	28480	5060-0702
2	08477-00004	1	PANEL:FRONT*	28480	08477-00004
3	08477-00003	1	BRACKET:CONNECTOR	28480	08477-00003
4	08477-00005	1	PANEL:REAR*	28480	08477-00005
5	5000-0702	1	SIDE COVER	28480	5000-0702
6			NOT ASSIGNED		
7	5060-0705	1	TOP COVER ASSY:5 X 8	28480	5060-0705
8	5000-0710	1	COVER:BOTTOM 5 X 8 SM	28480	5000-0710
9	5060-0727	1	FOOT ASSY	28480	5060-0727
10	1490-0031	1	STAND:TILT	28480	1490-0031
11	5040-0700	1	HINGE	28480	5040-0700
12	5020-0700	1	SPACER:CABINET	28480	5020-0700
			* SEE BACKDATING INFORMATION PARA. 52.		

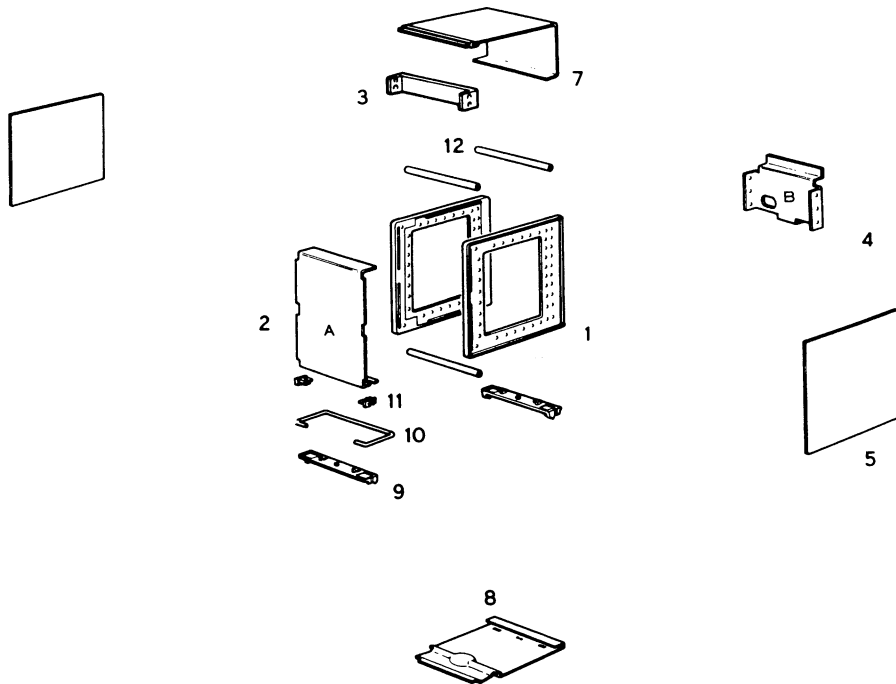


Figure 6. Cabinet Parts

Table 8. Code List of Manufacturers

The following numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-1 (Code to Name) and their latest supplements.

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
02660	Amphenol Corp.	. . . Broadview, Ill. 60153	71400	Bussman Mfg. Division	
04009	Arrow, Hart and Hegeman Electric Co.	. . . Hartford, Conn. 06106		McGraw-Edison Co.	St. Louis, Mo. 63017
04713	Motorola Semiconductor Products Inc.	. . . Phoenix, Ariz. 85008	75915	Littelfuse Inc.	. . . DesPlaines, Ill. 60016
07263	Fairchild Camera and Instrument Corp. Semiconductor Division	. . . Mountain View, Cal. 94040	80131	Electronic Industries Association	. . . Washington, D.C. 20006
28480	Hewlett-Packard Co.	. . . Palo Alto, Cal. 94304	82389	Switchcraft Inc.	. . . Chicago, Ill. 60630
56289	Sprague Electric Co	. . . N. Adams, Mass. 01247	87034	Marcooak Industries, Inc.	. . . Anaheim, Cal. 92803
70903	Belden Corp.	. . . Chicago, Ill. 60644	92418	Radio Materials Co.	. . . Chicago, Ill. 60646
			98978	International Electric Research Corp.	. . . Burbank, Cal. 91502

**52. Backdating Information**

53. The front and rear panels on instruments with serial prefixes prior to 963 are not active for replacement. To replace one of these front panels, order and install the following current parts.

- a. Front Panel 08477-00004
- b. S1 3101-1248 Pushbutton Power Switch
- c. R2 0757-0458 51.1K Ohm Resistor.

To replace one of these rear panels, order and install the following:

- a. Rear Panel 08477-00005
- b. W1 8120-1248 Power Cable
- c. F1 2110-0318 1/8 ASB Fuse.

**54. TROUBLESHOOTING AND SCHEMATIC DIAGRAMS**

**55. Introduction**

56. Schematic presentations in this manual show electrical circuit operation and are not intended to serve as wiring diagrams. Table 9 lists notes which apply to the schematic diagrams.

57. Some switch and circuit board assemblies are shown in part on different pages. To find a specific instrument component, refer to the "REF-

ERENCE DESIGNATIONS" box which appears on each schematic diagram. Reference designations within assemblies are abbreviated. The full designation includes the assembly on which the component is mounted, and the individual component designation. For example, resistor R1 mounted on assembly A1 has the complete reference designation of A1R1. Certain parts are not included on assemblies, and are classified as chassis parts. Chassis parts are assigned only the reference designation shown on the schematic diagram.

58. An asterisk indicates a factory selected part; the component value shown is the typical or most commonly selected value.













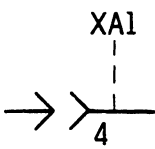
59. Component procurement information and specific component descriptions are included in Table 7.

