Errata

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Agilent Technologies

OPERATING AND SERVICE MANUAL

MODEL 1111A

SERIAL PREFIXED: 343-

AC CURRENT AMPLIFIER

01862-1

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GENERAL INFORMATION

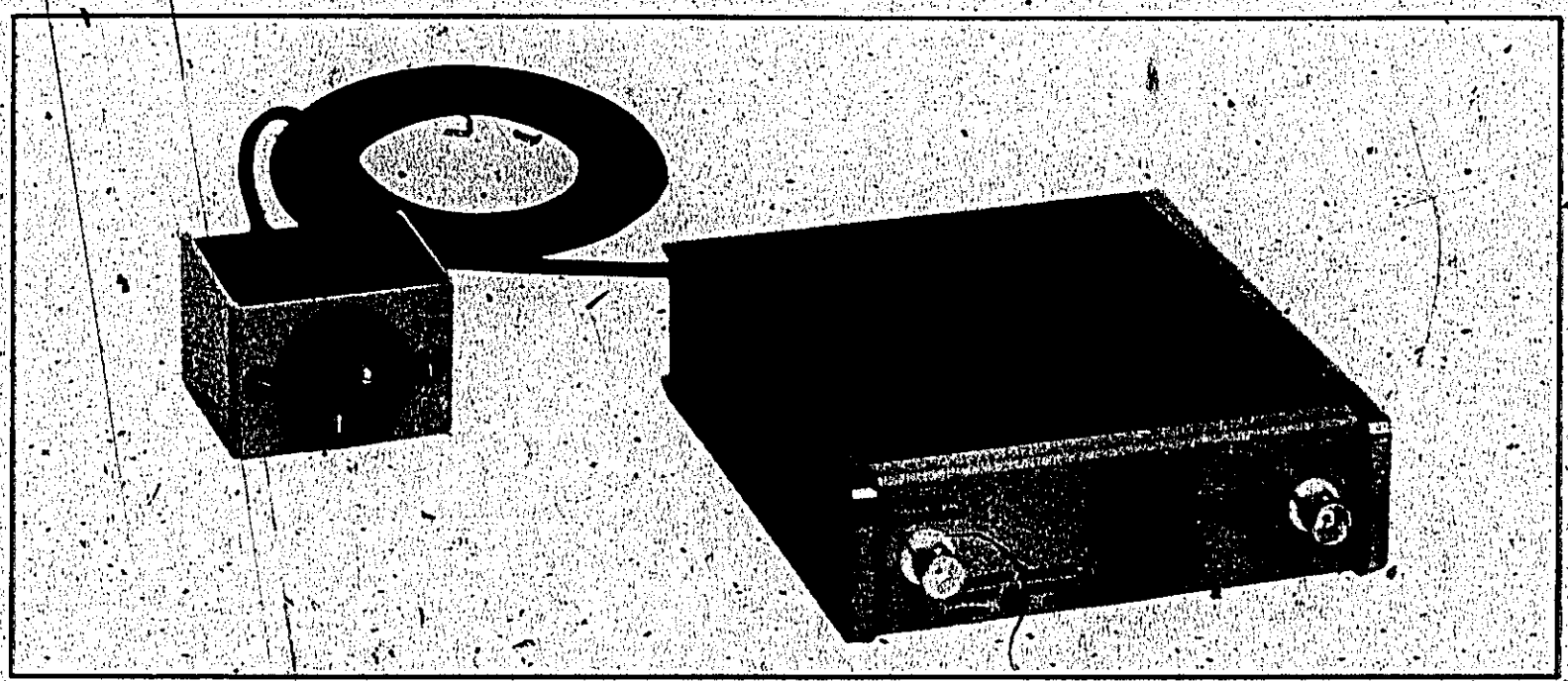


Figure 1-1. Model 1111A AC Current Amplifier

Table 1-1. Specifications for Model 1111A with Model 1110A 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:
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

OUTPUT IMPEDANCE:
50 ohms

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

WEIGHT:
Approximately 2 lb

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

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, wide-band 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 centimeter deflection 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 two-section, 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 ±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 three-pin 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.

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".

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.

OPERATION

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.

