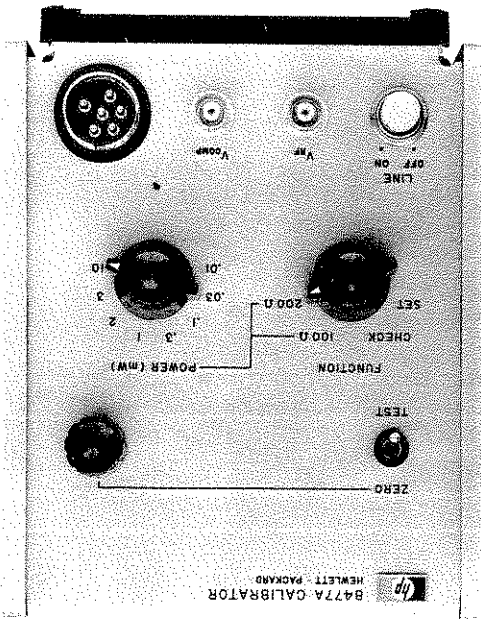


HP 8477A



8919 N

8477A

CALIBRATOR



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

NOTE

Page 16, Table 7:
 Change XF1 to 2110-0470, 1, Fuseholder Exer Post 20A 200V UL/IEC.
 Add the following immediately after XF1:
 2110-0465, 1, Fuseholder - Extr Post UL/IEC 0.25 x 1.25 Fuse
 2110-0467, 1, Nut Single Chamfer 1/2-28 thread
 1400-0090, 1, Washer, Rubber 5/8 OD.

Change the parts list as follows:
 AIR27 0698-3430 RESISTOR 21.5Ω 1%, .125W F TC = 0 ± 100.
 AIR32 0757-0289 RESISTOR 13.3k 1%, .125W F TC = 0 ± 100.
 AIR41 0698-4037 RESISTOR 46.4 1%, .125W F TC = 0 ± 100.
 AIR46 0698-3451 RESISTOR 133k 1%, .125W F TC = 0 ± 100.
 Page 14-15, Table 7:
 AIQ3-7, 9, 14-16, 21-23, 25, 26. The recommended replacement for AIQ3-7, 9, 14-16, 21-23, 25, 26, if they fail, is found in Change 4.

Page 2, Table 1:
 Replace the Power specification with the following:
 Power: 115 or 230 volts ±10%, 48—66 Hz, approximately 3 watts.
 Page 11, Table 5:
 Under "Para. Ref." 421, change the Max. meter indication to 3.103.

ERRATA

NEW ITEM

Serial Prefix or Number	1146A00561 to 00710	1	1146A00711 and above	1, 2	1827A, 1832A	1, 2, 3
Serial Prefix or Number	1922A	1-4				

To use this supplement:
 Make all ERRATA corrections
 Make all appropriate serial number related changes indicated in the tables below.

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

MANUAL IDENTIFICATION
 Model Number: 8477A
 Date Printed: Apr. 77, Feb. 84
 Part Number: 08477-90003

CALIBRATOR

ERRATA (Cont'd)

Page 25, Figure 13, Service Sheet 2:

Change the wire color connecting A3S1 to S3 from 927 to 923.

Change the following component values as indicated:

A1R27 to 21.5

A1R32 to 13.3k

A1R41 to 46.4

A1R46 to 133k.

Page 27, Figure 16 (Service Sheet 3):

Change A1Q2 to 1854-0039.

Service Sheet 2, Figure 12:

Change referenced R36, located between Q21 and Q22, to R41.

CHANGE 1

Page 17, Table 7, Change to read:

2 08447-00004 PANEL: FRONT-LIGHT GRAY

5 5000-0702 SIDE COVER-BLUE GRAY

7 5060-0705 TOP COVER-BLUE GRAY

8 5000-0710 BOTTOM COVER-BLUE GRAY

Add the following:

2 08477-00006 PANEL: FRONT-MINT GRAY

5 5000-8563 SIDE COVER-OLIVE GRAY

7 5060-8547 TOP COVER-OLIVE GRAY

8 5000-8569 BOTTOM COVER-OLIVE GRAY

CHANGE 2

Page 14, Table 7:

Change AIR21 to 2100-1771 R: VAR WW 200 OHMS 5% 1W

Change AIR22* to 0757-0394 R: FXD MET FLM 51.1 OHMS 1% 1/8W.

Page 25, Figure 13, Service Sheet 2:

Change AIR21 to 200 ohms; change AIR22* to 51.1 ohms.

CHANGE 3

Page 16, Table 7:

Replace the XFI listing with the following:

XFI 2110-0564 FUSEHOLDER BODY 12A MAX; 250V MAX

2110-0565 FUSEHOLDER CAP BAYONET; 12A, 250V MAX

2110-0569 NUT-HEX, PLASTIC

CHANGE 4

Page 14, Table 7:

A1Q3-7, 9, 14-16, 21-23, 25, 26. Change the part number for A1Q3-7, 9, 14-16, 21-23, 25, 26 to 1854-0810 CD2

TRANSISTOR NPN SI PD=625 mW FT=200 MHZ 28480.

Page 15, Table 7:

Delete C2.

Add FL1 9100-3142 FILTER-LINE CEE-22-TERMS 28480 9100-3142.

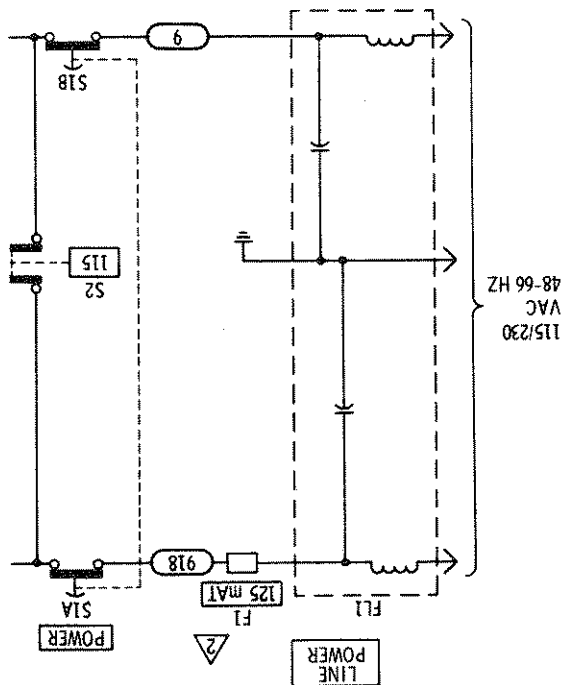
Delete R3 and R4.

Change S1 to 3101-1395 SWITCH-PB DPDT-DB ALTN G 10.5A 250 VAC 28480 3101-1395.

Page 27, Figure 16, Service Sheet 3:

Replace the power line portion of the schematic with the partial schematic in this supplement.

P/O Figure 16. Power Supply Circuits (P/O Change 4)



SAFETY CONSIDERATIONS

GENERAL - This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION - BEFORE APPLYING POWER

Verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

WARNINGS

Service instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

BEFORE SWITCHING ON THE INSTRUMENT

The protective earth terminal of the instrument must be connected to the protective conductor of the (main) power cord. The main plug shall only be inserted in a socket outlet provided with a non-rotate earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor cable is not sufficient protection. If the instrument is to be energized via an auto-transformer (or voltage reduction), make sure the common terminal is connected to the neutral (that is, the grounded side of the mains supply).

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will create a potential shock hazard that could result in personal injury.

Whenever it is likely that the operation has been repaired, the instrument must be made inoperative and be secured against any unintended operation.

Only fuses with the required rated current, voltage and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuses. To do so could cause a shock or fire hazard.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

SAFETY SYMBOLS

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

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

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



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the product.



Indicates hazardous voltages.



Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

WARNING

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

CAUTION

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



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Manual Part No. 08477-90003
Microfiche Part No. 08477-90004

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For calibrators with serial prefixes not listed, a
"Manual Changes" insert is included with this
manual.

SERIAL PREFIXES NOT LISTED

This manual applies directly to calibrators with
the serial number prefixes listed above.

SERIALS PREFIXED: 848-, 963-

CALIBRATOR 8477A

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.

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. INSTRUMENTS COVERED BY MANUAL

4. Each instrument carries a two-section serial number. The first section is a prefix. The contents of this manual apply directly to instruments which have the same serial number prefix as listed after "Serials Prefixed" on the inside title page. Revisions required to adapt this manual to other serial number prefixes are contained in a yellow "Manual Changes" insert supplied with the manual. For information about instruments with serial prefixes not listed on the title page or in the insert, contact the nearest Hewlett-Packard office.

5. INITIAL INSPECTION

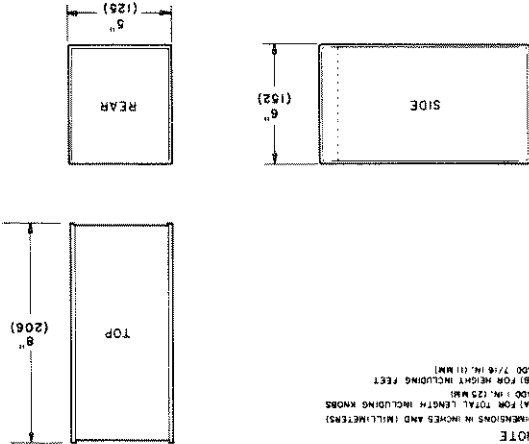
6. Mechanical Check

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

1. DESCRIPTION

Calibration Function: Output voltages corresponding to meter readings of: 0.01, 0.03, 0.1, 0.3, 1, 3, and 10 milliwatts.
 Calibration Uncertainty: $\pm 0.5\%$ on 0.01 and 0.03 mW ranges ($+20^\circ\text{C}$ to $+30^\circ\text{C}$), $\pm 0.2\%$ on 0.1 to 10 mW ranges ($+20^\circ\text{C}$ to $+30^\circ\text{C}$).
 RFI: Meets all conditions specified in MIL-I-6181D.
 Power: 115 or 230 volts $\pm 10\%$, 50 — 400 Hz, approximately 3 Watts.
 Weight: Net, 4 lbs, 8 oz. (2.04 kg).
 Accessories Furnished: 7-1/2 ft. (2.29m) power cable, NEMA plug.
 Combining Cases:
 1051A, 11-1/4 in. (286 mm) deep
 1052A, 16-3/8 in. (416 mm) deep
 The combining cases accept the 1/3-module HP instruments for bench use or rack mounting. See 1051A Data Sheet for details.