**60. Test Conditions**

61. For most tests of circuit operation when troubleshooting the instrument, the troubleshooting charts call out control settings. In special cases, notes on the schematics indicate control settings required to measure voltage levels in circuits. Generally, the following control settings should be selected, and changed only as the troubleshooting procedures indicate:

FUNCTION . . . . .	200Ω
POWER (mW) . . . . .	.01 mW
ZERO/TEST . . . . .	ZERO

Table 9. Schematic Notes

1. Resistance in ohms, capacitance in microfarads unless otherwise indicated.
2.  Screwdriver adjustment  
 Front panel control
3.  Front panel designation  
 Rear panel designation
4.  Printed circuit card border  
 Signal path  
 Feedback path
5. P/O Part of
6.  Wiper moves toward CW when control rotated clockwise
7.  Test point. Number in star matches number on printed circuit card.
8.  Breakdown diode
9.  Tunnel diode
10.  Wire color code. Numerical color code same as resistor coding. For example, 947 denotes white, yellow, violet wire.
11.  Indicates socket connections and pin numbers

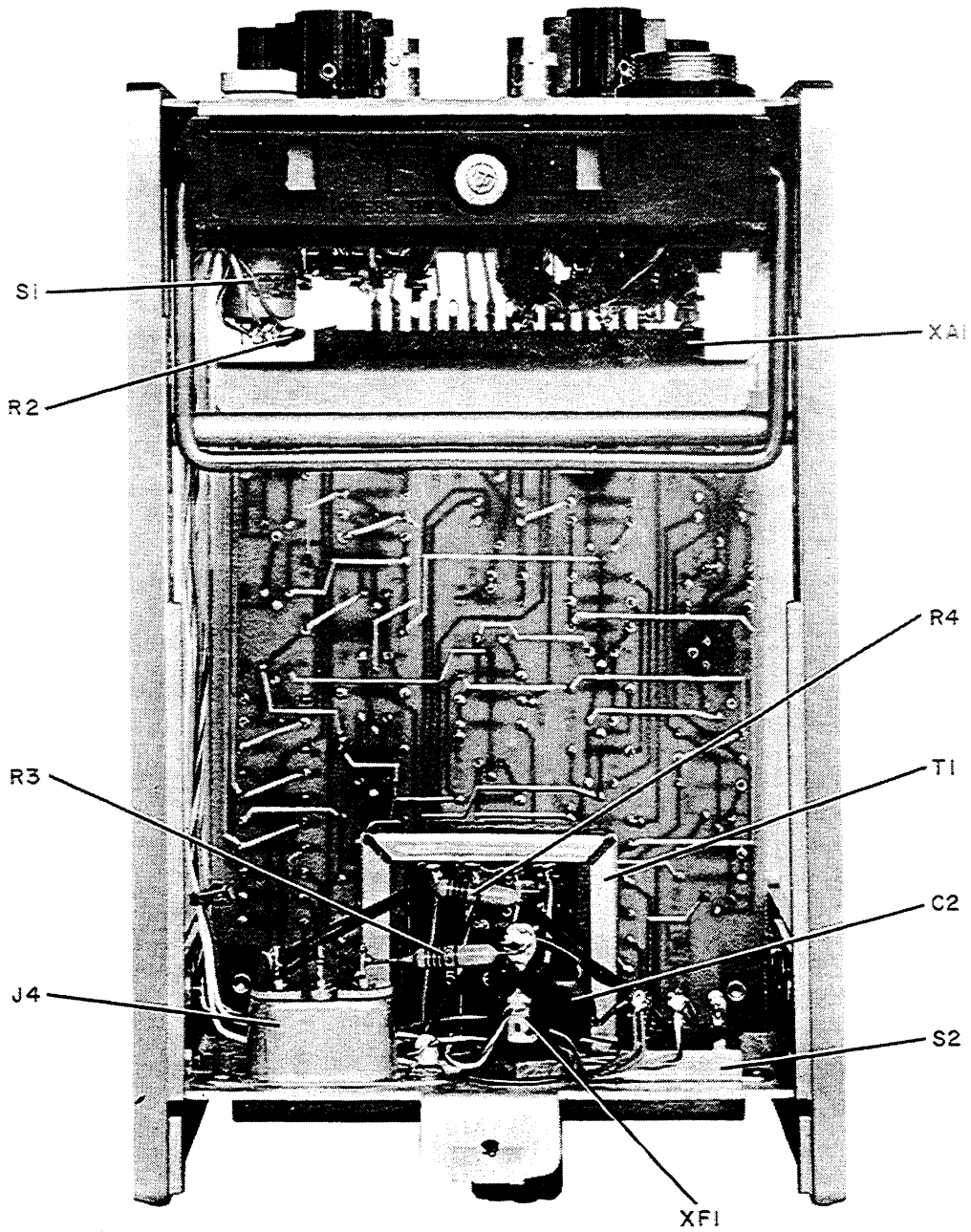


Figure 7. Bottom View, Cover Removed

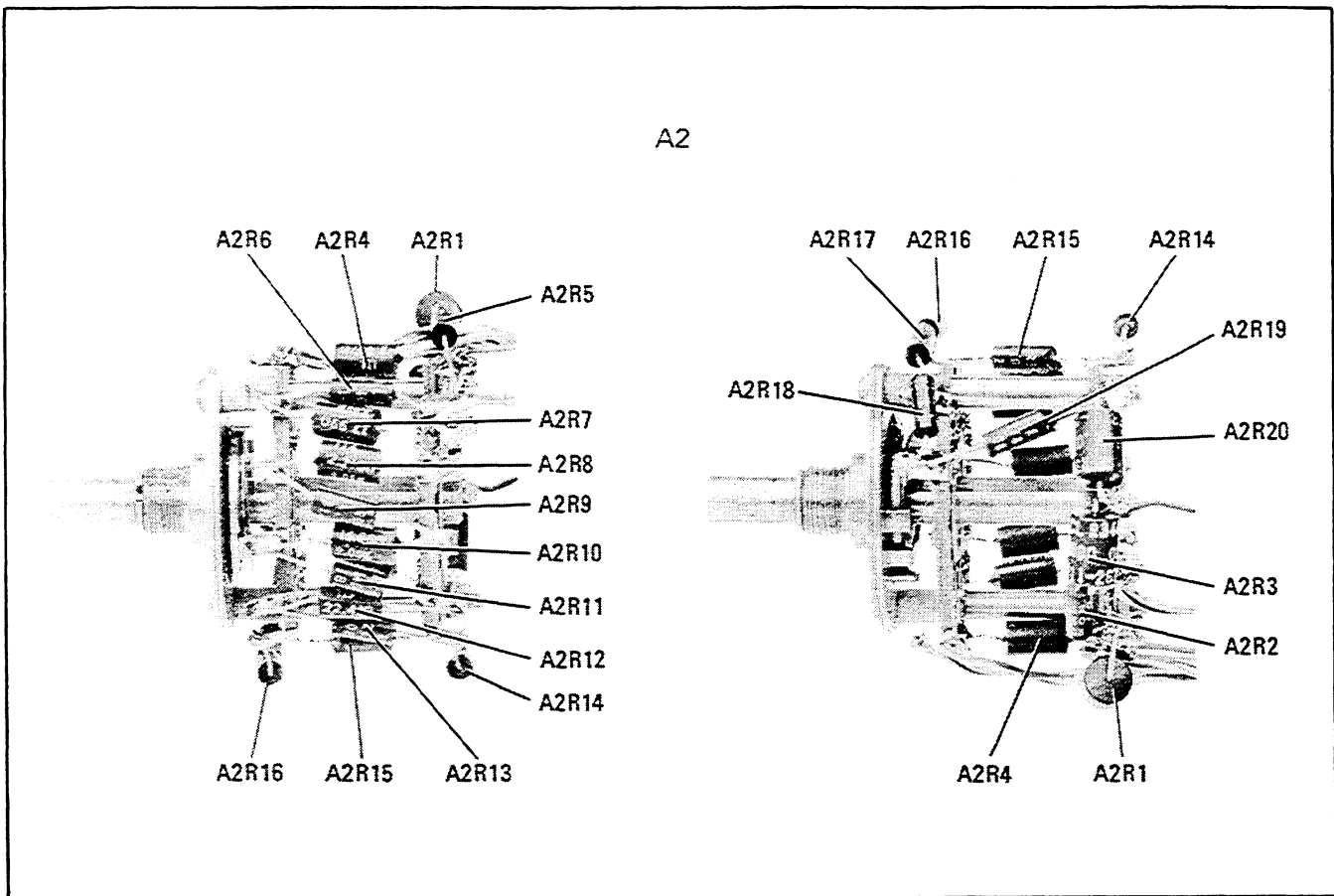


Figure 8. A2 Power Switch Assembly, Component Locations

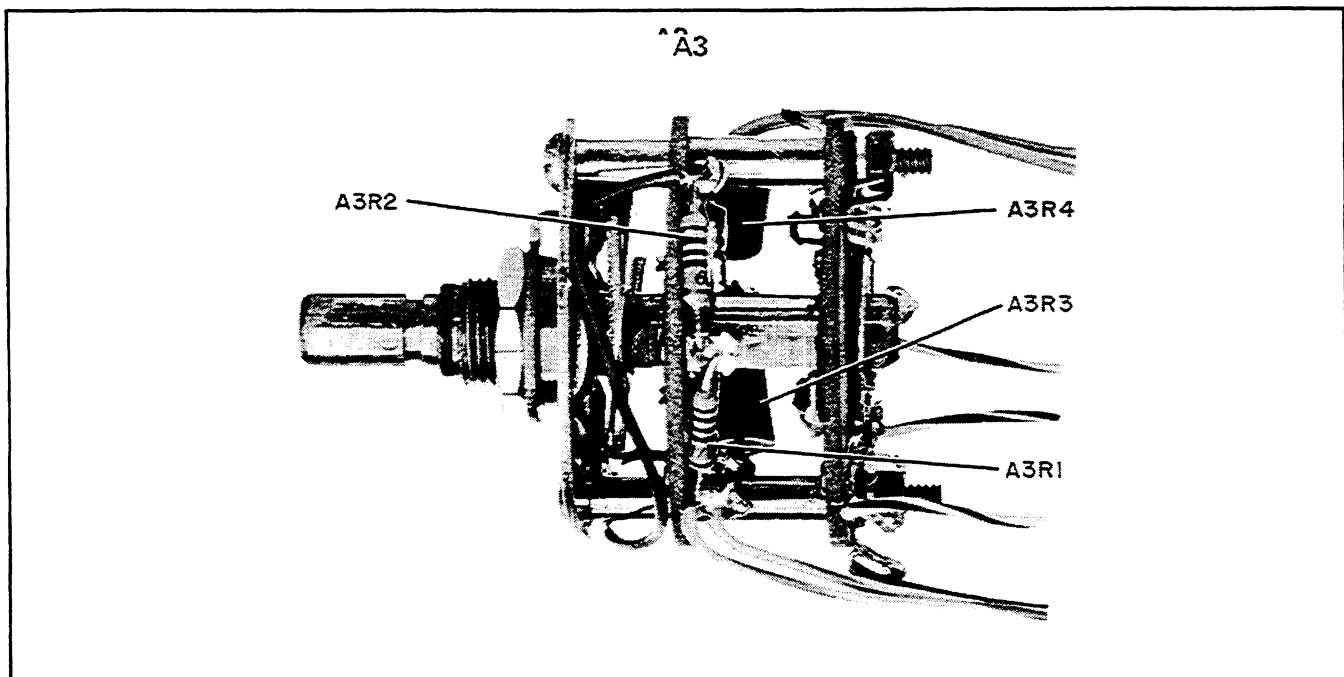


Figure 9. A3 Function Switch Assembly, Component Locations



**SERVICE SHEET 1**

**Introduction**

A 432 Power Meter derives its meter readings from two voltages,  $V_{RF}$  and  $V_{comp}$ , generated by two bridge circuits. Each bridge has two legs, one in the power meter and one external leg in a thermistor mount. (See the 432 manual.)