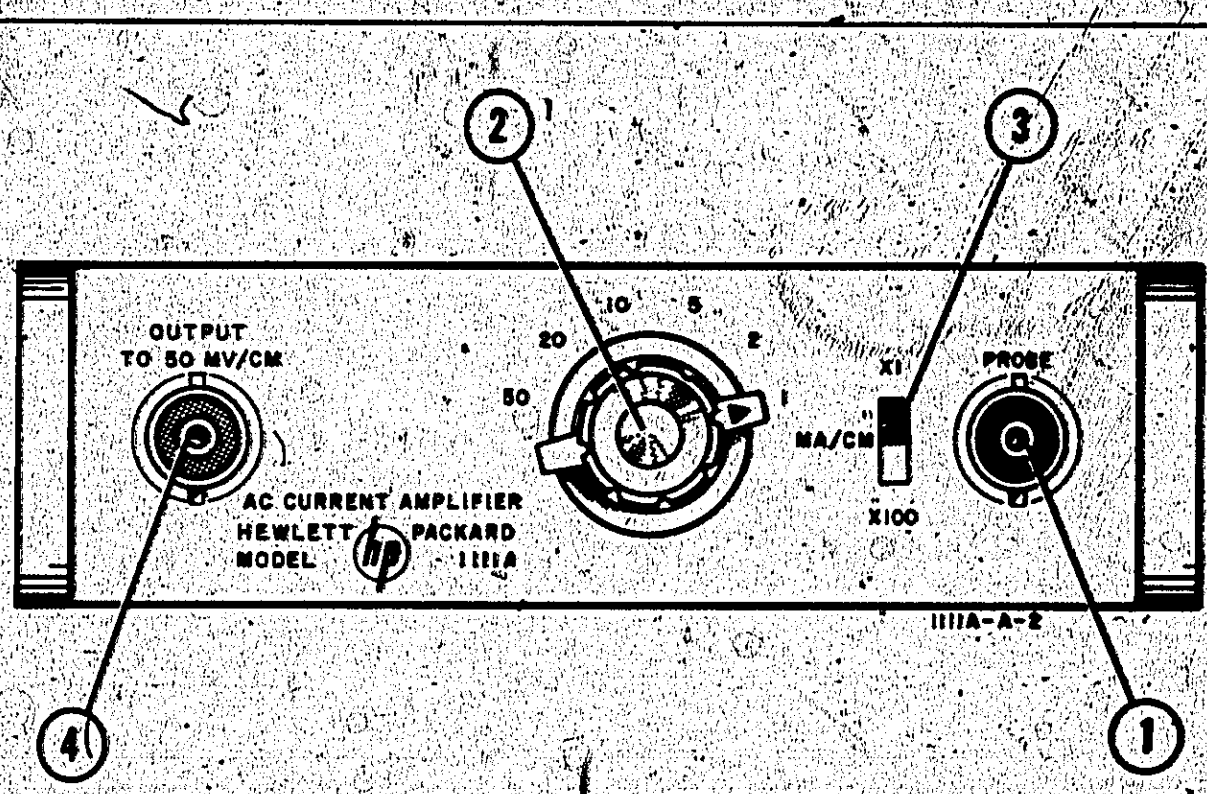
3-3. PANEL DESCRIPTION AND OPERATING PROCEDURE.

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



a) Panel Description

1. PROBE. Input connector for Model 1110A Probe.
2. MA/CM. Sets deflection sensitivity of oscilloscope trace in milliamperes/cm.
3. X1-X100. Changes sensitivity of MA/CM.
4. OUTPUT TO 50 MV/CM. Connects output of amplifier to oscilloscope.

b) Operation Procedure

1. Connect Model 1110A probe to PROBE input.
2. Set MA/CM to desired sensitivity.
3. Set to X1 for 1 ma/cm to 50 ma/cm range. Set to X100 for 100 ma/cm to 5 amp/cm range.
4. Connect OUTPUT TO 50 MV/CM to oscilloscope input. Set oscilloscope vertical sensitivity to 50 mv/cm.
5. Clip probe around current-carrying conductor.
6. Observe indication on oscilloscope.

Figure 3-1. Front Panel Description and Operation Procedure

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.

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.