NOTE
 DIMENSIONS IN INCHES AND MILLIMETERS
 (A) FOR TOTAL LENGTH INCLUDING HOOKS
 ADD .04 IN. (2.54 MM)
 (B) FOR HEIGHT INCLUDING FEET
 ADD .77 IN. (19.30 MM)



Dimensions:

Table 1. Specifications, HP 8477A Calibrator

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 Manufacturers 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-conductor 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 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

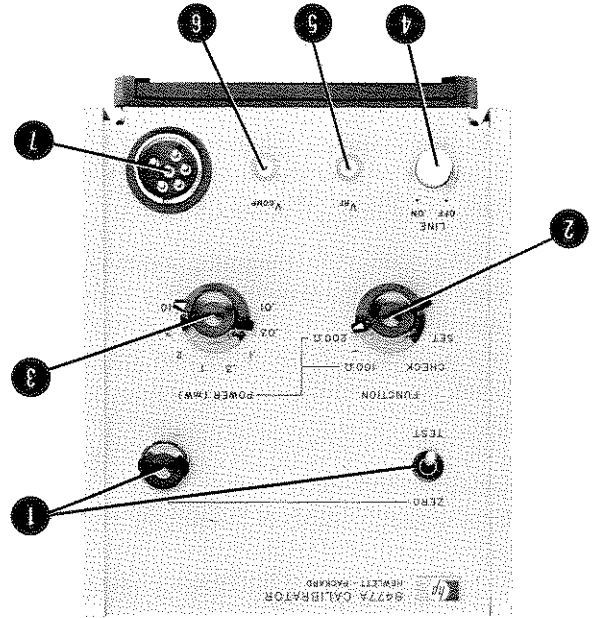
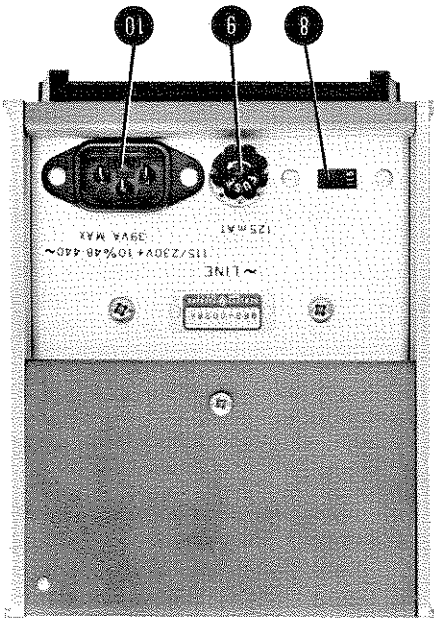
33. Operator maintenance is limited to replacement of the front panel LINE switch light and the rear panel fuse.

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 slow-blow fuse.

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

- 1 ZERO-TEST — Adjust 8477A output so 432 meter reads zero.
- 2 TEST — Applies correct dc voltages to 432 meter reads zero.
- 3 ZERO — Adjust 8477A output so 432 meter reads zero.
- 4 FUNCTION — Controls 8477 mount resistance and the operation for checking gain of the 432 bridge amplifiers.
- 5 SET — Used to adjust offset of 432 bridge amplifiers to zero.
- 6 CHECK — Applies dc voltage to 432 bridge amplifiers to check gain.
- 7 100Ω — Provides 100Ω to complete 432 bridges.
- 8 200Ω — Provides 200Ω to complete 432 bridges.
- 9 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 VRF — Connects VRF from 432 to 8477A.
- 6 VCOMP — Connects VCOMP 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/T means milliamp slo-blow).
- 10 AC power — Power cable receptacle (offset pin connected to 8477A Calibrator chassis).



CONTROLS AND CONNECTORS

36. Lamp Replacement

37. To replace the front panel line switch lamp (DSL), 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 DSL).
- d. Place white cover into switch receptacle.

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 VRF jack and Test Point 7 is equivalent to the V_{comp} 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

Note
P = Performance Test; A = Adjustments; T = Troubleshooting

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 BNC jack on the front panel of the 8477A and TP3 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) 0.1 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

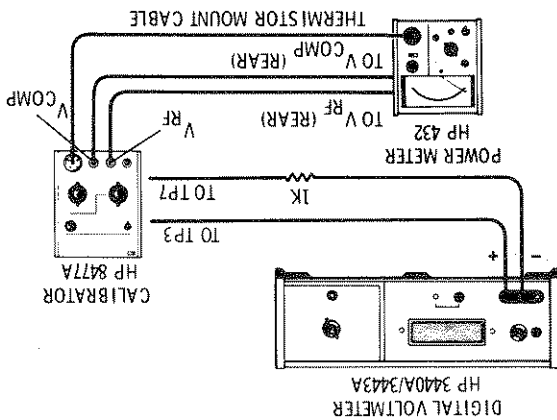


Figure 2. Zero Range Test Setup

3440A/3443A:
 RANGE AUTO

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

42. V_{comp}

- a. Make the following equipment settings:

8477A:
 POWER (mW) 0.1 mW
 FUNCTION 200 ohms
 ZERO/TEST TEST

740B:
 FUNCTION Δ VM
 VOLTMEETER 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 ∞ .

1. Depress the X1 SENSITIVITY and adjust its VOLTAGE SET to 5.
2. Push the X10 VOLTMEETER SENSITIVITY and adjust its VOLTAGE SET to 9.
3. Push the X10² VOLTMEETER SENSITIVITY and adjust the VOLTAGE SET to zero.
4. Push the X10³ VOLTMEETER 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 (VOLTMEETER SENSITIVITY set to X10²).
- 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).

1. Ensure that all VOLTAGE SET controls are set to zero (fully ccw).
2. Depress X10⁴ 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. Short the + and - inputs of the 11504A with a shorting wire. Carefully zero the 740B as follows:

42. V_{comp} (Cont)

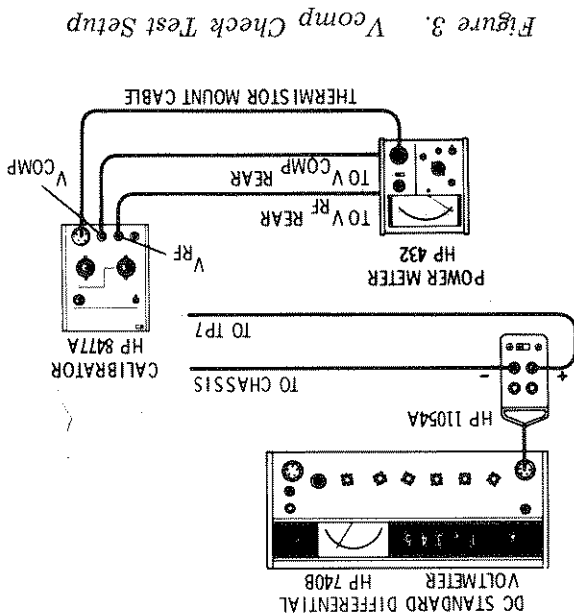


Figure 3. V_{comp} Check Test Setup

PERFORMANCE TESTS

PERFORMANCE TESTS

43. Range Accuracy

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

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

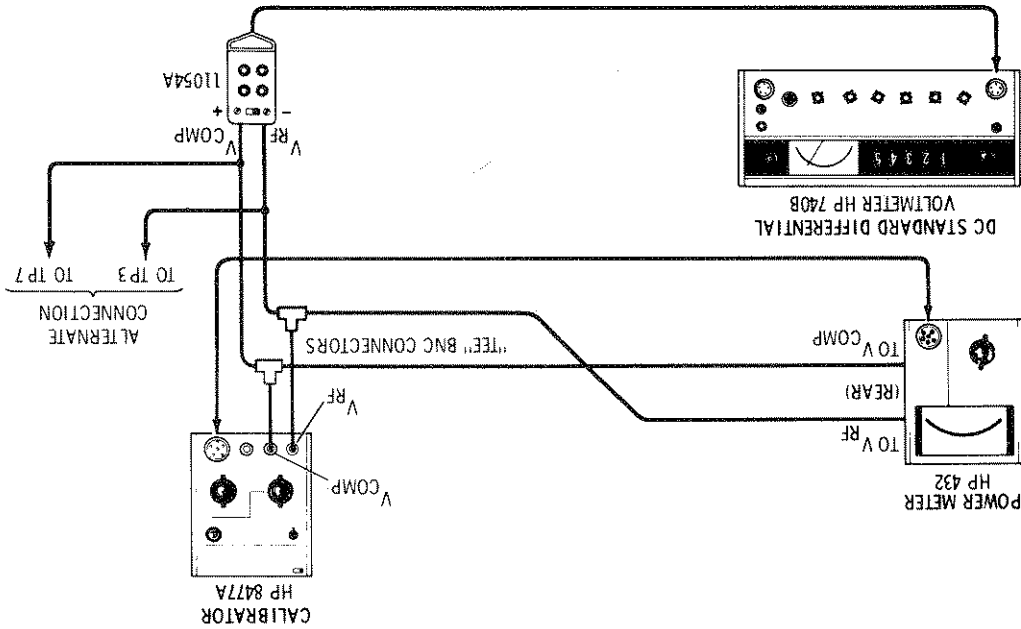


Figure 4. Range Accuracy Test Setup

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 VOLTMEETER SENSITIVITY to $X10^2$ and adjust the 8477A ZERO control for 0.000 ± 0.2 major division on the 740B meter.

PERFORMANCE TESTS

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 X10² VOLTMETER SENSITIVITY and adjust its VOLTAGE SET to 8. The 740B meter should indicate within plus-minus three major divisions of zero (± 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.

POWER (mW)	Voltage (mV) TP3 to TP7 Tolerance (\pm)
0.01	0.678 0.003 μ V
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 3. Range Accuracy Readings (200 Ω)

POWER (mW)	Voltage (mV) TP3 to TP7 Tolerance (\pm)
0.01	0.909 0.004 μ V
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

Table 4. Range Accuracy Readings (100 Ω)

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.

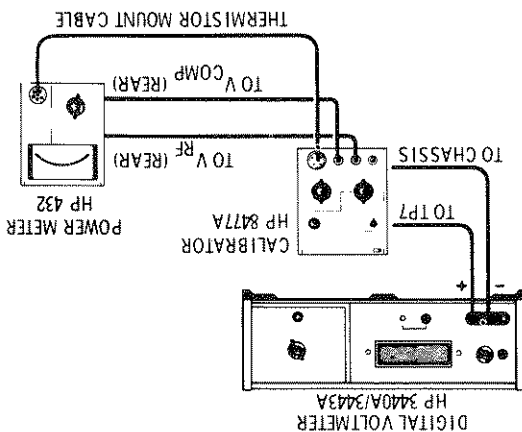
d. Connect the positive probe of the voltmeter to TP3 (negative lead to chassis).

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



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.

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

Table 5. Performance Test Record

45. CHECKS AND ADJUSTMENTS

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	ΔVM	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 AIR21 for a 740B meter indication of zero ±1 major division. If AIR21 cannot be adjusted to the above value, the value of AIR22 should be changed to make the adjustment possible.

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 ±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 ±0.002V.