When the 8447A Calibrator is connected to a power meter, it forms the external legs of the bridge circuits, and the calibrator controls  $V_{RF}$  and  $V_{comp}$ . The calibrator can set  $V_{RF}$  and  $V_{comp}$  to various voltage levels to simulate operation of thermistor mounts operating at several different power levels. This makes it possible to quickly test and adjust a 432 Power Meter.

The calibrator can also be used to check that a power meter's bridge circuitry is operating properly and that the bridge amplifiers have sufficient open loop gain for accurate power measurement. Because the calibrator's output amplifiers are current limited, it is possible for it to compensate for slight bridge unbalance in the power meter but not for gross unbalance due to faulty components.

**Block Diagram**

Figure 10 is a block diagram of the 8477A Calibrator, showing connections to the 432 Power Meter. The 8447A is connected to the 432 through the thermistor cable and two BNC cables. The BNC cables connect the  $V_{comp}$  and  $V_{RF}$  voltages to the 8477A and the thermistor cable completes the bridge circuits.

The  $V_{comp}$  reference voltage divider provides the reference voltage for the  $V_{comp}$  amplifier. The  $V_{comp}$  reference voltage depends on the settings of FUNCTION and POWER (mW) switches. Table 10 lists the reference voltages and switch positions.

The  $V_{comp}$  amplifier compares  $V_{comp}$  with the  $V_{comp}$  reference voltage. Any difference that exists is amplified and used to send a corrective current into the 432 compensation bridge at the  $V_{comp}/2$  point. This current changes the input voltage to the compensation bridge amplifier. This change in input causes the  $V_{comp}$  voltage to change until its value equals the  $V_{comp}$  reference

voltage. The output current of the  $V_{comp}$  amplifier is limited to 1 mA.

