Errata

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OPERATING AND SERVICE MANUAL

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MODEL 1111A

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AC CURRENT AMPLIFIER

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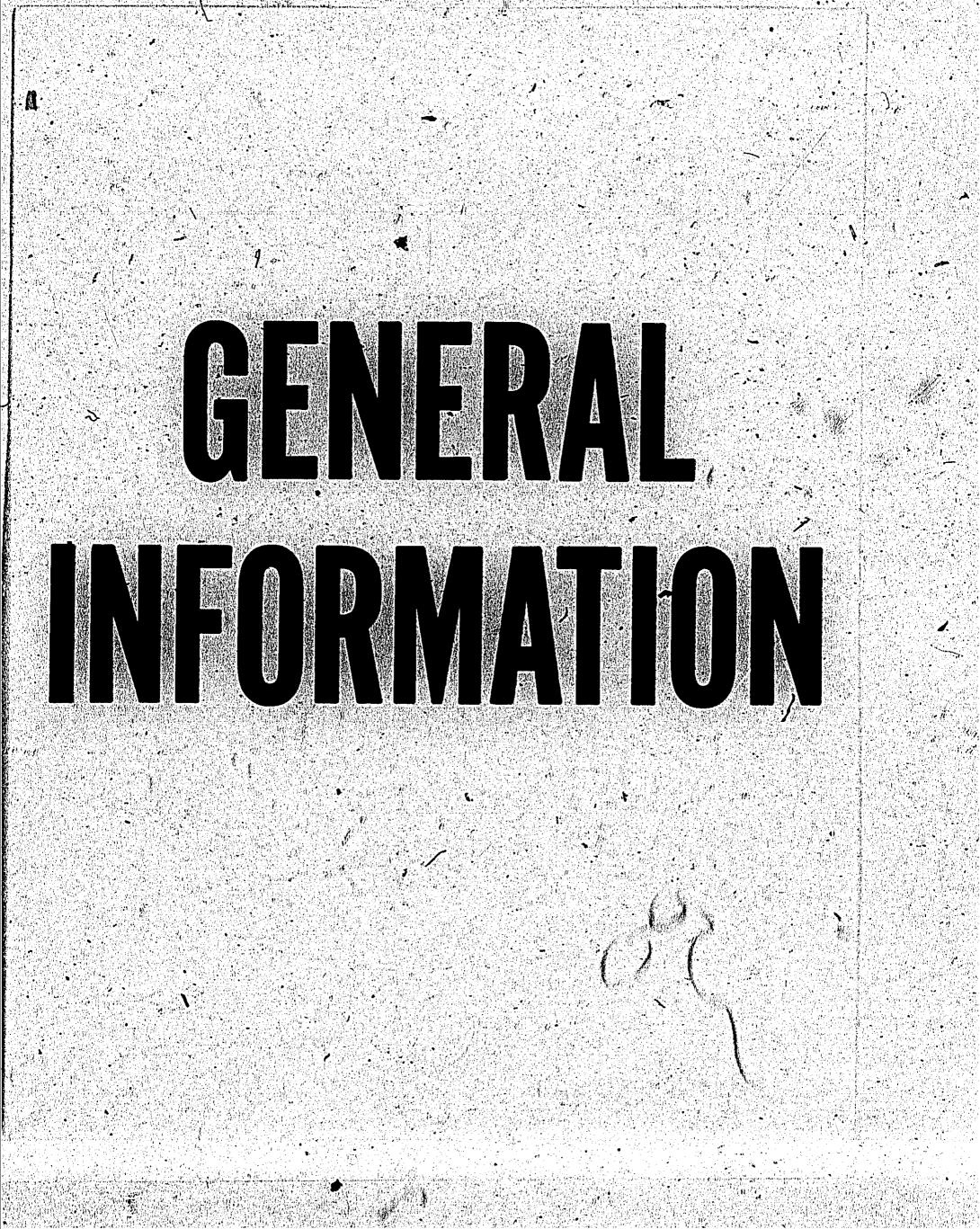
Test Equipment Required Sensitivity and Accuracy Check Power Supply Voltage Checks Calibration and Component Replacement Record

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Section I-Figure 1-1 and Table 1-1

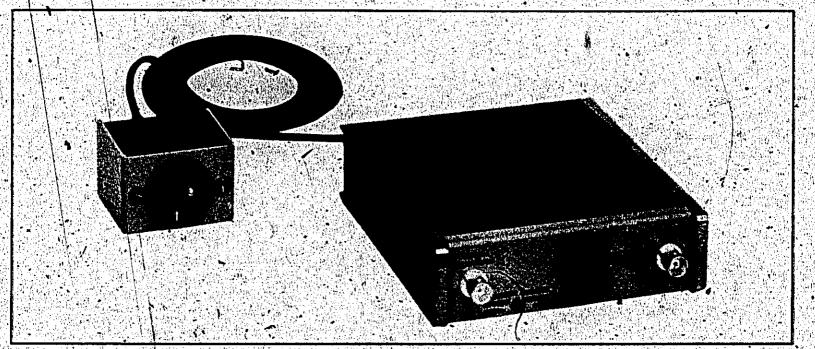


Figure 1-1. Model 1111A AC Current Amplifier

Table 1-1. Specifications for Model 1111A with Model M10A Probe

SENSITIVITY:

1 ma/cm to 50 ma/cm in X1

100 ma/cm to 5 amps/cm in X100, 1, 2, 5 sequence for X1 or X100

ACCURACY: ±3% on X1 sensitivity

±4% on X100 sensitivity

BANDWIDTH: 50 cps to 20 Mc.

RISE TIME: 18 nsec

NOISE:

1-0

Less than 100 µa pk-pk, referred to input

MAXIMUM AC CURRENT: Above 700 cps: 50 amps pk-pk Below 700 cps: decreases at 1.4 amps/20 cps

UTPUT IMPEDANCE: 50 ohms

DIMENSIONS: 1-1/2 in. high, 5-7/8 in. wide, 6 in. deep

WEIGHT: -Approximately 2 lb

POWER:"

(115 or 230 volts ± 10%, 50 to 1000 cps, 1.5 watts

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1.3

Sections I and II Paragraphs 1-1 to 2-12

SECTION I GENERAL INFORMATION

1-1. DESCRIPTION AND APPLICATIONS.

1-2. The Hewlett-Packard Model 1111A AC Current Amplifier, shown in Figure 1-1, is a stable, wideband amplifier to be used with the Model 1110A Probe. The Model 1111A amplifies the Probe output, extends the low frequency response to 50 cps, and provides 12 ranges of sensitivity from 1 ma/cm to 5 amps/cm (used with 50 mv/cm sensitivity oscilloscope). Complete specifications are given in . Table 1-1.

1-3. The Model 1111A is designed for use with an oscilloscope which has a calibrated vertical amplifier with 50 mv/cm sensitivity. When used with this sensitivity oscilloscope, the Model 1111A's attenuator may be read directly in milliamperes per centimeterdeflection on the CRT. The Model 1111A may be used with an oscilloscope having different sensitivity, but the conversion ratio must then be used.

1-4. INSTRUMENT. IDENTIFICATION

1-5. The Hewlett-Packard Company uses a twosection, eight-digit serial number to identify instruments (e.g. 000-00000). The serial number is located on a plate attached to the instrument rear panel. The first three digits are a serial prefix number, also appearing on the title page of this manual, and the last five digits identify a specific instrument. If the first three digits of the instrument serial number are not the same as those appearing on the title page, change sheets included with the manual will define differences between other instruments and the Model 1111A described herein. If the change sheets are missing, your @. Field Engineer can supply the information.

SECTION II PREPARATION FOR USE

2-1. INCOMING QUALITY CONTROL INSPECTION.

2-2. MECHANICAL INSPECTION. Upon receipt of your Model 1111A, check that the contents are intact and as ordered. Inspect the instrument for any damage incurred in shipping. If the instrument is damaged, notify the carrier immediately (refer to the warranty which appears on the inside back cover of this manual).

2-3. PERFORMANCE CHECK. Check the performance of the Model 1111A by making the tests as outlined in Paragraph 5-4 of this manual. This check may be used to verify instrument specifications and as part of an incoming quality control inspection.

2-4. AC POWER CONSIDERATION.

2-5. POWER REQUIREMENTS.

2-6. The Model 1111A requires an AC power source of 115 or 230 volts $\pm 10\%$, single phase, 50 to 1000 cps. The power required is approximately 1.5 watts. The Model 1111A is normally shipped from the factory for use from a 115-volt power source. To convert the instrument for use from a 230-volt source, slide the 115-230 switch to the "230" position. This switch is located on the power plug assembly.

2-7. THREE-CONDUCTOR CONNECTOR.

2-8. To protect operating personnel the National Electrical Manufacturers Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a threepin power plug which, when plugged into an appropriate receptacle, grounds the instrument. The offset round pin on the plug is the ground connection. To retain the protection feature when operating the instrument from a two-contact outlet, use a three-conductor to two-conductor adapter and connect the adapter wire to ground.

2-9. RACK INSTALLATION.

2-10. The Model 1111A may be placed in a @ 1051A combining case which may then be installed in an instrument rack. The Combining Case may also be mounted in the rack space of a @ Model 1117A Testmobile for convenience of keeping related-use instruments together (the @ 1051A also adapts 1/3 width modular instruments to a rack).

2-11. REPACKAGING FOR SHIPMENT.

2-12. The following is a general guide for packaging an instrument for shipment. If there are any questions regarding packaging methods, contact your Hewlett--Packard Field Office.

a. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

1-1

Section II Paragraph 2-13

b. Use plenty of packing material around all sides of the instrument and protect surfaces with cardboard strips.

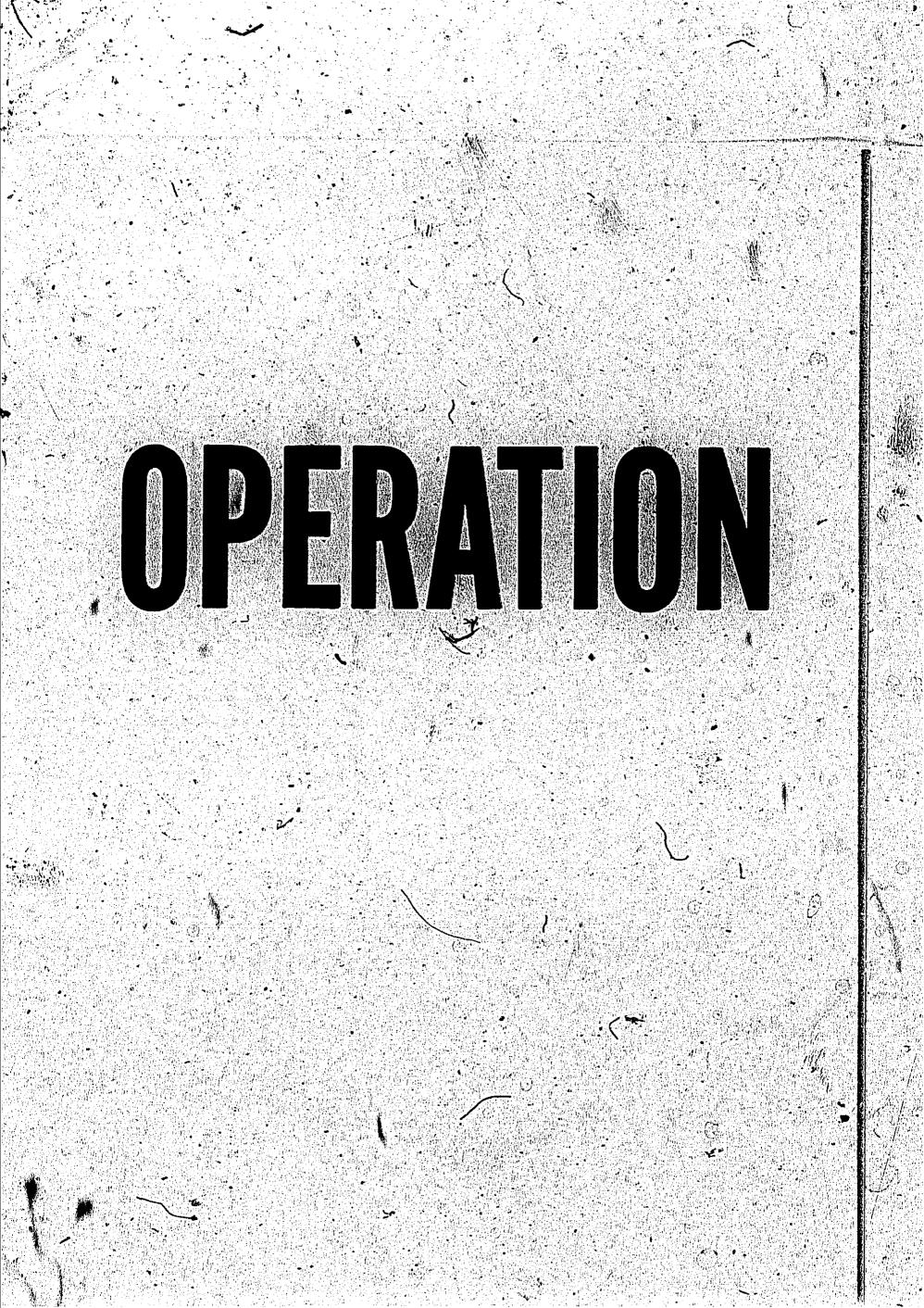
c: Place the instrument in a heavy cardboard carton or wooden box. Seal the container with heavy tape or metal straps.