49. REPLACEMENT 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, address order
- a. Instrument model number.
- b. Instrument serial number.
- c. Description of the part.
- d. Function and location of the part.

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

Table 6. Reference Designations and Abbreviations

REFERENCE DESIGNATORS		ABBREVIATIONS	
A	= assembly	H	= henries
B	= motor	HDW	= hardware
BT	= battery	HEX	= hexagonal
C	= capacitor	HG	= mercury
CP	= coupler	HR	= hour(s)
CR	= diode	Hz	= Hertz
DL	= delay line	IF	= intermediate freq
DS	= device signaling (lamp)	IMP	= impregnated
E	= misc electronic part	INC	= incandescent
		INCL	= include(s)
		INS	= insulation(ed)
		INT	= internal
		K	= kilo = 1000
		LH	= left hand
		LIN	= common
		LK WASH	= lock washer
		LOG	= logarithmic taper
		LPF	= low pass filter
		M	= milli = 10 ⁻³
		MEG	= meg = 10 ⁶
		MEG FLM	= metal film
		MET OX	= metallic oxide
		MFR	= manufacturer
		MHZ	= mega Hertz
		MINAT	= miniature
		MOM	= momentary
		MOS	= metallized
		MTG	= mounting
		MY	= "mylar"
		N	= nano (10 ⁻⁹)
		N/C	= normally closed
		NE	= neon
		NI PL	= nickel plate
G	= giga (10 ⁹)	RECT	= rectifier
GE	= germanium	RF	= radio frequency
GL	= glass	RH	= right hand
GRD	= grounded		
		P	= plug
		Q	= transistor
		R	= resistor
		RT	= thermistor
		S	= switch
		T	= transformer
		TB	= terminal board
		TP	= test point
		U	= integrated circuit
		V	= vacuum tube,
			neon bulb,
			photo cell, etc.
		VR	= voltage regulator
		W	= cable
		X	= socket
		Y	= crystal
		Z	= tuned cavity,
			network
A	= amperes	N/O	= normally open
AFC	= automatic frequency control	NOM	= nominal
AMPL	= amplifier	NPO	= negative positive zero (zero temp-perature coef-ficient)
BFO	= beat frequency oscilla-tor	NPN	= negative-positive-ve-gative
BE CU	= beryllium copper	NRF	= not recommended
BH	= binder head	SEMICON	= semiconductor
BP	= bandpass	SECT	= section(s)
BRS	= brass	SE	= selenium
BWO	= backward wave oscilla-tor	S-B	= screw
		S-CR	= slow-blow
		SF	= screw
		SPL	= special
		SPG	= spring
		SL	= slide
		SIL	= silver
		SI	= silicon
		SIL	= silver
		NSR	= not separately replaceable
		OBD	= order by description
		OH	= oval head
		OX	= oxide
		LH	= left hand
		LIN	= common
		LK WASH	= lock washer
		LOG	= logarithmic taper
		LPF	= low pass filter
		M	= milli = 10 ⁻³
		MEG	= meg = 10 ⁶
		MEG FLM	= metal film
		MET OX	= metallic oxide
		MFR	= manufacturer
		MHZ	= mega Hertz
		MINAT	= miniature
		MOM	= momentary
		MOS	= metallized
		MTG	= mounting
		MY	= "mylar"
		N	= nano (10 ⁻⁹)
		N/C	= normally closed
		NE	= neon
		NI PL	= nickel plate
		RECT	= rectifier
		RF	= radio frequency
		RH	= right hand
		P	= plug
		Q	= transistor
		R	= resistor
		RT	= thermistor
		S	= switch
		T	= transformer
		TB	= terminal board
		TP	= test point
		U	= integrated circuit
		V	= vacuum tube,
			neon bulb,
			photo cell, etc.
		VR	= voltage regulator
		W	= cable
		X	= socket
		Y	= crystal
		Z	= tuned cavity,
			network
A	= amperes	N/O	= normally open
AFC	= automatic frequency control	NOM	= nominal
AMPL	= amplifier	NPO	= negative positive zero (zero temp-perature coef-ficient)
BFO	= beat frequency oscilla-tor	NPN	= negative-positive-ve-gative
BE CU	= beryllium copper	NRF	= not recommended
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BP	= bandpass	SECT	= section(s)
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BWO	= backward wave oscilla-tor	S-B	= screw
		S-CR	= slow-blow
		SF	= screw
		SPL	= special
		SPG	= spring
		SL	= slide
		SIL	= silver
		SI	= silicon
		SIL	= silver
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		LH	= left hand
		LIN	= common
		LK WASH	= lock washer
		LOG	= logarithmic taper
		LPF	= low pass filter
		M	= milli = 10 ⁻³
		MEG	= meg = 10 ⁶
		MEG FLM	= metal film
		MET OX	= metallic oxide
		MFR	= manufacturer
		MHZ	= mega Hertz
		MINAT	= miniature
		MOM	= momentary
		MOS	= metallized
		MTG	= mounting
		MY	= "mylar"
		N	= nano (10 ⁻⁹)
		N/C	= normally closed
		NE	= neon
		NI PL	= nickel plate
		RECT	= rectifier
		RF	= radio frequency
		RH	= right hand
		P	= plug
		Q	= transistor
		R	= resistor
		RT	= thermistor
		S	= switch
		T	= transformer
		TB	= terminal board
		TP	= test point
		U	= integrated circuit
		V	= vacuum tube,
			neon bulb,
			photo cell, etc.
		VR	= voltage regulator
		W	= cable
		X	= socket
		Y	= crystal
		Z	= tuned cavity,
			network