The  $V_{RF}$  reference voltage divider is a precision resistor network which divides  $V_{comp}$  to produce the  $V_{RF}$  reference voltage. The  $V_{RF}$  reference voltage depends on the setting of the POWER (mW) switch.

The  $V_{RF}$  amplifier compares  $V_{RF}$  to the  $V_{RF}$  reference voltage. The difference is amplified and used to send a corrective current into the 432 RF bridge at the  $V_{RF}/2$  point. This current changes the input voltage to the RF bridge amplifier. This change in input causes the  $V_{RF}$  voltage to regulate to its correct value. The output current of the  $V_{RF}$  amplifier is limited to 100  $\mu$ A.

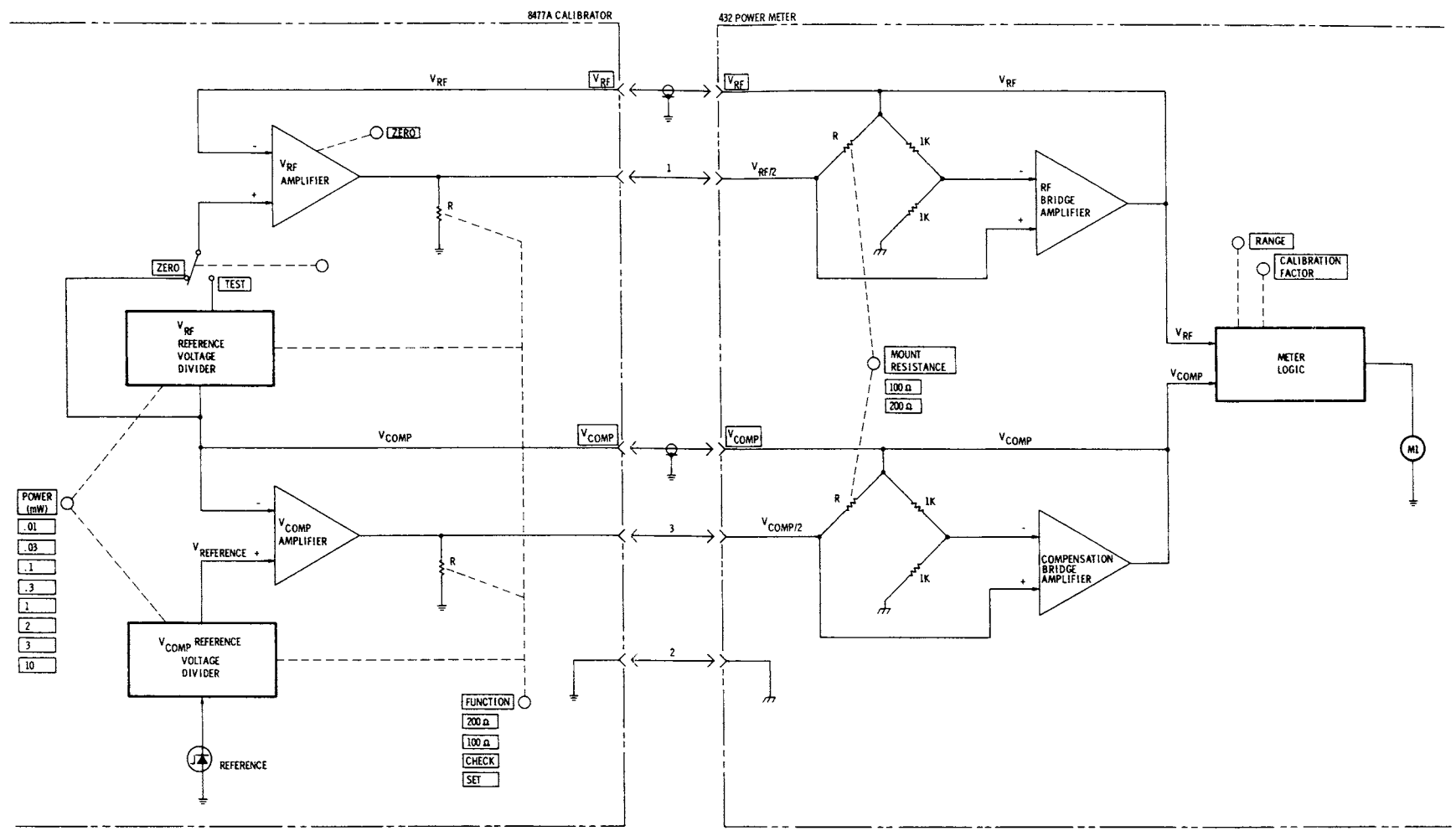
With the ZERO/TEST switch in the ZERO position, the  $V_{RF}$  reference voltage is connected to  $V_{comp}$ , and the offset of the  $V_{RF}$  amplifier is set by the ZERO control to compensate for offsets in the 432.

With the FUNCTION switch in the SET position, both the  $V_{RF}$  and  $V_{comp}$  reference voltages are +5.9 volts. The operator sets the offset of the 432 bridge amplifiers to zero in the SET position, and then switches to CHECK. In the CHECK position, both the  $V_{RF}$  and  $V_{comp}$  reference voltages (and hence the bridge voltages) are +2.2 volts. This change in the output voltages of the 432 bridge amplifiers means that a proportional change in the input voltages of these amplifiers must have taken place. If this change is sufficiently small (less than 0.4 mW), the 432 bridge amplifiers have enough gain for proper operation.

