

Errata

Title & Document Type: 3444A DC Multi-Function Unit Operating and Service Manual

Manual Part Number: 03444-90004

Revision Date: April 1970

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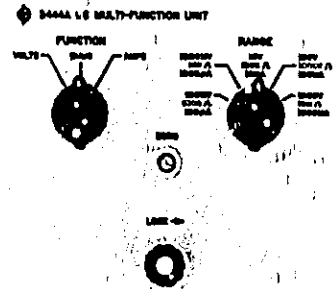
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.



Agilent Technologies

HP 3444A

DC MULTI-FUNCTION UNIT 3444A



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HP 3444A

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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

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OPERATING AND SERVICE MANUAL

-hp- Part No. 03444-90004

MODEL 3444A DC MULTI-FUNCTION UNIT

Serials Prefixed: 973-

Appendix C, Manual Backdating Changes, adapts
manual to serials prefixed 435-, 543-, 638-, 644-, 821-, 927-.

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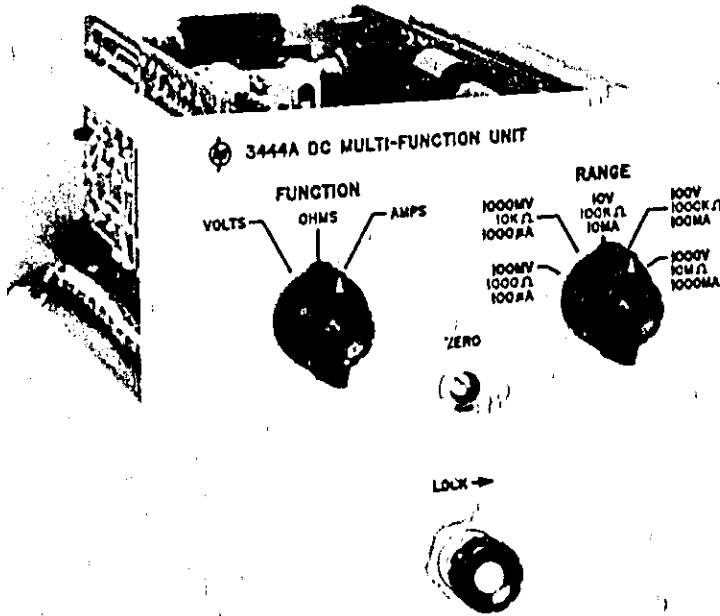


Figure 1-1. Model 3444A Multi-Function Meter

Table 1-1. Specifications

<p>Voltage Range: 4-digit presentation of 99.99 mV, 999.9 mV, 9.999 Volts, 99.99 Volts, and 999.9 Volts full scale with 5% overrange capability and overrange indicator.</p> <p>Current Range: 4-digit presentation of 99.99 μA, 999.9 μA, 9.999 mA, 99.99 mA and 999.9 mA with 5% overrange capability and overrange indicator.</p> <p>Resistance Range: 4-digit presentation of 999.9 ohms, 9.999 kilohms, 99.99 kilohms, 999.9 kilohms and 9.999 megohms with 5% overrange capability and overrange indicator.</p> <p>Voltage Accuracy: 9.999 V to 999.9 V (full scale): $\pm 0.05\%$ of reading ± 1 digit including line voltage variations of $\pm 10\%$ from nominal. A front panel adjustment on the 3440A insures accuracy over the temperature range between $+15^{\circ}\text{C}$ and $+40^{\circ}\text{C}$ and $\pm 0.1\%$ ± 1 digit over the temperature range of 0°C to $+15^{\circ}\text{C}$ and $+40^{\circ}\text{C}$ to $+50^{\circ}\text{C}$.</p> <p>99.99 mV and 999.9 mV (full scale):</p> <p>$\pm 0.1\%$ of reading ± 1 digit including line voltage variations of $\pm 10\%$ from nominal. A front panel adjustment on the 3440A insures accuracy over the temperature range between $+15^{\circ}\text{C}$ and $+40^{\circ}\text{C}$ and $\pm 0.15\%$ ± 1 digit over the temperature range of 0°C to $+15^{\circ}\text{C}$ and $+40^{\circ}\text{C}$ to $+50^{\circ}\text{C}$.</p> <p>Current Accuracy: $\pm 0.2\%$ of reading ± 1 digit with line variations of $\pm 10\%$ from nominal.</p>	<p>Resistance Accuracy:</p> <p>$\pm 0.3\%$ of reading ± 1 digit for all ranges up to the 10 megohm range with line variations of $\pm 10\%$ from nominal.</p> <p>$\pm 1\%$ of reading ± 1 digit on the 10 megohm range with line variations of $\pm 10\%$ from nominal.</p> <p>Ohmmeter Current:</p> <table border="1"> <thead> <tr> <th>RANGE</th> <th>SHORT CIRCUIT CURRENT</th> </tr> </thead> <tbody> <tr> <td>1 K</td> <td>1 mA</td> </tr> <tr> <td>10 K</td> <td>100 μA</td> </tr> <tr> <td>100 K</td> <td>10 μA</td> </tr> <tr> <td>1 M</td> <td>1 μA</td> </tr> <tr> <td>10 M</td> <td>0.1 μA</td> </tr> </tbody> </table> <p>Range Selection: Manual</p> <p>Voltmeter input Impedance: Constant 10.2 megohms (to dc) all ranges.</p> <p>Ammeter Input Resistance:</p> <table border="1"> <thead> <tr> <th>RANGE</th> <th>INPUT RESISTANCE</th> </tr> </thead> <tbody> <tr> <td>100 μA</td> <td>1000 ohms</td> </tr> <tr> <td>1000 μA</td> <td>100 ohms</td> </tr> <tr> <td>10 mA</td> <td>10 ohms</td> </tr> <tr> <td>100 mA</td> <td>1.3 ohms</td> </tr> <tr> <td>1000 mA</td> <td>0.4 ohms</td> </tr> </tbody> </table>	RANGE	SHORT CIRCUIT CURRENT	1 K	1 mA	10 K	100 μ A	100 K	10 μ A	1 M	1 μ A	10 M	0.1 μ A	RANGE	INPUT RESISTANCE	100 μ A	1000 ohms	1000 μ A	100 ohms	10 mA	10 ohms	100 mA	1.3 ohms	1000 mA	0.4 ohms
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SECTION I GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The hp-Model 3444A DC Multi-Function Unit in combination with the hp-Model 3439A or 3440A Digital Voltmeter or the hp-Model 3434A Comparator measures dc volts, dc amps, or ohms. Five ranges are provided for each function, allowing dc voltage measurements from 99.99 mV to 999.9 V full scale; ohms measurements from 999.9 ohms to 9.999 megohms full scale; and dc amps measurements from 99.99 microamps to 999.9 milliamps full scale. Five percent overrange is possible on all ranges and functions. Function and range are selected manually.

1-3. Complete specifications for the Model 3444A used in combination with the Model 3439A or 3440A are given in Table 1-1. Specifications for the Model 3444A when used with the Model 3434A Comparator are shown in the Model 3434A Operating and Service Manual.

1-4. INSTRUMENT AND MANUAL IDENTIFICATION.

1-5. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define the differences between your instrument and the Model 3444A described in this manual.

Table 1-1. Specifications (Cont'd)

<p>Polarity: Automatic indication.</p> <p>Input Filter Characteristics:</p> <p>Voltage: Less than 450 msec to 99.95% of final value for full scale step function on 10, 100 and 1000 volt ranges.</p> <p>Less than one sec to within 99.95% of final value for a full scale step function on 100 and 1000 mV ranges.</p> <p>Current: Less than one sec to 99.95% of final value for a full scale step function on all current ranges.</p> <p>Resistance: 1000 ohms to 1 megohm: less than 1.0 second to 99.95% of final value.</p> <p>10 Megohms: less than 5.0 seconds to 99.95% of final value.</p> <p>Input Filter AC Rejection:</p> <p>Voltage: 10, 100, and 1000 volt ranges: 30 dB at 60 Hz, increasing 12 dB/octave.</p> <p>100 and 1000 mV ranges: maximum of 40 mV and 400 mV p-p respectively at 60 Hz for less than 0.1% of full scale error; allowable ac increasing at 6 dB per octave.</p> <p>Current: p-p ripple current may be up to 40% of full scale range at 60 Hz for less than 0.1% of full scale error; allowable ac increasing at 6 dB per octave.</p>	<p>Common Mode Rejection:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: left;">Voltage:</td> <td style="text-align: center;">DC</td> <td style="text-align: center;">60</td> </tr> <tr> <td>100 mV</td> <td style="text-align: center;">130 dB</td> <td style="text-align: center;">5 V p-p*</td> </tr> <tr> <td>1000 mV</td> <td style="text-align: center;">110 dB</td> <td style="text-align: center;">10 V p-p*</td> </tr> <tr> <td>10 V</td> <td style="text-align: center;">90 dB</td> <td style="text-align: center;">70 dB</td> </tr> <tr> <td>100 V</td> <td style="text-align: center;">70 dB</td> <td style="text-align: center;">50 dB</td> </tr> <tr> <td>1000 V</td> <td style="text-align: center;">50 dB</td> <td style="text-align: center;">30 dB</td> </tr> </table> <p>Current:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">DC</td> <td style="text-align: center;">60</td> </tr> <tr> <td>100 μA</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 3 V p-p*</td> </tr> <tr> <td>1000 μA</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> <tr> <td>10 mA</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> <tr> <td>100 mA</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> <tr> <td>1000 mA</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> </table> <p>Resistance:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">DC</td> <td style="text-align: center;">60</td> </tr> <tr> <td>1 Kilohm</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 5 V p-p*</td> </tr> <tr> <td>10 Kilohm</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> <tr> <td>100 Kilohm</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> <tr> <td>1000 Kilohm</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> <tr> <td>10 Megohm</td> <td style="text-align: center;">< 500 Vdc*</td> <td style="text-align: center;">< 10 V p-p*</td> </tr> </table> <p>* Error less than 0.1% of full scale.</p> <p>Dimensions:</p> <p>6" (12.25 cm) wide, 4-11/16" (11.90 cm) high, 9-1/8" (23.15 cm) long.</p>	Voltage:	DC	60	100 mV	130 dB	5 V p-p*	1000 mV	110 dB	10 V p-p*	10 V	90 dB	70 dB	100 V	70 dB	50 dB	1000 V	50 dB	30 dB		DC	60	100 μ A	< 500 Vdc*	< 3 V p-p*	1000 μ A	< 500 Vdc*	< 10 V p-p*	10 mA	< 500 Vdc*	< 10 V p-p*	100 mA	< 500 Vdc*	< 10 V p-p*	1000 mA	< 500 Vdc*	< 10 V p-p*		DC	60	1 Kilohm	< 500 Vdc*	< 5 V p-p*	10 Kilohm	< 500 Vdc*	< 10 V p-p*	100 Kilohm	< 500 Vdc*	< 10 V p-p*	1000 Kilohm	< 500 Vdc*	< 10 V p-p*	10 Megohm	< 500 Vdc*	< 10 V p-p*
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SECTION II INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 3444A DC Multi-Function Unit. Included are initial inspection procedures, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of marks or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check the electrical performance of the instrument, using the procedure outlined in Paragraph 5-5. If there is damage or deficiency, see the warranty on the inside front cover of this manual.

2-5. INSTALLATION.

2-6. Install the Model 3444A in the compartment provided in the hp- Model 3439A or 3440A Digital Voltmeter or Model 3434A Comparator. Make certain that the connector at the rear is inserted properly and the front panel locking screw is tightened.

2-7. REPACKAGING FOR SHIPMENT.

2-8. The following is a general guide for repackaging an instrument for shipment. If you have any questions,

contact your local hp- Sales and Service Office. (See Appendix B for locations.)

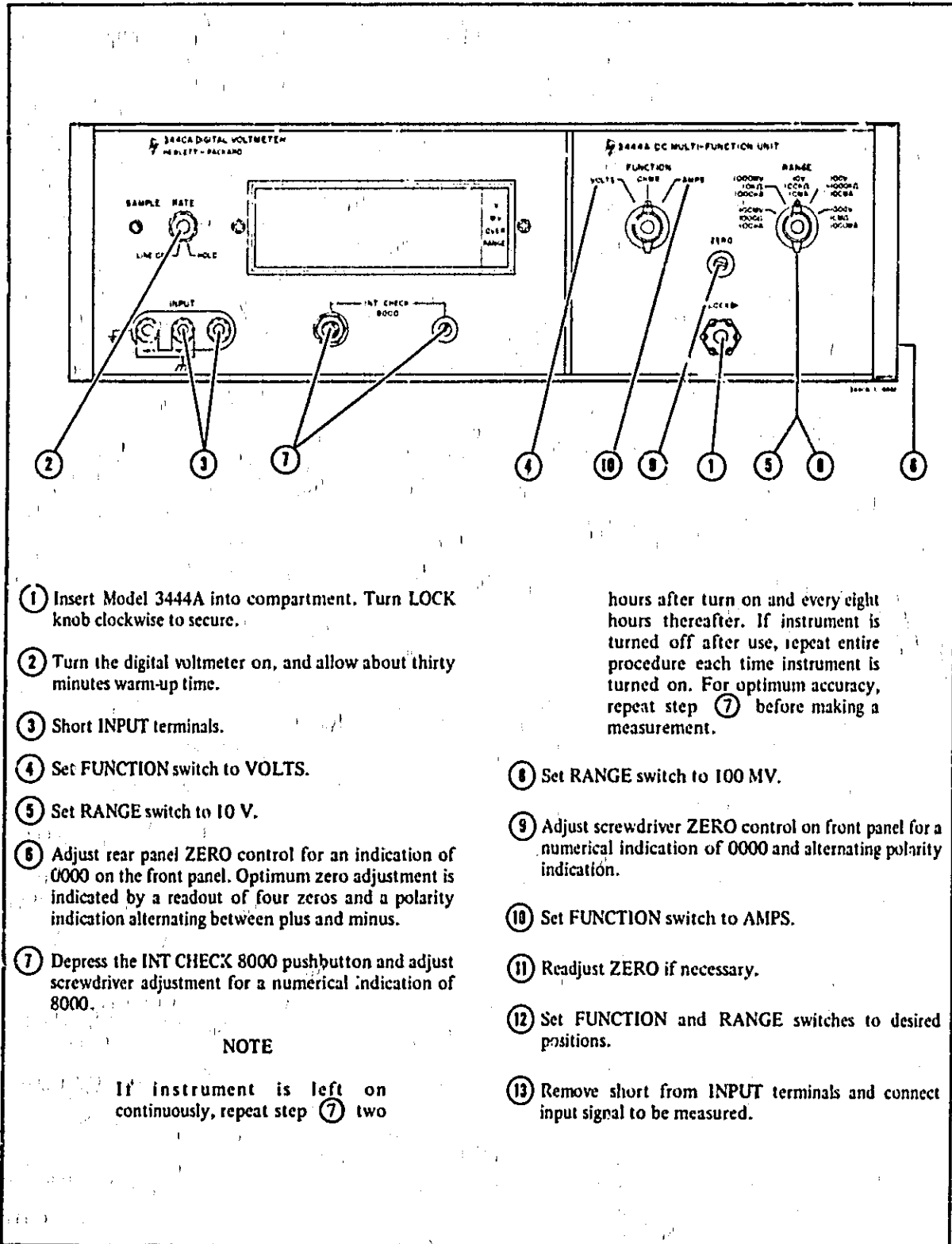
NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument.

- a. Place instrument in original container if available. If not, a suitable container may be purchased from your nearest hp- Sales and Service Office.

If original container is not used.

- b. Wrap instrument in heavy paper or plastic before placing in an inner container.
- c. Use plenty of packing material around all sides of instrument and protect panel faces with cardboard strips.
- d. Use a heavy carton or wooden box to house the instrument and inner container and use strong tape or metal bands to seal the shipping container.
- e. Mark shipping container "DELICATE INSTRUMENT," or "FRAGILE."



- ① Insert Model 3444A into compartment. Turn LOCK knob clockwise to secure.
- ② Turn the digital voltmeter on, and allow about thirty minutes warm-up time.
- ③ Short INPUT terminals.
- ④ Set FUNCTION switch to VOLTS.
- ⑤ Set RANGE switch to 10 V.
- ⑥ Adjust rear panel ZERO control for an indication of 0000 on the front panel. Optimum zero adjustment is indicated by a readout of four zeros and a polarity indication alternating between plus and minus.
- ⑦ Depress the INT CHECK 8000 pushbutton and adjust screwdriver adjustment for a numerical indication of 8000.