d. Mark the packing container "FRAGILE-DELICATE INSTRUMENT".

3

2-13. If an instrument is being returned to Hewlett-Packard Company for servicing or repair, attach a tag to the instrument specifying owner, desired action, model number, and serial number. Ship the instrument to Hewlett-Packard Customer Service at the address on the warranty page. All correspondence should refer to an instrument by model number and the full (eight-digit) serial number.

Model 1111A



Section III Paragraphs 3-1 to 3-7

3-1

SECTION III OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 1111A provides amplification of the output of the Model 1110A Probe, and calibrated control of the sensitivity. Front-panel controls set the sensitivity in milliamperes/centimeter whenused with an oscilloscope with 50 mv/cm sensitivity.

3-3. PANEL DESCRIPTION AND OPERATING

3-4. Figure 3-1(a) provides a brief description of front panel controls and connectors, keyed by number to the panel illustration. A step-by-step operating procedure is provided in Figure 3-1(b). Additional operating considerations are given in Paragraph 3-5.

3-5. OPERATING CONSIDERATIONS

3-6. GENERAL. The following paragraphs contain information about making measurements using the Model 1111A with the Model 1110A Current Probe. While most of the considerations relate to the Model 1110A, the information is provided here since the two instruments are designed for use together.

3-7. DIRECTION OF CURRENT FLOW. The arrow on the probe body indicates the direction of conventional current flow which produces a positive output from the probe and amplifier. Thus there is a "sense of polarity" when observing current waveforms on the

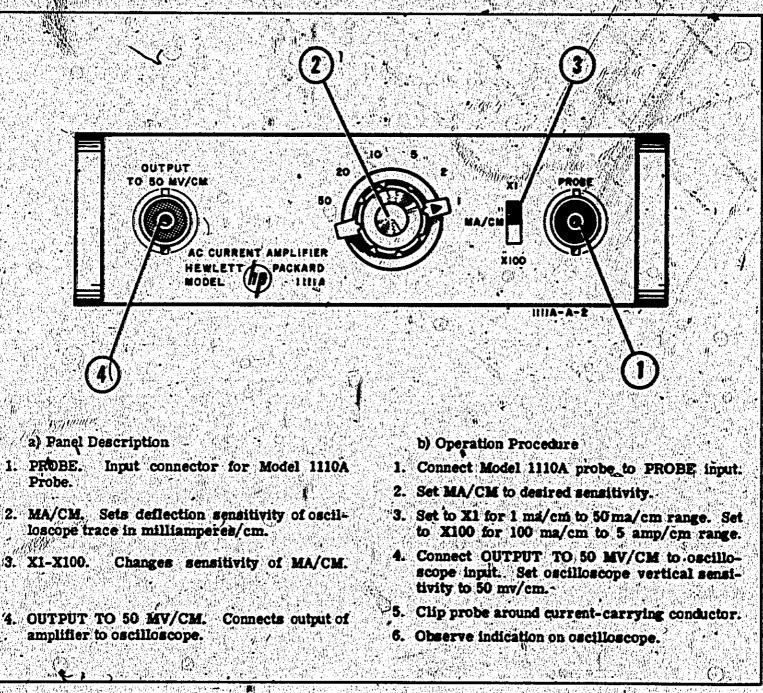


Figure 3-1. Front Panel Description and Operation Procedure

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Section III Paragraphs 3-8 to 3-13

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oscilloscope, and the polarity can be reversed by removing the probe from any wire, rotating the probe 180°, and clipping it around the wire again.

3-8. INCREASING SENSITIVITY. The sensitivity of the probe may be increased by looping the wire through two or more times. The increase in sensitivity is directly proportional to the number of loops; i.e., 2 loops = twice sensitivity. However, the increase in sensitivity is accompanied by an increase in the series loading effect due to the probe, which increases as the square of the number of loops. Also, the looped wire itself adds inductance and shunt capacitance to ground which may be significant at high frequencies.

3-9. SUMMING CURRENTS. The probe may be clipped around wires carrying different currents as well as around loops of the same wire. In either case the instantaneous output of the probe is the algebraic sum of the instantaneous currents through the probe. In this way currents may be balanced (in push-pull circuits, for example) by clipping the probe around two wires in which the currents are 180° out of phase as they pass through the probe; and adjusting the circuit for minimum output from the probe:

3-10. EFFECTS OF EXTERNAL FIELDS. The probe is magnetically shielded to minimize the effects of external magnetic fields. However, strong fields near power transformers or electric motors may cause an unwanted output from the probe and amplifier. To check for such fields, hold the probe with jaws closed and no wire through it in the region in which you intend to make the measurement. If the probe output is excessive compared to the expected measurement, make, the measurement at some other point along the wire farther from the source of the field, or orient the probe lead for minimum undesired output. If there is little or no output from the probe and amplifier the field will not affect the measurement. Model 1111A

3-11. PEAK CURRENT. The maximum peak-to-peak current which the probe and amplifier will accept is a function of frequency. Figure 3-2 shows a plot of peak-to-peak current vs frequency.

3-12. MAXIMUM DC CURRENT. The Current Amplifier and Probe will perform as specified in Table 1-1 if the DC current present is less than 0.5 amps. Above 0.5 amperes DC, performance is derated since the DC current acts to decrease Probe head inductance and to raise the low frequency -3 db point.

3-13. HIGH FREQUENCY RESPONSE. Performance of Current Amplifier and Probe will be within specifications if the load capacitance presented to the output of the Model 1111A is less than 30 pf. The high frequency -3 db point is determined by the capacitive load at the input. The typical high frequency oscilloscope has an input capacitance of 28 pf, hence high frequency operation of the Probe and Amplifier is not affected.

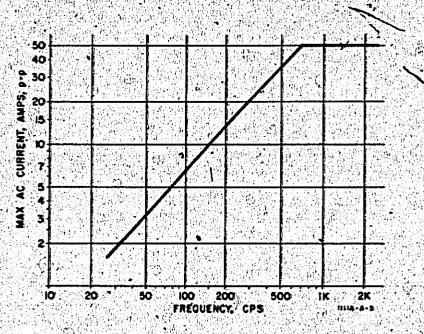
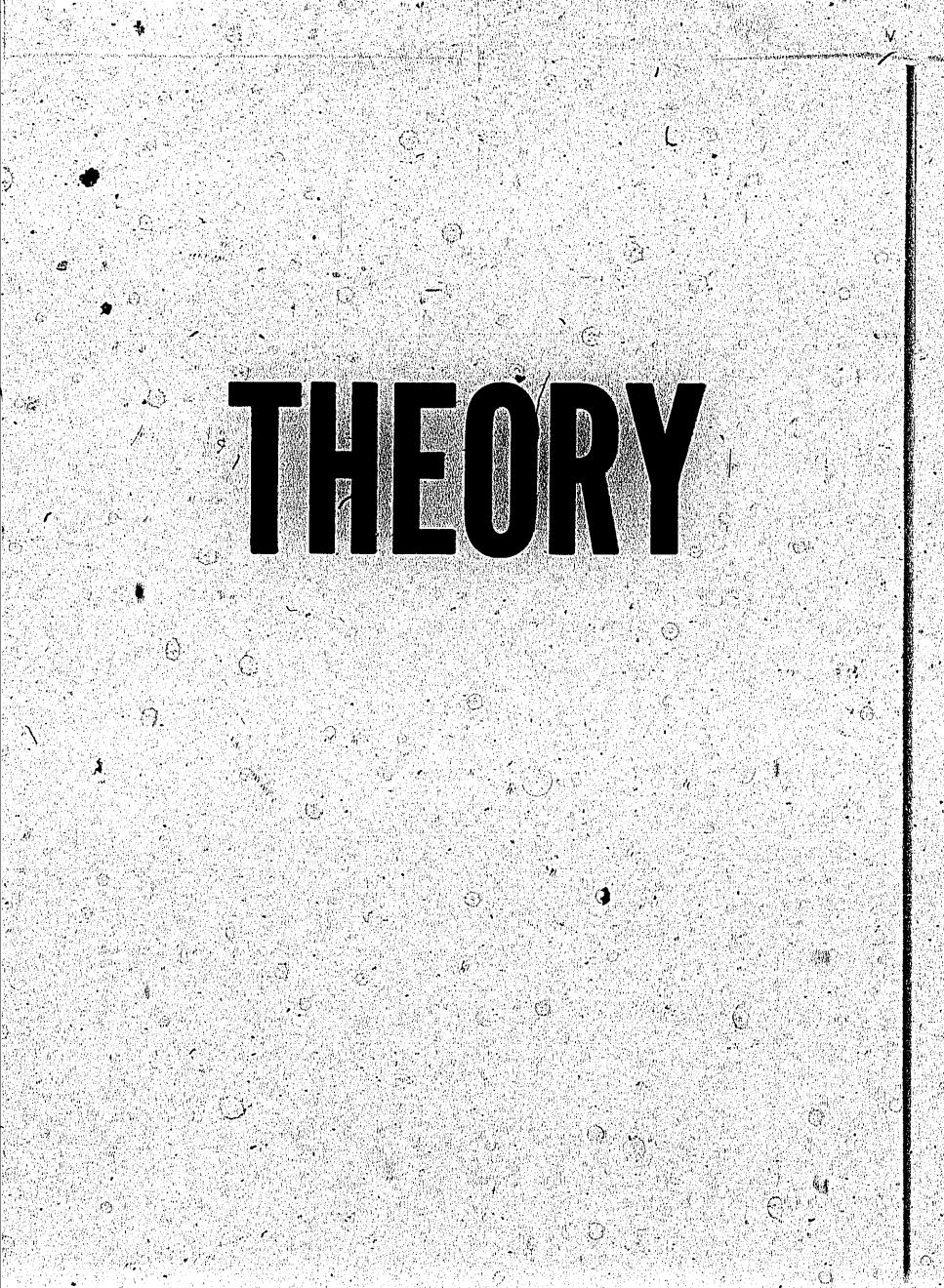


Figure 3-2. Peak-to-Peak Current vs Frequency



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Section IV Paragraphs 4-1 to 4-7

4-1

SECTION IV PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 1111A is a current amplifier for the output of the G Model 1110A Probe and extends the low-frequency response. As shown in the block diagram, Figure 4-1, the Model 1111A consists of power supply, input amplifier, sensitivity range switching, and output amplifier. Refer also to the instrument schematic, Figure 5-9 for circuit location of components referred to in the following explanation.