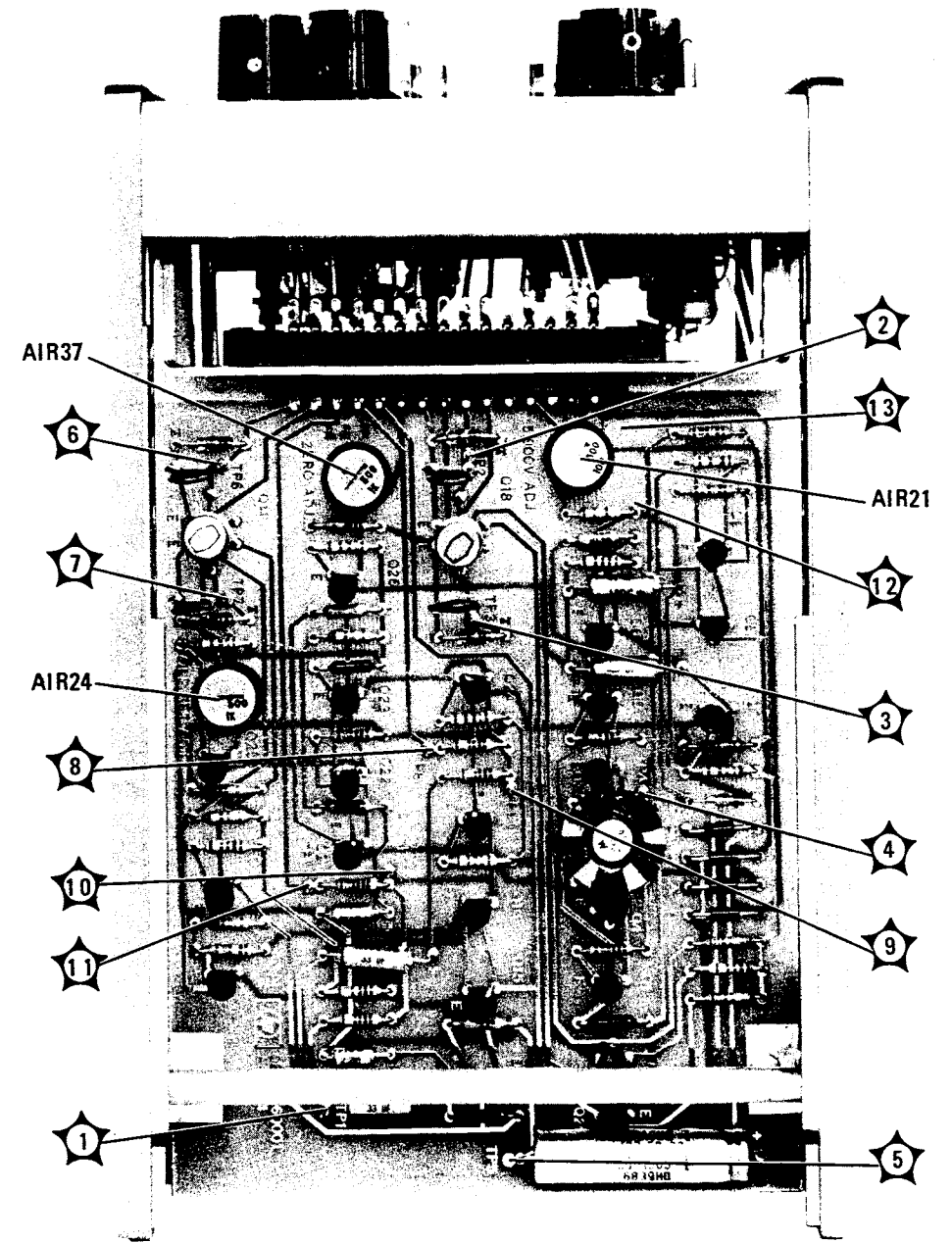
Table 10.  $V_{comp}$  Reference Voltages

POWER (mW)	FUNCTION	REFERENCE VOLTAGE
0.01 - 3	200	+5.9V
10	200	+3.1V
0.01 - 10	100	+2.2V
	SET	+5.9V
	CHECK	+2.2V





Block Diagram



Top View, Cover Removed

Figure 10. Functional Block Diagram and Test Point and Adjustment Locations



### SERVICE SHEET 2

#### Introduction

The voltage amplifiers control the bridge voltages,  $V_{RF}$  and  $V_{comp}$ , coming from the power meter. With A2 Function Switch Assembly and A3 Power Switch Assembly set as shown,  $V_{comp}$  is referenced to an internal, calibrator reference and  $V_{RF}$  is referenced to  $V_{comp}$ .

To troubleshoot the amplifiers, connect the calibrator to a 432 Power Meter: connect  $V_{RF}$  to  $V_{RF}$  and  $V_{comp}$  to  $V_{comp}$  with BNC cables, and connect the instruments' front panel connectors together using the thermistor mount cable supplied with the power meter. Follow the procedures outlined in the troubleshooting tree.

#### Equipment:

- Power Meter . . . . . HP 432 series
- Thermistor Mount Cable . . . . . HP 8120-1082
- Cable Assembly (2) . . . . . HP 10503A
- Digital Voltmeter . . . . . HP 3440/3443
- Cable Assembly . . . . . HP 11002A

#### $V_{RF}$ Reference Voltage Divider

With the FUNCTION switch set to 100 or 200 ohms, A2R4 through A2R20 divide  $V_{comp}$  to produce a reference voltage for the  $V_{RF}$  amplifier. The division ratio is set by the POWER switch.

#### $V_{RF}$ Differential Amplifier

Q18A/B, Q19 and Q20 compare  $V_{RF}$  to the  $V_{RF}$  reference voltage from the voltage divider. Q26 is the current source for the amplifier. R37 is the coarse offset adjust and R1, used to zero the 432 meter, is the fine offset adjust. CR13

and CR14 prevent Q18A/B from becoming back biased. R52, R53, C15 and C16 filter out high frequency interference.

#### $V_{RF}$ Amplifier and Current Limited Amplifier

Q21 amplifies the difference voltage and drives Q22. Q24 is a 100  $\mu$ A current source. Q22 and Q23 form an amplifier limited to 200  $\mu$ A maximum. The result is an output capable of delivering no more than 100  $\mu$ A to the 432 bridge.

#### $V_{comp}$ Reference Voltage Divider

A2R1 through A2R3 provide the reference voltage for the  $V_{comp}$  amplifier. The division ratio is set by the FUNCTION and RANGE switches.

#### $V_{comp}$ Differential Amplifier

Q11A/B, Q12 and Q13 compare  $V_{comp}$  to the  $V_{comp}$  reference voltage. Q25 is the current source for the amplifier. R24 controls the offset of Q11A/B. CR11 and CR12 prevent Q11A/B from becoming back biased. R50, R52, C11 and C12 filter out high frequency interference.

#### $V_{comp}$ Amplifier and Current Limited Amplifier

Q14 amplifies the difference voltage and drives Q15. Q17 is a 1 mA current source. Q15 and Q16 form an amplifier limited to 2 mA maximum. The result is an output capable of delivering no more than 1 mA to the 432 bridge.

#### Bridge Resistors

A3R1 through A3R4 complete the 432 thermistor bridges for a mount resistance of 200 ohms. A3R2 and A3R4 complete the bridges for a mount resistance of 100 ohms.