See introduction to this section for ordering information

Reference	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R30	0757-0465	2	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	1	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	0698-3260		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0698-3260
A1R36	0698-3260		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0698-3260
A1R37	2100-1773		R:VAR MET 1K OHM 5% TYPE H 1/2W	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		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 T0-9 CASES	98978	1X8F-032-025B
A2	08477-60002	1	SWITCH ASSY:POWER	28480	08477-60002
A2R1	0811-2673	1	R:FXD MW 1273 OHM 0.02% 1/40W	28480	0811-2673
A2R2	0811-2674	1	R:FXD MW 409.1 OHM 0.02% 1/40W	28480	0811-2674
A2R3	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R4	0811-2677	1	R:FXD MW 2.807 OHM 0.05% 1/40W	28480	0811-2677
A2R5	0811-2672	1	R:FXD MW 5.616 OHM 0.05% 1/40W	28480	0811-2672
A2R6	0811-2676	1	R:FXD MW 1.674 OHM 0.05% 1/40W	28480	0811-2676
A2R7	0811-2679	1	R:FXD MW 17.99 OHM 0.05% 1/40W	28480	0811-2679
A2R8	0811-2678	1	R:FXD MW 2.216 OHM 0.05% 1/40W	28480	0811-2678
A2R9	0811-2680	1	R:FXD MW 54.06 OHM 0.05% 1/40W	28480	0811-2680
A2R10	0811-2681	1	R:FXD MW 16.80 OHM 0.05% 1/40W	28480	0811-2681
A2R11	0811-2682	1	R:FXD MW 181.2 OHM 0.05% 1/40W	28480	0811-2682
A2R12	0811-2684	1	R:FXD MW 22.40 OHM 0.05% 1/40W	28480	0811-2684
A2R13	0811-2683	1	R:FXD MW 263.3 OHM 0.05% 1/40W	28480	0811-2683
A2R14	0811-2685	1	R:FXD MW 289.2 OHM 0.05% 1/40W	28480	0811-2685
A2R15	0811-2686	1	R:FXD MW 174.1 OHM 0.05% 1/40W	28480	0811-2686
A2R16	0811-2688	1	R:FXD MW 1079 OHM 0.05% 1/40W	28480	0811-2688
A2R17	0811-2689	1	R:FXD MW 1134 OHM 0.05% 1/40W	28480	0811-2689
A2R18	0811-2690	1	R:FXD MW 11.01K OHM 0.05% 1/40W	28480	0811-2690
A2R19	0811-2687	1	R:FXD MW 178.1 OHM 0.05% 1/40W	28480	0811-2687
A2R20	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R21	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R22	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R23	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R24	0811-2677	1	R:FXD MW 2.807 OHM 0.05% 1/40W	28480	0811-2677
A2R25	0811-2672	1	R:FXD MW 5.616 OHM 0.05% 1/40W	28480	0811-2672
A2R26	0811-2676	1	R:FXD MW 1.674 OHM 0.05% 1/40W	28480	0811-2676
A2R27	0811-2679	1	R:FXD MW 17.99 OHM 0.05% 1/40W	28480	0811-2679
A2R28	0811-2678	1	R:FXD MW 2.216 OHM 0.05% 1/40W	28480	0811-2678
A2R29	0811-2680	1	R:FXD MW 54.06 OHM 0.05% 1/40W	28480	0811-2680
A2R30	0811-2681	1	R:FXD MW 16.80 OHM 0.05% 1/40W	28480	0811-2681
A2R31	0811-2682	1	R:FXD MW 181.2 OHM 0.05% 1/40W	28480	0811-2682
A2R32	0811-2684	1	R:FXD MW 22.40 OHM 0.05% 1/40W	28480	0811-2684
A2R33	0811-2683	1	R:FXD MW 263.3 OHM 0.05% 1/40W	28480	0811-2683
A2R34	0811-2685	1	R:FXD MW 289.2 OHM 0.05% 1/40W	28480	0811-2685
A2R35	0811-2686	1	R:FXD MW 174.1 OHM 0.05% 1/40W	28480	0811-2686
A2R36	0811-2688	1	R:FXD MW 1079 OHM 0.05% 1/40W	28480	0811-2688
A2R37	0811-2689	1	R:FXD MW 1134 OHM 0.05% 1/40W	28480	0811-2689
A2R38	0811-2690	1	R:FXD MW 11.01K OHM 0.05% 1/40W	28480	0811-2690
A2R39	0811-2687	1	R:FXD MW 178.1 OHM 0.05% 1/40W	28480	0811-2687
A2R40	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R41	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R42	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R43	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R44	0811-2677	1	R:FXD MW 2.807 OHM 0.05% 1/40W	28480	0811-2677
A2R45	0811-2672	1	R:FXD MW 5.616 OHM 0.05% 1/40W	28480	0811-2672
A2R46	0811-2676	1	R:FXD MW 1.674 OHM 0.05% 1/40W	28480	0811-2676
A2R47	0811-2679	1	R:FXD MW 17.99 OHM 0.05% 1/40W	28480	0811-2679
A2R48	0811-2678	1	R:FXD MW 2.216 OHM 0.05% 1/40W	28480	0811-2678
A2R49	0811-2680	1	R:FXD MW 54.06 OHM 0.05% 1/40W	28480	0811-2680
A2R50	0811-2681	1	R:FXD MW 16.80 OHM 0.05% 1/40W	28480	0811-2681
A2R51	0811-2682	1	R:FXD MW 181.2 OHM 0.05% 1/40W	28480	0811-2682
A2R52	0811-2684	1	R:FXD MW 22.40 OHM 0.05% 1/40W	28480	0811-2684
A2R53	0811-2683	1	R:FXD MW 263.3 OHM 0.05% 1/40W	28480	0811-2683
A2R54	0811-2685	1	R:FXD MW 289.2 OHM 0.05% 1/40W	28480	0811-2685
A2R55	0811-2686	1	R:FXD MW 174.1 OHM 0.05% 1/40W	28480	0811-2686
A2R56	0811-2688	1	R:FXD MW 1079 OHM 0.05% 1/40W	28480	0811-2688
A2R57	0811-2689	1	R:FXD MW 1134 OHM 0.05% 1/40W	28480	0811-2689
A2R58	0811-2690	1	R:FXD MW 11.01K OHM 0.05% 1/40W	28480	0811-2690
A2R59	0811-2687	1	R:FXD MW 178.1 OHM 0.05% 1/40W	28480	0811-2687
A2R60	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R61	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R62	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R63	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R64	0811-2677	1	R:FXD MW 2.807 OHM 0.05% 1/40W	28480	0811-2677
A2R65	0811-2672	1	R:FXD MW 5.616 OHM 0.05% 1/40W	28480	0811-2672
A2R66	0811-2676	1	R:FXD MW 1.674 OHM 0.05% 1/40W	28480	0811-2676
A2R67	0811-2679	1	R:FXD MW 17.99 OHM 0.05% 1/40W	28480	0811-2679
A2R68	0811-2678	1	R:FXD MW 2.216 OHM 0.05% 1/40W	28480	0811-2678
A2R69	0811-2680	1	R:FXD MW 54.06 OHM 0.05% 1/40W	28480	0811-2680
A2R70	0811-2681	1	R:FXD MW 16.80 OHM 0.05% 1/40W	28480	0811-2681
A2R71	0811-2682	1	R:FXD MW 181.2 OHM 0.05% 1/40W	28480	0811-2682
A2R72	0811-2684	1	R:FXD MW 22.40 OHM 0.05% 1/40W	28480	0811-2684
A2R73	0811-2683	1	R:FXD MW 263.3 OHM 0.05% 1/40W	28480	0811-2683
A2R74	0811-2685	1	R:FXD MW 289.2 OHM 0.05% 1/40W	28480	0811-2685
A2R75	0811-2686	1	R:FXD MW 174.1 OHM 0.05% 1/40W	28480	0811-2686
A2R76	0811-2688	1	R:FXD MW 1079 OHM 0.05% 1/40W	28480	0811-2688
A2R77	0811-2689	1	R:FXD MW 1134 OHM 0.05% 1/40W	28480	0811-2689
A2R78	0811-2690	1	R:FXD MW 11.01K OHM 0.05% 1/40W	28480	0811-2690
A2R79	0811-2687	1	R:FXD MW 178.1 OHM 0.05% 1/40W	28480	0811-2687
A2R80	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R81	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R82	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R83	0811-2675	2	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A2R84	0811-2677	1	R:FXD MW 2.807 OHM 0.05% 1/40W	28480	0811-2677
A2R85	0811-2672	1	R:FXD MW 5.616 OHM 0.05% 1/40W	28480	0811-2672
A2R86	0811-2676	1	R:FXD MW 1.674 OHM 0.05% 1/40W	28480	0811-2676
A2R87	0811-2679	1	R:FXD MW 17.99 OHM 0.05% 1/40W	28480	0811-2679
A2R88	0811-2678	1	R:FXD MW 2.216 OHM 0.05% 1/40W	28480	0811-2678
A2R89	0811-2680	1	R:FXD MW 54.06 OHM 0.05% 1/40W	28480	0811-2680
A2R90	0811-2681	1	R:FXD MW 16.80 OHM 0.05% 1/40W	28480	0811-2681
A2R91	0811-2682	1	R:FXD MW 181.2 OHM 0.05% 1/40W	28480	0811-2682
A2R92	0811-2684	1	R:FXD MW 22.40 OHM 0.05% 1/40W	28480	0811-2684
A2R93	0811-2683	1	R:FXD MW 263.3 OHM 0.05% 1/40W	28480	0811-2683
A2R94	0811-2685	1	R:FXD MW 289.2 OHM 0.05% 1/40W	28480	0811-2685
A2R95	0811-2686	1	R:FXD MW 174.1 OHM 0.05% 1/40W	28480	0811-2686
A2R96	0811-2688	1	R:FXD MW 1079 OHM 0.05% 1/40W	28480	0811-2688
A2R97	0811-2689	1	R:FXD MW 1134 OHM 0.05% 1/40W	28480	0811-2689
A2R98	0811-2690	1	R:FXD MW 11.01K OHM 0.05% 1/40W	28480	0811-2690
A2R99	0811-2687	1	R:FXD MW 178.1 OHM 0.05% 1/40W	28480	0811-2687
A2R100	0811-2675	1	R:FXD MW 1000 OHM 0.02% 1/40W	28480	0811-2675
A3R1	0757-0199	2	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
A3R2	0698-3156	1	R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156
A3R3	0757-0279	1	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A3R4	0757-0280	8	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A3R5	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W		

See Introduction to this section for ordering information

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
XA1	1251-0160	1	CONNECTOR:15 PIN	28480	1251-0160
KF1	1400-0084	1	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
	0370-0077	3	MISCELLANEOUS KN08:SKIRTED BAR FOR 0.250" DIA SHAFT (POWER)	28480	0370-0077
	0370-0077	1	KN08:SKIRTED BAR FOR 0.250" DIA SHAFT (FUNCTION)	28480	0370-0077
	0370-0310	1	KN08:ROUND BLK 0.625" DIA (ZERO)	28480	0370-0310

Table 7. Replaceable Parts

See introduction to this section for ordering information

Figure 6. Cabinet Parts

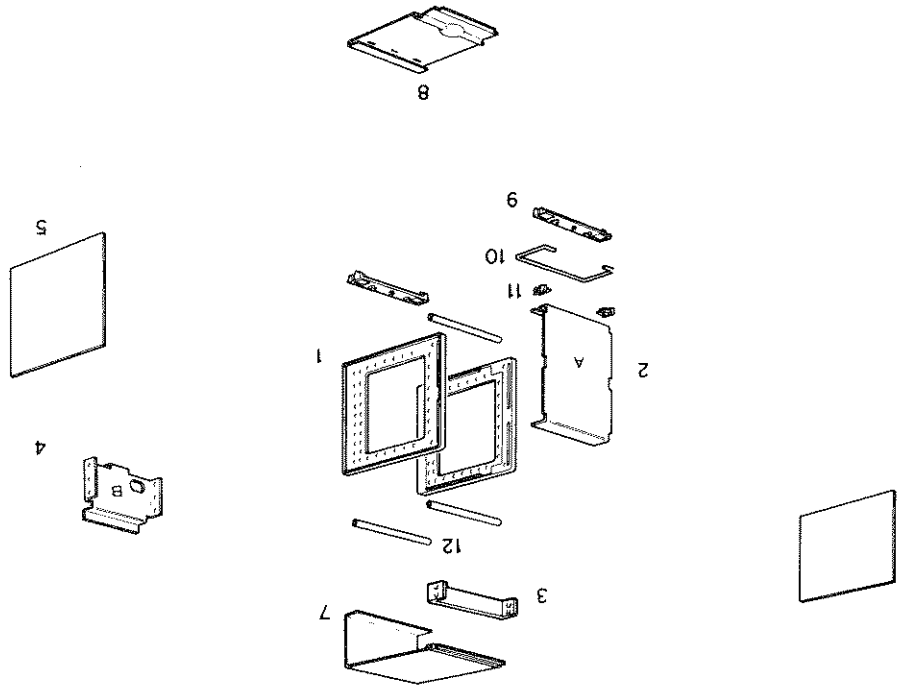


Table 7. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	5060-0702	1	CABINET PARTS	28480	5060-0702
2	0847T-00004	1	FRAME ASSEMBLY	28480	0847T-00004
3	0847T-00003	1	PANEL:FRONT*	28480	0847T-00003
4	0847T-00005	1	PANEL:REAR*	28480	0847T-00005
5	5000-0702	1	SIDE COVER	28480	5000-0702
6	5060-0705	1	NOT ASSIGNED	28480	5060-0705
7	5000-0710	1	TOP COVER ASSY:5 X 8	28480	5060-0710
8	5000-0710	1	COVER:BOTTOM 5 X 8 SM	28480	5060-0710
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

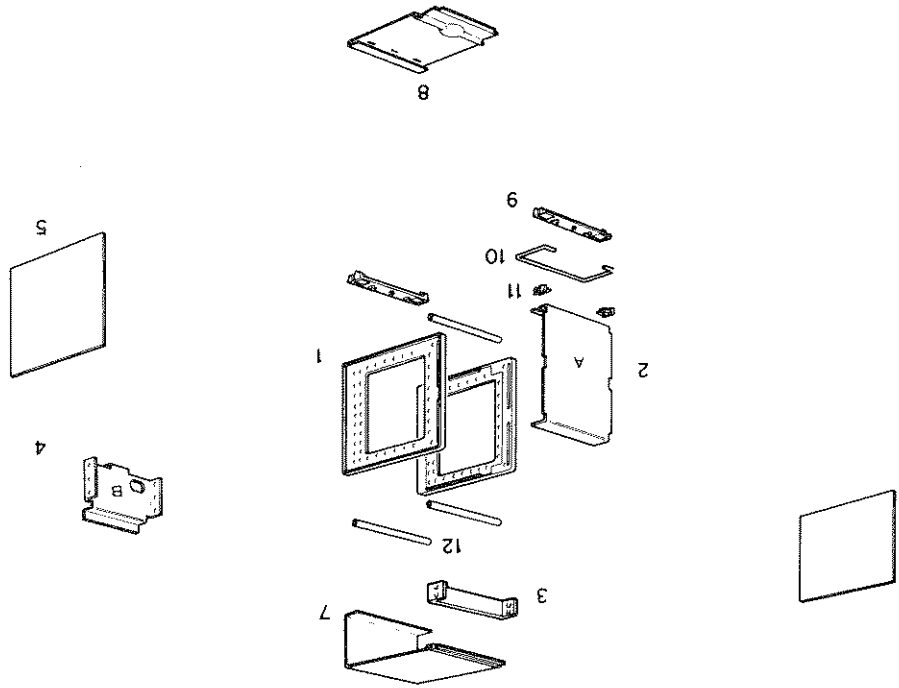


Table 7. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	5060-0702	1	CABINET PARTS	28480	5060-0702
2	0847T-00004	1	FRAME ASSEMBLY	28480	0847T-00004
3	0847T-00003	1	PANEL:FRONT*	28480	0847T-00003
4	0847T-00005	1	PANEL:REAR*	28480	0847T-00005
5	5000-0702	1	SIDE COVER	28480	5000-0702
6	5060-0705	1	NOT ASSIGNED	28480	5060-0705
7	5000-0710	1	TOP COVER ASSY:5 X 8	28480	5060-0710
8	5000-0710	1	COVER:BOTTOM 5 X 8 SM	28480	5060-0710
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.		