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4-3. POWER SUPPLY.

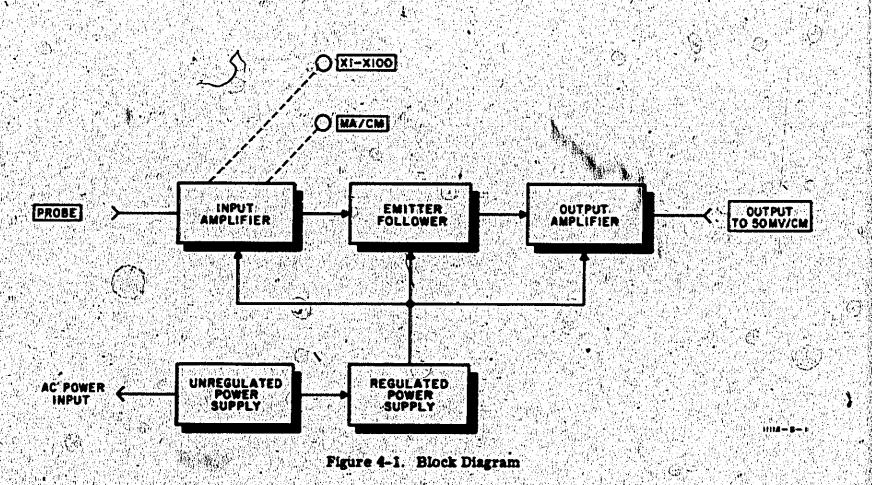
4-4. The power supply is a conventional transformerrectifier, supply with C127, C128, and R130 acting as filters to attenuate 120-cycle ripple (produced by fullwave rectifier). Further filtering and output voltage stabilization is provided by series regulator Q105. The base voltage for Q105 is provided by reference diode CR102, which (breaks-down at approximately 14.7 volts. Diode CR102 maintains a constant voltage, which tends to keep the output voltage constant despite changes in the unregulated collector voltage due to line voltage variations.

4-5. INPUT AMPLIFIER.

4+6. The input amplifier pair consists of commonbase amplifier Q101 and common-emitter amplifier Q102. The current input from the probe is coupled

into the emitter of Q101: through S101 and C101. Switch S101, provides a 100:1 current divider with R101-R102, giving six additional ranges of sensitivity with switch S102. Amplifiers Q101 and Q102 are interconnected by two feedback loops: a controlled positive feedback loop from the collector of Q102 to the base of Q101, and a negative feedback loop from the collector of Q102 to the emitter of Q101. The negative loop tends to shunt current away from the Q101 emitter as the input current from the probe increases. The difference between probe and (eeg back current flows into the emitter of Q101, and is then amplified by Q102. The gain, or current/voltage conversion ratio, is determined by S102, which has six ranges of sensitivity. In the illustration of Figure 4-2, S102 is set so the conversion ratio is determined by RIII and RII2. At high frequencies L101 and C108 shape the frequency response for a smooth rolloff beyond 20 megacycles. Similar circuits in the feedback loop are switched in at other positions of S102. The positive feedback loop consisting of R103, R109, and C105 tends to lower the amplifier input impedance at low frequencies, extending the response of the probe with amplifier to 50 cps.

4-7. SENSITIVITY SWITCH. Sensitivity switch S102 performs three separate functions in determining. the output sensitivity. It sets the current/voltage conversion ratio of the Q101-Q102 amplifier pair



Section IV

Paragraphs 4-8 to 4-9

(S102E), it selects 1:1 or 10:1 attenuation between Q102 and Q103 (S102D) and it changes the collectorload of Q101 (S102A, B, C) to allow greater dynamic range on larger current inputs.

4-8. OUTPUT AMPLIFIER.

5

4-2

4-9. The output amplifier pair consists of emitter

Model 1111A

follower Q108 and output amplifier Q104. Emitter follower Q103 isolates the 10:1 attenuator from the output and provides a low impedance drive for Q104. Common-emitter amplifier Q104 is a conventional amplifier with the gain set by R129 (emitter circuit). The output from Q104 collector is coupled thrifted C125 to J102, the instrument output connector.

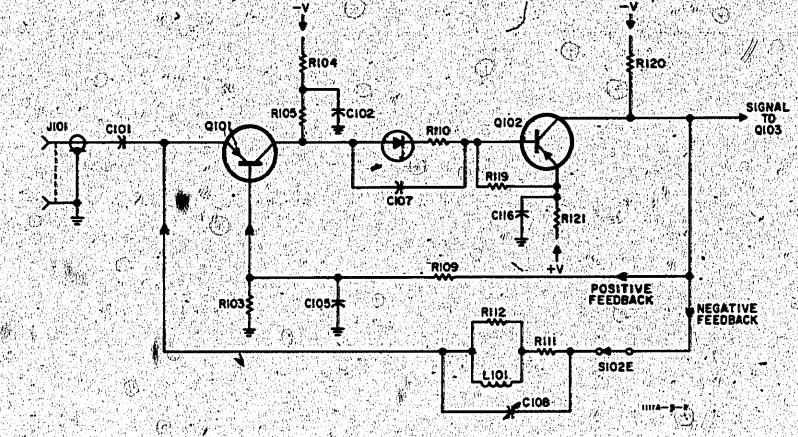


Figure 4-2. Simplified Circuit (Input Amplifier)

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SECTION V MAINTENANCE

5-1. TEST EQUIPMENT REQUIRED

5-2. INSTRUMENTS. Table 5-1 lists the set instruments required for the performance checks and for making the Model 1111A adjustments. Substitute equipment should provide performance according to the specifications listed in Table 5-1. Be sure test equipment has been recently calibrated and always allow manufacturer's suggested warmup period to obtain full accuracy.

5-3. SPECIAL LOADS. Three special loads are required: 50Ω , 600Ω , and 22 pf. These may be made by using the appropriate connector-adapter and component required. Figure 5-1 illustrates the 600 Ω load required. The 50 Ω load may be made using a 50±0.5 Ω resistor and either the dual banana plug

connector or a BNC-banana plug adapter. For the capacitive load, use a 22 pf capacitor (@ Stock No. 0140-0145) and a BNC connector (@ Stock No. 1250-0079). Solder the capacitor between center conductor (on rear of connector) and the shield (next to threaded section).

5-4. PIRFORMANCE CHECK.

5-5. The procedure of Paragraphs 5-6 through 5-9 should determine if the Model 1111A is operating within its specifications. If performance is out of specifications, refer, to Paragraphs 5-10 through 5-13 for the adjustment procedure or to the troubleshooting suggestions of Paragraph 5-14. In the procedures using the Model 1110A Probe, always be sure the head surfaces are clean and that the jaws close firmly.

No.	Description	Important Specifications	Use	Recommended Equipment
1	Signal Generator	Output: 1 volt into 50 R, constant with frequency Frequency: 50 Kc-20 Mc	Check sensitivity, accuracy and bandwidth	Model 606A
2	AC Voltmeter	Accuracy: 1%. Range: 0.1 volts	Check sensitivity accuracy and bandwidth	🎯 Model 400H
3	Current Probe	Bandwidth: 45 Mc Rise Time: 8 nsec Output: 1 mv/ma	Check sensitivity, accuracy and bandwidth Adjust pulse response	Model 1110A •
4	Audio Oscillator	-Range: 50 cps - 50 Kc Output: 1.5 volts into 600 Ω constant with frequency	Check bandwidth Adjust gain	🏵 Model 200CD
5	R.F. Millivoltmeter	Range: 0.1 volts Bandwidth: 1 Mc - 20 Mc Accuracy: 13% full scale	Check bandwidth	Model 411A
6	Sampling Oscilloscope and plug-in	Bandwidth: 100 Mc. Sync Pulse: 1.5 volts into 50 Ω, 1.5 nsec risetime Sensitivity: 10 mv/cm	Adjust pulse response	Model 185B and Model 187B
7	High Frequency Oscilloscope and plug-in	Bandwidth: 50 Mc Senaitivity: .05 v/cm	Check: noise	Model 175A and Model 1751A
8	Square Wave Generator	Frequency: 400 Kc Rise Time: 3 nsec Output: 0.5 volts into 50Ω	Adjust pulse and high frequency response	Textronix Model 107 Square Wave Generator
9	Special Loads	50 Ω : 50 ± 0.5 Ω Resistor 600 Ω : See Figure 5-1 22 PF: Capacitor and BNC connector	See Paragraph 5-3	

Table 5-1. Test Equipment Required

Section V Paragraphs 5-6 to 5-8

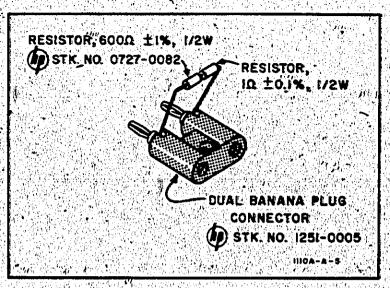


Figure 5-1. Special 600 Ω Load

5-6. SENSITIVITY AND ACCURACY.

a. Refer to Table 5-1 and Figure 5-2 and connect test equipment. Items required are 2, 3, 4 and 9.

b. Set Voltmeter range to 0.1 volts.

c. Set Oscillator frequency to 50 kc.

d. Disconnect Voltmeter from Model 1111A output and reconnect Voltmeter across the 600 g load.

e. Set Oscillator output for a Voltmeter reading of 9.1 volts.

f. Disconnect the Voltmeter from the load and reconnect it to the Model 1111A output.

g. Set the Model 1111A sensitivity to 1 MA/CM, X1.

h. Check Model 1111A output according to Table 5-2.

i. Disconnect Voltmeter from Model 1111A output and reconnect it across the 600 Ω load.

i. Set the Oscillator output for a Voltmeter reading of 1.0 volts.

k. Disconnect the Voltmeter from the 600 Ω load and connect it to the Model 1111A output.

m. Set the Model 1111A sensitivity to 1 MA/CM, X100.

n. The Voltmeter reading should be 0.01 volts±4%.

5-7. NOISE.

5-2

a. Connect the Probe (item 3 in Table 5-1) to the Model 1111A input.

b. Connect the Model 1111A output to the Oscilloscope plug-in (item 7 in Table 5-1).

c. Set oscilloscope and plug-in SENSITIVITY to .05 VOLTS/CM, SWEEP TIME to 50 μ SEC/CM, SWEE/P MODE to PRESET, and TRIGGER SOURCE to LINE.

d. Set Model 1111A sensitivity to 1 MA/CM, X1.

e. Position the Probe and Amplifier (no input to probe) so the external field coupling is minimum as viewed on CRT.

f. With oscilloscope trace intensity set for normal, look closely at the high frequency random noise displayed. Any noise should be less than 1 mm peakto-peak, which corresponds to less than 100 μ a p-p.

5-8. BANDWIDTH.

a. Refer to Table 5-1 and Figure 5-2 and connect test equipment. Items requires are 2, 3, 4 and 9.

b. Set Model 1111A sensitivity to 1 MA/CM, X1.

c. Set Voltmeter range to 0.1 volts.

d. Set Oscillator frequency to 10 Kc and amplitude for a zero db reading on the Voltmeter.

e. Set Oscillator frequency to 50 cps.

f. Voltmeter reading should be -3 db or greater.