A1

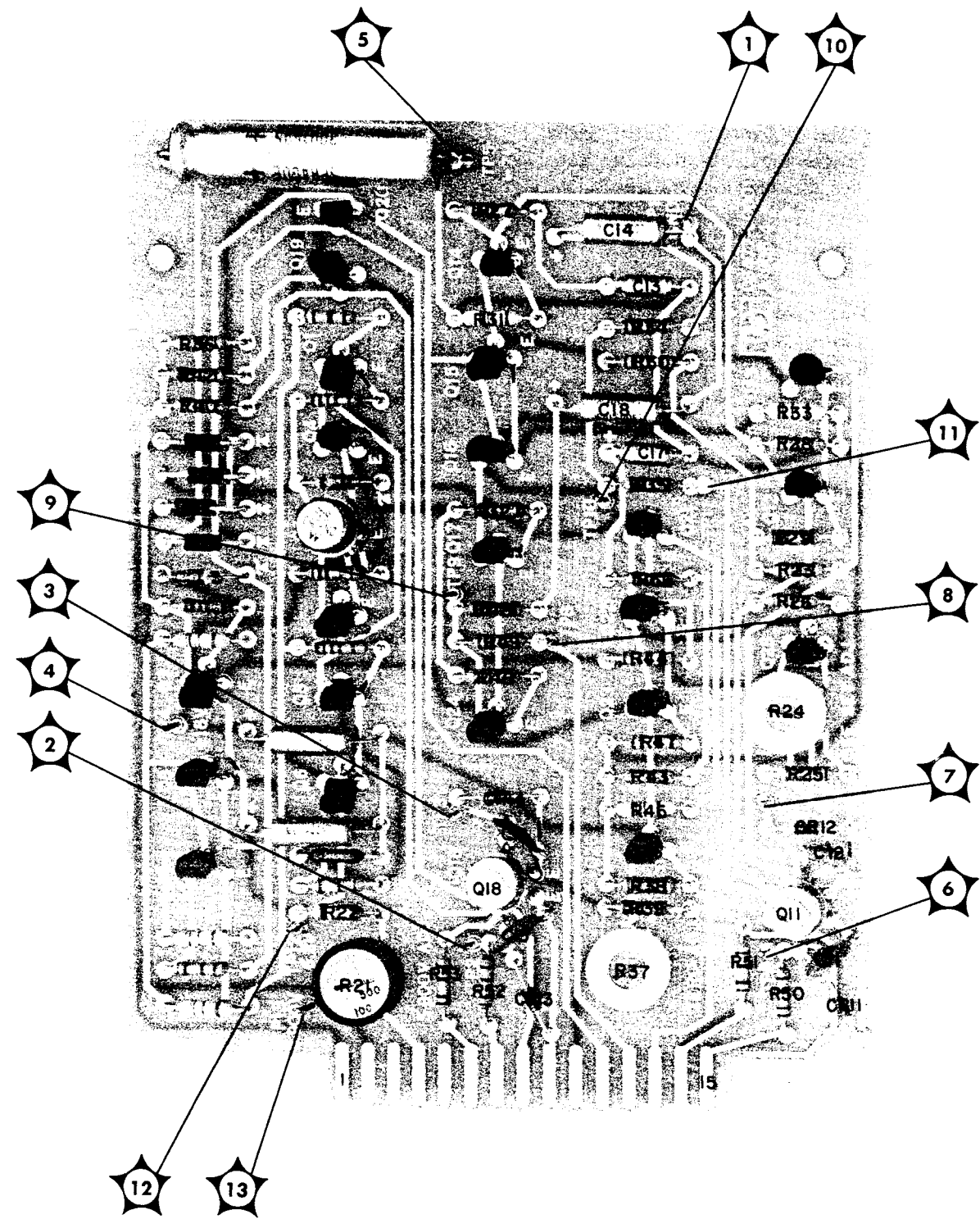
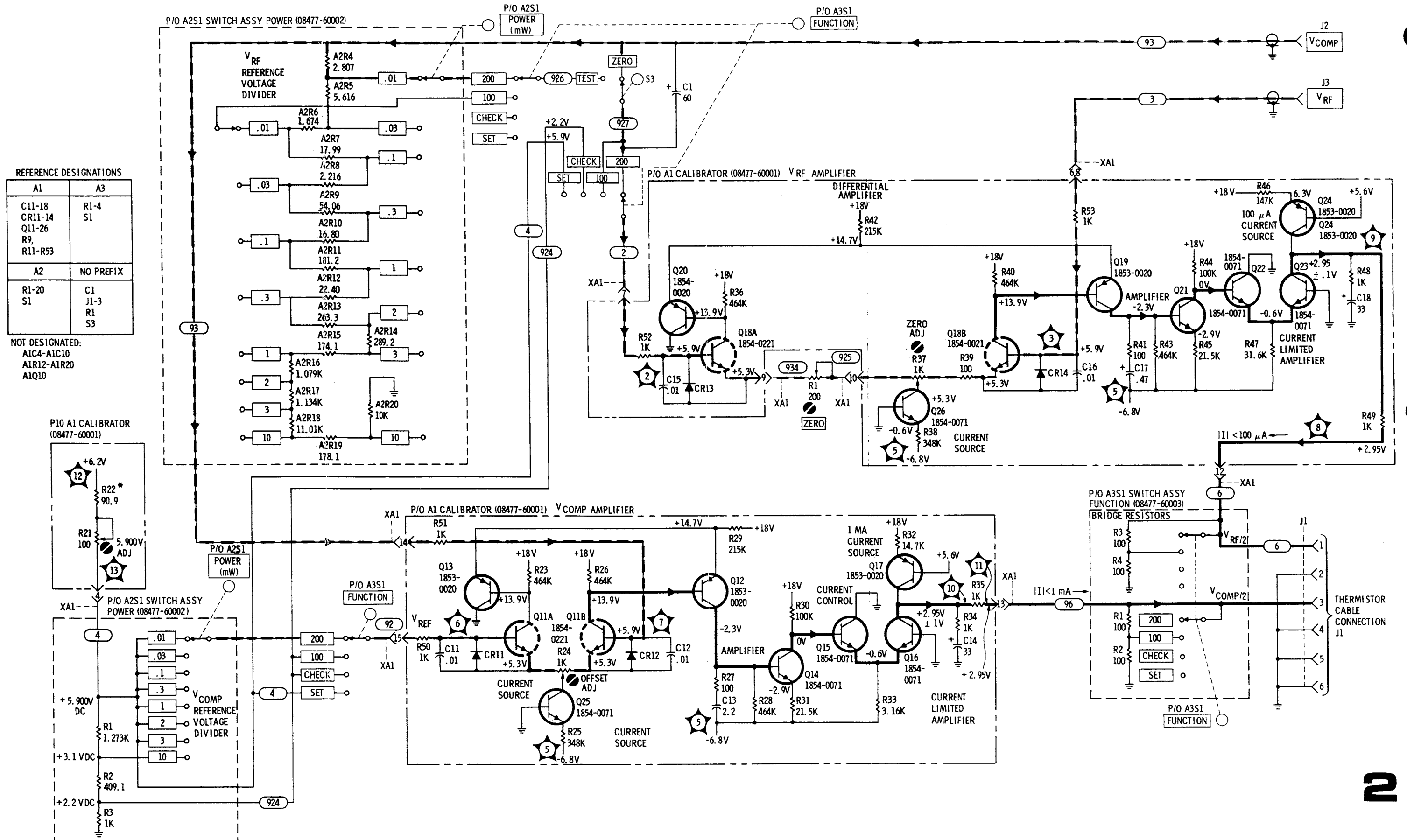