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	Manufacturer	Address	Code	Manufacturer	Address
02660	Amphenol Corp.	Broadview, Ill. 60153	71400	Bussman Mfg. Division	St. Louis, Mo. 63017
04009	Arrow, Hart and Hegeman Electric Co.	Hartford, Conn. 06106	75915	Litelfuse Inc.	DesPlaines, Ill. 60016
04713	Motorola Semiconductor		80131	Electronic Industries Association	Washington, D.C. 20006
07263	Fairchild Camera and Instrument Products Inc.	Phoenix, Ariz. 85008	82389	Switchcraft Inc.	Chicago, Ill. 60630
28480	Hewlett-Packard Co. Division . . . Mountain View, Cal. 94040		87034	Marcooak Industries, Inc.	Anaheim, Cal. 92803
56289	Sprague Electric Co.	N. Adams, Mass. 01247	92418	Radio Materials Co.	Chicago, Ill. 60646
70903	Belden Corp.	Chicago, Ill. 60644	98978	International Electric Research Corp.	Burbank, Cal. 91502

Table 8. Code List of Manufacturers

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 AI has the complete reference designation of AI.R1. 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














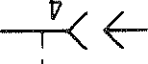
1.	Resistance in ohms, capacitance in microfarads unless otherwise indicated.	
2.	Screwdriver adjustment	
3.	Front panel designation	
	Rear panel designation	
4.	Printed circuit card border	
	Signal path	
	Feedback path	
5.	P/O	
	Part of	
6.	Wiper moves toward CW when control rotated clockwise	
7.	Test 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.	
	Indicates socket connections and pin numbers	

Figure 7. Bottom View, Cover Removed

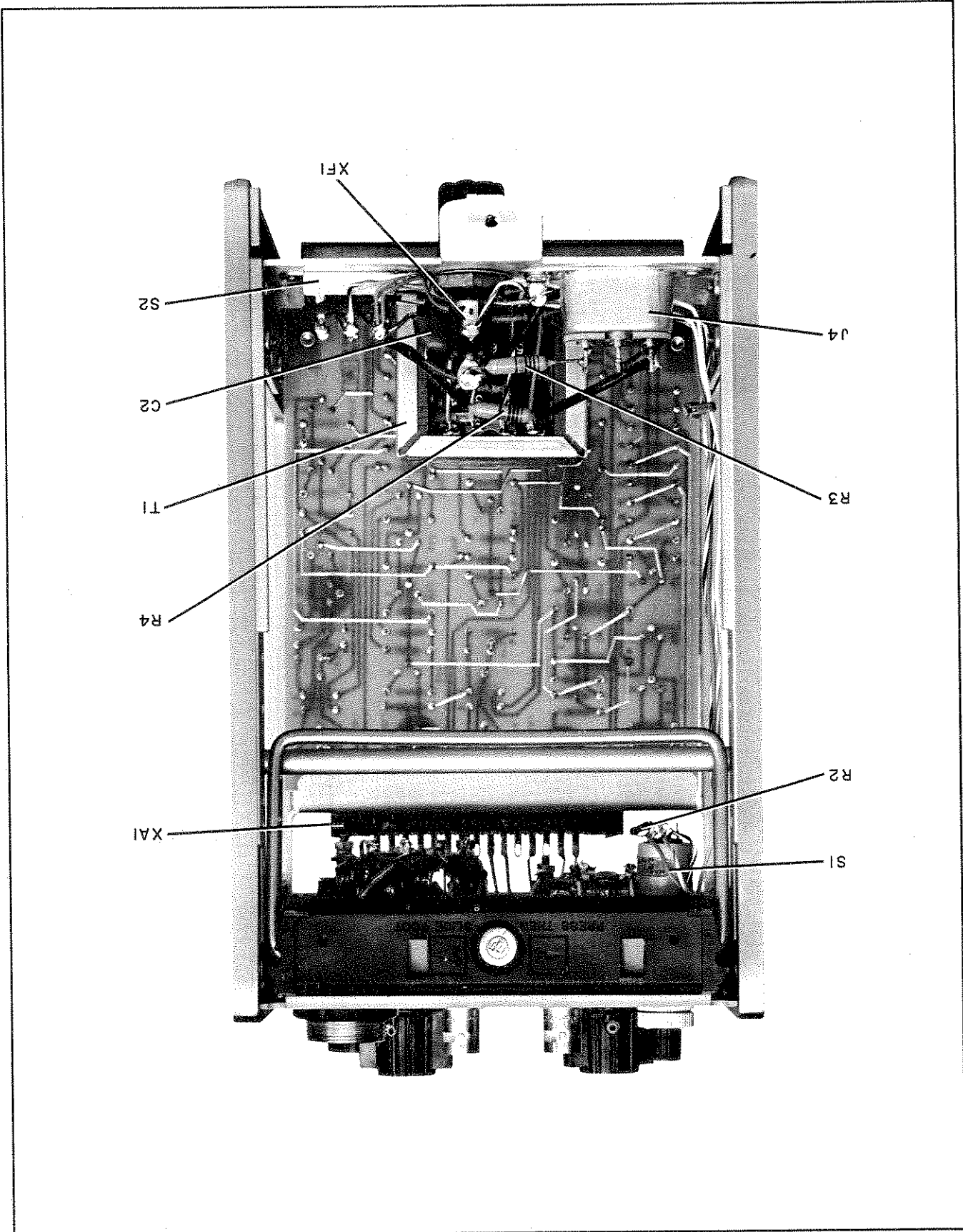


Figure 9. A3 Function Switch Assembly, Component Locations

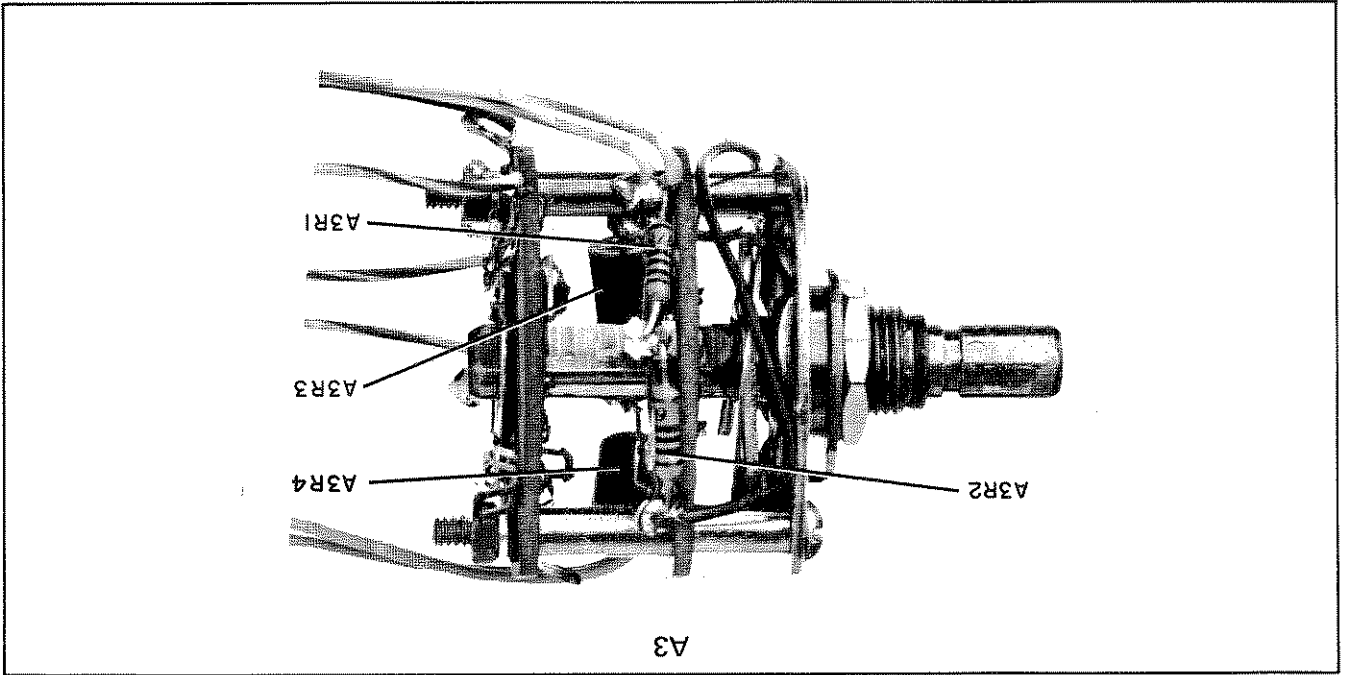
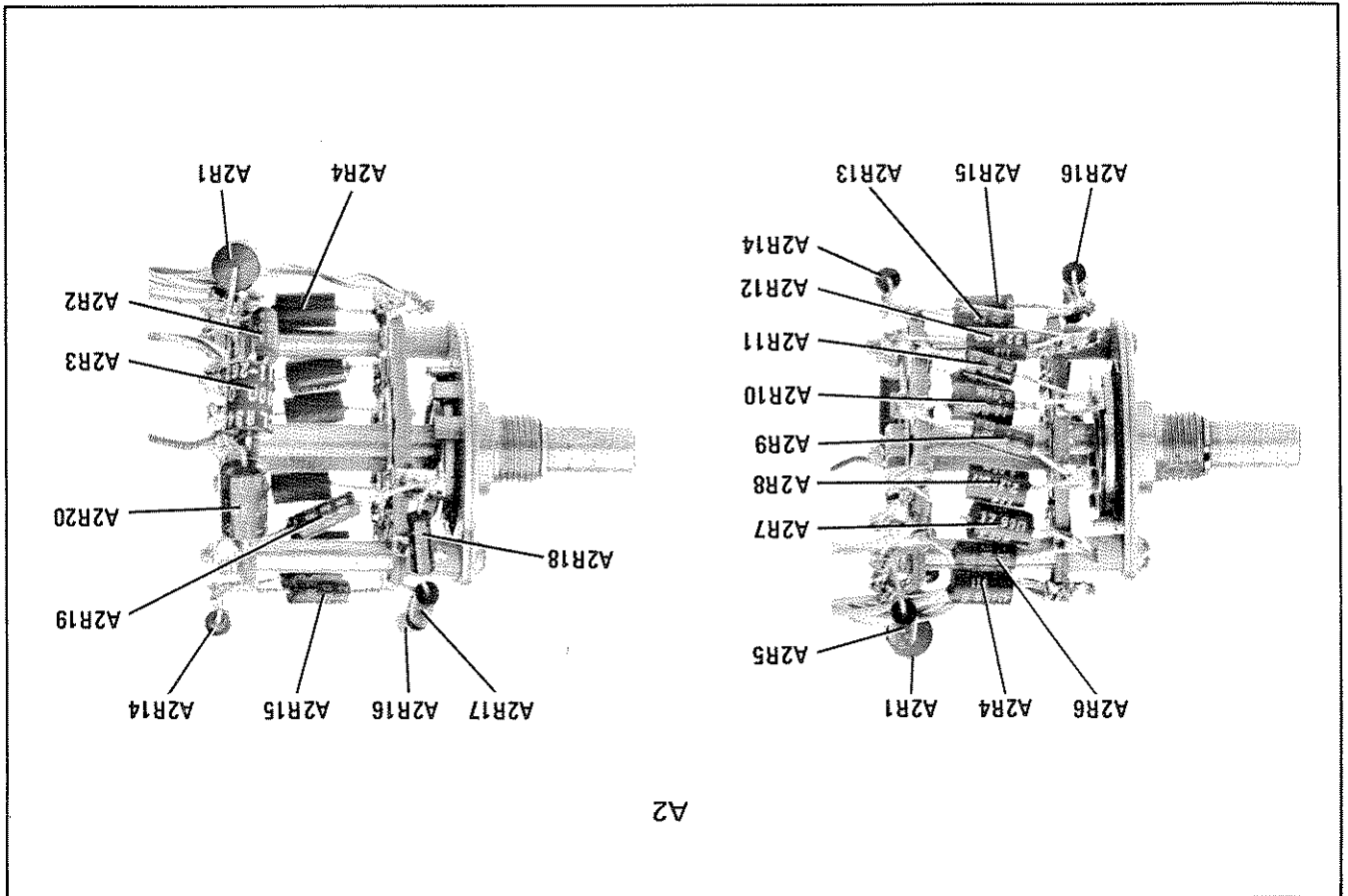