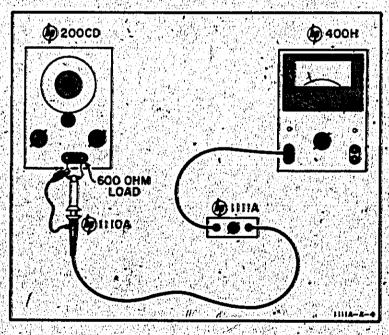


Figure-5-2. Oscillator-Voltmeter Test Setup".

Model 1111A . Sensitivity, MA/CM	Voltmeter	Voltmeter
	Range, Volts	Reading, Volts
2		0.1 ±3% 0.05 ±3%
10	.03 .01	0.02 ±3% 0.01 ±3%
· · · · · · · · · · · · · · · · · · ·	.01 .003	0.005 ±3% 0,002 ±3%

Table 5-2. Sensitivity and Accuracy Check

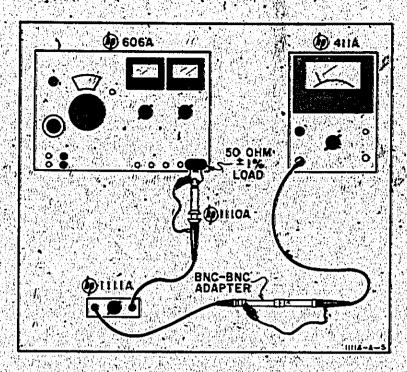


Figure 5-3: Signal Generator - RF Millivoltmeter Test Setup

g. Repeat procedure starting with step b, using appropriate Voltmeter range, and checking other Model/1111A sensitivity ranges.

h. Disconnect test setup. Refer to Figure 5-3 and Table 5-1 and connect test equipment specified, using items 1, 3, 5 and 9.

i. Set Model 1111A sensitivity to 1 MA/CM, X1:

j. Set the Millivoltmeter range to 0.1 volts.

k. Set the Signal Generator frequency to 1 Mc and the output amplitude for a zero db reading on the Millivoltmeter.

m. Set the Signal Generator frequency to 20 Mc.

n. Millivoltmeter reading should be -3 db or greater.

p. Repeat procedure starting with step j, using appropriate Millivoltmeter range, and checking the other Model 1111A sensitivity ranges.

5-9. RISE TIME.

a. Refer to Table 5-1 and Figure 5-4 and connect specified equipment, items 3 6, and 9. The 50 Ω load is connected to the oscilloscope sync pulse output.

b. Set Oscilloscope MODE to FREERUN and switch on SYNC PULSE.

c. Set Model 111/1A sensitivity to 1 MA/CM, X1.

d. Adjust Oscilloscope and plug-in SENSITIVITY, TIME SCALE and MAGNIFIER controls to display leading edge of pulse.

e. The rise time (between 10% and 90%) amplitude points) should be 18 nanoseconds or less.

f. Check other Model 1111A sensitivity ranges for the same rise time specification.

5-10. ADJUSTMENTS.

5-11. AMPLIFIER GAIN SET.

a. Refer to Table 5-1 and Figure 5-2 and connect specified equipment, items 2, 3, 4 and 9.

b. Set Oscillator frequency to 50 Kc.

c. Set Model 1111A sensitivity to 1 MA/CM; X1.

d. Disconnect Voltmeter from Model 1111A output and reconnect Voltmeter across Oscillator output.

e. Set Oscillator output for reading of 0.1 volts.

f. Reconnect Voltmeter to Model 1111A. output.

g. Adjust R129, 1 ma/cm Gain Set, for Voltmeter

h. Set Model 1111A sensitivity to 10 MA/CM, X1.

i. Adjust R123, 10 ma/cm Gain Set for a Voltmeter reading of 0.01 volts.

j. Refer to Table 5-2 to check the Model 1111A output on other sensitivity settings.

5-12. PULSE AND HIGH FREQUENCY RESPONSE,

5-13. The adjustments for pulse and high frequency response will have some interaction, requiring a repeat of the procedure to optimize the performance. When an adjustment affects more than one sensitivity range, a compromise setting may be necessary. The objective for these adjustments is to obtain the best pulse response combination possible; this means best rise time within specifications with leastringing and overshoot.

a. Refer to Table 5-1 and Figure 5-5, and connect specified equipment, items 3, 6, 7 and 8. One additional item is required: a capacitive load, described

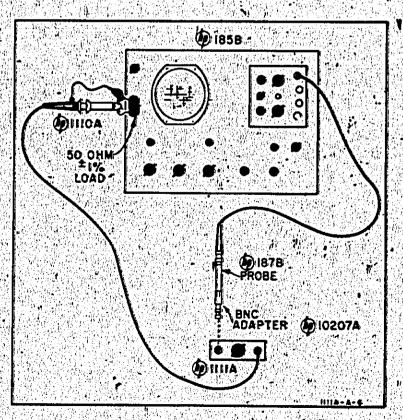


Figure 5-4. Rise Time Check Setup

5-3

Section V Paragraphs 5-14 to 5-19

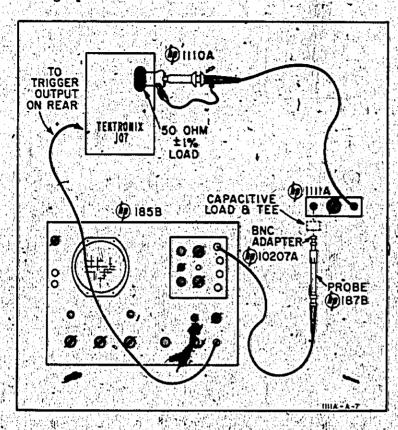


Figure 5-5. Pulse and High Frequency Response Test Setup

in Paragraph 5-3. Use a BNC tee connector to connect the capacitive load and oscilloscope probe to the Model 1111A output.

b. Set the Square Wave Generator amplitude control fully clockwise (output approximately 0.5 volts) and frequency control, "fully counterclockwise (about 400 Kc).

c. Set Model 1111A Sunsitivity to 1 MA/CM, X1.

d. Set Oscilloscope and plug-in controls as follows: TIME SCALE to 200 NSEC/CM, TIME SCALE MAGNI-FIER to X2, TRIGGER SLOPE to -, SENSIFYITY to 200 MILLIVOLTS/CM, and SCANNING TO INTERNAL.

e. Adjust controls to obtain a good display of the positive pulse.

f. Adjust R106, Pulse Resp., for best leading edge of square wave. Turning R106 clockwise decreases overshoot and speeds rise time (opposite effect for ccw rotation). Setting R106 too far clockwise causes a high frequency ring and a lower frequency ring occurs for excessive counterclockwise setting.

g. Adjust C104, Pulse Resp., for best leading edge. Increasing the capacitance increases overshoot and slows rise time. Opposite effects occur with decreased capacitance.

h. Check all Model 1111A sensitivity ranges and if necessary readjust R106 or C104 for best compromise pulse response.

i. Return sensitivity control to 1 MA/CM, X1.

j. Adjust C108 for best overshoot conditions. Increasing capacitance (turning cw) reduces overshoot and affects simple overshoot (rather than ringing).

5-4

Model 1111A

k. Set sensitivity control to 2 MA/CM, X1.

m. Adjust C109 for best overshoot conditions. Increasing capacitance (turning cw) reduces overshoot, also affecting simple overshoot conditions.

n. Adjustments C108 and C109 interact and final settings should be best compromise.

p. The adjustment of R106, C104, C108, and C109 should provide a pulse response on all ranges as follows: approximately 2% overshoot and less than two cycles of ringing. Replace instrument cover to make the check. If these conditions are not met initially, it may be possible to make a better adjustment, or a component may be defective (see Troubleshooting, Paragraphs 5-14 to 5-21).

q. Set Oscilloscope and plug-in as in step d, except change TIME SCALE MAGNIFIER to X1 and SENSI-TIVITY to 10 MILLIVOLTS/CM.

r. Set Model 1111A sensitivity to 10 MA/CM, X1.

s. Adjust C118, Flat Top Adjust, with an insulated tool, so the initial part of the pulse top is flat.

t. Check flat top on 20 MA/CM and 50 MA/CM sensitivity and set C118 for best compromise of the three ranges. Replace cover for final check.

5-14. TROUBLESHOOTING.

5-15: CIRCUIT.VOLTAGES.

5-16. The schematic diagram of Figure 5-9 gives typical DC voltage values for the conditions listed in the notes. When a trouble is noted, check these voltages as a means of determining the faulty circuit or component.

5-17. POWER SUPPLY.

5-18. RESISTANCE MEASUREMENTS. Use an ohmmeter (e.g. @ Model 410C or Model 412A) and make resistance measurements to instrument chassis ground. These may be useful in locating possible shorted components. Readings specified are minimum and these values assume variable circuit controls are set to about mid-range. Disconnect power cord from source.

a. Measure at white wire of power cord (in either assembly A101 or A103). Resistance on X10K range should be minimum of $10K \Omega$.

.b. Measure at black wire of power cord. Resistance on X100 range should be minimum of 200 Ω .

c. Measure at ground pin of power plug. Resistance on X100 range should be 0Ω .

d. Measure at emitter of Q105. Resistance on X1K range should be minimum of 1500 Ω .

5-19. VOLTAGE: MEASUREMENTS. Connect a Model 1110A Current Probe at the Model 1111A input (with no probe attached, oscillations in the amplifiermay occur). These measurements will help determine if the DC voltage supplies are operating properly. Use a DC voltmeter (e.g. D Model 410C or Model 412A) and check voltages with respect to instrument

Section V Paragraphs 5-20 to 5-26

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a sha ka	able 5-3. Power Supply V	oltage Checks	
Measurement Point	Typical Voltage to	Ground	Allowable Range
White lead of power cord	+41Y		-36V to +46V
Black lead of power cord	-6.5V		-6.0V to -6.8V
Q105 emitter	+7.5V		+7.2V to +7.8V
Q105 collector	+24V		+20V to +29V

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chassis ground. Model'1111A should be connected to normal AC line voltage. Check voltages according to Table 5-3.

5-20. AMPLIFIER OSCILLATIONS.

5-21. Because of the positive feedback used in the amplifier circuit, oscillations may occur if adjustments R106, C104, C108, or C109 are not correct. If one of these adjustments seems incorrect, always follow the procedures of Paragraph 5-11 and do not make any arbitrary settings of the adjustments. To check the amplifier for oscillations proceed as follows:

a: Connect a Model 1110A Current Probe to the Model 1111A input;

- b. Connect the "output of the Model 1111A to the input of an AC Voltmeter (item 2 in Table 5-1).

c. Set the Voltmeter to the 0.3 volts scale.

d. Switch through all sensitivity ranges of the Model 1111A and check for a voltmeter reading with the Current Probe not attached to a current source. If an output occurs on this voltmeter range, an oscillation exists and Paragraph 5-11 should be followed.

5-22. REPAIR AND REPLACEMENT.

5-23. COMPONENT LOCATION.

5-24. Figures 5-6, 5-7, and 5-8 identify all the components of the Model 1111A which have reference designators. These components, and those miscellaneous parts having no designators, are listed in Section VI with replacement stock information.