NOTE

If instrument is left on continuously, repeat step ⑦ two

hours after turn on and every eight hours thereafter. If instrument is turned off after use, repeat entire procedure each time instrument is turned on. For optimum accuracy, repeat step ⑦ before making a measurement.

- ⑧ Set RANGE switch to 100 MV.
- ⑨ Adjust screwdriver ZERO control on front panel for a numerical indication of 0000 and alternating polarity indication.
- ⑩ Set FUNCTION switch to AMPS.
- ⑪ Readjust ZERO if necessary.
- ⑫ Set FUNCTION and RANGE switches to desired positions.
- ⑬ Remove short from INPUT terminals and connect input signal to be measured.

Figure 3-1, Operating Instructions

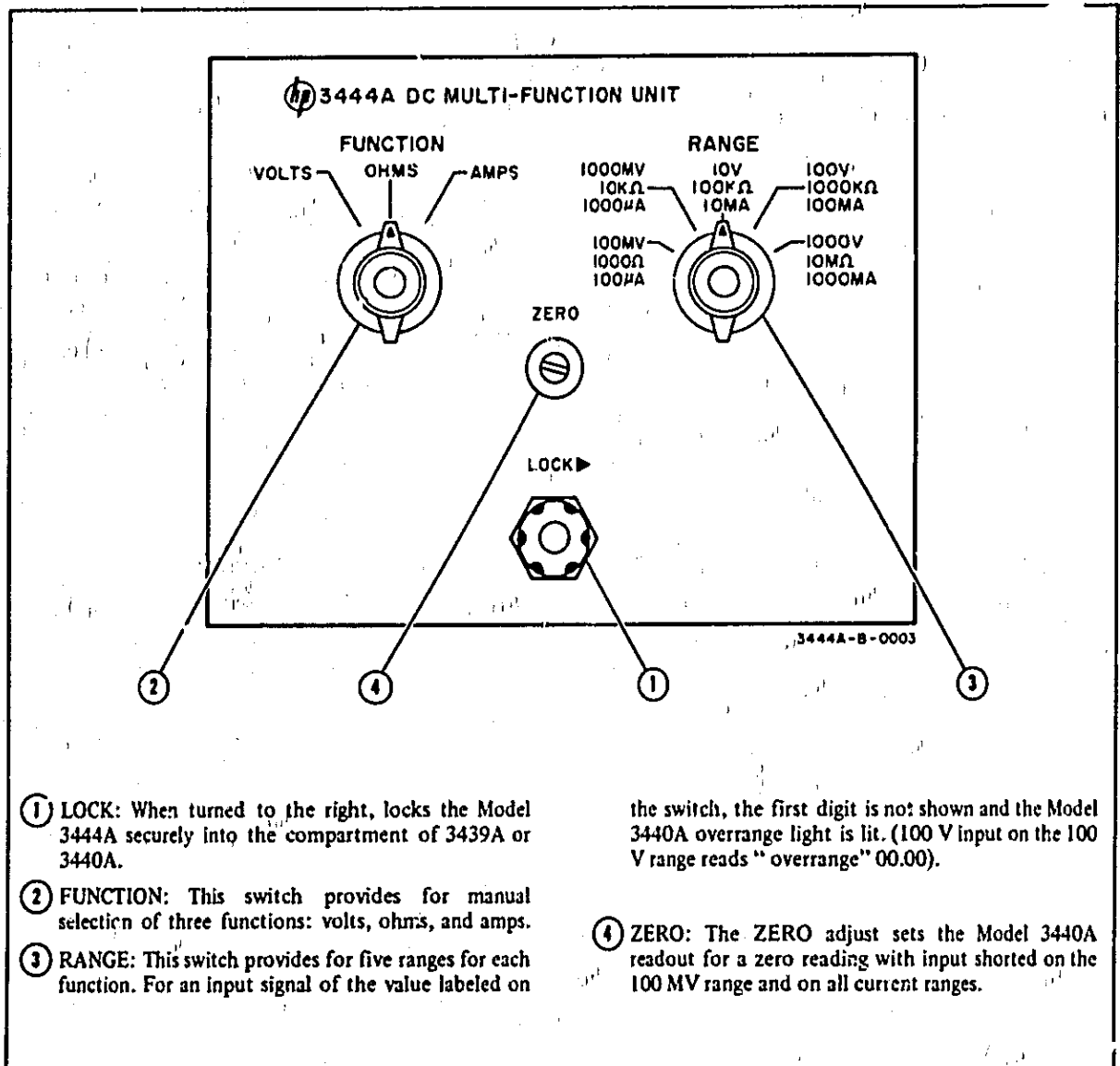
SECTION III OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 3444A can be used to measure dc volts, ohms, or dc amps. Figure 3-2 shows the 3444A front panel controls and gives a brief description of each.

3-3. OPERATING INSTRUCTIONS.

3-4. Instructions for operating the Model 3444A with either the Model 3439A or 3440A Digital Voltmeter are given in Figure 3-1. Instructions for operation with the Model 3434A Comparator are included in the 3434A Operating and Service Manual.



- ① LOCK: When turned to the right, locks the Model 3444A securely into the compartment of 3439A or 3440A.
- ② FUNCTION: This switch provides for manual selection of three functions: volts, ohms, and amps.
- ③ RANGE: This switch provides for five ranges for each function. For an input signal of the value labeled on

the switch, the first digit is not shown and the Model 3440A overrange light is lit. (100 V input on the 100 V range reads "overrange" 00.00).

- ④ ZERO: The ZERO adjust sets the Model 3440A readout for a zero reading with input shorted on the 100 MV range and on all current ranges.

Figure 3-2. Model 3444A Control

SECTION IV

THEORY OF OPERATION

4-1. GENERAL INFORMATION.

4-2. The hp Model 3444A DC Multi-Function Unit allows the Model 3439A or 3440A Digital Voltmeter or Model 3434A Comparator to measure dc voltage, resistance, or dc current. The Model 3444A uses a chopper-stabilized amplifier on the 100 mV and 1000 mV ranges, and on all ohmmeter and ammeter ranges.

4-3. AMPLIFIER OPERATION.

4-4. Figure 4-1 shows a block diagram of the amplifier. A dc voltage applied to the modulator is converted to ac and amplified by the ac amplifier. The demodulator, operating in synchronization with the modulator, acts as a half-wave rectifier, providing a dc output.

4-5. PHOTOCOPPER OSCILLATOR.

4-6. The Model 3444A Photochopper uses a relaxation oscillator containing three neon lamps. These lamps light alternately in a 1, 2, 3, 2, 1 sequence. Lamps 1 and 3 illuminate the photoconductors of the modulator and demodulator, while lamp 2 provides a recovery time for the photoconductors. In this way, one pair of photoconductors is allowed to return to maximum resistance before the other pair is illuminated. Lamps 1 and 3 each illuminate one photoconductor in the modulator and one in the demodulator. Oscillator frequency is adjusted to 200 Hz to minimize the possibility of a beat between power line and oscillator frequencies.

4-7. MODULATOR AND DEMODULATOR.

4-8. In the modulator, one photoconductor is connected to the input, while the other is connected to a dc feedback voltage which is derived from and is proportional to the amplifier output. The output side of both photoconductors is capacitively coupled to the ac amplifier. The photoconductors present a high resistance when dark, and a low resistance when illuminated. Since the two photoconductors are illuminated alternately, the modulator output alternates between the input voltage level and the feedback voltage level.

4-9. Demodulator action is similar to that of a half-wave rectifier, producing a dc signal from the output of the ac amplifier. The demodulator output is the same polarity as the input signal, and is filtered and applied to the dc amplifier.

4-10. AC AMPLIFIER.

4-11. The ac amplifier consists of four stages, stabilized by feedback. The amount of feedback is varied according to range and function to provide the proper gain.

4-12. DC AMPLIFIER.

4-13. Parallel diodes limit the input to the dc amplifier and aid in overload recovery. A zener-regulated power supply for the dc amplifier improves stability of operation. The output of the dc amplifier is proportional to, and the same polarity as the input voltage. The amplifier output goes to the input comparator in the Model 3439A or 3440A Digital Voltmeter or the 3434A Comparator.

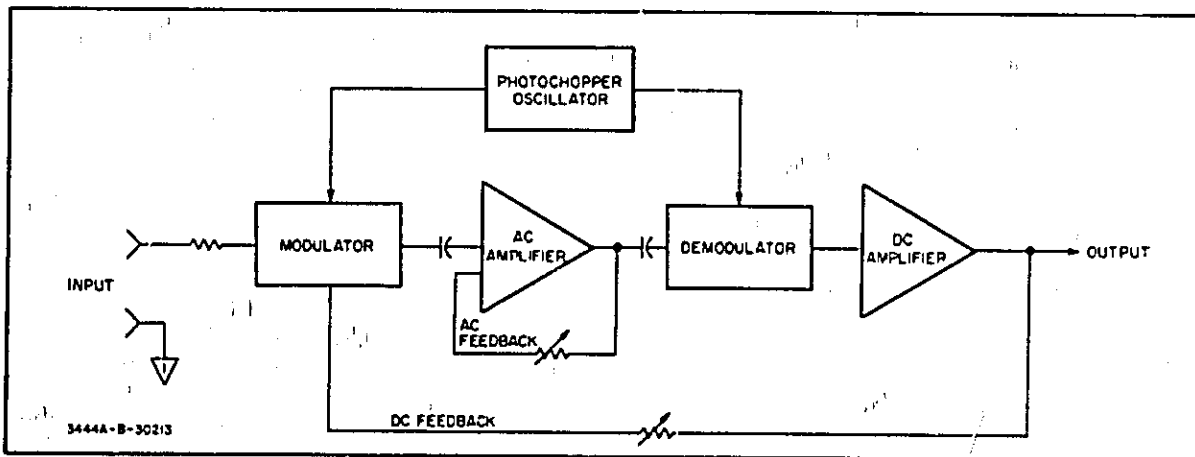


Figure 4-1. Amplifier Block Diagram

4-14. VOLTMETER OPERATION.

4-15. The Model 3444A provides dc voltmeter ranges of 100 mV, 1000 mV, 10 V, 100 V, and 1000 V full scale. On the three higher ranges, the amplifier is not used, and the 3444A output is taken directly from the input attenuator in the Model 3434A, 3439A, or 3440A. The output of the 3444A is 9.8 V for a full-scale reading on any range.

4-16. Figure 4-2 is a diagram of the voltmeter operation. On the 100 mV range, the amplifier gain is adjusted to 98, producing an output of 9.8 V for a full-scale input of 100 mV. On the 1000 mV range, gain is reduced to 9.8. When used in the Model 3439A or 3440A Digital Voltmeter, polarity selection and display are automatic.

4-17. OHMMETER OPERATION.

4-18. Figure 4-3 illustrates the ohmmeter operation and range switching. A constant current from the -20 V reference is supplied to the unknown resistance connected to the input terminals, and the 3444A then measures the voltage drop across the unknown resistance. The voltage drop developed is directly proportional to the resistance. The value of current is such that a voltage drop of 1 V is obtained across a full-scale resistance. Amplifier gain is fixed at 9.8, producing an output of -9.8 V for full-scale resistance at the input. Table 4-1 gives the short-circuit current appearing at the input terminals for each range.

Table 4-1. Ohmmeter Current

RANGE	SHORT-CIRCUIT CURRENT
1000 ohms	1 mA
10 kilohms	100 μ A
100 kilohms	10 μ A
1000 kilohms	1 μ A
10 megohms	0.1 μ A

4-19. AMMETER OPERATION.

4-20. In the ammeter mode of operation, a precision resistor is placed in parallel with the input, as shown in Figure 4-4. The 3444A measures the voltage across the precision resistor, this voltage being directly proportional to the current applied to the input. Voltage across the precision resistor is 0.1 V for full scale current input on all ranges, and amplifier gain is fixed at 98, producing a 3444A output voltage of ± 9.8 V. When used with the Model 3439A or 3440A Digital Voltmeter, polarity selection and readout are automatic.

4-21. Ammeter input resistance for each range is given in Table 4-2. These values include instrument wiring resistance which is approximately 0.3 ohms.

Table 4-2. Ammeter Input Resistance

RANGE	INPUT RESISTANCE
100 μ A	1000 ohms
1000 μ A	100 ohms
10 mA	10 ohms
100 mA	1.3 ohms
1000 mA	0.4 ohms

4-21. RANGE AND FUNCTION INFORMATION.

4-22. Range and function information to the front panel readout are controlled by the manual switches. Range is indicated by a decimal lamp. In the voltmeter mode of operation, the "MV" indicator is lit on the two lower ranges, and the "V" indicator on the three higher ranges. No function readout is present in ohmmeter and ammeter operation. The polarity indicator is also disabled in the ohmmeter mode.

4-23. Range and function information for use with a digital recorder are also provided when the 3444A is used with a 3440A Digital Voltmeter. In the standard instrument, this information is in the form of 4-line, 1-2-2-4 BCD code, "1" state positive. 1-2-4-8 BCD output is available on special order.