Figure 8. A2 Power Switch Assembly, Component Locations



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

The V_{comp} reference voltage divider provides the V_{comp} 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.

Figure 10 is a block diagram of the 8477A Callibrator, 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 VRF voltages to the 8477A and the thermistor cable completes the bridge circuits.

Block Diagram

The callibrator 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 callibrator'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.

A 432 Power Meter derives its meter readings from two voltages, VRF 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 Callibrator is connected to a power meter, it forms the external legs of the bridge circuits, and the callibrator controls VRF and V_{comp} . The callibrator can set VRF 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.

Introduction

SERVICE SHEET 1

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

Table 10. V_{comp} Reference Voltages

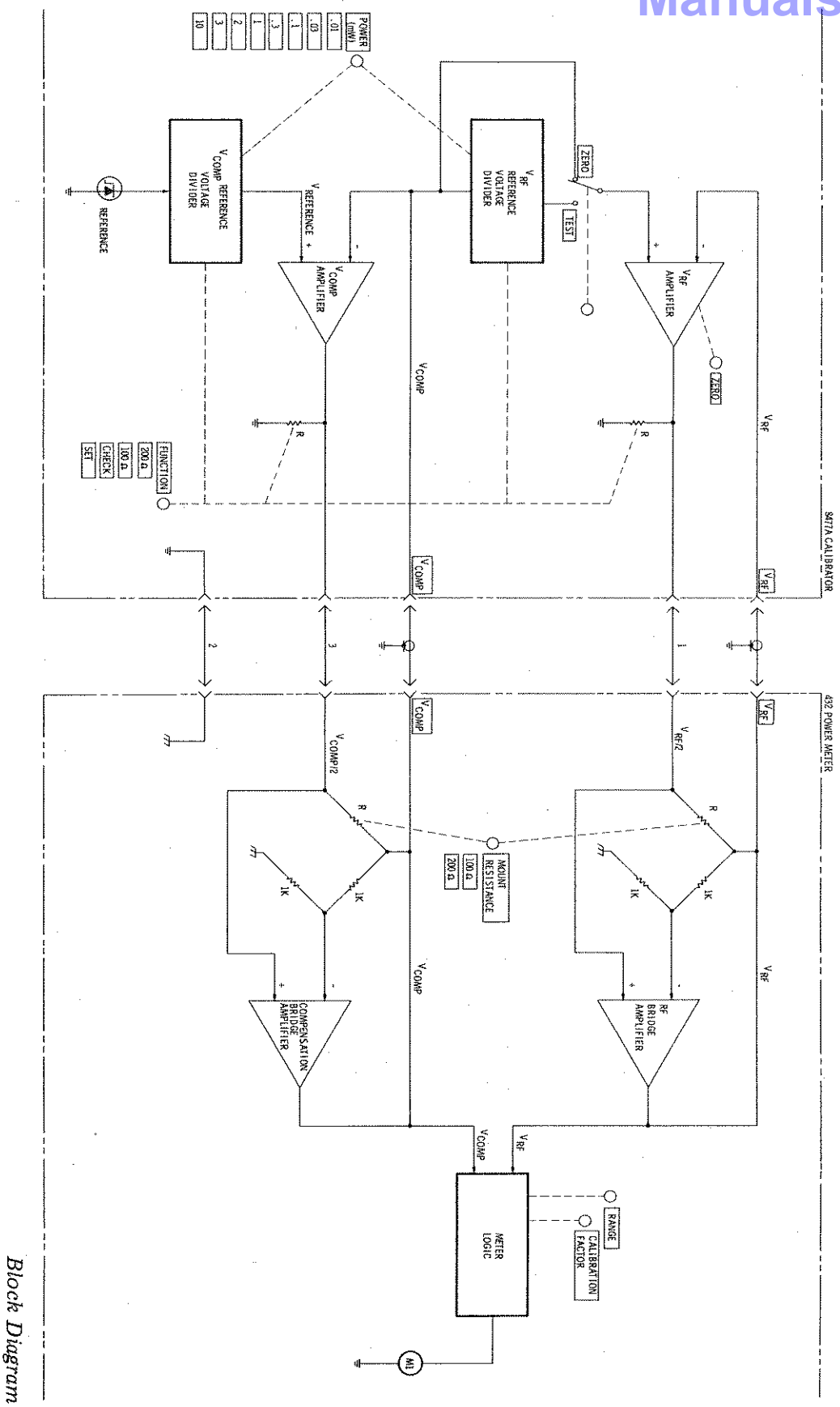
With the FUNCTION switch in the SET position, both the VRF and V_{comp} reference voltages are +5.9 volts. The operator sets the offset of the 432 bridge amplifiers to zero in the SET position, and then switches to CHECK. In the CHECK position, both the VRF and V_{comp} reference voltages (and hence 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.

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

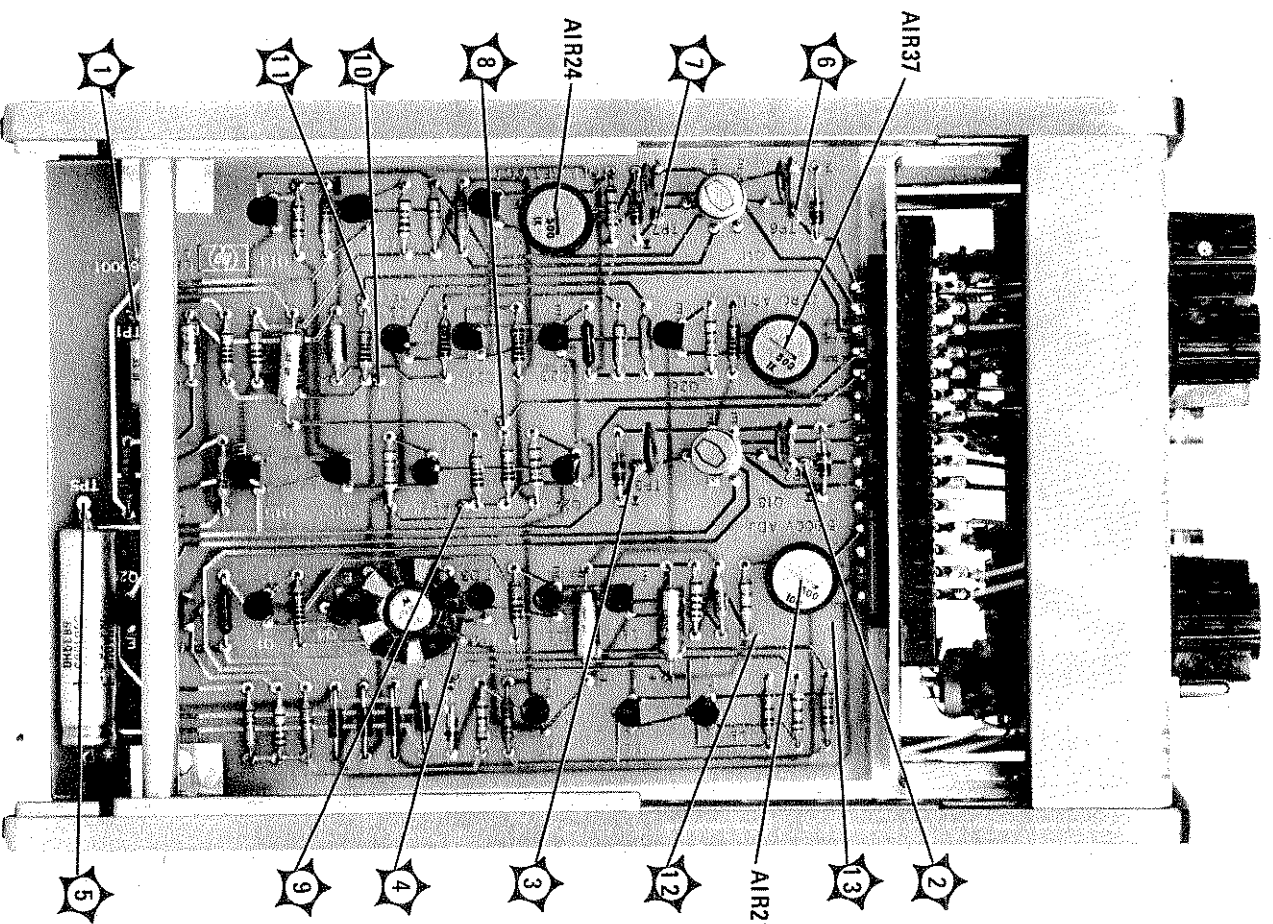
The VRF amplifier compares VRF to the VRF reference voltage. The difference is amplified and used to send a corrective current into the 432 RFBridge at the $V_{RF}/2$ point. This current changes the input voltage to the RFBridge amplifier. This change in input causes the VRF voltage to regulate to its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

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

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



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, VRF and Vcomp, coming from the power meter.