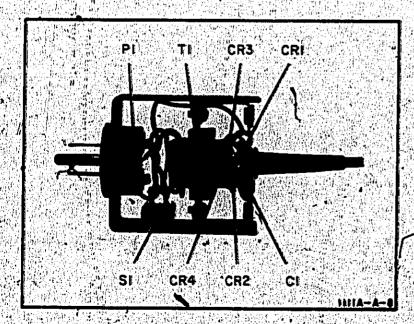


Figure 5-6. Power Supply Assembly

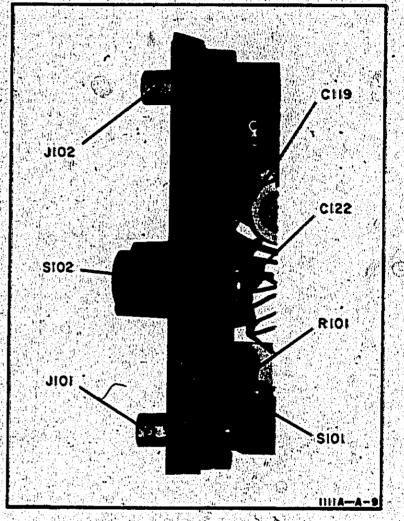


Figure 5-7. Front Panel and Sensitivity Switch Components

5-25. <u>REPLACING ETCHED CIRCUIT BOARD</u> COMPONENTS.

5-26. The etched circuit board, assembly A101, has components on one side of the board and the etched circuit conducting paths on the opposite side. The connection between sides of the board is completed by a plated conductive layer of metal through component holes. Hewlett-Packard Service Note M-20D also contains useful information on etched circuit repair. The important steps and considerations are:

a. Use a low heat (37 to 47.5 watts, less than 800° F idling temperature), slightly bent chisel tip (1/16 to 1/8 inch diameter) soldering iron, and a small diameter, high tin content solder. If a rosin solder is used, clean the area thoroughly after soldering.

b. Components may be removed by placing the soldering iron on the component lead on either side of the board, and pulling up on the lead. If heat is

Section V Paragraph 26 (cont'd)

applied to the component side of the board, greater care is required to avoid damage to the component (especially true for diodes). If heat damage may occur, grip the lead with a pair of pliers to provide a heat sink between the soldering iron and component.

c. If a component is obviously damaged or faulty, clip the leads close to the component and then unsolder the leads from the board.

d. Large components such as potentiometers and tube sockets may be removed by rotating the soldering iron from lead to lead and applying steady pressure to lift the part free (the alternative is to clip the leads of a damaged part).

e. Since the conductor part of the etched circuit board is a metal plated surface, covered with solder,

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Model 1111A

use care to avoid overheating and lifting the conductor from the board. A conductor may be cemented back in place with a quick drying acetate base cement (use sparingly) having good insulating properties. Another method for repair is to solder a section of good conducting wire along the damaged area.

f. Clear the solder from the circuit board hole before inserting a new-component lead. Heat the solder in the hole, remove the iron, and quickly insert a pointed non-metallic object, such as a toothpick.

g. Shape the new component leads and clip to proper length. Insert the leads in the holes and apply heat and solder, preferably on the conductor side.

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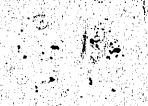


Table 5-4. Calibration and Component Replacement Record

For Hewlett-Packard Company Model 1111A Current Amplifier

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	CALIBRATION	
Date	Description of Calibration Made	Paragraph Procedure(s) Used



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esignator		Nature of Failur
· · · · · · · · · · · · · · · · · · ·	自己的话,我们就把我们有什么。我要你好想吗?"	و المركب المرجون العام المرجون الم

Date	Component Designator	Nature of Failure

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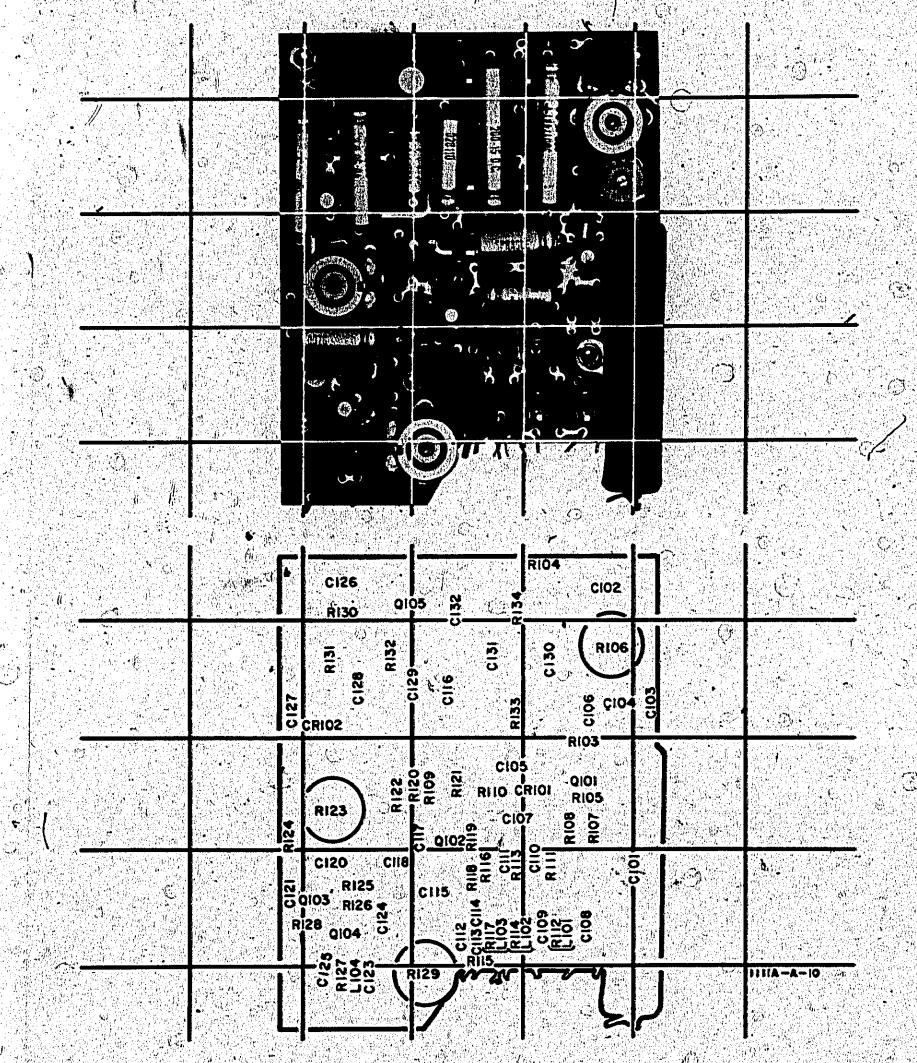
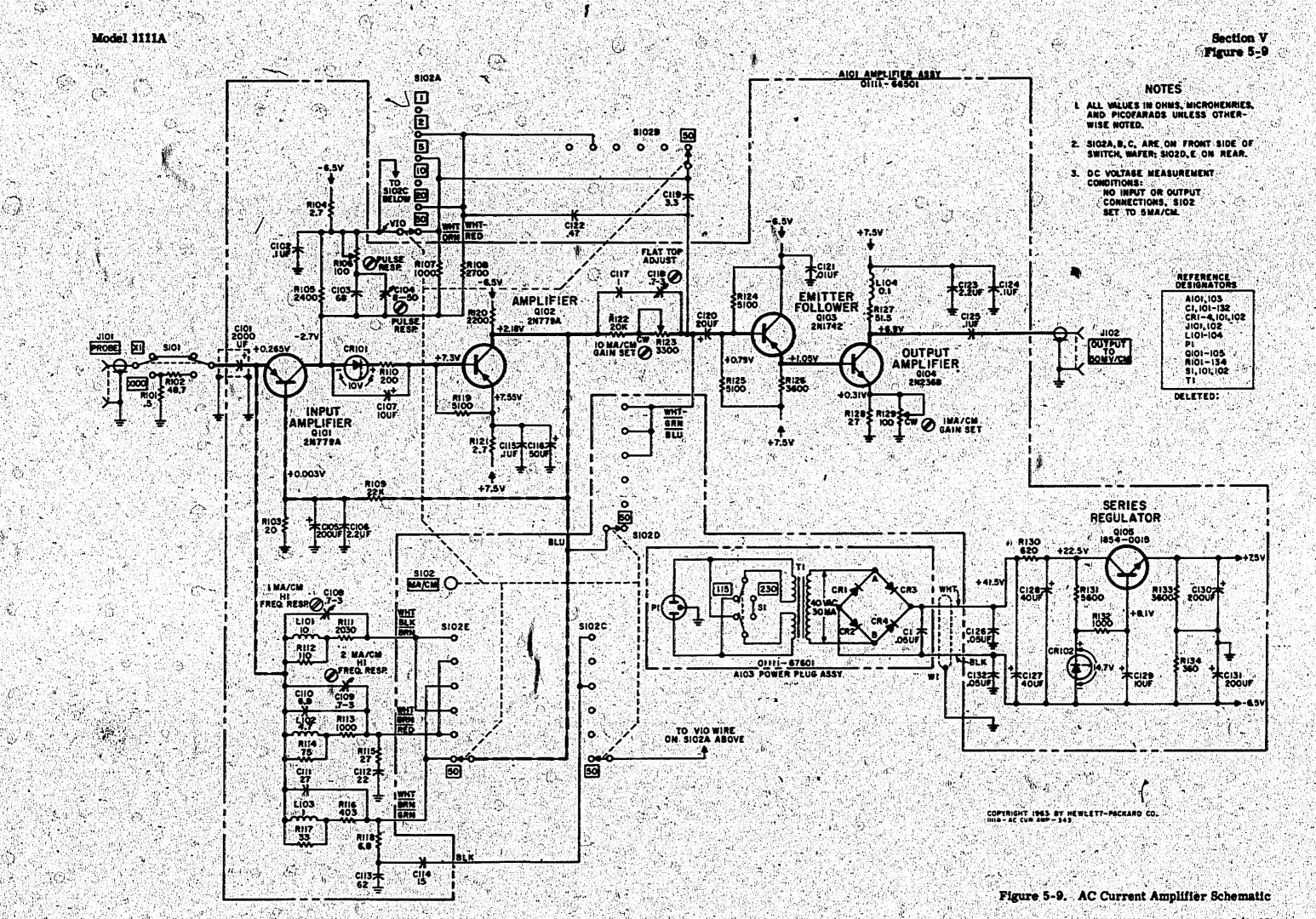


Figure 5-8. Etched Circuit Board Components

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SECTION VI

6-1. INTRODUCTION,

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphanumerical order of their reference designators and indicates the description and \oplus stock number of each part, together with any applicable notes. Table 6-2, lists parts in alpha-numerical order of their \oplus stock numbers and provides the following information on each part:

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in appendix.

c. Manufacturer's stock number.

d. Total quantity used in the instrument (TQ column).

e. Recommended spare part quantity for complete maintenance during one year of isolated service (RS column).

6-3. Miscellaneous and cabinet parts not indexed by reference designators are listed at the end of Table

6-4. ORDERING INFORMATION.

6-5. To order a replacement part, address order or inquiry either to your nearest Hewlett-Packard field office or to

> CUSTOMER SERVICE Hewlett-Packard Company 395 Page Mill Road Palo Alto, California

or, in Western Europe, to

Hewlett-Packard S.A. 54 Route des Acacias Geneva, Switzerland

6-6. Specify the following information for each part:

- a. Model and complete serial number of instrument.
- b, Hewlett-Packard stock number.
- c. Circuit reference designator.
- d. Description.

6-7. To order a part not listed in Tables 6-1 and 6-2, give a complete description of the part and include its function and location.