Figure 12. A1 Calibrator Circuits, Component Locations



REFERENCE DESIGNATIONS

A1	A3
C11-18	R1-4
CR11-14	S1
Q11-26	
R9, R11-R53	
A2	NO PREFIX
R1-20	C1
S1	J1-3
	R1
	S3

NOT DESIGNATED:  
A1C4-A1C10  
A1R12-A1R20  
A1Q10

2

Figure 13. Calibrator Circuits

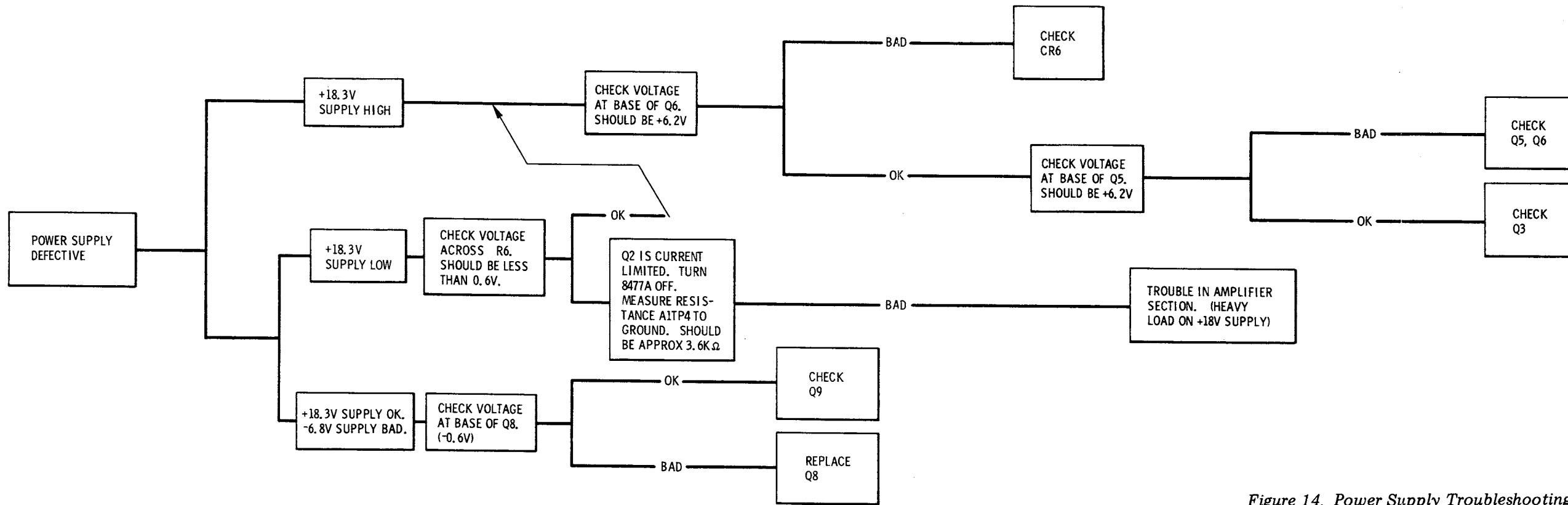


Figure 14. Power Supply Troubleshooting

**SERVICE SHEET 3**

**Introduction**

To troubleshoot the power supply, connect the calibrator to a 432 Power Meter: connect  $V_{RF}$  to  $V_{RF}$  and  $V_{comp}$  to  $V_{comp}$  with BNC cables, and connect the instruments' front panel connectors together using the thermistor mount cable supplied with the power meter. Follow the procedures outlined in the troubleshooting tree.

**Equipment**

- Power Meter . . . . . HP 432 Series
- Thermistor Mount Cable . . . . . HP 8120-1082
- Cable Assembly (2) . . . . . HP 10503A
- Digital Voltmeter . . . . . HP 3440/3443
- Cable Assembly . . . . . HP 11002A

**Current Source**

Q1 provides collector current for Q5 and base drive for Q3.

**Series Regulator**

Q5 drives series regulator Q2 through emitter follower Q3.

**Current Limiter**

Q4 prevents accidental overloads from damaging the power supply. If the voltage drop across R6 exceeds 0.6V, Q4 turns on. This tends to turn Q3 and Q2 off until the overload is removed.

**Differential Amplifier**

Q5 and Q6 compare the +18V (nominal) with the +6.2V reference through R3 and R4. Any difference is amplified by Q5 and fed to Q3 to correct the output voltage of the series regulator.

**Reference Voltage**

CR6, a stable, low noise zener diode, provides the reference voltage for the power supply and the  $V_{comp}$  reference voltage divider.

**Amplifier and Shunt Regulator**

Q9 is driven by Q8 and controls the -6.8 volt supply. If the supply goes more negative, the bias on Q8 increases. This causes Q9 to conduct more, pulling the voltage back to -6.8 volts.