With A2 Function Switch Assembly and A3 Power Switch Assembly set as shown, Vcomp is referenced to an internal, calibrator reference and VRF is referenced to Vcomp.

To troubleshoot the amplifiers, connect the calibrator to a 432 Power Meter: connect VRF to VRF and Vcomp to Vcomp 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

VRF Reference Voltage Divider

With the FUNCTION switch set to 100 or 200 ohms, A2R4 through A2R20 divide Vcomp to produce a reference voltage for the VRF amplifier. The division ratio is set by the POWER switch.

VRF Differential Amplifier

Q18A/B, Q19 and Q20 compare VRF to the VRF 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.

VRF Amplifier and Current Limited Amplifier

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

Vcomp Reference Voltage Divider

A2R1 through A2R3 provide the reference voltage for the Vcomp amplifier. The division ratio is set by the FUNCTION and RANGE switches.

Vcomp Differential Amplifier

Q11A/B, Q12 and Q13 compare Vcomp to the Vcomp 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.

Vcomp 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 thermistors for bridges for a mount resistance of 200 ohms. A3R2 and A3R4 complete the bridges for a mount resistance of 100 ohms.

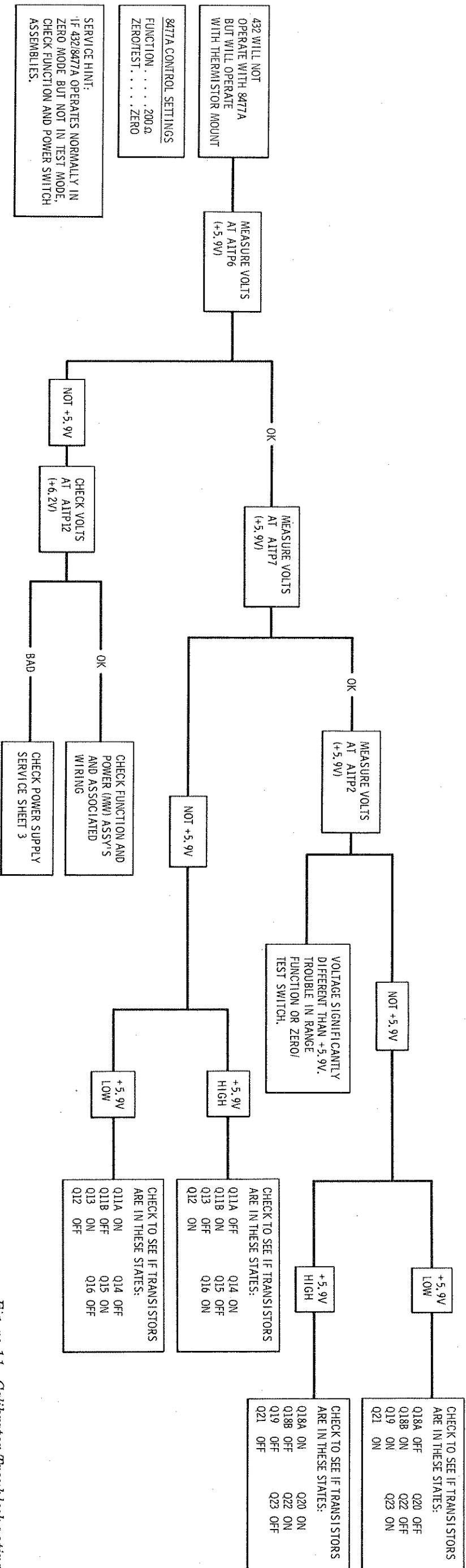
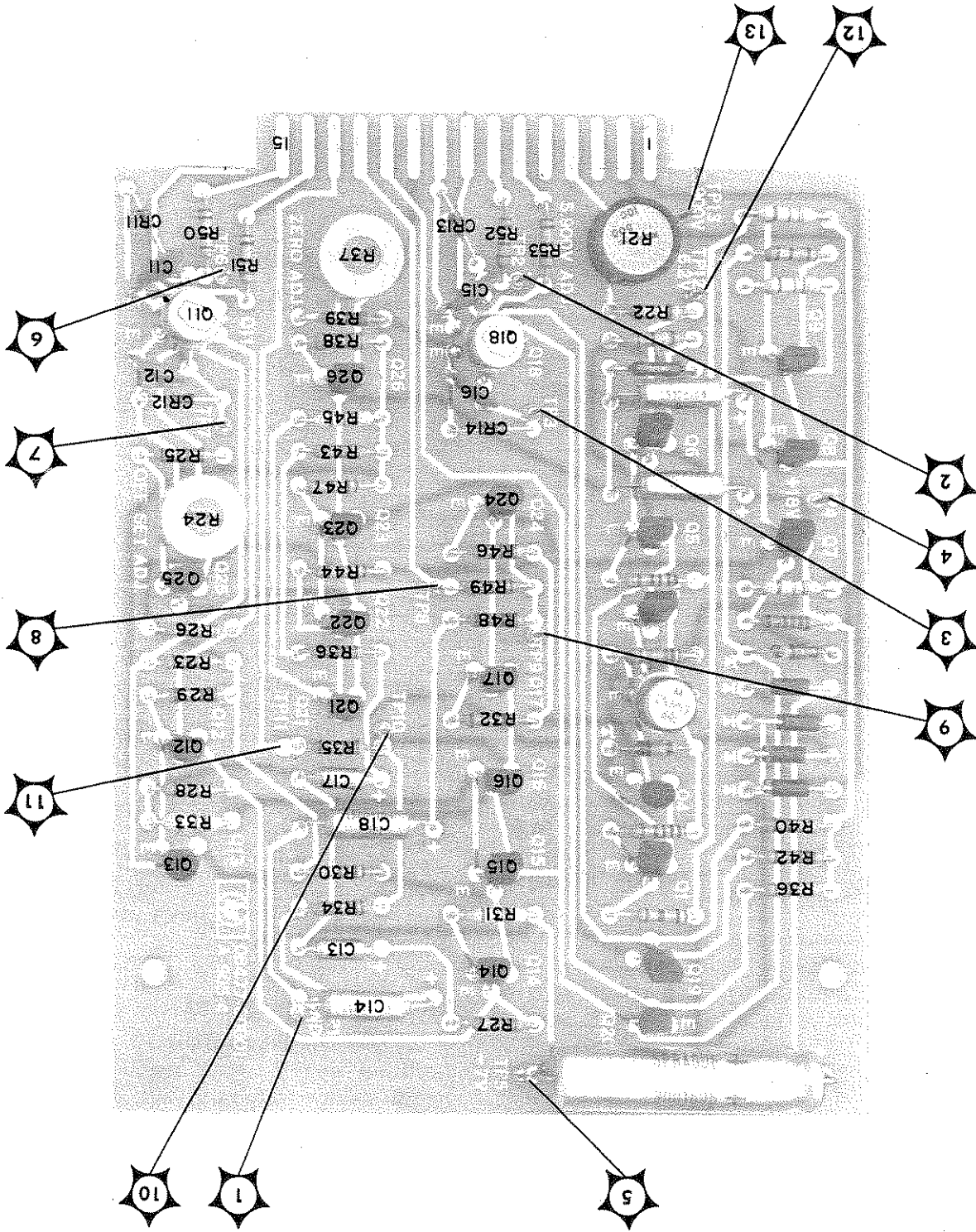


Figure 11. Calibrator Troubleshooting

Figure 12. A1 Calibrator Circuits, Component Locations



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

NOT DESIGNATED:
A104-ALC10
A1R12-A1R20
A1010

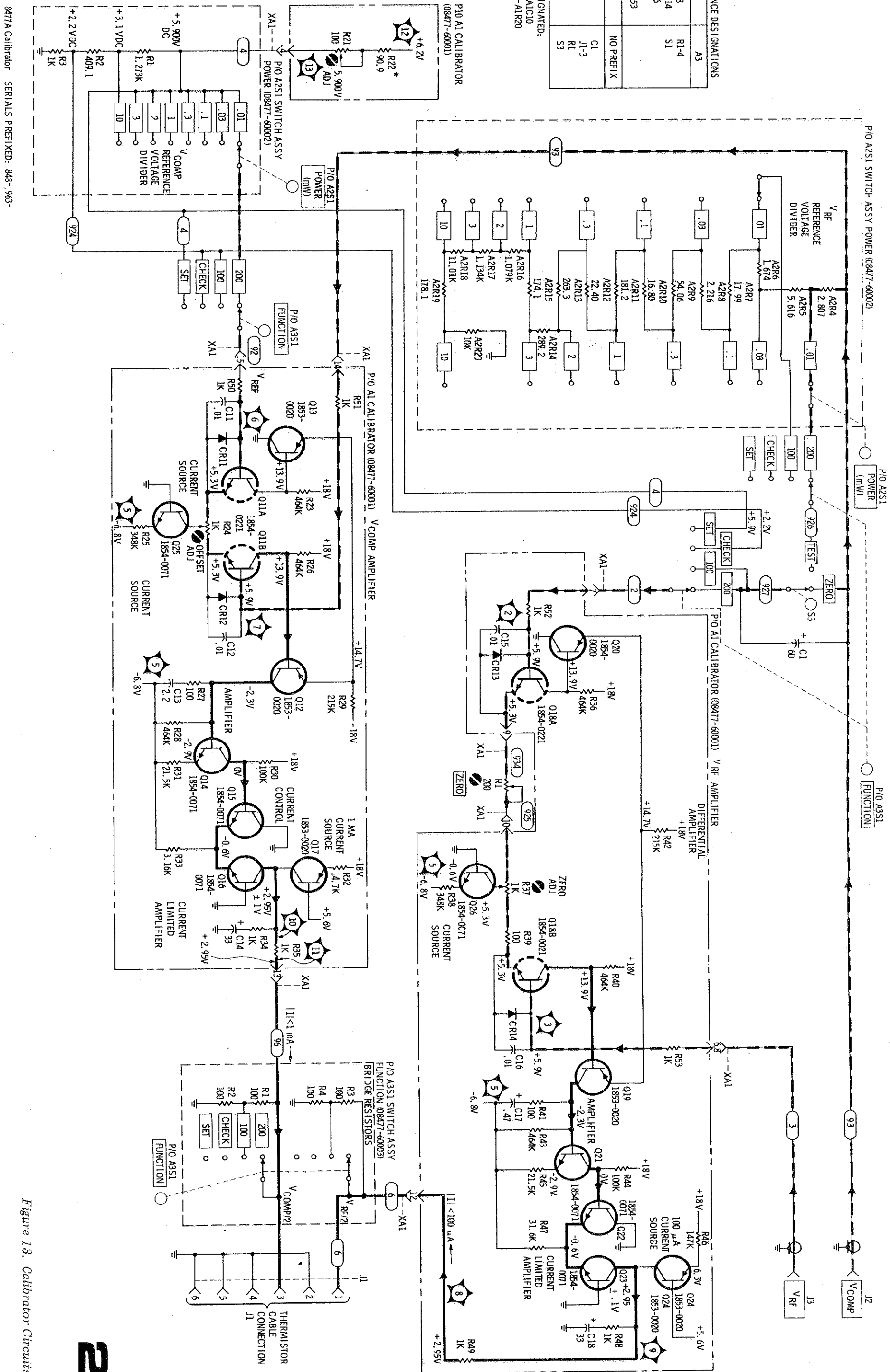


Figure 13. Calibrator Circuits

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.