REFERENCE DESIGNATORS

A = assembly B = motor C = capacitor CR = diode DL = delay line	F = fuse FL = 1 tter J = ja k K = relay L = inductor	P = phag Q ⁽¹⁾ = cransistor R = resistor RT = thermistor S = switch	V = vacuum tube, neon bulb, photocell, etc. W = cable X = socket Y = crystal
DS = device signaling (lamp) E = misc electronic part	M = meter MP = mechanical part <u>ABBR</u>	T - transformer	Z : network
A # amperes BP = bandpass BWO = backward wave oscillator	F = farads FXD = fized GE = germanium	NC = normally closed - NE = neon - NO = normally open NPO = negative positive zero	S-B = slow-blow SE = selenium SECT = section(s) SI = silicon
CER = ceramic CMO = cabinet mount only COEF= coefficient COM = common	GLu = glass (GRD = ground(ed) H = benries HG = mercury	(zero temperature coefficient) NSR = not separately replaceable	SIL = silver. SL = slide SPL = special TA = tantalum
COMP composition CONN connection CRT = cathode-ray tube	HR = hour(s) - IMPG = impregnated NCD = incandescent	OBD = order by description OX = oxide	TD = time delay TI = titanium dioxide TOG = toggle TOL = tolerance
DEPC= deposited carbon EIA = Tubes or transistors meeting Electronic Industries' Associa	INS = : insulation(ed) K = kilo = 1000 LIN = linear taper	P.f. = peak PC = printed circuit board PF = picofarads = 10 ⁻¹² farads	TRIM= trimmer TWT = traveling wave tube U = micro = 10 ⁻⁸ VAC = vacuum
normally result in instrument operating within specifications; tubes and transistors	LOG' = bgarithmic taper	PP = peak-to-peak- PIV = peak inverse voltage POR = porcelain POS = position(s)	VAR = variable W/ = with W = watts WW = wirewound
selected for best performance will be supplied if ordered by Getock numbers.	MINAT = miniature METFIM = metal film MPR = manufacturer MOM = momentary	POLY= polystyrane POT = potentiometer RECT= rectifier ROT = rotary	W/O = without • optimum value : selected at factory, average value
ELECT = electrolytic ENCAP = encapsulated	MTG = sounting MY = mylar	RMS = root-mean-square RMO = rack mount only	shown (part may be omitted)

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Section VI Table 6-1

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Table 8-1. Reference Designation Index

- Circuit Reference	Stock No.	Description	Note
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A1 A2 A3 A4 THRU	01111-86003 01111-86002 01111-86001	INDUCTOR/RESISTOR:10 UH/110 OHM INDUCTOR/RESISTOR:4.7 UH/75 OHM INDUCTOR/RESISTOR:1.0 UH/33 OHM	
A100		NOT ASSIGNED	
A101- A102 A103	01111-66501 01111-61901 01111-67601	ASSY: AMPLIFIER ASSY: SWITCH ASSY: POWER PLUG	
C2 THRU	0150-0096	C:FXD CERTO.05 UF LOOVDCW	
C100 C101 C102 C103	01111-80701 0150-0084 0140-0192 1	NOT ASSIGNED ASSY:CAPACITOR 2000 UF C:FXD CER 1 UF +80-20% 50VDCW C:FXD MICA 68 PF 5% 300VDCW	
C104 C105 C106 C107 C108	0130-0017 0180-0060 0160-0128 0180-0059 0132-0005	C:VAR CER 8-50 PF N750 C:FXD ELECT 200 UF +100-10% 3VDCW C:FXD CER 2.2 UF 20% 25 VDCW C:FXD ELECT 10 UF +100-10% 25VDCW C:VAR POLY 0.7-3 PF 350VDCW	
C109 C110 C111 C112 C112 C113	0132-0005 0150-0047 0140-0042 0140-0145 0140-0205	C:VAR POLY 0.7-3 PF 350VDCW C:FXD TI 6.8 PF 10% 500VDCW C:FXD MICA 27 PF 5% 500VDCW C:FXD MICA 22 PF 5% 500VDCW C:FXD MICA 62 PF 5% 300VDCW	
C114 C115 C116 C117 C118	0140-0101 0150-0084 0180-0058 0150-0029 0132-0005	C:EXD MICA 15 PF 5% 500VDCW C:FXD CER .1 UF +80-20% 50VDCW C:FXD ELECT 50 UF +100-10% 25VDCW C:FXD TI 1 PF 10% 500VDCW C:FXD TI 1 PF 10% 500VDCW	
C119 C120 C121 C122 C122 C123	0150-0059 0180-0076 0150-0012 0150-0021 0160-0128	C:FXD CER 3.3 PF +/-NPO 600VDCW C:FXD ELECT 20 UF 25VDCW C:FXD CER 0.01 UF 20% 1KV C:FXD TI 0.47 PF 5% 500VDCW C:FXD CER 2.2 UF 20% 25VDCW	
C124 C125 C126 C127 C128	0150-0084 0150-0084 0150-0052 0180-0050 0180-0050	C:FXD CER .1 UF +80-20% 50VDCW C:FXD CER .1 UF +80-20% 50VDCW C:FXD CER 0.05 UF 20% 400VDCW C:FXD ELECT 40 UF +100-15% 50VDCW C:FXD ELECT 40 UF +100-15% 50VDCW	
Č129 C130 C131 C132	0180-0059 0180-0104 0180-0104 0150-0092	C:FXD ELECT 10 UF +100-10% 25VDCW C:FXD ELECT 200 UF 15VDCW C:FXD ELECT 200 UF 15VDCW C:FXD ELECT 200 UF 15VDCW C:FXD CER 0.05 UF 20% 400VDCW	
CR1 CR2 CR3 CR4 CR5 THRU	1901-0025 1901-0025 1901-0025 1901-0025	SEMICON DEVICE : DIODE JUNCTION SEMICON DEVICE : DIODE JUNCTION SEMICON DEVICE : DIODE JUNCTION SEMICON DEVICE : DIODE JUNCTION	
CRIOO		NOT ASSIGNED	
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Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	. Description	Note
- CR101 CR102	1902-0025 1902-0078	SEMICON DEVICE DIODE ZENER 10V SEMICON DEVICE DIODE ZENER 14.7V	
J101 - J102	1250-0123 1250-0123	CONNECTOR BNC	
L101 L102 L103 *	01111-86004	N.S.R. PART OF A1 N.S.R. PART OF A2 N.S.R. PART OF A3 INDUCTOR:0.1 UH	
P1	1251-0348	PLUG:POWER	
Q101 Q102 Q103 Q104 Q105 /	1850-0075 1850-0075 1850-0055 1854-0019 1854-0015	TRANSISTOR: GE 2N779A PNP TRANSISTOR: GE 2N779A PNP TRANSISTOR: GE 2N1742 PNP TRANSISTOR: 2N2368 TRANSISTOR: SI 2N375 NPN	
R101 R102 R103 R104 R105	0727-0899 0721-0028 0683-2005 0699-0001 0683-2425	R:FXD DEPC .5 OHM 2% 1/2W (DISC RESISTOR) R:FXD DEPC 48.7 OHM 1% 1/8W R:FXD COMP 20 OHM 5% 1/4W R:FXD COMP 2.7 OHM 10% 1/2W R:FXD COMP 2400 OHM 5% 1/4W	
R106 R107 R108 R109 R110	2100-0108 0683-1025 0683-2725 0683-2235 0683-2015	R:VAR COMP 100 OHM 10% LIN 1/3W R:FXD COMP 1.0K OHM 5% 1/4W R:FXD COMP 2.7K OHM 5% 1/4W R:FXD COMP 22K OHM 5% 1/4W R:FXD COMP 200 OHM 5% 1/4W	
R111 R112 R113 R113 R114 R115	0727-0116 0727-0100 ** 0683-2705	R:FXD DEPC 2.03K OHM 1% 1/2W N.S.R. PART OF A1 R:FXD DEPC 1K OHM 1% 1/2W N.S.R. PART OF A2 R:FXD COMP 27 OHM 5% 1/4W	
R116 R117 R118 R119 R120	0727-0072 0683-0685 0683-5125 0683-2225	R: EXD DEPC 403 OHM 1% 1/2W N.S.R. PART OF A3 R: FXD COMP 6.8 OHM 5% 1/4W R: FXD COMP 5.1K OHM 5% 1/4W R: FXD COMP 2.2K OHM 5% 1/4W	
R121 R122 R123 R124 R124 R125	0699-0001 0727-0173 2100-0182 0683-5125 0683-5125	R:FXD COMP 2.7 OHM 10% 1/2W R:FXD DEPC 20K OHM 1% 1/2W R:VAR COMP 3.3K OHM 10% LIN 3/10W R:FXD COMP 5.1K OHM 5% 1/4W R:FXD COMP 5.1K OHM 5% 1/4W	
R126 R127 R128 R129 R130	0683-3625 0727-0025 0683-2705 2100-0108 0689-6215	R:FXD COMP 3.6K OHM 5% 1/4W R:FXD DEPC 51.5 OHM 1% 1/2W R:FXD COMP 27 OHM 5% 1/4W R:VAR COMP 100 OHM 10% LIN 1/3W R:FXD COMP 620 OHM 5% 1W	
R131 R132 R133 R134	0687-5621 0687-1021 0686-3625 0686-3615	R:FXD COMP 5.6K OHM 10% 1/2W R:FXD COMP 1K OHM 10% 1/2W R:FXD COMP 3.6K-OHM 5% 1/2W R:FXD COMP 360 OHM 5% 1/2W	
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Section VI Table 6-1

6-4

Model 1111A

Circuit Reference	Stock No.	Description	Note
S1 S2 THRU	3101-0033	SWITCH:SLIDE DPDT	
\$100 \$101 \$102	3101-0070	NOT ASSIGNED SWITCH:SLIDE DPDT SWITCH:ROTARY 1 SECTION,6 POSITION	
n	9100-0183	TRANSFORMER : POWER	
		MISCELLANEOUS	
	0370-0104 01111-07601 01111-46101 01111-61601 5000-0023 5000-0082	KNOB:MA/CM COVER FOR PLUG ASSEMBLY A103 TERMINAL BOOT:CABLE CABLE:POWER BODY:CABINET PLATE:CABINET SIDE	
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Section VI Table 6-2