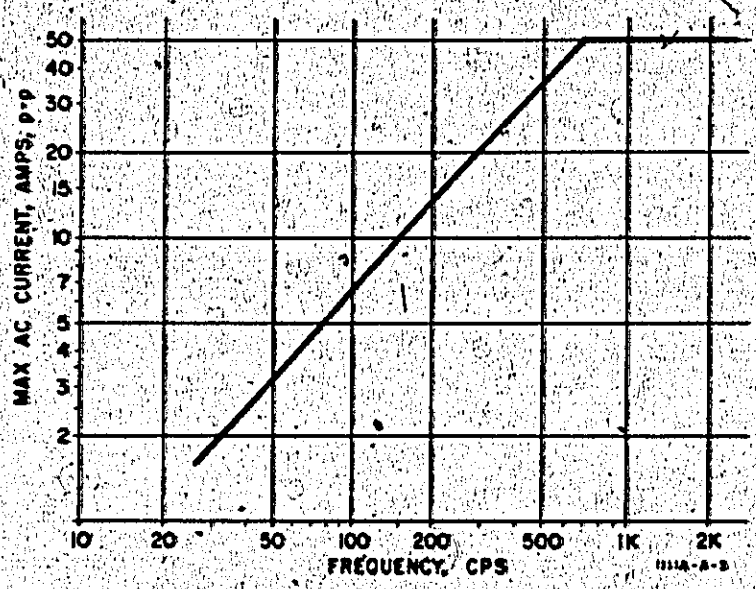


Figure 3-2. Peak-to-Peak Current vs Frequency

THEORY

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 1111A is a current amplifier for the output of the 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.

4-3. POWER SUPPLY.

4-4. The power supply is a conventional transformer-rectifier, supply with C127, C128, and R130 acting as filters to attenuate 120-cycle ripple (produced by full-wave 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 common-base 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 feedback 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 R111 and R112. 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

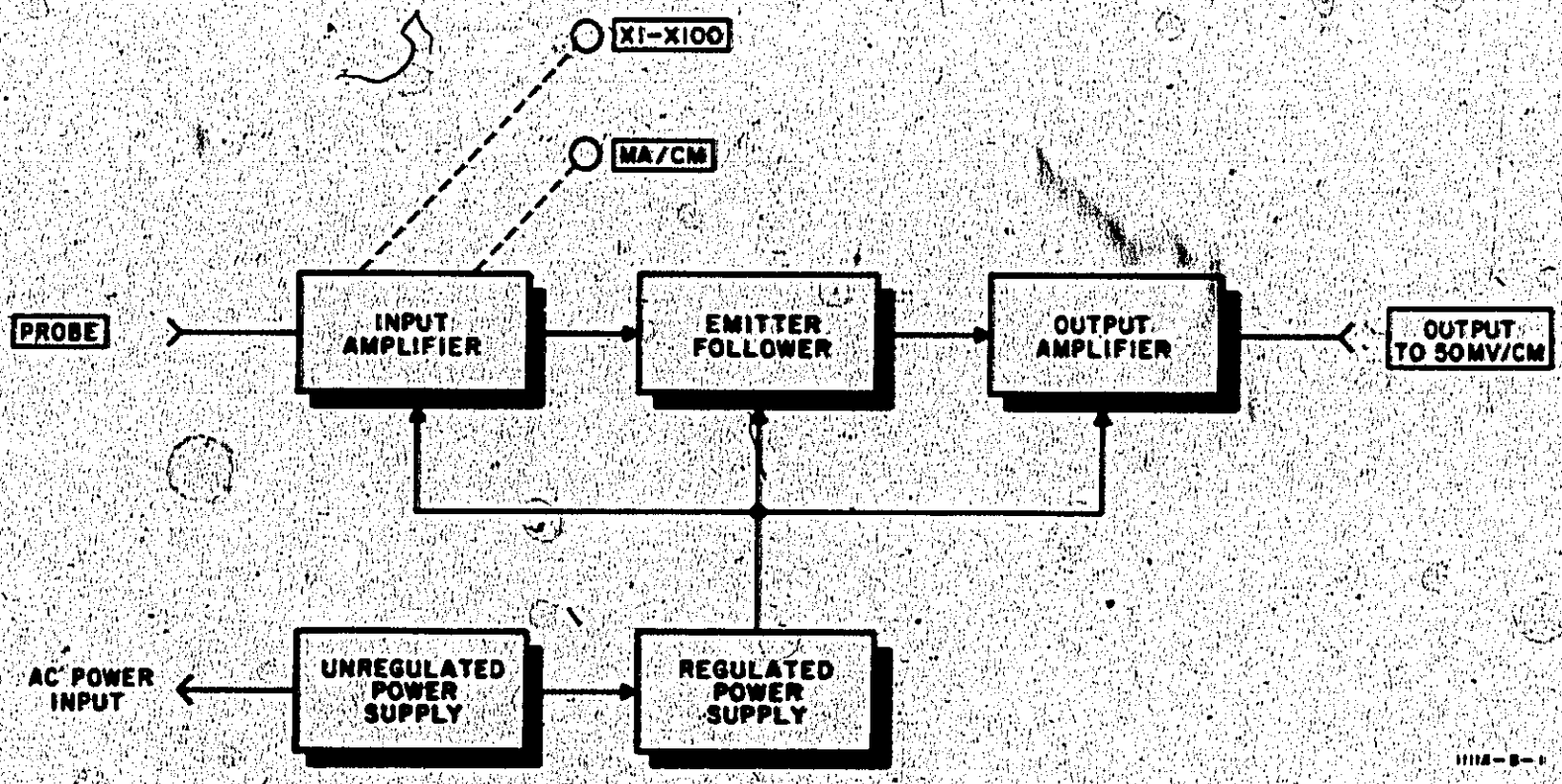


Figure 4-1. Block Diagram

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

4-8. OUTPUT AMPLIFIER.