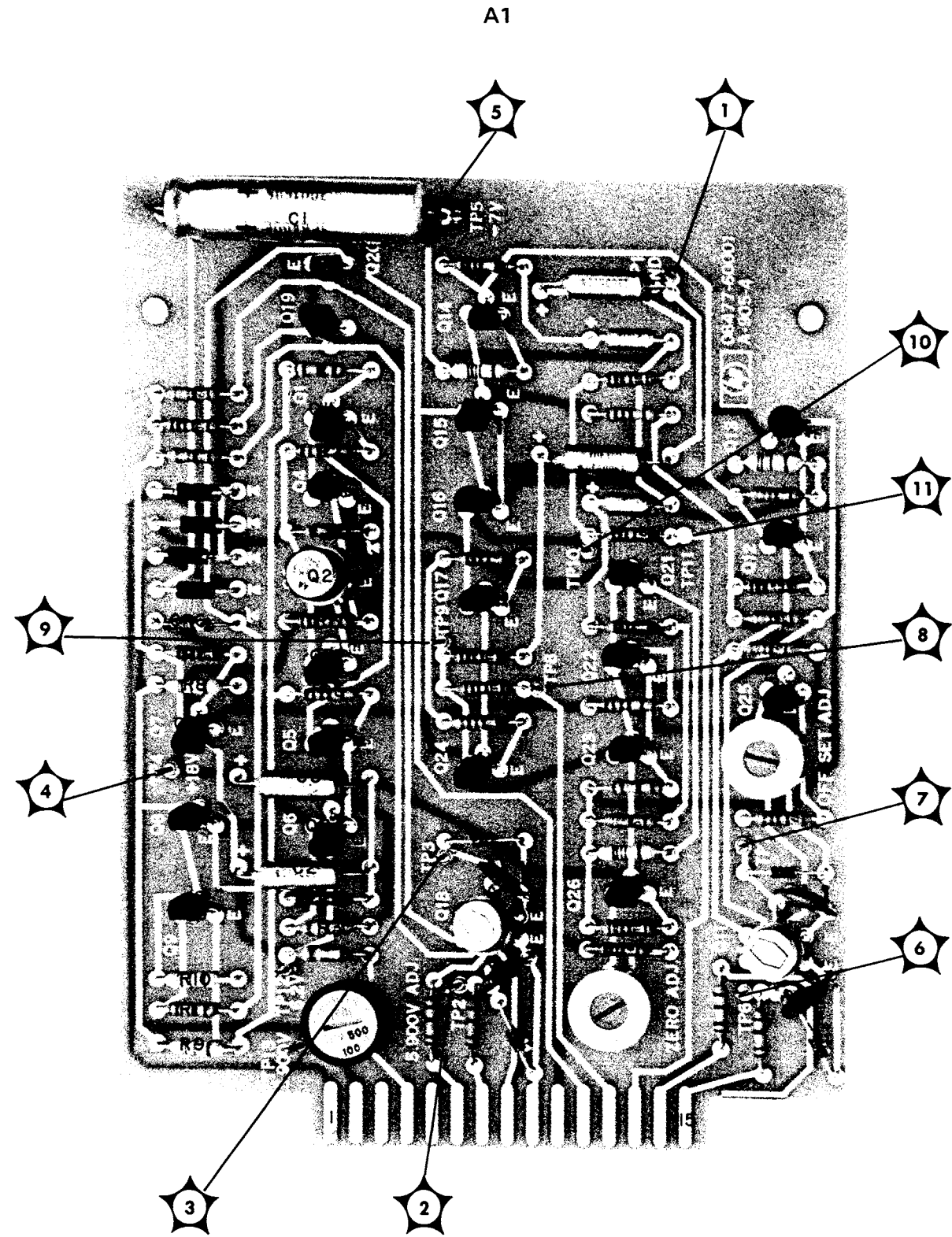


Figure 15. A1 Calibrator Power Supply Circuits, Component Locations

Figure 16. Power Supply Circuits

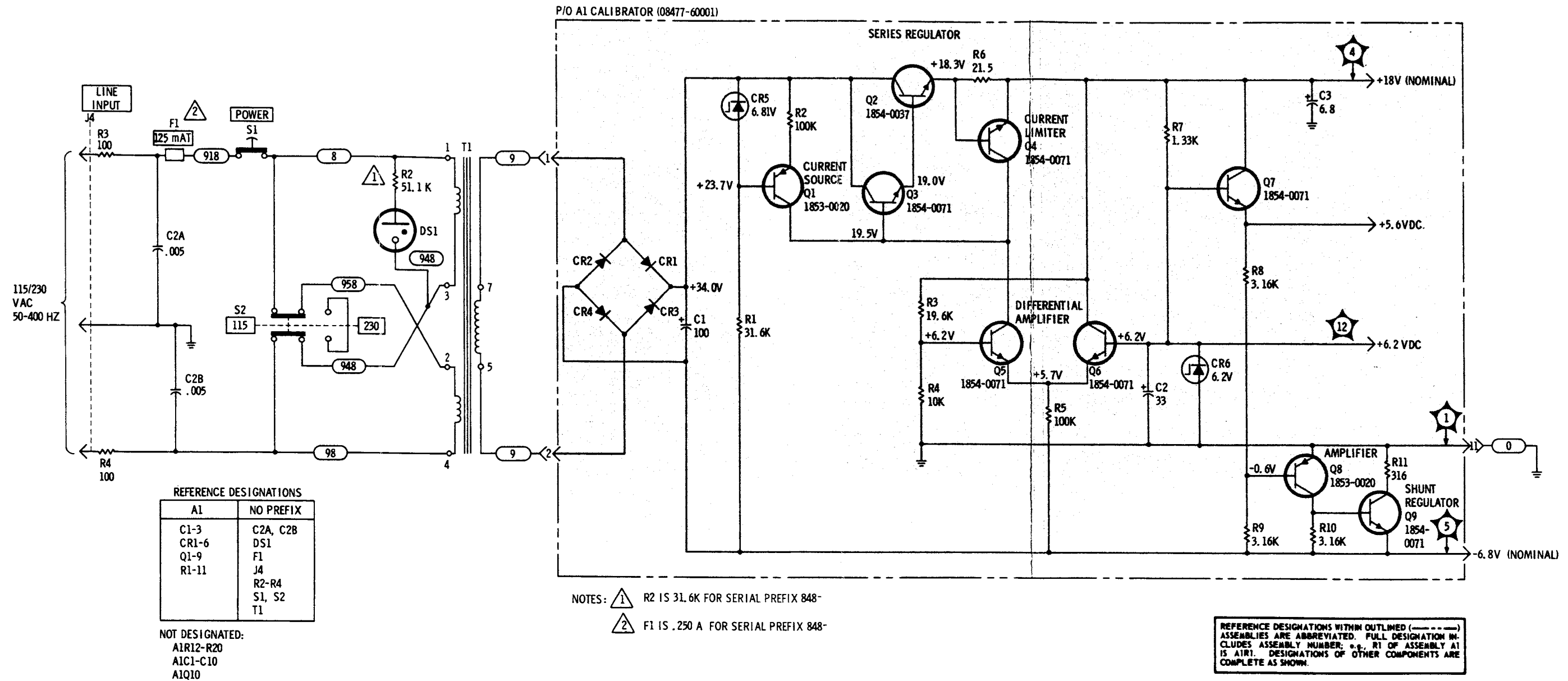


Figure 16. Power Supply Circuits

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