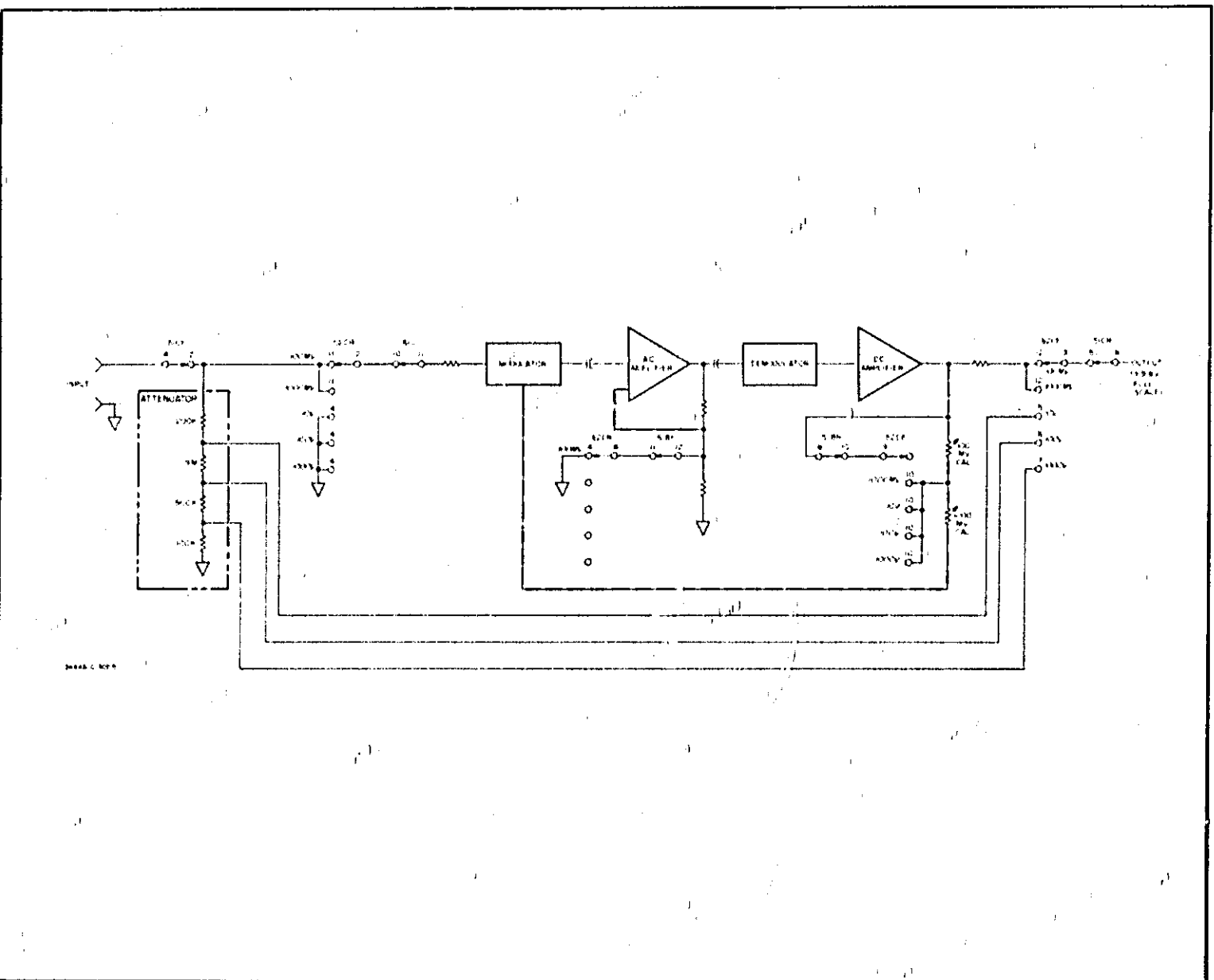


Figure 4-2. Simplified Voltmeter Diagram

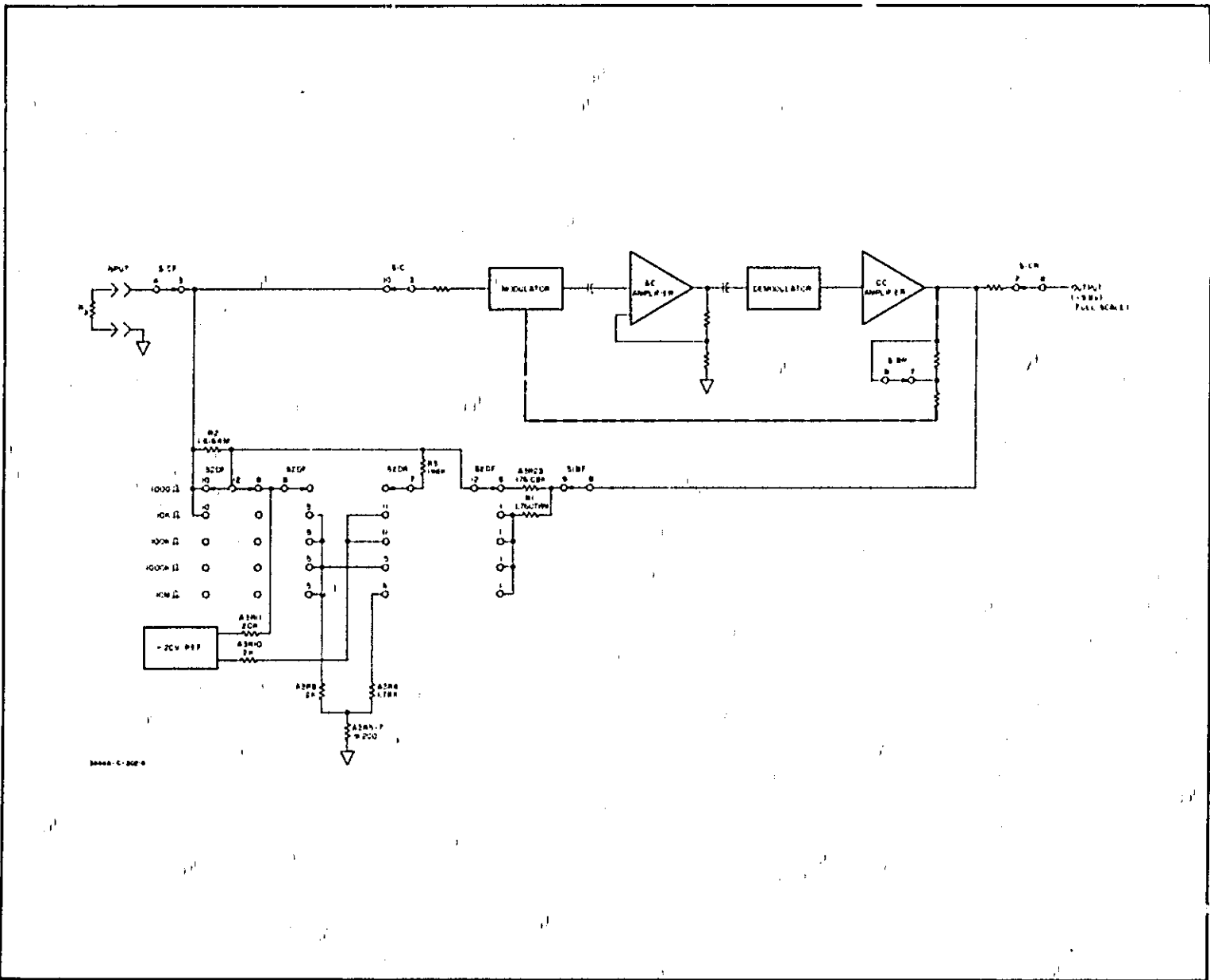


Figure 4-3. Simplified Ohmmeter Diagram

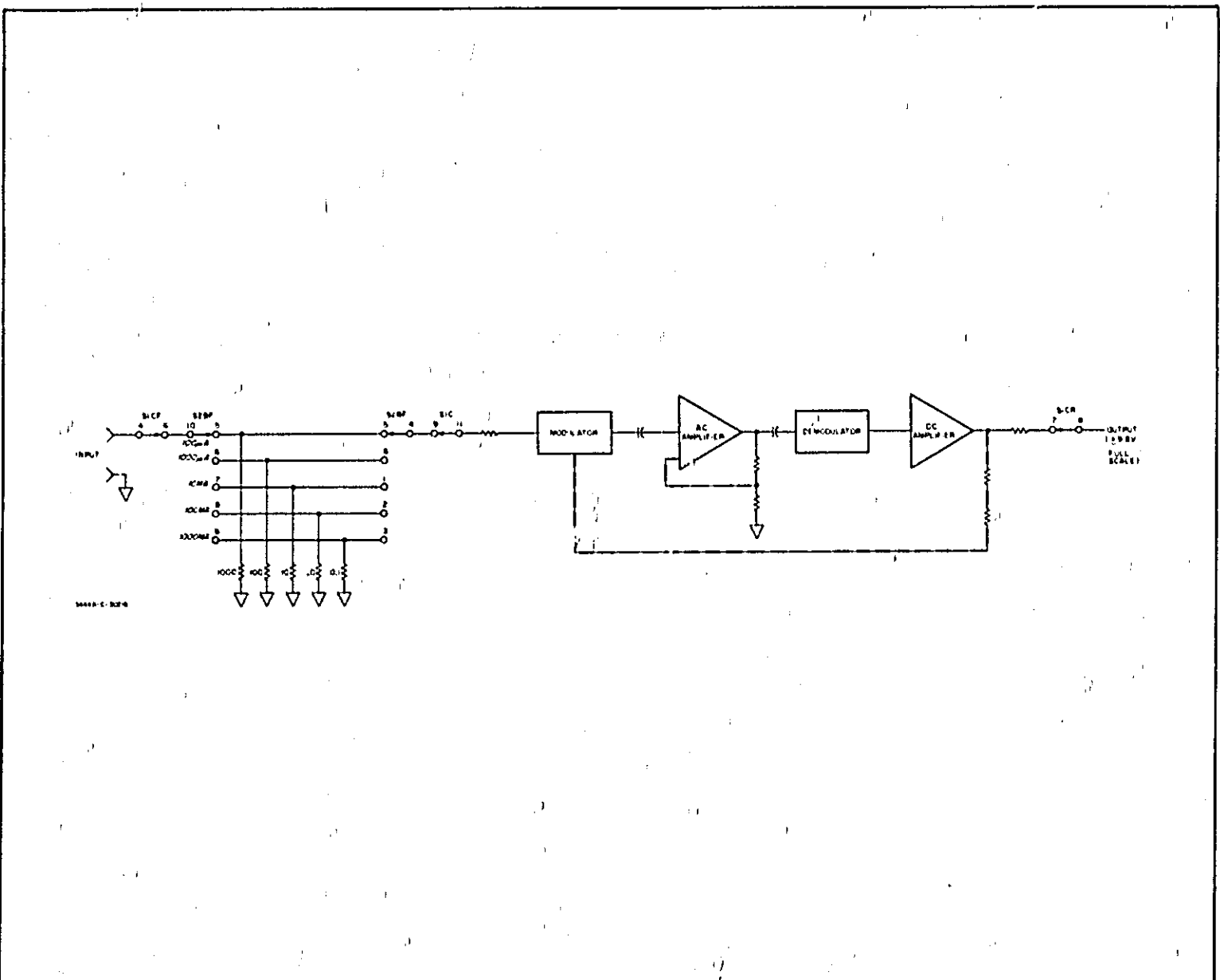


Figure 4-4. Simplified Ammeter Diagram

Table 5-1. Test Equipment Required

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED MODEL
DC Standard	Output: to 1000 V Accuracy: 0.01%	Performance Checks Calibration	-hp- Model 740B DC Standard/ Differential Volt- meter
DC Differential Voltmeter	Range: to 50 V		
Variable Transformer	Output: 103 to 127 Vac (207 to 253 Vac)	Performance Checks	Superior Electric Co. Powerstat 3PF116 (for 115 V line or 3PF216 (for 230 V line)
Resistors	Resistance: Accuracy: 0.1 ohms 0.02% 10 ohms 0.02% 100 ohms 0.02% 500 ohms 0.02% 10 kilohms 0.02% 1 megohm 0.02% 1 kilohm 0.02% 100 kilohms 0.02% 9 megohms 0.1% 10 ohms 10 W 1 megohm 1.0%	Performance Checks Calibration	Leeds and Northrup Model 4221-B -hp- Part No. 0811-0396 General Radio Co. Model RLC (order by value and tolerance) -hp- Part No. 0811-0402 -hp- Part No. 0811-0354 -hp- Part No. 0811-0205 -hp- Part No. 0816-0023 -hp- Part No. 0698-5475
DC Power Supply	Output: 50 V, 1 A	Performance Checks Calibration	-hp- Model 6294A DC Power Supply
Digital Recorder	1-2-2-4 Code to Standard Instrument	Performance Checks	-hp- Model 562A Digital Recorder
DC Voltmeter	Range: to 1000 V	Troubleshooting	-hp- Model 412A DC Vacuum Tube Voltmeter
DC Milliammeter	Range: 0.001 mA to 3.0 mA		
Electronic Counter	Frequency: 200 Hz Period: 1 sec	Calibration	-hp- Model 5221A Electronic Counter
Oscilloscope	Bandwidth: 450 kHz Sweep Time: 2 ms/cm	Troubleshooting	-hp- Model 120B Oscilloscope

SECTION V MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains information necessary to maintain the Model 3444A DC Multi-Function Unit. The following paragraphs describe the Performance Checks, Adjustment and Calibration Procedures, and Troubleshooting information.

5-3. REQUIRED TEST EQUIPMENT.

5-4. Recommended test equipment for maintaining and checking performance of the Model 3444A is listed in Table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

5-5. PERFORMANCE CHECKS.

5-6. Use the following procedures to verify proper operation of the Model 3444A when used with a Model 3439A or 3440A Digital Voltmeter. If the Model 3444A is to be used with a Model 3434A Comparator only, use the performance checks outlined in the 3434A Operating and Service Manual. A Performance Check Card is provided at the end of this section for recording the performance of the 3444A. This card can be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check. It should be determined that the Model 3439A or 3440A is operating within specifications before attempting the following performance checks of the 3444A. If the 3444A is found to be out of specifications at any point in this procedure, refer to Paragraph 5-12, Adjustment and Calibration Procedure.

5-7. VOLTMETER ACCURACY CHECK.

- a. Connect Model 3440A/3444A, dc standard, and variable transformer as shown in Figure 5-1.
- b. Set variable transformer to 115 V (or 230 V).
- c. Turn equipment on and allow to warmup for 30 minutes.
- d. Adjust SAMPLE RATE to maximum. Set FUNCTION to VOLTS, RANGE to 10 V. Short INPUT terminals.
- e. Adjust 3440A rear panel ZERO control for front panel indication of 0.000, with polarity indicator alternating between + and -.
- f. Depress INT CHECK 8000 pushbutton and adjust screwdriver adjustment for readout of 8000.
- g. Set RANGE to 100 mV. With INPUT shorted, adjust 3444A front panel ZERO for indication of 00.00, with polarity indicator alternating between + and -. Remove INPUT short.
- h. Set dc standard output to +90.00 mV. Indication should be +89.90 to +90.10 mV.
- i. Set dc standard output to positive and negative voltages shown in Table 5-2. Readout should be as indicated for each case.

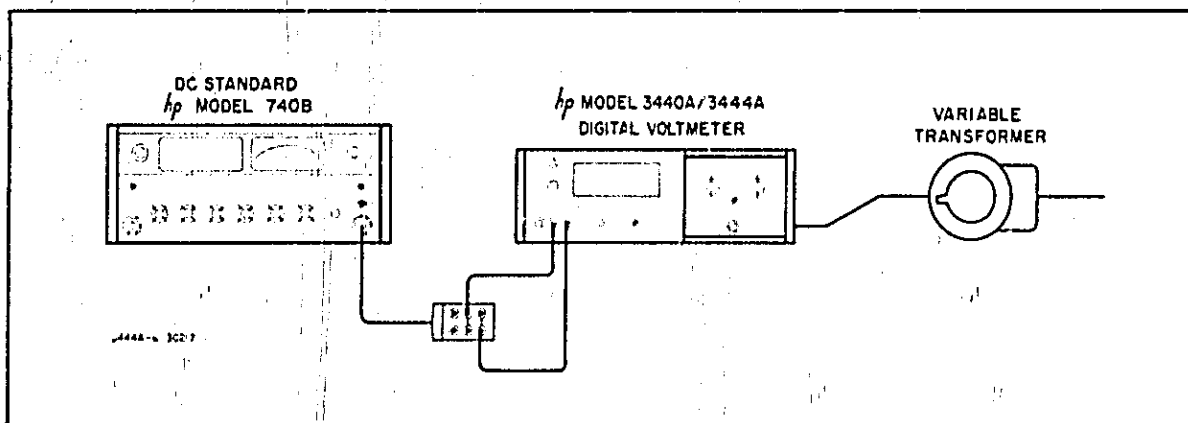


Figure 5-1. Voltmeter Accuracy Check

Table 5-2. Voltmeter Performance

3444A RANGE	DC STANDARD OUTPUT	READOUT
100 mV	±90.00 mV	±89.90 to 90.10 mV
100 mV	±50.00 mV	±49.94 to 50.06 mV
100 mV	±10.00 mV	±9.98 to 10.02 mV
1000 mV	±100.0 mV	±99.8 to 100.2 mV
1000 mV	±500.0 mV	±499.4 to 500.6 mV
1000 mV	±900.0 mV	±899.0 to 901.0 mV

- j. Repeat step i with variable transformer set to 103 V and 127 V (or 207 V and 253 V).

5-8. OHMMETER PERFORMANCE CHECK.

- a. The precision resistors listed in Table 5-3 are required for this check.
- b. Turn Model 3440/3444A on and allow 30 minutes warm-up time. Set SAMPLE RATE to maximum.
- c. Set FUNCTION to VOLTS, RANGE to 10 V. Short INPUT terminals and adjust 3440A rear panel ZERO control for indication of 0.000, with polarity indicator alternating between + and -.
- d. Depress INT CHECK pushbutton and adjust screwdriver control for indication of 8000.
- e. Set RANGE to 100 mV. With INPUT shorted, adjust 3444A front panel ZERO control for an indication of 00.00 with polarity indicator alternating between + and -.
- f. Set FUNCTION to OHMS, RANGE to 1000 ohms.

- g. Connect 100 ohm ±0.02% precision resistor to INPUT terminals. Readout should be 099.6 to 100.4.

NOTE

When making measurements on the 1000 Ohm range, input leads should be kept as short as possible.

- h. Using precision resistors listed in Table 5-3, make ohmmeter accuracy checks as shown.

Table 5-3. Ohmmeter Checks

RANGE	PRECISION RESISTANCE	READOUT
1000 ohms	100 ohms ± 0.02%	099.6 to 100.4
1000 ohms	500 ohms ± 0.02%	498.4 to 501.6
1000 ohms	1000 ohms ± 0.02%	996.9 to 003.1*
10 kilohms	10 kilohms ± 0.02%	9.969 to 0.031*
100 kilohms	100 kilohms ± 0.02%	99.69 to 00.31*
1000 kilohms	1 megohm ± 0.02%	996.9 to 003.1*
10 megohms	9 megohms ± 0.1%	8.900 to 9.100

* OVERRANGE indicator on.