Table 6-2. Replaceable Parts

Stock No.	Description #	Mír.	Mir. Part No.	ΤQ	R
0130-0017 0132-0005 0140-0042 0140-0101 0140-0145	C:VAR CER 8-50 PF N750 C:VAR POLY 0.7-3 PF 350 VDCW C:FXD M1CA 27 PF 5% 500VDCW C:FXD M1CA 15 PF 5% 500VDCW C:FXD M1CA 22 PF 5% 500VDCW	00853	535-031-4R TYPE DR1427 E5	3	
0140-0192 0140-0205 0150-0012 0150-0021 0150-0029	C:FXD MICA 68 PF 5% 300VDCW C:FXD MICA 62 PF 5% 300VDCW C:FXD CER 0.01 UF 20% 1KV C:FXD TI 0.47 PF 5% 500VDCW C:FXD TI 1 PF 10% 500VDCW	04062 04062 56289 78488 78488			
0150-0047 0150-0052 0150-0059 0150-0084 0150-0096	C:FXF TI 6.8 PF 10% 500VDCW C:FXD CER 0.05 UF 20% 400VDCW C:FXD CER 3.3 PF +/-NPO 600VDCW C:FXD CER 1 UF +80-20% 50VDCW C:FXD CER 0.05 UF 100VDCW	78488. 05729 72982 56289 91418	TYPE GA 20X503 MC4 301 000 COJ0 339C 33C41 TA	1 2 1 4	
0160-0128 0180-0050 0180-0058 0180-0059 0180-0059	C:FXD CER 2.2 UF 20% 25VDCW C:FXD ELECT 40 UF +160-15% 50VDCW C:FXD ELECT 50 UF +100-10% 25VDCW C:FXD ELECT 10 UF +100-10% 25VDCW C:FXD ELECT 200 UF +100-10% 3VDCW	56289 56289 56289 56289 56289 56289	5015 D 32538 TYPE 300186A1 300 106G 025 300116 A1	22121	うちたい人気のな
0180-0076 0180-0104 0370-0104 0683-0685 0683-1025	C:FXD ELECT 20 UF 25VDCW C:FXD ELECT 200 UF 15VDCW KNOB R:FXD COMP'6.8 OHW 5% 1/4W R:FXD COMP 1.0K OHM 5% 1/4W	56289 56289 28480 01121 01121		INNII	
0683-2005 0683-2015 0683-2225 0683-2235 0683-2235	R : FXD COMP 20 0HM 5% 1/4W R : FXD COMP 200 0HM 5% 1/4W R : FXD COMP 2.2K 0HM 5% 1/4W R : FXD COMP 2.2K 0HM 5% 1/4W R : FXD COMP 2400 0HM 5% 1/4W	01121 01121 01121 01121 01121 01121	CB 2015 CB 2225	111111111	
0683-2705 0683-2725 0683-3625 0683-5125 0686-3615	R:FXD COMP 27 OHM 5% 1/4W R:FXD COMP 2.7K OHM 5% 1/4W R:FXD COMP 3.6K OHM 5% 1/4W R:FXD COMP 5.1K OHM 5% 1/4W R:FXD COMP 360 OHM 5% 1/2W	01121 01121 01121	CB 2705 CB 2725 CB 3625 CB 5125 EB 3615	21131	
0686-3625 0687-1021 0687-5621 0689-6215 0699-0001	R:FXD COMP 3.6K OHM 5% 1/2W R:FXD COMP 1K OHM 10% 1/2W R:FXD COMP 5.6K OHM 10% 1/2W R:FXD COMP 620 OHM 5% 1W R:FXD COMP 2.7 OHM 10% 1/2W	01121 01121	EB 3625 EB 1021 EB 5621 GB 6215 GB 27G1	11112	
0721-0028 0727-0025 0727-0072 0727-0100 0727-0116	R:FXD DEPC 1K OHM 1% 1/2W 4 R:FXD DEPC 2.03K OHM 1% 1/2W	19701 19701 19701 19701 19701 19701	DC1/8A DC1/2CR5 DC1/2CR5 CD1/2CR5 DC1/2CR5 DC1/2CR5	11	
0727-0173 0727-0899 1250-0123 1251-0348 1850-0055	R:FXD DEPC 20K OHM 1% 1/2W R:FXD DEPC .5 OHM 2% 1/2W CONNECTOR:BNC PLUG:POWER TRANSISTOR:GE 2N1742 PNP		DC1/2CR5 0727-0899 UG-1094/U 160-11 2N1742	71211	
850-0075 854-0015 854-0019	TRANSISTOR:GE 2N779A PNP TRANSISTOR:SI 2N375 NPN TRANSISTOR:2N2368	87216 28480 07263	2N779A 1854-0015 S-5781	2	2]]

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Section VI Table 6-2

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Model 1111A

	"Table 6-2. Replaceable Parts	(Cont'd)			
🖗 Stock No. 🦳	Description#	Mfr.	Mír. Part No.	TQ	RS
1901-0025 1902-0025 , 1902-0078	SEMICON DEVICE DIDDE JUNCTION SEMICON DEVICE DIDDE SI ZENER 10V SEMICON DEVICE DIDDE ZENER 14.7 V	28480 28480 28480	1901-0025 1902-0025 1902-0078	411	011
01111-07601 01111-46101 01111-61601 01111-61901 01111-66501	COVER FOR PLUG ASSEMBLY A103 TERMINAL BOOT:CABLE CABLE:POWER ASSY:SWITCH ASSY:AMPLIFIER	28480 28480 28480 28480 28480 28480	01111-07601 01111-46101 01111-61601 01111-61901 01111-66501	нднгд	00000
01111-67601. 01111-80701 01111-86001 01111-86002 01111-86003	ASSY: POWER PLUG ASSY: CAPACITOR 2000 UF INDUCTOR/RESISTOR: 1.0 UH/33 OHM INDUCTOR/RESISTOR: 4.7 UH/75 OHM INDUCTOR/RESISTOR: 10 UH/110 OHM	28480 28480 28480 28480 28480 28480	01111-67601 01111-80701 01111-86001 01111-86002 01111-86003	нннн	100000
01111-86004 2100-0108 2100-0182 3100-0427 3101-0033	INDUCTOR:0.1 UH R:VAR COMP 100 OHM 10% LIN 1/3W R:VAR COMP 3.3K OHM 10% LIN 3/10W SWITCH:ROTARY 1 SECTION,6 POSITION SWITCH:SLIDE DPDT	28480 11237 28480 28480 42190	01111-86004 WPE 70 2100-0182 3100-0427	HUNHH	01100
3101-0070 5000-0023 5000-0082 9100-0183	SWITCH:SLIDE DPDT BODY:CABINET PLATE:CABINET SIDE TRANSFORMER:POWER	79727 28480 28480 28480	126-8 5000-0023 5000-0082 9100-0183	HANH	0000
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See introduction to this section

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Appendix

APPE NDIX

CODE LIST OF MAN URERS (She

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

Net	Manufacturer	Adhesi
		변화 중 안전한 전통 같다.
0013		Nount Holly Springs, Pa.
	L Humidaib Ca. Nestrex Corp.	Collag. Calls.
	Barloch Paching Co.	
26.2	Electronic Products.	Div. Canden, R. J.
00856	Aerovan Corp.	. Hew Bedlard, Mass.
00775		Harrisburg, Pa.
00781		Boonton, N. J. boratories, Inc.
		Burlington, Wis.
00853	Sangamo Electric Campa	and the second
	Ordilb Divition (Cana	eitnest A Maelan 110
00465	Goe Engineering Co.	Los Angeles, Calif.
00131	Carf E. Heines Corp.	Las Argeies, Calif.
01255	Allen Bradley Co. Litton Industries., Inc.	Hilwoukes, Wis.
	Pacific Semiconductors	Beverly Nilts, Calif.
	Texas Instruments, lac.	States of the Second Second
16	Transistor Products (
	The Alliance Mig. Co.	Alliance, Gate
	Chassi-Trak Corp.	Indianopolis, Ind.
01505	Ameroch Corp	Yan Reys, Calif. Rockford, III.
01562	Pulse Engineering Co.	Santa Clara, Calif. 400
02114	Ferrozcabe Corp. all Ama Cale Mig., Gu.	tica Sugnities, M.Y.
02216	Cale Mig., Co. 199	Pale Alto, Calif.
. 02660	- Anghanoi-Borg Electroni	Chicare, III.
w/35	Radio Colle of America,	Semiconductor Somerville_ R. J.
		inc. Old Seybrook, Cunr.
,02177	-Hontins Entimenting Ca.	Sam Fernande,, Calif:
)03564	G.E. Semiconductor Prod	ets Dast, Svencusa, N.Y.
03705	Apen Machine & Toolf Co.	Dayton, Ohia
03797	Eldens Corp.	El Nonte, Calif.
03477	Transition Electionic Ca	p. Wakefield, Hass.
03954	Pyrofilm Resiston Co. Are Marine Notors, Inc	Herristeun, N. J. Ees Angeles, Calif.
	Atten, Hart and Hegeman	
1.1		Hartford, Cane,
04062	Elmenca Products Ca.	New York, N. W.
94227	Hi-Q Division of Acroven	Wyrtin Beach, S. C.
04298	Eigin National Walch Co.	
11 U.S	. Electronics Division	ALL COURT STREET
	Dunnet Division of New Int	Burbank, Calif.
84404	Dynes Division of Kenlet	I-Packard Cal
04630	in the second states	I-Packard Ca. Pale Alle, Calif.
04630	Sylvania Electric Prods. Electronic Tubo Div.	I-Packard Co. Palo Allo, Calif. Inc. Wountain Ylaw, Calif.
$\mathbf{x}, \mathbf{x} \in \mathbb{C}$	Sylvania Electric Prods. Electronic Tube Div. Materala, Inc., Senicond	It-Packard Co. Palo: Allo: Calif. Inc. Mountain Ylew, Calif. Inco: Prod. Div.
0465 D 04713	Sylvania Electile Prods. Electronic Tube Div. Hoterala, Inc. Semicond	It-Packard Co. Pale Allo, Calif. Inc. Mountain Ylew, Calif. scior Prod. Div. Phoenis, Arizona
04631 04713 04773	Sylvania Electric Prods. Electronic Tube Div. Motarala, Inc., Semicond Ritton Ca., Inc., Western	It-Packard Co. Palo: Allo: Calif. Inc. Mountain View, Calif. Joint Div. Phoesis, Arizona Div. Culver City, Calif.
04631 04713 04773	Sylvana Electile Prods. - Electrone Tobo Div. Materala, Inc., Senicond Ritton Ca., Inc., Western Automatic Electric Ca.	II-Packard Ca. Raio Allo, Calif.
04650 04713 04713 04773	Sylvania Electile Prods. Electronie Tube Div. Muterala, Inc., Semicond Rittom Ca., Mc., Western Automatic Electric Ca. Automatic Electric Sales	II-Packard Ca. Pala Allo, Calif. Ins. • Nountain View, Calif. uctor Prod. Div. Phoenis, Arizena Div. Cuiver City. Calif. Northlake, III. Corp. Northlake, III.
04650 04713 04713 04773 04773 04777 04776 04796 04970	Sylvana Electile Prod., Electrone Tube Div. Baterala, Inc., Soncodo Ritton Ca., mc., Vestera Automatic Electure Ca. Automatic Electure, Sales Sequoia Vice & Cable Ca.	I-Packard Ca. Pale Allo, Calif. Int. Buentain Ylew, Calif. Int. Proonis, Arizena Div. Celver City, Calif. Northiake, III. Rodward City, Calif.
04650 04713 04713 04732 04773 04773 04774 04796 04070 05006	Sylvana Electile Prods. - Electine Tabo Dr. Vatorala, Inc., Sencond Elitton Ca., Inc., Western Automatic Electric Ca. Astonatic Electric Sales: Sequoia Tire & Cable Ca. - M., Wolfer Company Twenhelt-Cestury Plastic	II-Packard Ca. Raio Allo, Calif. Ins. * Hountain View, Calif. scior Prod. Div. Phoenis, Arizona Oiv. Cuives City, Calif. Rothlabe, III. Rothlabe, III. Rothlabe, III. Chicage 14, III. 11, Inc.
04650 04713 04713 04773 04773 04773 04776 04796 04970 05006	Sylvana Electile Prod., Electrone Tabo Div. Buterala, Inc., Soncood Butterala, Inc., Soncood Automatic Electure Ca. Automatic Electure Sales Iseanaia Ture & Cable Ca. P. M. Moter Conpany Twendet: Century Plantia	I-Packard Ca. Pale Alle, Calif. Inc. Bountain View, Calif. Poonis, Arizana Div. Cuiver City. Calif. Northlake, 37. Corp. Northlake, 37. Corp. Northlake, 111. Rodwood City, Calif. Chicage 44, 111. N. Inc. Las Angeles, Calif.
04650 04713 04713 04732 04773 04773 04774 04796 04070 05006	Sylvanie Electile Prods. - Electione Tubo Dr. Voterela, Inc., Senicond - Elittom Ca., Inc., Vesteino Automatic Electing Ca. Automatic Electing Sales: Seenoin Tire & Cable Ca. - M. Moler Company Ywenheth Century Plastic Vestingbouse Electric Ca	I-Packard Co. Palo Allo, Calif. Inc. Mountain View, Calif. Inc. Phoenis, Arizona Div. Culver City. Calif. Northlake, 155. Corg. Northlake, 155. Corg. Northlake, 111. Chicage 44, 112. 5. Aegeles, Calif.
04650 04713 04713 04773 04773 04773 04776 04796 04970 05006	Sylvana Electile Prod., Electrone Tabo Div. Buterala, Inc., Soncood Butterala, Inc., Soncood Automatic Electure Ca. Automatic Electure Sales Iseanaia Ture & Cable Ca. P. M. Moter Conpany Twendet: Century Plantia	I-Packard Ca. Pale Alle, Calif. I.S. * Hountain View, Calif. scice Prod. Div. Phoenix, Arizona Div. Cuiver City, Calif. Northiake, III. Rodmood City, Calif. Chicage 44, III. n. Inc. Las. Angeles, Calif. Y engreed, Pa.
04650 04713 04713 04773 04773 04773 04776 04796 04870 05006 05006 05277 05342 05593	Sylvanie Electile Prods. - Electione Tubo Dr. Wolevela, Inc., Senicond - Elittom Ca., Inc., Westeins Automatic Electine Ca. Automatic Electine Sales: Senios Dire & Cable Ca. P. M. Woler Company Twenfielt Crebus Plastia Westingbouse Electric Car Seni-Candecter Dept. Ultranis, Inc.	I-Packard Co. Palo Allo, Calif. Inc. Mountain View, Calif. Corp. Div. Phoenis, Arizona Div. Culver City. Calif. Northlake, 18. Corp. Northlake, 18. Corp. Northlake, 18. Corp. Northlake, 18. Corp. Antheory City, Calif. Chicage 44, 18. S. Las Aegebes, Calif. B. Youngrood, Pal. Sen Maton, Calif.
04650 04713 04713 04773 04773 04773 04775 04794 04870 05006 05006 05277 05342 05593 05624	Sylvania Electile Prods. - Electione Tabo Dr. Voterela, Inc., Senicond Elitton Ga., Inc., Westenn Automatic Electric Ca. Actonatic Electric Ca. Actonatic Electric Sales: Sequent Tire & Cabler Ca. - M, Wither Company Twenheth Century Plastic Vestingsonse Electric Ca Sequences Electric Capace Sequences Canadector Oppt. Ultronic, Inc. Barber Colman Ca.	I-Packard Co. Palo Allo, Calif. Inc. Wountain View, Calif. Inc. Phoeniz, Arizana Div. Culver City. Calif. Northiake, 115. Corg. Northiake, 115. Corg. Northiake, 115. Corg. Northiake, 115. Corg. And City, Calif. Chicage 44, 115. San Angeles, Calif. San Bates, Calif. San States, Calif. Rockford, 116. Rockford, 116.
04650 04713 04713 04773 04773 04773 04775 04794 04870 05006 05006 05277 05342 05593 05624	Sylvania Electile Prods. - Electione Tabo Dr. Voterela, Inc., Senicond Elitton Ga., Inc., Westenn Automatic Electric Ca. Actonatic Electric Ca. Actonatic Electric Sales: Sequent Tire & Cabler Ca. - M, Wither Company Twenheth Century Plastic Vestingsonse Electric Ca Sequences Electric Capace Sequences Canadector Oppt. Ultronic, Inc. Barber Colman Ca.	I-Packard Co. Palo Allo, Calif. Inc. Wountain View, Calif. Inc. Phoeniz, Arizana Div. Culver City. Calif. Northiake, 115. Corg. Northiake, 115. Corg. Northiake, 115. Corg. Northiake, 115. Corg. And City, Calif. Chicage 44, 115. San Angeles, Calif. San Bates, Calif. San States, Calif. Rockford, 116. Rockford, 116.
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04650 04713 04713 04773 04773 04773 04775 04794 04870 05006 05006 05277 05342 05593 05624	Sylvania Electile Prods. - Electione Tabo Dr. Voterela, Inc., Senicond Elitton Ga., Inc., Westenn Automatic Electric Ca. Actonatic Electric Ca. Actonatic Electric Sales: Sequent Tire & Cabler Ca. - M, Wither Company Twenheth Century Plastic Vestingsonse Electric Ca Sequences Electric Capace Sequences Canadector Oppt. Ultronic, Inc. Barber Colman Ca.	I-Packard Co. Palo Allo, Calif. Inc. Wountain View, Calif. Inc. Phoeniz, Arizana Div. Culver City. Calif. Northiake, 115. Corg. Northiake, 115. Corg. Northiake, 115. Corg. Northiake, 115. Corg. And City, Calif. Chicage 44, 115. San Angeles, Calif. San Bates, Calif. San States, Calif. Rockford, 116. Rockford, 116.
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04655 04713 04713 04713 04773 04773 04775 04796 04796 04796 05789 05789 05789 05789 05006 05789 05006 05135 06175 06175	Sylvanie Electile Prods. - Electione Theb Drv Walerela, inc., Senicond Tiltion Ca., Inc., Westein- Automatic Electine Ca. Automatic Electine Ca. P. M. Water Company Twenfielt Cestury Plastie Vestingbouse Electric Car Senic Candecter Dept. Ultrain: Inc. Bastor Cala. Division Stewart Engineering, Ca. The Bassick Ca. Division Stewart Engineering Ca. The Bassick Ca. Bustor Cal. Division Stewart Engineering Ca. The Bassick Ca. Bustor Cal. Division Stewart Engineering Ca. The Bassick Ca.	I-Packard Ca. Pale Allo, Calif. Iduntain View, Calif. Noontain View, Calif. Poonis, Arizana Div. Cuiver City. Calif. Northlake, 37. Corp. Northlake, 111. Rodwood City. Calif. Chicage 14. 112. Tengreed, Pa. San Bateo, Calif. B. Tengreed, Pa. San Bateo, Calif. Roklaid, 38. Sanayvale, Calif. Brokhyn, N.Y. Sants Crar. Calif. Bridgrapht, Can. Les Angelet, Calif. Bridgrapht, Can. Les Angelet, Calif. Com. Reckaid, 38. Paracesh, N.Y.
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	Robert M, Hadley Co.	as Angeles, Calif.
72562	Robert M, Hadley Co. Eye Resistor Corp.	
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79251	Wesco Mig. Co.	Chicago, Ill.
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Appendix