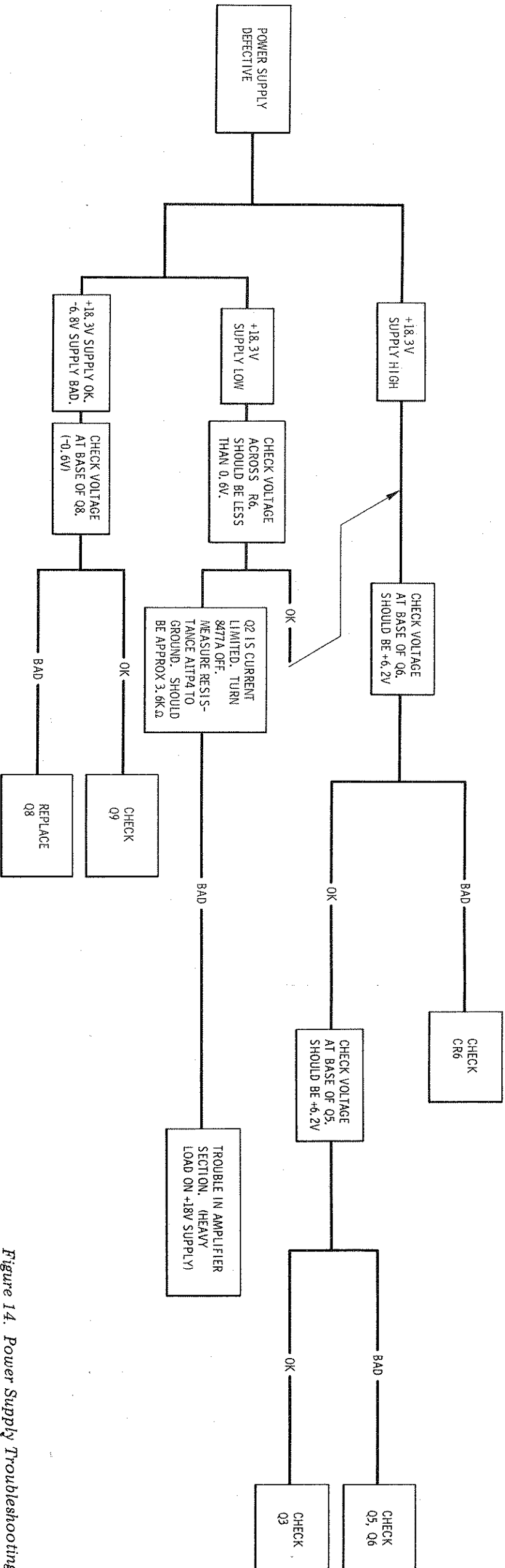
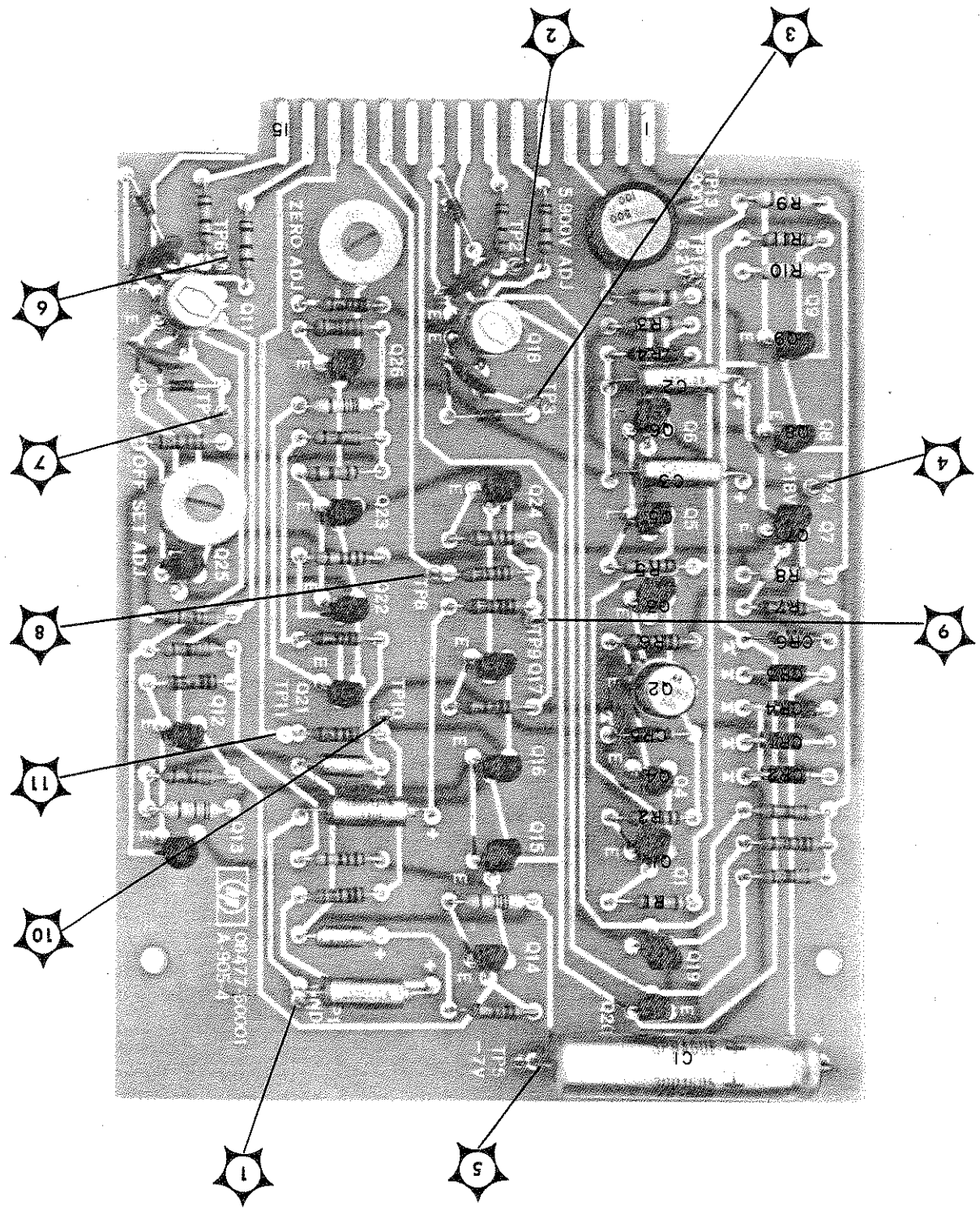


Figure 14. Power Supply Troubleshooting

Figure 15. A1 Calibrator Power Supply Circuits, Component Locations



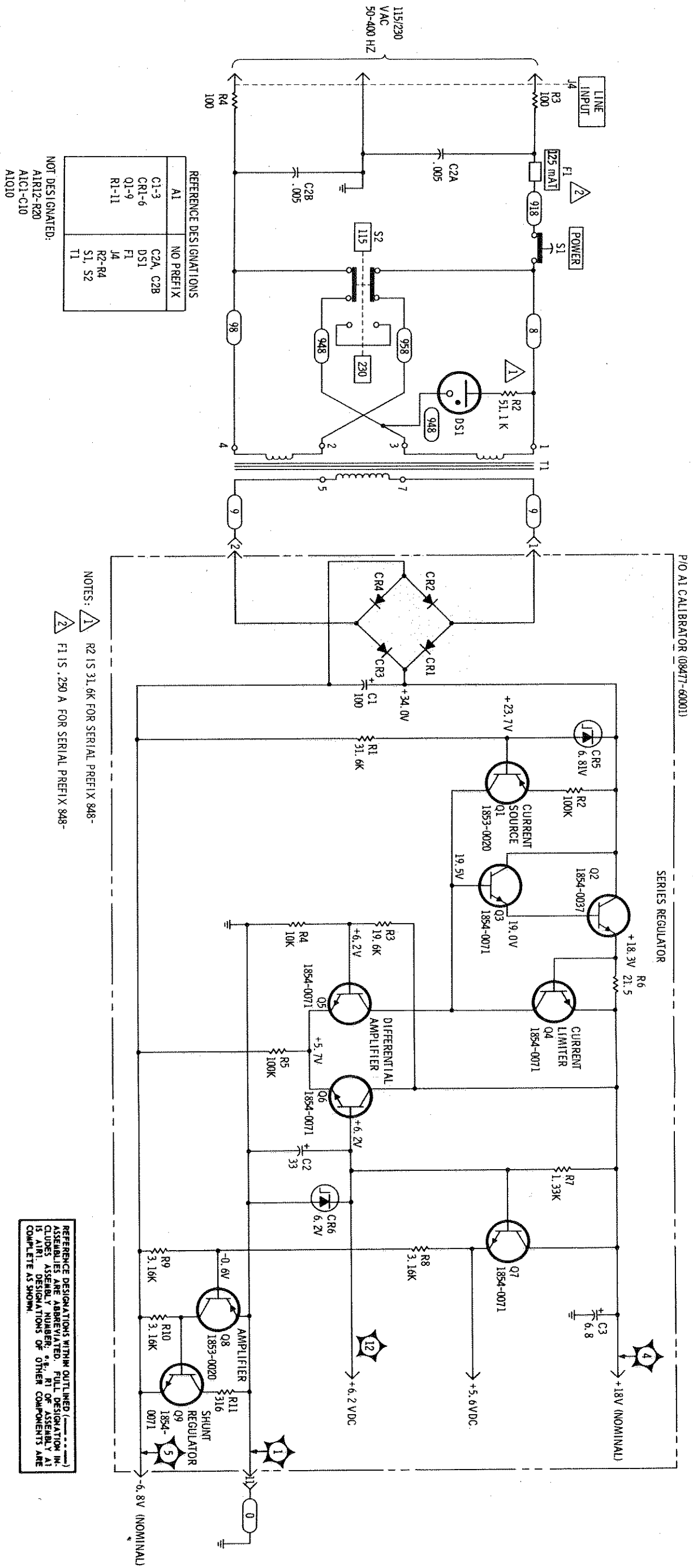


Figure 16. Power Supply Circuits