5-9. AMMETER PERFORMANCE CHECKS.

- a. Connect equipment as shown in Figure 5-2.
- b. Turn equipment on and allow 30 minutes warm-up time.
- c. Set FUNCTION to VOLTS, RANGE to 10 V. Short INPUT terminals.

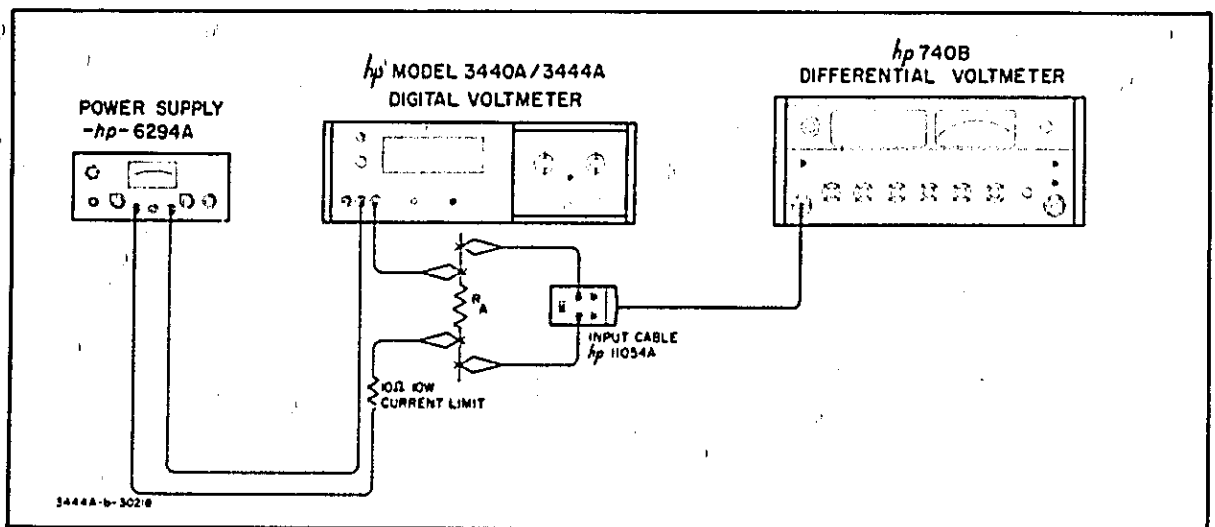


Figure 5-2. Ammeter Accuracy Check

Table 5-4. Ammeter Checks

RANGE	R _A VALUE	DIFFERENTIAL VM READING	READOUT
100 μA	10 K ±0.02%	1.000 V	99.79 to 00.21*
1000 μA	10 K ±0.02%	10.00 V	997.9 to 002.1*
10 mA	10 K ±0.02%	50.00 V	4.989 to 5.101
100 mA	10 Ω ±0.02%	1.000 V	99.79 to 00.21*
1000 mA	0.1 Ω ±0.02%	0.100 V	997.9 to 002.1*

* OVERRANGE indicator on

- d. Adjust 3440A rear panel ZERO control for indication of 0.000, with polarity indicator alternating between + and -.
- e. Depress INT CHECK pushbutton and adjust screwdriver control for indication of 8000.
- f. Set FUNCTION to AMPS, RANGE to 100 μA. With INPUT shorted, adjust 3444A front panel ZERO for indication of 00.00, with polarity indicator alternating between + and -.
- g. Connect a 10 kilohms ±0.002% resistor in the R_A position shown in Figure 5-2. Adjust dc power supply output to obtain a 1.000 V reading on the differential voltmeter. 3440A indication should be 99.79 to 00.21.
- h. Using settings shown and values for R_A indicated in Table 5-4, make ammeter checks shown.

NOTE

On high current ranges, allow time for differential voltmeter reading to become stable. This is necessary due to heating of the current limiting resistor. Also keep contact resistance as low as possible.

5-10. VOLTMETER INPUT RESISTANCE CHECK.

- a. Connect equipment as shown in Figure 5-3.
- b. Set FUNCTION to VOLTS, RANGE to 10 V.
- c. Set dc standard output to 10.00 V.
- d. Front panel display should be between 9.090 V and 9.122 V. This corresponds to an input resistance of 10.0 to 10.4 megohms where:

$$R_{input} = \frac{E_{displayed}}{E_{input} \cdot E_{displayed}} \times R_{series}$$

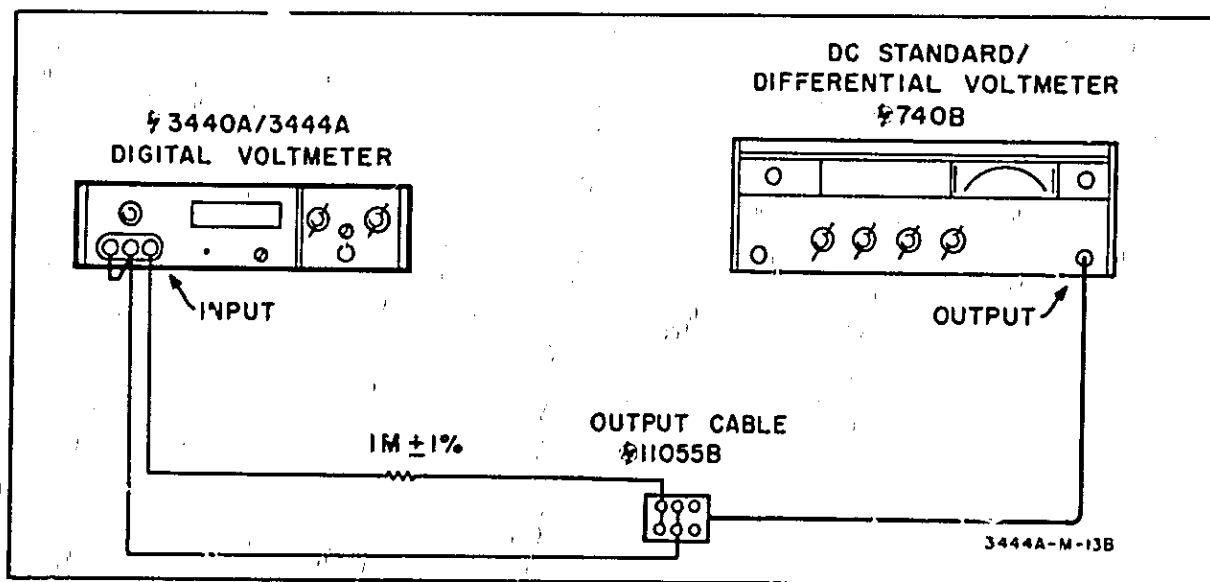


Figure 5-3. Input Resistance Check

5-11. DIGITAL RECORDER OUTPUT CHECK.

NOTE

This procedure is written for a Model 3440A/3444A and digital recorder using 1-2-2-4 BCD code.

- a. Connect equipment as shown in Figure 5-4.
- b. Set FUNCTION to VOLTS, SAMPLE RATE to maximum.
- c. Set RANGE as indicated in Table 5-5, and adjust dc standard output to obtain 3440A readout indicated in each case. Check recorder for correct printout.

Table 5-5. Voltmeter Printout Check

RANGE	3440A PRINTOUT	PRINTOUT
1000 mV	-200.0 mV	120004
100 mV	-02.00 mV* (-102 mV)	902005
100 mV	-20.00 mV	120005
1000 mV	+200.0 mV	020004
100 mV	+20.00 mV	020005

* OVERRANGE Indicator on

NOTE

Printer columns are numbered from right to left. Column 1 (right column) indicates range. Table 5-6 indicates correct printout in column 1 for each function and range. Columns 2 through 5 print the numerical readout of the 3440A. Column 6 (left column) prints function and polarity information. Correct printout for each function is indicated in Table 5-7.

Table 5-6. Column 1 Printout

FUNCTION	RANGE	COLUMN 1 PRINTOUT
Volts	100 mV	5
	1000 mV	4
	10 V	3
	100 V	2
	1000 V	1
Ohms	1000 ohms	4
	10 kilohms	3
	100 kilohms	2
	1000 kilohms	1
	10 megohms	0
Amps	100 μ A	5
	1000 μ A	4
	10 mA	3
	100 mA	2
	1000 mA	1

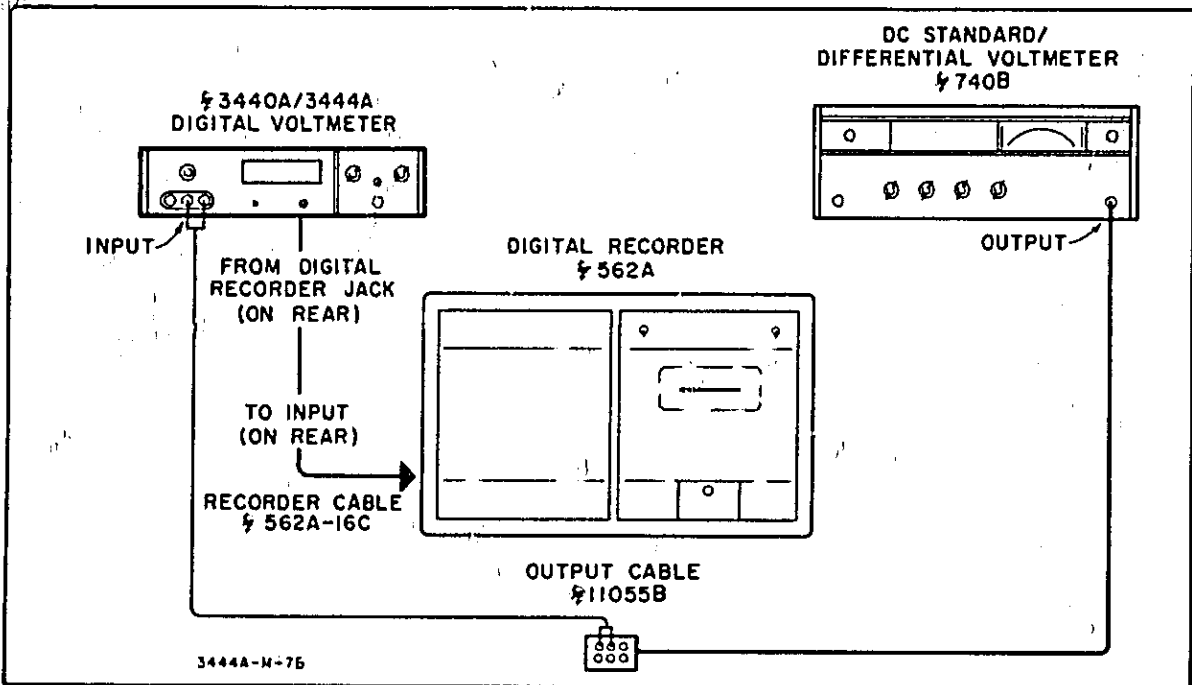


Figure 5-4. Digital Recorder Output Check

Table 5-7. Column 6 Printout

FUNCTION AND POLARITY	COLUMN 6 PRINTOUT
+ dc Volts	0
- dc Volts	1
+ dc Amps	2
- dc Amps	3
ohms	5
overrange (any function)	9

- d. Disconnect dc standard. Using precision resistors and range settings shown in Table 5-3, compare printout of columns 1 and 6 with Tables 5-6 and 5-7. Columns 2 through 5 should be the same as the 3440A readout in each case.
- e. Using equipment and test set-up shown in Figure 5-2 in addition to printer, perform checks given in Table 5-4 and compare printout with Tables 5-6 and 5-7. Again, columns 2 through 5 should match 3440A readout.

5-12. ADJUSTMENT AND CALIBRATION PROCEDURES.

5-13. The following procedures should be performed only after it has been definitely determined by the Performance Checks given in Paragraph 5-5 through 5-11 that the Model 3444A is out of specifications. Figure 5-5 shows the location of adjustments and test points. If calibration cannot be accomplished in accordance with this procedure, refer to the Troubleshooting information in Paragraph 5-18.

5-14. CHOPPER FREQUENCY.

- a. Connect an electronic counter to A2TP1 and set FUNCTION SELECTOR to FREQUENCY, GATE TIME to 1 SEC.

NOTE

Access to adjustments and test points is gained by removing the 3440A top cover.

- b. Set 3444A FUNCTION to VOLTS, RANGE to 100 mV.
- c. Connect a dc standard to INPUT and set to 1 V. This will heavily overdrive the amplifier.
- d. Adjust A4A1R3 for an electronic counter indication of 200 ± 1 Hz. A4A1R3 is accessible through a hole in the photochopper cover.

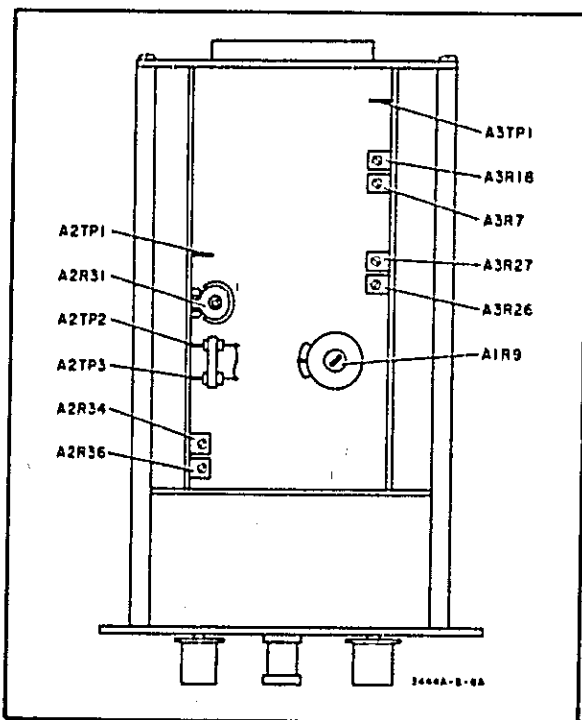


Figure 5-5. Location of Adjustments

5-15. VOLTMETER CALIBRATION.

NOTE

The calibration procedure for the 10, 100, and 1000 V ranges is given in Section V of the 3439A or 3440A Operating and Service Manual. Before calibrating the 3444A, check calibration of the 10 V range. The following procedure is written for calibration of the 3444A within the 3439A or 3440A Digital Voltmeter. If the 3444A is to be used only with the 3434A Comparator, perform the calibration procedure given in Section V of the 3434A Operating and Service Manual.

- a. Set FUNCTION to VOLTS, RANGE to 10 V. Short INPUT terminals.
- b. Adjust 3440A rear panel ZERO control for indication of 0.000, with polarity indicator alternating between + and -.
- c. Depress INT CHECK pushbutton and adjust screwdriver control for readout of 8000.
- d. Set RANGE to 100 mV and adjust 3444A front panel ZERO control for indication of 00.00, with polarity indicator alternating between + and -.

- e. Set RANGE to 1000 mV. Adjust A2R31 (see Figure 5-5) for a zero readout and flashing polarity indication. Remove INPUT short.
- f. Connect dc standard to INPUT and adjust output to +800.0 mV. Adjust A2R36 for a readout of +800.0 mV.
- g. Set dc standard output to -800.0 mV. Readout should be -800.0 mV. If necessary, readjust A2R36 to split difference between positive and negative readings. Both readings must be between 799.1 and 800.9.
- h. Set dc standard output to +80.00 mV.
- i. Set 3444A RANGE to 100 mV and adjust A2R34 for a readout of +80.00 mV.
- j. Set dc standard output to -80.00 mV. Readout should be -80.00 mV. If necessary, readjust A2R34 to split difference between positive and negative readings. Both readings must be between 79.91 and 80.09.

————— NOTE —————

If adjustments are made in the voltmeter calibration, the ohmmeter and ammeter calibration procedures should be performed.

5-16. OHMMETER CALIBRATION.

- a. Set FUNCTION to VOLTS, RANGE to 10 V. Short INPUT.
- b. Adjust 3440A rear panel ZERO control for indication of 0.000, with polarity indicator alternating between + and -.
- c. Depress INT CHECK pushbutton and adjust screwdriver control for reading of 8000.
- d. Set RANGE to 100 mV and adjust 3444A front panel ZERO control for indication of 00.00, with polarity indicator alternating between + and -. Remove INPUT short.
- e. Set FUNCTION to OHMS, RANGE to 10 kilohms.
- f. Connect a 10 kilohms $\pm 0.02\%$ resistor to INPUT, and adjust A3R18 for an indication of 0.000 with the OVERRANGE indicator on.