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Revised: Sept. 11, 1963

CODE LIST OF MANU TURERS (Sheet 2 of 2)

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17716	Philes Corporation (Lansdale	41145	Raytheon Mrg. Co., Semicon	luctor Div	491.47	Ares Biothers Inc.	Janaica, M.Y.	00006	Hales Teel and Die	Los Angeles, Calif.
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ามมา	Western Fibrous Glass Products: Ca.	satia	Scientific Radio Products, In			Hictodol, Inc.	Sa. Pasadena, Cant.		Ind. Inc.	Refwood City, Calif.
1	San Francisco, Calif.		Real States and States	Loveland, Calo.		Sealectra Corp.	Hamajonech, M. Y.	00500	Rahm-Bros. Soring Co.	San bandin, Calif." -
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	Cutles-Hammer, Inc		Curbss-Wright Corp.			North Hills Electric Co.	Mineola, R.Y.		Texas Instruments, Inc.	
16220	Goold-Rational Batteries, Inc. St., Paul, Mine,		Electionics Div.	East Paterson, M.J.		Clavite Transiston Prod.			Wetals, and Controls, Day,	Versaulies, Ky.
11472	General Electric Distributing Corp.	94310	Tro Dan Prod: Div. of Nodel			Un. of Clevile Curs.	Wallhow, Mass.	00000	Touer Hig; Carp.	Pravidence, R.L.
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	Wiffer Dial & Haneplate Co. El Nonte, Calif.		National Cost Co.	Sheridan, Wye.		Delevan Electronics Corp.	East Awara, W.Y.			Yan Xuys, Calif.
	Radio Materials. Co.		Vittanton, Inc.	Bridgeport, Conn.		Tiles Carperation	indianapolis, Indiana		Computer Diode Corp.	Loli, H.J.
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	Bassett, Pvente, Calif.		Cariton Screw Co.	Chicigo, UK		SSIGNED IN THE LATES			A ""N" C Nanulacturing Co.	
91112	Sutvania Electric Prod. Inc.		Miciowaye Associates, Inc.			FEDERAL SUPPLY COD			Atohm Electronics	Sun Yalley, Calif.
	Semiconductor Dry. Woburn, Mass.		Escel Translainer Co.	Catland, Calif.		RS HANDBOOK			Cooliton	Oakland, Calif.
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All our products are warranted against defects in materials and workmanship for one year from *b* the date of shipment. Our obligation is limited to repairing or replacing products (except tubes) which prove to be defective during the warranty period. We are not liable for consequential damages.

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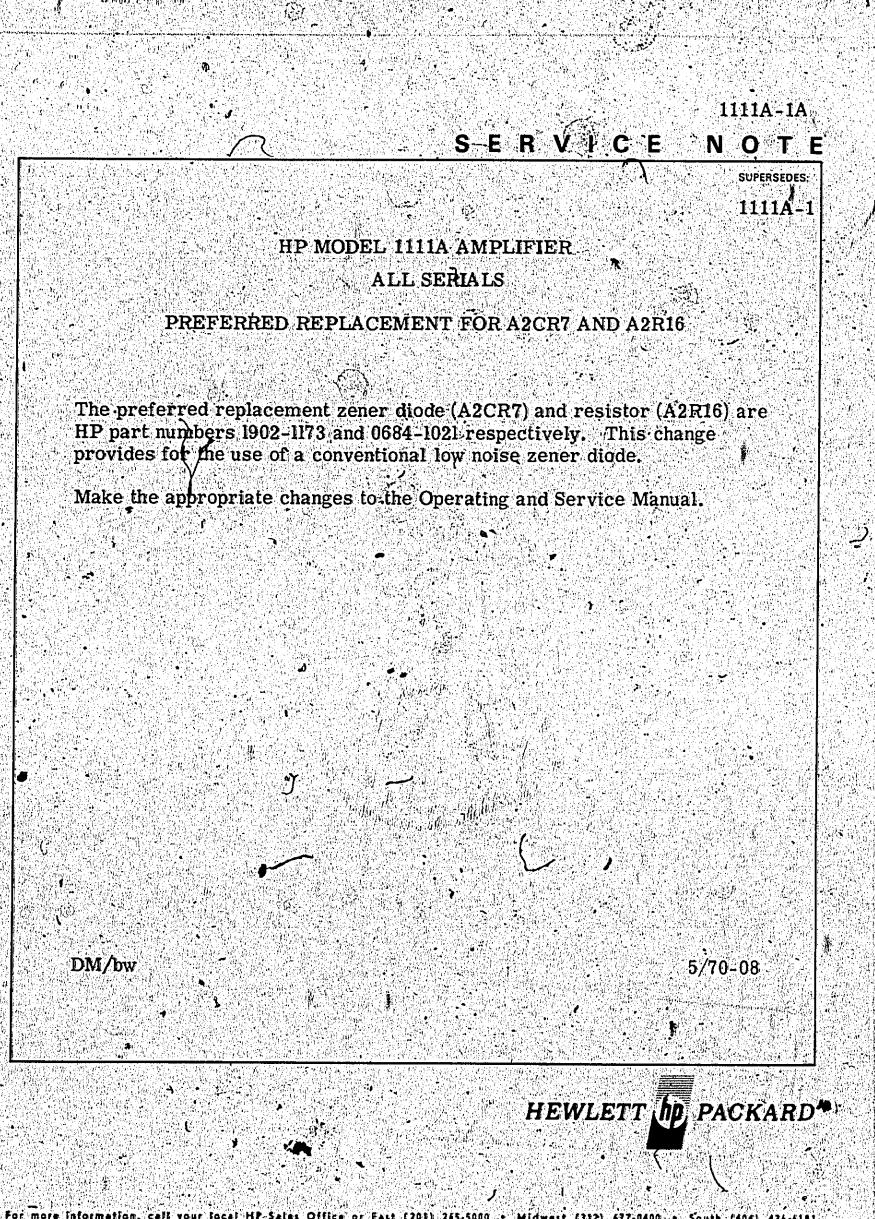
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