————— NOTE —————

If range of A3R18 is not sufficient to adjust to correct readout, measure voltage at A3TPI. Voltage should be approximately -20 V. Voltage may be adjusted by adding or removing jumpers across A3R12, A3R13, or A3R14 (at top edge of A3) until range of A3R18 is such that voltage can be adjusted above and below -20 V. If jumpers are added or removed, repeat steps e and f.

- g. Set RANGE to 10 Megohms.
- h. Connect a 9 megohm $\pm 0.2\%$ resistor to INPUT. Adjust A3R7 for an indication of 9.000.

5-17. AMMETER CALIBRATION.

- a. Connect equipment as shown in Figure 5-2.
- b. Set FUNCTION to VOLTS, RANGE to 10 V. Short INPUT terminals.
- c. Adjust 3440A rear panel ZERO control for indication of 0.000, with polarity indicator alternating between + and -.
- d. Depress INT CHECK pushbutton and adjust screwdriver control for reading of 8000.
- e. Set FUNCTION to AMPS, RANGE to 100 mA. Adjust 3444A front panel ZERO for indication of 00.00, with polarity indicator alternating between + and -. Remove INPUT short.
- f. Connect a 10 ohm $\pm 0.02\%$ resistor in the R_A position in test set-up.
- g. Adjust dc power supply output to obtain a reading of 1.000 V on the differential voltmeter.
- h. Adjust A3R26 for a 3440A readout of 00.00 with OVERRANGE indicator on.
- i. Replace 10 ohm resistor (in R_A position) with a 0.1 ohm $\pm 0.02\%$ resistor.
- j. Set RANGE to 1000 mA. Adjust dc power supply output to obtain a reading of 0.100 V on the differential voltmeter.
- k. Adjust A3R27 for a 3440A readout of 000.0, with OVERRANGE indicator on.

5-18. TROUBLESHOOTING.

5-19. The following troubleshooting procedures should be used only after it has been determined that the difficulty cannot be corrected by the Adjustment and Calibration procedure. Make certain that the trouble is not caused by conditions external to the 3444A. Check for burned or loose components, loose connection, broken wires, or any similar condition which might suggest the source of trouble. Make certain that the printed circuit board connections are clean and tight. Check to see that the 3444A rear connector mates properly with the jack in the main instrument. Dirt or contamination on this connector may cause errors or noise, particularly on the lower ranges. Type TF Freon (hp- Part No. 8500 J232) is recommended for cleaning this connector.

5-20. Range and function on which trouble occurs may indicate the source of the trouble. The amplifier is used on all ammeter and ohmmeter ranges, and on the 100 mV and 1000 mV ranges. If error appears in only one function or range, trouble may be in the switches.

5-21. AMPLIFIER CHECKS.

5-22. If operation on 10 V, 100 V, and 1000 V ranges is correct, but is not correct on other ranges and functions, perform the following checks of the amplifier.

- a. Measure dc voltages at transistors A2Q1-4 as indicated on the schematic diagram, Figure 7-2. Allow $\pm 10\%$.
- b. Remove the shorting plug connecting A2TP2 and A2TP3, and check waveforms under conditions indicated in Figures 5-6 and 5-7.

5-23. AMPLIFIER LOOP GAIN CHECK.

- a. Set FUNCTION to VOLTS, RANGE to 10 V. Short INPUT.
- b. Adjust 3440A rear panel ZERO control for indication of 0.000, with polarity indication alternating between + and -.
- c. Set RANGE to 100 mV and adjust 3444A front panel ZERO for indication of 00.00, with alternating polarity indication.
- d. Set RANGE to 1000 mV. Indication should be 000.0. If not, adjust A2R31.
- e. Remove shorting plug connecting A2TP2 and A2TP3. Connect a 5 V dc source between the two test points (polarity is immaterial), and note front

panel readout. Remove the 5 V source. Readout should change by 1 or 2 counts.

- f. Compute loop gain; using the following formula:

$$\text{Loop gain} = \frac{5000}{\text{number of counts change}}$$

Loop gain must be at least 2000. If not, A2Q2, A2Q3, or A2Q4 may be at fault. If excessive noise is also present on the 100 mV range, A2Q1 or the photochopper assembly may be defective.

5-24. 100 mV RANGE NOISE CHECK.

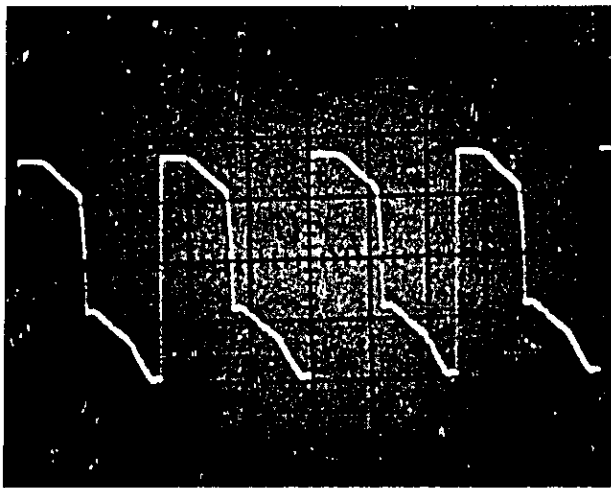
- a. Set FUNCTION to VOLTS, RANGE to 100 mV. Short INPUT.
- b. Observe readout for period of 15 seconds. Right hand (least significant) digit should not change more than ± 2 counts. If excessive noise is present, check A2Q1, A2Q5, A2Q6, or photochopper assembly.

5-25. OHMMETER CURRENT CHECK.

- a. Set FUNCTION to OHMS, RANGE to 1000 ohms.
- b. Connect a dc milliammeter (hp- Model 412A) to INPUT terminals. Current should be 0.9 to 1.1 mA.
- c. Set dc milliammeter and 3444A RANGE as indicated in Table 5-8. Current measurement should be within limits given in each case. If incorrect current reading is obtained on all ranges, check ohmmeter reference supply (A3Q1-3 and associated components). If reading is incorrect on only one range, check switch contacts and resistors associated with that range. See Figure 4-3 or Figure 7-3.

Table 5-8. Ohmmeter Current Check

AMMETER RANGE	3444A RANGE	CURRENT READING
3 mA	1000 ohms	0.9 to 1.1 mA
0.3 mA	10 kilohms	0.09 to 0.11 mA
0.03 mA	100 kilohms	0.009 to 0.011 mA
0.003 mA	1000 kilohms	0.9 to 1.1 μ A
0.001 mA	10 megohms	0.09 to 0.11 μ A



a. Location = A2TP1

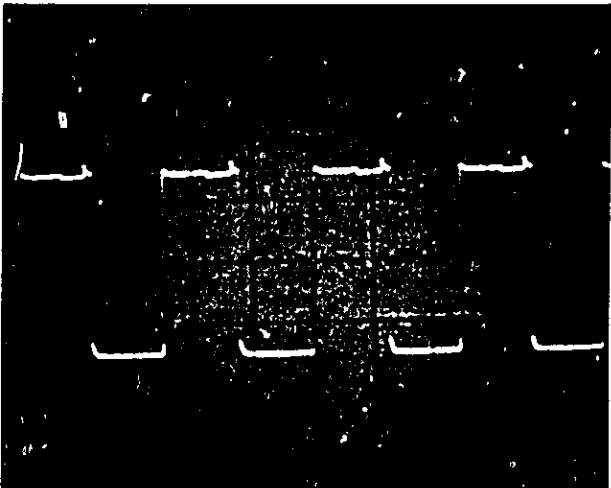
3444A RANGE = 1000 mV

Shorting plug removed from A2TP2 and
A2TP3

Input Voltage = +850 mV

Vertical Sensitivity = 20 volts/cm

Sweep = 2 ms/cm



b. Location = collector of A2Q3

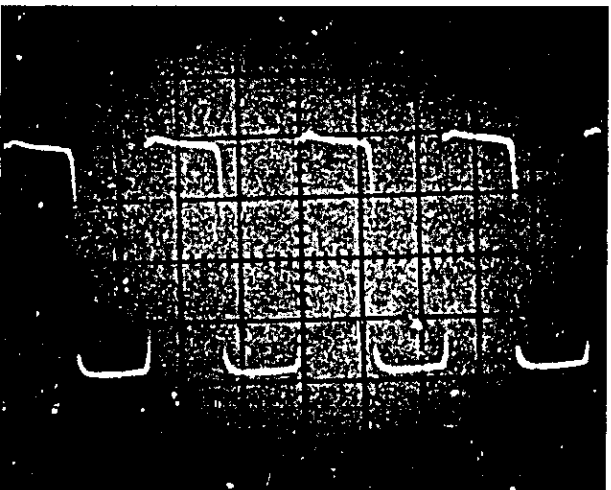
3444A RANGE = 1000 mV

Shorting plu. removed from A2TP2 and
A2TP3

Input Voltage = +850 mV

Vertical Sensitivity = 1.0 volts/cm

Sweep = 2 ms/cm



c. Location = collector of A2Q2

3444A RANGE = 1000 mV

Shorting plug removed from A2TP2 and
A2TP3

Input Voltage = +850 mV

Vertical Sensitivity = 0.2 volt/cm

Sweep = 2 ms/cm

Figure 5- Typical Amplifier Waveforms

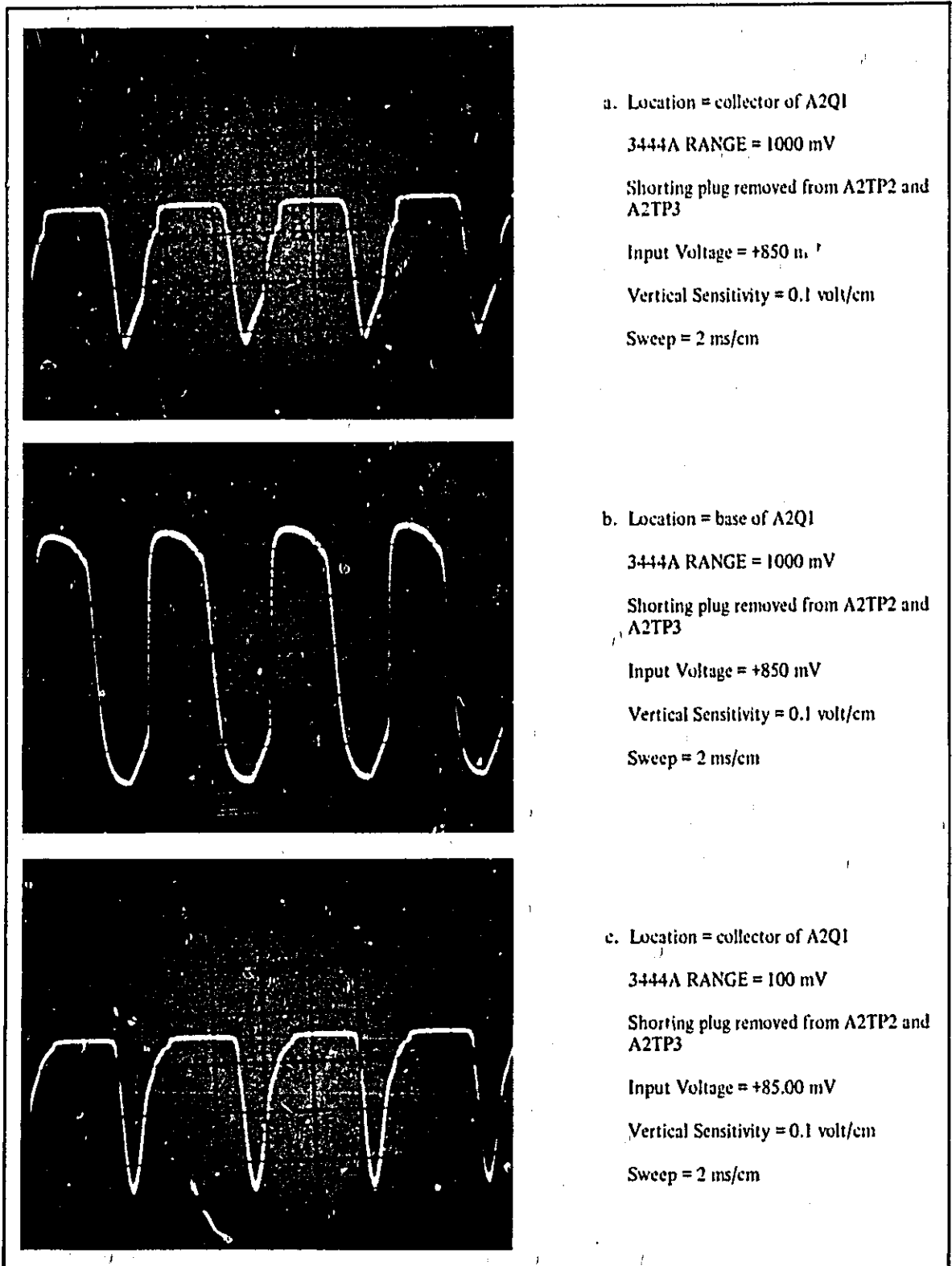


Figure 5-7. Typical Amplifier Waveforms

PERFORMANCE CHECK CARD

Hewlett-Packard Model 3444A
DC Multi-Function Unit

Tests performed by _____
Date _____

Serial No. _____

Paragraph	Description	Reading	Test Limits	
5-7	Voltmeter Accuracy Check			
	Range	Input		
	100 mV	+ 90.00 mV	_____	+89.90 to 90.10 mV
	100 mV	- 90.00 mV	_____	89.90 to 90.10 mV
	100 mV	+ 50.00 mV	_____	+49.94 to 50.06 mV
	100 mV	- 50.00 mV	_____	-49.94 to 50.06 mV
	100 mV	+ 10.00 mV	_____	+09.98 to 10.02 mV
	100 mV	- 10.00 mV	_____	-09.98 to 10.02 mV
	1000 mV	+ 100.0 mV	_____	+099.8 to 100.2 mV
	1000 mV	- 100.0 mV	_____	-099.8 to 100.2 mV
	1000 mV	+ 500.0 mV	_____	+499.4 to 500.6 mV
	1000 mV	- 500.0 mV	_____	-499.4 to 500.6 mV
	1000 mV	+ 900.0 mV	_____	+899.0 to 901.0 mV
1000 mV	- 900.0 mV	_____	-899.0 to 901.0 mV	
5-8	Ohmmeter Performance Checks			
	Range	Input		
	1000 ohms	100 ohms	_____	999.6 to 1000.4
	1000 ohms	500 ohms	_____	498.4 to 501.6
	1000 ohms	1000 ohms	_____	996.9 to 1003.1
	10 kilohms	10 kilohms	_____	9.969 to 10.031
	100 kilohms	100 kilohms	_____	99.69 to 100.31
	1000 kilohms	1 megohm	_____	996.9 to 1003.1
	10 megohms	9 megohms	_____	8.900 to 9.100
5-9	Ammeter Checks			
	Range	VM Reading		
	100 μ A	1.000 V	_____	99.79 to 100.21
	1000 μ A	10.00 V	_____	997.9 to 1002.1
	10 mA	50.00 V	_____	4.989 to 5.101
	100 mA	1.000 V	_____	99.79 to 100.21
	1000 mA	0.100 V	_____	997.9 to 1002.1
5-10	Input Resistance Check	_____	9.090 V to 9.122 V	
5-11	Digital Recorder Output Check	_____		

SECTION VI REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphabetic order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the following:

- a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.
- b. Description of the part. (See list of abbreviations below.)
- c. Typical manufacturer of the part in a five digit code. (See Appendix A for list of manufacturers.)
- d. Manufacturer's part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

6-6. NON-LISTED PARTS.

6-7. 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.

DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part	TC	= thermocouple
B	= motor	FL	= filter	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
BT	= battery	HR	= heater	Q	= transistor	W	= cable
C	= capacitor	IC	= integrated circuit	QCR	= transistor-diode	X	= socket
CR	= diode	J	= jack	R	= resistor	XDS	= lampholder
DL	= delay line	K	= relay	RT	= thermistor	XF	= fuseholder
DS	= lamp	L	= inductor	S	= switch	Z	= network
E	= misc electronic part	M	= meter	T	= transformer		

ABBREVIATIONS

Ag	= silver	ID	= inside diameter	ns	= nanosecond (s) = 10 ⁻⁹ seconds	sl	= slide
Al	= aluminum	Impg	= impregnated	nsr	= not separately replaceable	SPDT	= single-pole double-throw
A	= amperes (s)	incd	= incandescent			SPST	= single-pole single-throw
Au	= gold	ins	= insulation (ed)	Ω	= ohm (s)	Ta	= tantalum
C	= capacitor	kΩ	= kilohm (s) = 10 ³ ohms	obd	= order by description	TC	= temperature coefficient
cer	= ceramic	MHz	= megahertz = 10 ⁶ hertz	OD	= outside diameter	TiO ₂	= titanium dioxide
ct	= common	L	= inductor	p	= peak	tg	= toggle
comp	= composition	lin	= linear taper	pc	= printed circuit	tol	= tolerance
conv	= conversion	log	= logarithmic taper	pF	= picofarad (s) = 10 ⁻¹² farads	trim	= trimmer
dep	= deposited	m	= milli = 10 ⁻³	piv	= peak inverse voltage	TSTR	= transistor
DPI	= double-pole double-throw	mA	= milliamperes (s) = 10 ⁻³ amperes	p/o	= part of	V	= volt (s)
DPS	= double-pole single-throw	MHz	= megahertz = 10 ⁶ hertz	pos	= position (s)	v.a.w	= alternating current working voltage
elec	= electrolytic	MΩ	= megohm (s) = 10 ⁶ ohms	pot	= potentiometer	var	= variable
enclap	= end insulated	met film	= metal film	p-p	= peak-to-peak	vdcw	= direct current working voltage
F	= farad (s)	mfr	= manufacturer	ppm	= parts per million	W	= watt (s)
FET	= field effect transistor	mtg	= mounting	prec	= precision (temperature coefficient, long term stability, and/or tolerance)	w/	= with
fix	= fixed	mV	= millivolt (s) = 10 ⁻³ volts	R	= resistor	wiv	= working inverse voltage
GaAs	= gallium arsenide	μ	= micro = 10 ⁻⁶	Rh	= rhodium	w/o	= without
GHz	= gigahertz = 10 ⁹ hertz	μV	= microvolt (s) = 10 ⁻⁶ volts	rms	= root-mean-square	ww	= wirewound
gd	= guard (ed)	my	= Mylar	rot	= rotary	*	= optimum value selected at factory, average value shown (part may be omitted)
Ge	= germanium	nA	= nanoampere (s) = 10 ⁻⁹ amperes	Se	= selenium	**	= no standard type number assigned (selected or special type)
grd	= ground (ed)	NC	= normally closed	sect	= section (s)		
H	= henry (ies)	Ne	= neon	Si	= silicon		
Hg	= mercury	NO	= normally open				
Hz	= hertz (cycle (s) per second)	NPO	= negative positive zero (zero temperature coefficient)				

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Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	03444 66501		Assembly: Master Board	hp-	
C1	0160 0871	1	C: fxd my die 2.0 microfarads 20% 30 vdcw	66289	146P obd
C2, C3	0180 0089	2	C: fxd elect 10 microfarads -10% +100% 150 vdcw	56289	300106G150DF4
C4			Not assigned		
C5	0160 0168	2	C: fxd 0.1 microfarad 10%	56289	192P10492
CR1, CR2 CR3 thru CR6	1901 0026	8	Not assigned Diode: Si 30 mA at +1 V 100 piv 12 pF	93332	D3072
R1	0761 0104	1	R: fxd met film 680 kilohms 5% 1/4 W	hp-	
R2 thru R4			Not assigned		
R5	0683 8255	1	R: fxd comp 8.2 megohms 5% 1/4 W	01121	CB8255
R6	0683 1015	2	R: fxd comp 100 ohms 5% 1/4 W	01121	CB1015
R7	0811 0911	1	R: fxd prec ww 10.114 kilohms 0.1% 0.1 W	hp-	
R8	0683 2025	1	R: fxd comp 2000 ohms 5% 1/4 W	01121	CB2025
R9			Not assigned		
R10	0761 0078	1	R: fxd met film 12 kilohms 5% 1/4 W	hp-	
R11	0686 1826	1	R: fxd comp 1800 ohms 5% 1/4 W	01121	EB1826
R12	0683 8245	1	R: fxd comp 820 kilohms 5% 1/4 W	01121	CB8245
R13	0683 1045	6	R: fxd comp 100 kilohms 5% 1/4 W	01121	CB1045
R14, R15			Not assigned		
R16	0811 0394	1	R: fxd prec ww 0.10051 ohms 0.1% 0.1 W	hp-	
R17			Not assigned		
R18	0811 1117	1	R: fxd prec ww 1.0143 ohms 2% 0.1 W	hp-	
R19			Not assigned		
R20 thru R24	0683 2236	5	R: fxd comp 22 kilohms 5% 1/4 W	01121	CB2236
R25 thru R30	0683 4735	6	R: fxd comp 47 kilohms 5% 1/4 W	01121	CB4735
R31	0683 1045		R: fxd comp 100 kilohms 5% 1/4 W	01121	CB1045
R32			Not assigned		
R33	0684 6631	3	R: fxd comp 68 kilohms 10% 1/4 W	01121	CB6831
R34 thru R36			Not assigned		
R37	0683 1265	1	R: fxd comp 12 megohms 5% 1/4 W	01121	CB1265
A2	03444 66502		Assembly: Amplifier	hp-	
C1	0140 0200	1	C: fxd dipped mica 390 pF 5%	06853	ADM15F391J3C
C2	0180 0059	1	C: fxd elect 10 microfarads -10% +100% 25 vdcw	56289	300106G025BB4
C3	0180 0076	1	C: fxd elect 20 microfarads 25 vdcw	56289	400181A2
C4	0160 0168	1	C: fxd 0.1 microfarad 10%	56289	192P10492
C5	0160 0154	1	C: fxd 2200 pF 10%	56289	192P22292
C6	0180 0061	1	C: fxd elect 100 microfarads +100% -10% 15 vdcw	56289	300107G0150D4
C7	0170 0038	2	C: fxd my 0.22 microfarads 10% 200 vdcw	56289	148P22492
C8	0160 0015	1	C: fxd TiO ₂ die 2.2 pF 10% 500 vdcw	82142	Type JM obd
C9	0180 0294	1	C: fxd Ta elect 390 microfarads 20% 10 vdcw	06751	TSW3-10 397
C10	0140 0198	1	C: fxd 200 pF 5% Added beginning with serial prefix 644.	04062	ADM15F201J3C
CR1, CR2	1901 0025		Diode: Si 30 mA at +1 V 100 piv 12 pF	93332	Q3072
CR3	1902 0157	1	Diode: breakdown 82 V 5% 1 W	04713	IN3042B
CR4, CR5	1901 0025		Diode: Si 30 mA at +1 V 100 piv 12 pF	93332	Q3072
CR6	1902 0049	1	Diode: breakdown 6.5 V 5%	04713	SZ10939-122
CR7	1902 0182	1	Diode: breakdown 20 V 5%	04713	SZ10939-272
Q1	1854 0023	1	TSTR: Si NPN	00872	A-1081
Q2	1854 0087	1	TSTR: Si NPN 2N3417	24446	2N3417
Q3	1854 0029	4	TSTR: Si NPN EIA type 2N2712	24446	2N2712
Q4	1850 0128	1	TSTR: Ge PNP EIA type 2N3988	01295	2N3988
	1205 0002	1	Heat sink: transistor	07387	3AL 635-2R
Q5, Q6	1854 0033	1	TSTR: Si NPN EIA type 2N3391	03508	2N3391
Q7	1853 0001	2	TSTR: Si PNP	03877	ST 8047
R1	0683 2055	1	R: fxd comp 2 megohms 5% 1/4 W	01121	CB2055
R2	0683 6845	3	R: fxd comp 680 kilohms 5% 1/4 W	01121	CB6845
R3	0683 1035	5	R: fxd comp 10 kilohms 5% 1/4 W	01121	CB1035
R4	0683 1025	2	R: fxd comp 1000 ohms 5% 1/4 W	01121	CB1025
R5	0683 1045		R: fxd comp 100 kilohms 5% 1/4 W	01121	CB1045
R6	0683 2455	1	R: fxd comp 2.4 megohms 5% 1/4 W	01121	CB2455
R7	0683 1065		R: fxd comp 10 megohms 5% 1/4 W	01121	CB1065
R8	0683 6845		R: fxd comp 680 kilohms 5% 1/4 W	01121	CB6845
R9	0683 1025		R: fxd comp 1000 ohms 5% 1/4 W	01121	CB1025
R10	0683 6835	1	R: fxd comp 68 kilohms 5% 1/4 W	01121	CB6835

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A2 (Cont'd)						
R11	0683-1535	1	R: fxd comp 15 kilohms 5% 1/4 W	01121	CB1535	
R12	0683-1035	1	R: fxd comp 10 kilohms 5% 1/4 W	01121	CB1035	
R13	0683-4745	1	R: fxd comp 470 kilohms 5% 1/4 W	01121	CB4745	
R14	0683-6845	1	R: fxd comp 680 kilohms 5% 1/4 W	01121	CB6845	
R15	0683-3325	1	R: fxd comp 3300 ohms 5% 1/4 W	01121	CB3325	
R16	0683-2225	1	R: fxd comp 2200 ohms 5% 1/4 W	01121	CB2225	
R17	0683-1235	1	R: fxd comp 12 kilohms 5% 1/4 W	01121	CB1235	
R18	0758-0047	1	R: fxd met ox flm 7.5 kilohms 5% 1/2 W	07115	C20	abd
R19	0683-2035	1	R: fxd comp 200 kilohms 5% 1/4 W	01121	CB2035	
R20	0683-1015	1	R: fxd comp 100 ohms 5% 1/4 W	01121	CB1015	
R21, R22	0683-4705	2	R: fxd comp 47 ohms 5% 1/4 W	01121	CB4705	
R23	0683-5625	1	R: fxd comp 5600 ohms 5% 1/4 W	01121	CB5625	
R24	0683-5645	1	R: fxd comp 560 kilohms 5% 1/4 W	01121	CB5645	
R25	0683-3045	1	R: fxd comp 300 kilohms 5% 1/4 W	01121	CB3045	
R26	0683-1045	1	R: fxd comp 100 kilohms 5% 1/4 W	01121	CB1045	
R27	0698-0050	1	R: fxd comp 3.6 megohms 5% 1/4 W	01121	CB3655	
R28	0683-1035	1	R: fxd comp 10 kilohms 5% 1/4 W	01121	CB1035	
R29	0683-1045	1	R: fxd comp 100 kilohms 5% 1/4 W	01121	CB1045	
R30	0683-1845	1	R: fxd comp 180 kilohms 5% 1/4 W	01121	CB1845	
R31	2100-0962	1	R: var comp lin 3 kilohms 30% 1/4 W	75055	MTC-1	abd
R32	0683-3025	2	R: fxd comp 3000 ohms 5% 1/4 W	01121	CB3025	
R33	0811-0140	1	R: fxd ww 695 kilohms 0.2% 0.25 W	05347	510A	abd
R34	2100-0888	2	R: var prec ww 10 kilohms 10% 0.5 W	80294	236P-1-103	
R35	0811-0370	1	R: fxd ww 89.5 kilohms 0.1% 0.1 W	hp-		
R36	2100-0889	1	R: var prec ww 1000 ohms 10% 0.5 W	80294	236P-1-102	
TP1	0360-0124	2	Terminal: pin for 3/32" printed circuit board	71279	2970-3	
TP2, TP3	0360-0435	2	Terminal: board pin silver plated brass	hp-		
A3						
	03444-66503		Assembly: Function	hp-		
C1	0160-0161	1	C: fxd 0.01 microferads Deleted beginning with serial prefix 536.	04062	abd	
C2	0160-0179	1	C: fxd 33 pF 5% 300 vdcw Added beginning with serial prefix 536.	04062	ADM15E330J3S	
CR1	1902-0071	1	Diode: Si breakdown 9 V 5%	hp-		
Q1, Q2	1853-0009	2	TSTR: Si PNP	01295	5M5727	
Q3	1853-0030	1	TSTR: Si PNP	03877	ST8047 I	
	1205-0011	1	Heat sink for A303	98978	TXBF 0258	
R1	0811-0396	1	R: fxd prec ww 10 ohms 0.025% 1/4 W	hp-		
R2	0811-0397	1	R: fxd prec ww 100 ohms 0.025% 1/4 W	hp-		
R3	0811-0403	1	R: fxd prec ww 1000 ohms 0.025% 1/4 W	hp-		
R4	0757-1022	1	R: fxd met flm 1.78 kilohms 1% 1/4 W	75042	CEB T-O	abd
R5	0811-0400	1	R: fxd prec ww 229.7 ohms 0.1% 1/2 W	hp-		
R6	0757-1023	1	R: fxd met flm 6.04 kilohms 1% 1/4 W	75042	CEB T-O	abd
R7	2100-0974	1	R: var prec ww 5000 ohms 10% 0.5 W	80294	236P-1-502	
R8	0811-0404	1	R: fxd prec ww 2000 ohms 0.01% 1/4 W	hp-		
R9			Not assigned			
R10	0757-0739	1	R: fxd met flm 2000 ohms 1% 1/4 W	75042	CEB T-O	abd
R11	0811-0408	1	R: fxd prec ww 20 kilohms 0.07% 1/4 W	hp-		
R12	0757-0189	1	R: fxd met flm 33.2 ohms 1% 1/8 W	75042	CEA T-O	abd
R13	0757-1021	1	R: fxd met flm 66.5 ohms 1% 1/4 W	75042	CEB T-O	abd
R14	0757-1020	1	R: fxd met flm 133 ohms 1% 1/4 W	75042	CEB T-O	abd
R15, R16	03444-82602	2	R: ww 1000 ohms (matched pair)	hp-		
R17	0757-0340	1	R: fxd met flm 10 kilohms 1% 1/4 W	19701	MF5C T-O	abd
R18	2100-0888	1	R: var prec ww 10 kilohms 10% 0.5 W	80294	236P-1-103	
R19	0683-1035	1	R: fxd comp 10 kilohms 5% 1/4 W	01121	CB1035	
R20	0683-3025	1	R: fxd comp 3000 ohms 5% 1/4 W	01121	CB3025	
R21	0683-1035	1	R: fxd comp 10 kilohms 5% 1/4 W	01121	CB1035	
R22	0757-0736	1	R: fxd met flm 1.5 kilohms 1% 1/4 W	75042	CEB T-O	abd
R23	0811-0409	1	R: fxd prec ww 176.08 kilohms 0.1% 0.1 W	hp-		
R24, R25			Not assigned			
R26	2100-0973	1	R: var prec ww 100 ohms 10% 0.5 W	80294	236P-1-200	
R27	2100-0972	1	R: var prec ww 20 ohms 10% 0.5 W	80294	236P-1-101	
R28	0757-0346	1	R: fxd met flm 10 ohms 1% 1/8 W	19701	MF5C T-O	abd
TP1	0360-0124		Terminal: pin for 3/32" printed circuit board	71279	2970-3	

Table G-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A4	01444 62801	1	Filter: Chopper Assembly includes: Photochopper Assembly (5060 E937), A4C1, A4C2, A4CR1, A4CR2, A4R1	hp	
C1	0170 0038		C: fad my 0.22 microfarads 10% 200 vdcw	56289	146P22492
C2	0170 0053	1	C: fad poly 0.033 microfarads 5% 50 vdcw	56289	134P3335R5
CR1, CR2	1901 0156	2	Diode: Si 50 mA at 1 V 20 piv	03877	SG3288
R1	0666 2245	1	R: fad comp 220 kilohms 5% 1/2 W	01121	EB2245
	5060 5937	1	Photochopper Assembly, includes: Neon Subassembly (5060 5935), A4V1 thru A4V4, aluminum housing	hp	
A4A1	5060 5935	1	Neon Subassembly, includes the following parts:	hp	
C1, C2	0160 3517	2	C: fad 0.018 microfarad 10% 50 vdcw	16546	C22C183 K
C3	0160 3435	2	C: fad 0.047 microfarad 10% 50 vdcw	84411	601PE obd
C4	1080 0309	1	C: fad 4.7 microfarads 20% 10 vdcw	56289	150Q475X0010A2 DYS
C5	0160 3435	1	C: fad 0.047 microfarad 10% 50 vdcw	84411	601PE obd
CR1, CR2	1902 0031	2	Diode: Si breakdown 12.7 V 5%	04713	SZ10339 212
CR3	1902 0666	1	Diode: Si breakdown 162 V 5%	04713	obd
DS1, DS2	2140 0234	2	Lamp: neon	74276	A219
Q1 thru Q4	1854 0158	4	TSTR: Si NPN	04713	SPS3676
R1	0761 0092	1	R: fad 180 kilohms 5% 1/4 W	16299	C32 obd
R2	0683 3935	2	R: fad 39 kilohms 5% 1/4 W	01121	CE3935
R3	2100 2655	1	R: var cermet 100 kilohms 10% 1/2 W	73138	62 213 1
R4	0683 3935	1	R: fad 39 kilohms 5% 1/4 W	01121	CE3935
R5*, R6*			Factory selected value		
R7	0684 1231	1	R: fad 12 kilohms 10% 1/4 W	01121	CB1231
R8, R9	0684 1051	2	R: fad 1 megohm 10% 1/4 W	01121	CB1051
R10, R11	0683 2255	2	R: fad 2.2 megohm 5% 1/4 W	01121	CE2255
R12	0761 0083	1	R: fad 68 kilohms 5% 1/4 W	16299	C32 obd
	1930 0096		Photochopper block includes A4V1 thru A4V4	hp	
CHASSIS MOUNTED PARTS					
C3	0160 0743	1	C: fad poly 0.015 microfarads 20% 50 vdcw	56289	194P1530R5
J1, J2	1251 0498	2	Connector: printed circuit 22 tuning fork type contacts dip solder terminals	hp	
P6	1251 1025	1	Connector: male 50 contacts rack and panel plug	71785	57-10500 23
R1	0811 0412	1	R: fad prec ww 1.76076 megohms 0.05% 1/4 W	hp	
R2	0811 0411	1	R: fad prec ww 1.6164 megohms 0.02% 1/4 W	hp	
R3	0811 0410	1	R: fad prec ww 198 kilohms 0.02% 1/4 W	hp	
R4	2100 0172	1	R: var pn comp 3 megohms 20% 1/4 W	11237	Type 45 obd
S1	03446 61901	1	Switch Assembly: S1 and S2	hp	
S1R1	0693 2241	1	R: fad comp 220 kilohms 10% 2 W	01121	H62241
S2C1	0180 0224	1	C: fad Al elect 10 microfarads + 75% - 10% 15 vdcw	56289	30D10EG016EA4
S2L1	9140 0018	1	Coil: electromagnetic RF choke single layer wound unshielded 1 microhenry	78526	H0977
S2R1, S2R2	0684 6931	1	R: fad comp 68 kilohms 10% 1/4 W	01121	CE6831
MISCELLANEOUS					
	0340 0008		Terminal: stand off round post shape teflon	98291	ST 1000 L2
	0340 0038	6	Post: terminal use with 0340 0039 to form insulated feed through terminal	98291	X L 0417E2 10
	0370 0039	6	Bushing: insulator for stand off terminals and feed through terminals	98291	X B 0417E 12
	0370 0077	2	Knob: bar	hp	
	0370 0068	1	Knob: latch round 5/8" diam black for 1/4" diam shaft	hp	
	1200 0091	2	Insulator: bushing nylon shoulder 0.235" OD, 0.115" ID	26365	974 Special

Table 6-1. Replaceable Parts (Cont'd)




REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.
MISCELLANEOUS	(Cont'd)					
	1390 0029		1	Fastener: latch adjustable pawl, clockwise locking less knob	91079	48 99-137 22
	1410 0062		1	Bushings: pos 0 435" OD by 0 438" lg	hp-	
	03444 00201		1	Panel: front	hp-	
	03444 00202		1	Panel: rear	hp-	
	03444 00203		1	Panel: sub	hp-	
	03444 01201		1	Bracket: board	hp-	
	03444 04101		1	Plate: insulating	hp-	
03444 80004		1	Manual: Operating and Service	hr-		

SECTION VII CIRCUIT DIAGRAMS


7-1. INTRODUCTION.

7-2. This section contains the schematic diagrams and component location drawings necessary to maintain the Model 3444A.


7-3. GENERAL NOTES.


- a. Only partial reference designators are shown within assembly outlines. Prefix with assembly designation for complete designator.
- b. Resistances are given in ohms, capacitances in microfarads unless otherwise specified.
- c.  indicates front panel marking.
- d.  indicates rear panel marking.
- e.  denotes screwdriver adjustment.

f.  denotes assembly.

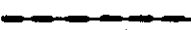
g.  denotes wire color using resistor color code. First number indicates base color, second number indicates wider stripe, third number indicates narrower stripe (924 = White, Red, Yellow).

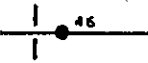
h.  indicates signal ground.

i.  indicates attenuator ground.

j.  indicates power supply ground.

k.  denotes signal path.

l.  denotes feedback path.

m.  number denotes wired connection.

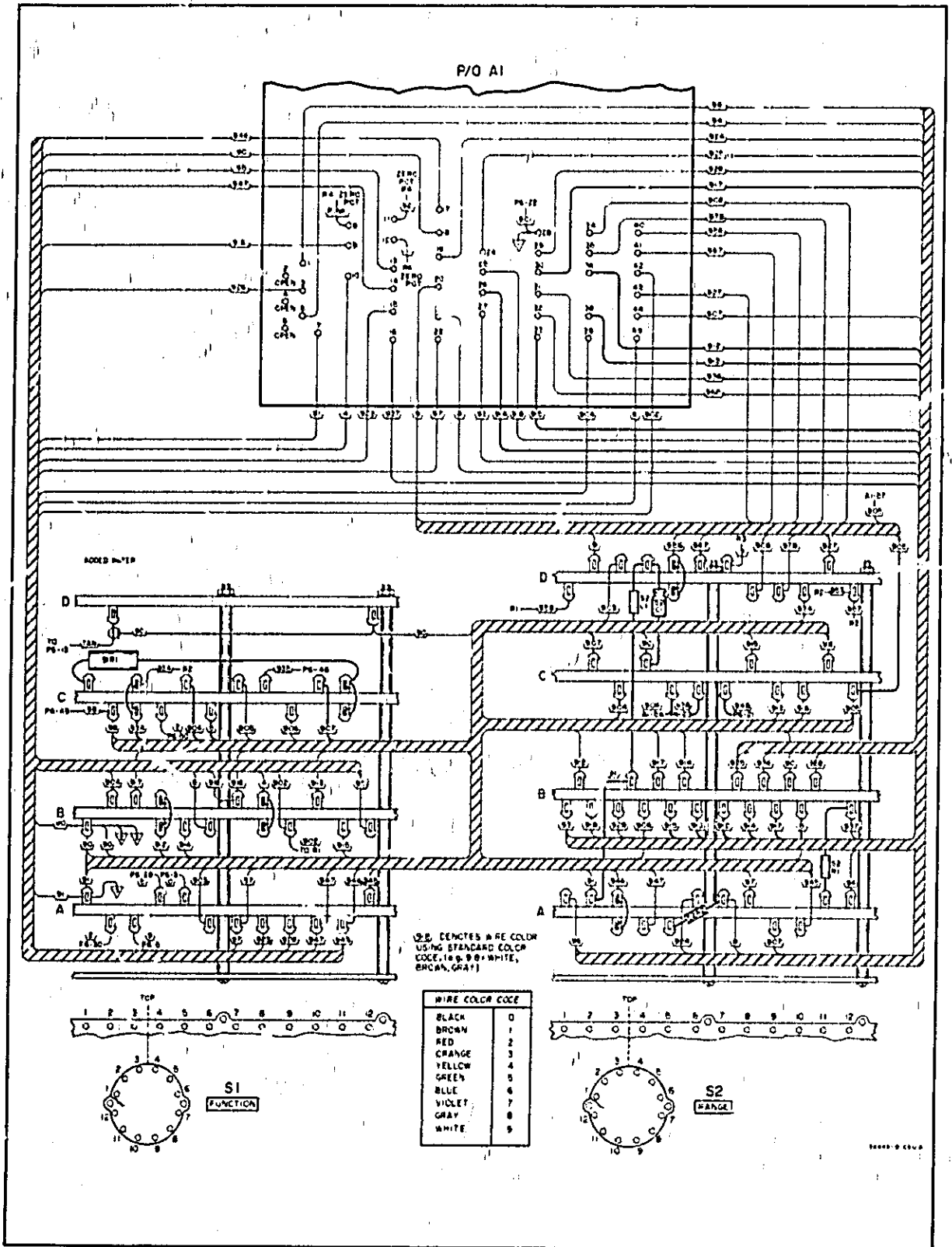
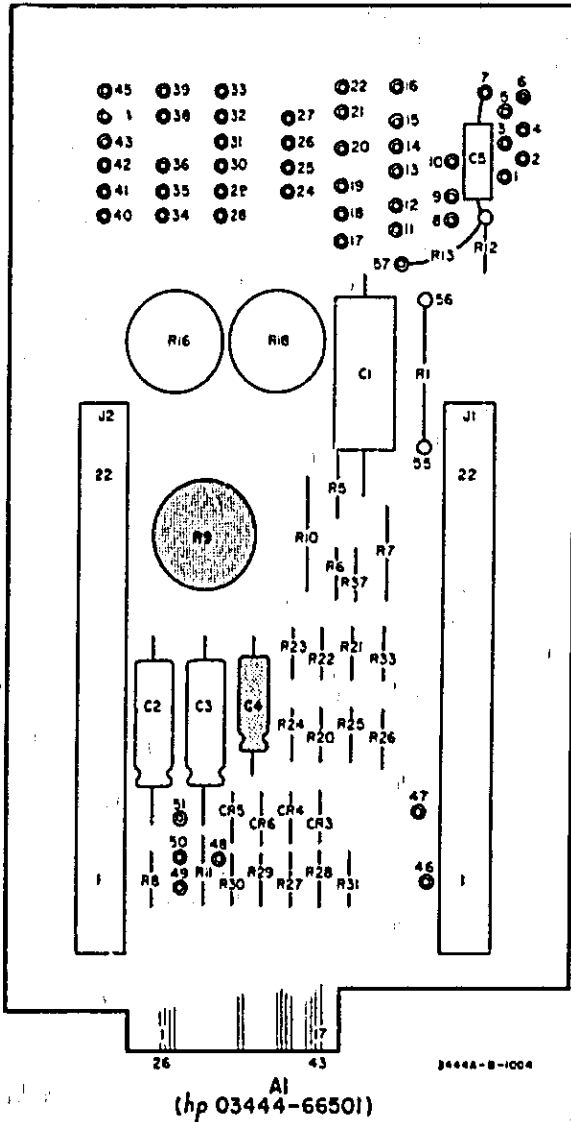


Figure 7-1. Switch Diagram

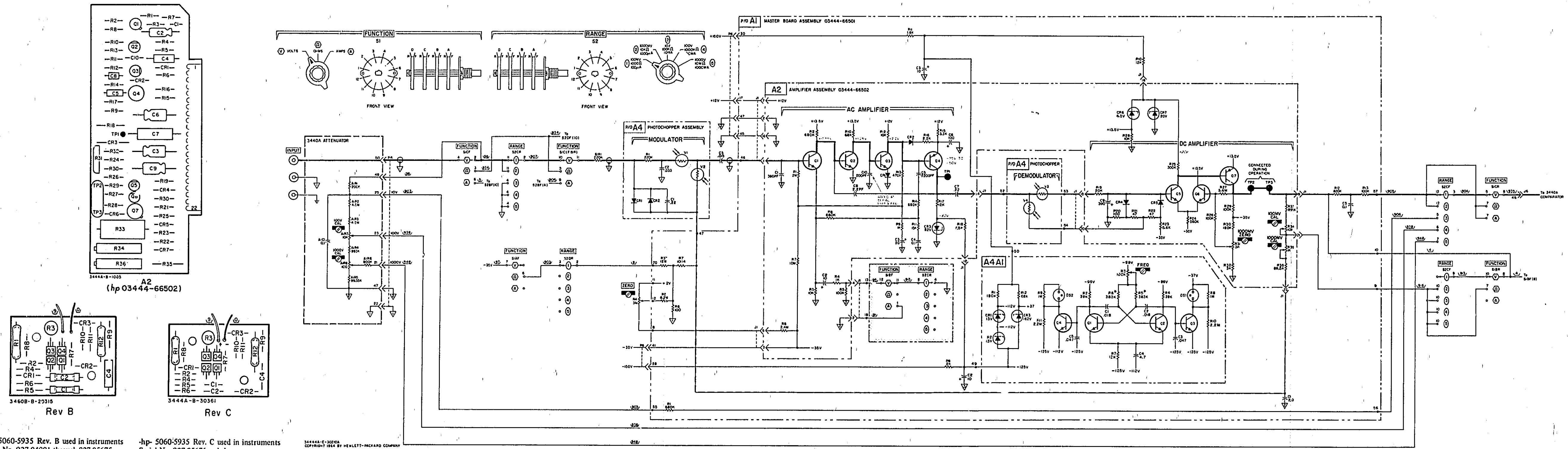


- 1 - wht/blu to S2AR1
- 2 - open for 1-2-2-4 code
wht/yel (from 5) for 1-2-4-8 code
- 3 - wht/red/blu to S1AF9
- 4 - open for 1-2-2-4 code
wht/red/blu (from 3) for 1-2-4-8 code
- 5 - wht/yel to S2AR12
- 6 - open for 1-2-2-4 code
wht/blu (from 1) for 1-2-4-8 code
- 7 - wht/brn to S1AR1
- 8 - pink to zero pot R4
- 9 - wht/brn/blu to S1BR7
- 10 - yel to S1BR8 and S1BF8
- 11 - wht/red to zero pot R4
- 12 - brn to center of zero pot R4
- 13 - wht/grn to S1BF12
- 14 - wht/yel/vio to S1AF10
- 15 - wht/red/orn to S1AF8
- 16 - wht/orn/vio to S2BF12 and S2R1
- 17 - wht/yel/blu to S1AF11
- 18 - wht/blk to S1BF1
- 19 - wht/red/yel to S2AR6
- 20 - wht to S2DR2
- 21 - gy to S2AR7 and S2R2
- 22 - wht/vio to S1AF7 (-35 V)
- 24 - wht/red/grn to S2BR7-1/2
- 25 - wht/brn/gy to S2BF2
- 26 - wht/brn/yel (lg) to S2BF8
- 27 - wht/orn to S2BF1
- 28 - wht/blk/brn (cable) to P6 pin 22
- 29 - wht/red/gy to S2BF3
- 30 - wht/brn/vio (lg) to S2BF9
- 31 - wht/orn/blu to S2BR8-1/2
- 32 - wht/blu/gy to S2BR10-1/2
- 33 - wht/brn/grn (lg) to S2BF5
- 34 - wht/blk/gy to S2DF8
- 35 - wht/vio/gy to S2DF9
- 36 - wht/brn/red (lg) to S2BF7
- 38 - wht/brn/grn (lg) to S2BF6
- 39 - wht/blk/yel to S1BR2
- 40 - wht/grn/blu to S2DR5 and S2DF5
- 41 - wht/blu/vio to S2DR6
- 42 - wht/blk/red to S1BF9 and to R1
- 43 - wht/red/vio to S2DR11
- 44 - wht/blk/vio to S2AF9
- 45 - blu to S1BF6
- 46 - to C3
- 47 - to A+V2
- 48 - wht/blk/brn to ∇ of A4
- 49 - } to A4
- 50 - } to A4
- 51 - to junction of A4V3 and A4V4
- 52 - to 14 of J1
- 53 - to 15 of J1
- 54 - to 17 of J1
- 55 - wht/blk/orn to P6 pin 25
- 56 - wht/blk/blu (lg) to S2CF5
- 57 - wht/blk/grn to S2CF12

A1C4 and A1R9 deleted in Serial No. 927-04901 and up.

A1 is connected directly to the following pins of P6: 1, 2, 9, 13, 14, 16, 17, 26, 28, 30, 33, 34, 35, 36, 38, 41, 43.

Figure . 2. AI Component Location



-hp- 5060-5935 Rev. B used in instruments Serial No. 927-04901 through 927-05675.

-hp- 5060-5935 Rev. C used in instruments Serial No. 927-05676 and above.

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Figure 7-3. Schematic Diagram, A2 Amplifier Assembly

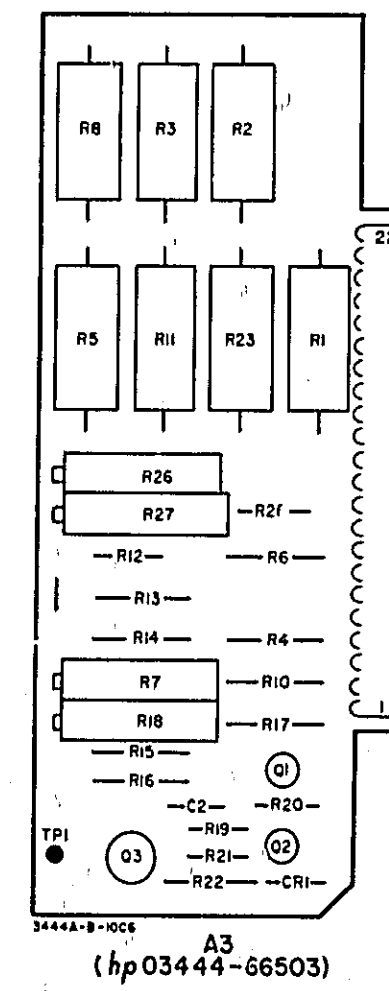
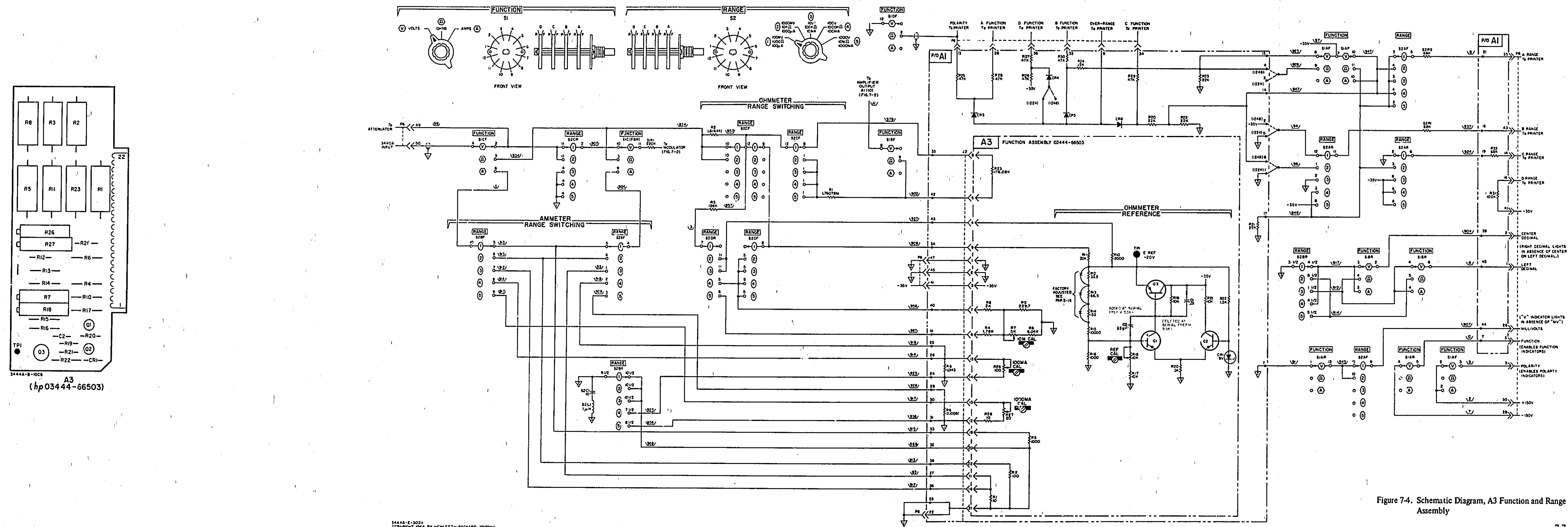


Figure 7-4. Schematic Diagram, A3 Function and Range Assembly

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
85660	Knitted Hords, Inc.	Menden, Conn.	92418	Slap's Controls, Div. of Essex Wire Corp.	Mansfield, Ohio	98141	R-Tronics, Inc.	Jamaica, N.Y.
85511	Seamless Rubber Co.	Chicago, Ill.	92632	Watson Mfg. Co.	Calver City, Calif.	98159	Rubber Tech, Inc.	Carson, Calif.
86174	Falmer Bearing Co.	Los Angeles, Calif.	93929	G. V. Controls	Livingston, N. J.	98220	Hewlett-Packard Co., Moseley Div.	Passadena, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.	94137	General Cable Corp.	Bayonne, N. J.	98278	Microdat, Inc.	So. Pasadena, Calif.
86579	Precision Rubber Products Corp.	Dayton, Ohio	94142	Phelps Dodge	Yonkers, N.Y.	98291	Salectro Corp.	Manhasset, N.Y.
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N. J.	94144	Raptheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.	98276	Zero Mfg. Co.	Burbank, Calif.
86928	Leighton Mfg. Co.	Glendale, Calif.	94148	Scientific Electronics Products, Inc.	Leveland, Colo.	98278	Etc Inc.	Cleveland, Ohio
87031	Marco Industries	Anaheim, Calif.	94154	Wagner Elect. Corp., Tool-Sol Div.	Newark, N. J.	98331	General Mills Inc., Electronics Div.	Minneapolis, Minn.
87216	Phlco Corporation (Lansdale Division)	Lansdale, Pa.	94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N. J.	98324	Peeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.	94222	Seab Chester Corp.	Chester, Pa.	98321	North Hills Electronics, Inc.	Glen Cove, N.Y.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.	94330	Wire Cloth Products, Inc.	Bellwood, Ill.	98378	International Electronic Research Corp.	Burbank, Calif.
87920	Towet Mfg. Corp.	Providence, R.I.	94375	Asynaptic Metal Products Co.	Brookva, N.Y.	99169	Columbia Technical Corp.	New York, N.Y.
88140	Cutter-Hammer, Inc.	Lisle, Ill.	94682	Westcoast Pressed Aluminum Corp.	Worcester, Mass.	99213	Vernon Associates	Palo Alto, Calif.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.	94696	Magnecraft Electric Co.	Chicago, Ill.	99378	Altec Corp.	Wichster, Mass.
88698	General Mills, Inc.	Buffalo, N.Y.	95023	George A. Philbrick Researches, Inc.	Boston, Mass.	99378	Marshall Ind., Capacitor Div.	Menorville, Calif.
89231	Gaybar Electric Co.	Oakland, Calif.	95236	Allien Products Corp.	Dania, Fla.	99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
89473	G. E. Distributing Corp.	Schenectady, N.Y.	95238	Continental Connector Corp.	Woodside, N.Y.	99880	Delevan Electronics Corp.	East Ayrers, N.Y.
89665	United Transformer Co.	Chicago, Ill.	95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.	99840	Ultra Corporation	Indianapolis, Ind.
90030	United Shoe Machinery Corp.	Beverly, Mass.	95265	National Coil Co.	Shenando, Wyo.	99928	Bronson Corp.	Whippany, N. J.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Prasalt, N. J.	95275	Vitamon, Inc.	Bridgeport, Conn.	99934	Reubrandt, Inc.	Boston, Mass.
90970	Bearing Engineering Co.	San Francisco, Calif.	95278	Gordon Corp.	Bloomfield, N. J.	99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.	95354	Methods Mfg. Co.	Rolling Meadows, Ill.	99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.	95356	Arnold Engineering Co.	Marango, Ill.			
91345	Melter Dial & Nameplate Co.	El Monte, Calif.	95712	Ogco Electric Co., Inc.	Franklin, Ind.			
91418	Radio Materials Co.	Chicago, Ill.	95924	Sieman Mfg. Co.	Wayne, Ill.			
91506	Angut Inc.	Attleboro, Mass.	95927	Wochesser Co.	Chicago, Ill.			
91637	Gale Electronics, Inc.	Columbus, Neb.	96067	Microwave Assoc., West Inc.	Sunnyvale, Calif.			
91662	Eico Corp.	Willow Grove, Pa.	96095	Hi-Q Div. of Aerovox Corp.	Glean, N.Y.			
91737	Grenar Mfg. Co., Inc.	Wohlesfield, Mass.	96256	Thompson-Weissner Inc.	Mt. Carmel, Ill.			
91827	K F Development Co.	Redwood City, Calif.	96296	Solar Manufacturing Co.	Los Angeles, Calif.			
91886	Malco Mfg. Co., Inc.	Chicago, Ill.	96306	Microswitch, Div. of Minn.- Honeywell	Freeport, Ill.			
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.	96330	Carlton Screw Co.	Chicago, Ill.	9900F	Malco Tool and Die	Los Angeles, Calif.
91961	Nahu-Bros. Spring Co.	Oakland, Calif.	96341	Carlton Associates, Inc.	Burlington, Mass.	9900Z	Willow Leather Products Corp.	Newark, N.J.
92180	Tru-Connector Corp.	Peabody, Mass.	96501	Excel Transformer Co.	Oakland, Calif.	990AB	ETA	England
92367	Eigal Optcal Co. Inc.	Rochester, N.Y.	96723	San Fernando Elect. Mfg. Co.	San Fernando, Calif.	990BB	Precision Instrument Components Co.	Van Nuys, Co. J.
92607	Tessalite Insulated Wire Co., Inc.	Tarrytown, N.Y.	96881	Thomson Ind. Inc.	Long Is., N.Y.	990CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
92702	IMC Magnetics Corp.	Westbury Long Island, N.Y.	97464	Industrial Retaining Ring Co.	Irvington, N. J.	990HM	Rubber Eng. & Development	Wayward, Calif.
92566	Hudson Lamp Co.	Kearny, N. J.	97539	Automatic & Precision Mfg.	Englewood, N. J.	990RN	A "M" D Mfg. Co.	San Jose, Calif.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.	97979	Reon Resistor Corp.	Yonkers, N.Y.	990QQ	Coeltron	Oakland, Calif.
93369	Rebhan & Myers Inc.	Pasadena Park, N. J.	97983	Litton System Inc., Adler-Weston Cannon, Div.	New Rochelle, N.Y.	990RW	California Eastern Lab.	Burlington, Calif.
						990YY	S. K. Smith Co.	Los Angeles, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

9900F	Malco Tool and Die	Los Angeles, Calif.
9900Z	Willow Leather Products Corp.	Newark, N.J.
990AB	ETA	England
990BB	Precision Instrument Components Co.	Van Nuys, Co. J.
990CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
990HM	Rubber Eng. & Development	Wayward, Calif.
990RN	A "M" D Mfg. Co.	San Jose, Calif.
990QQ	Coeltron	Oakland, Calif.
990RW	California Eastern Lab.	Burlington, Calif.
990YY	S. K. Smith Co.	Los Angeles, Calif.



MANUAL BACKDATING CHANGES

MODEL 3444A

DC MULTIFUNCTION UNIT

Manual Serial Prefixed: 973

-hp- Part No. 03444-9000-

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
821-04900 and below	1		
927-06175 and below	2		

CHANGE 1**Page 5-5, Paragraph 5-14:**

Change Step d to read "Adjust A1R9 for an electronic counter indication of 200 ± 1 Hz.

Page 6-2, Replaceable Parts:

Add A1C4 -hp- Part No. 0180-0269 C: fxd A1 elec 1 μ F.

Add A1R9 -hp- Part No. 21G0-0084 R: var lin comp 50 k Ω .

Page 6-4, Replaceable Parts:

A4 -hp- Part No. 03444-62801 Filter: Chopper Assembly, includes:
Photochopper Assembly (1990-0026), A4C1, A4C2, A4CR1, A4CR2, A4R1.

-hp- Part No. 1990-0026 Photochopper Assembly, includes:
Neon subassembly (5082-5180), A4V1 thru A4V4, aluminum housing.

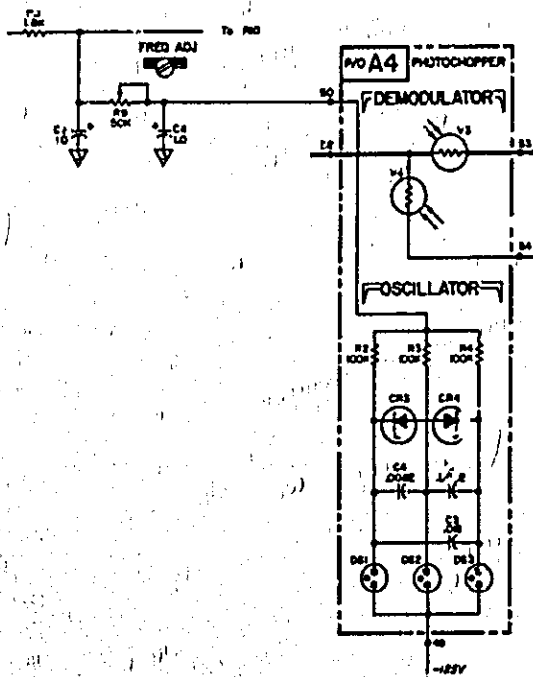
-hp- Part No. 5082-5180 Neon subassembly, includes:
Printed circuit board containing A4DS1 thru A4DS3, A4CR3, A4CR4, A4C3 thru A4C5, A4R2 thru A4R4.

Manual Backdating Changes Model 3444A Page 2

CHANGE 1 (Cont'd)

Page 7-5, Figure 7-3:

Replace the Oscillator portion of the schematic (A4A1) as follows, adding A1R9 and A1C4:



CHANGE 2

Master board assembly A1 was changed to Rev D, beginning with instrument Serial No. 973-06176. This revision eliminated mounting holes for A1R9. Rev D printed circuit boards cannot be used in instruments Serial No. 821-04900 and below unless the photochopper has been replaced with Part No. 5060-5937.

MANUAL CHANGES

Model 3444A

DC MULTI-FUNCTION UNIT

Manual Part No. 03444-90004

■ New or Revised Item

ERRATA

Page iii. Under the List of Tables add Page 1-0 to the specifications.

Page 5-7, Paragraph 5-22. Change the reference in step a to Figure 7-3.

Page 5-9. Change the figure next to step b to apply to steps a and c.

Change the figure next to step a to apply to step b and note that instruments with transistorized A4A1 display better symmetry than shown.

Page 6-2. Change A2Q1 to low noise transistor, -hp- Part Number 1854-0226 for all replacement.

Page 6-3. Change A2R31 to P/N 2100-2489, R: Var, 5 k Ω , 10%, 1/2 W.

Page 6-3. Change A2R34 and A3R18 to Part Number 2100-0451, R: Var, 10 k Ω , 10%, 1W.
Change A2R36 to Part Number 2100-0354, R: Var, 1 k Ω , 10%, 1W.

Page 6-4. Change S1 Part Number to 03444-61901.

Page 7-4. No. 38 is wht/brn/orn.

Page 7-5, A4A1 Schematic. The cathode of CR1 is connected to -99 V.



Change the lower left avalanche diode to CR2. The junction of DS1 and R8 is connected to +37 V.


Add +37 V connection to the junction of DS2 and R9.

The Emitter of Q3 is connected to -112 V.


Change A2R31 to 5 K.

Page 7-7. Change A3R15 to 1000 ohms.

A3C1 connects between base of A3Q3 and ground (). Change ground at terminal 47 of connector P6 to .

Change ground at terminal 1 of connector J2 to .

Add wired connection number 48 (See Para. 7-3 m) between P6 terminal 47 and J2 terminal 1.

Change ground at terminal 22 of connector P6 to .

ADDENDA

CHANGE NO. 1: For Serial 0973A07161 and above.

Page 6-2. Change A2C3 to 0180-1794, C fxd 22 μ F 35 V.

Change A2C6 to 0180-1835, C fxd 68 μ F 15 V.

Page 7-5. Change A2C6 to 68 μ F.

NOTE: the above parts should be used for all replacement.

3 March 1975

Supplement A for 03444-90004