4-9. The output amplifier pair consists of emitter 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 thr[illegible] C125 to J102, the instrument output connector.

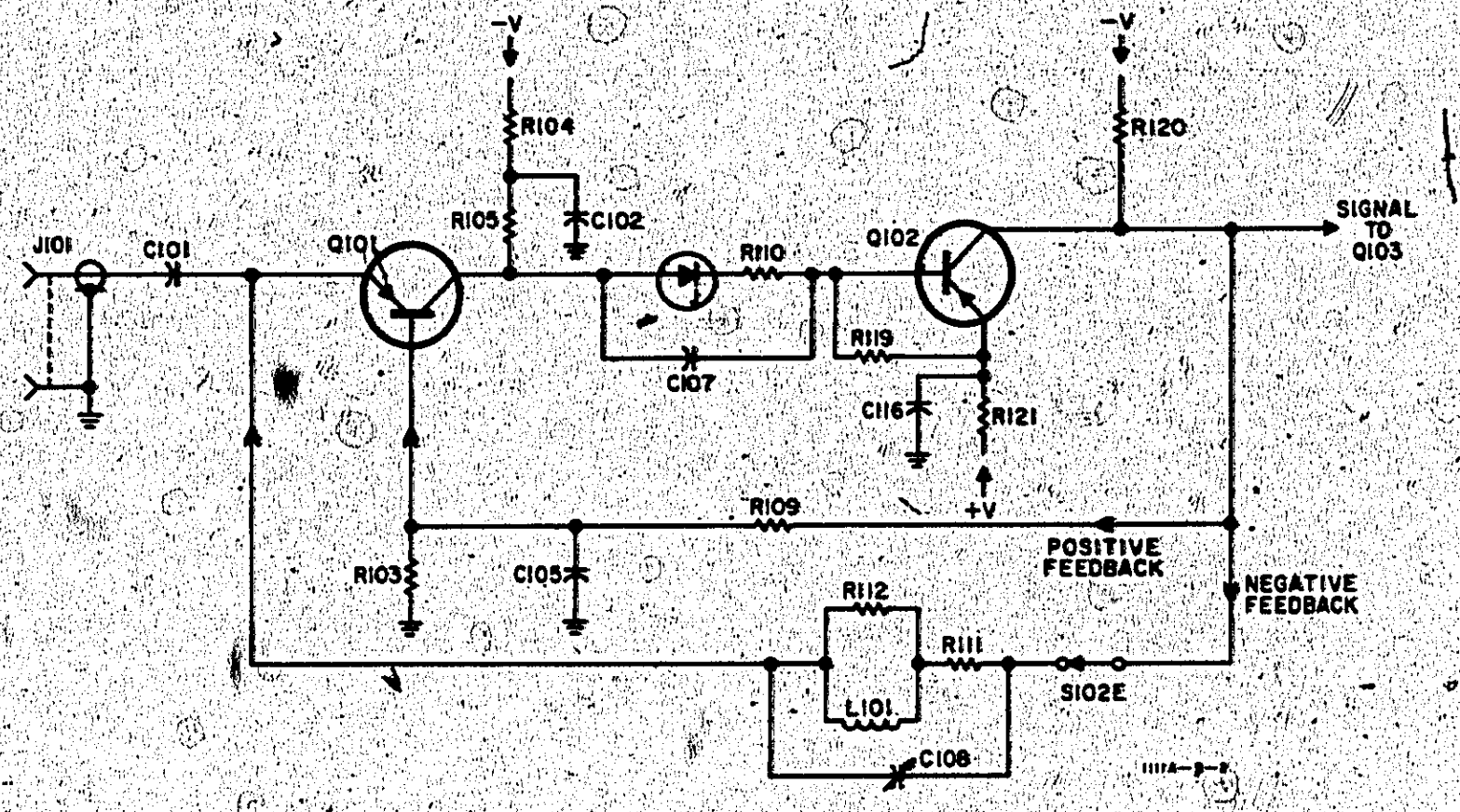


Figure 4-2. Simplified Circuit (Input Amplifier)

MAINTENANCE

SECTION V
MAINTENANCE

5-1. TEST EQUIPMENT REQUIRED.

5-2. INSTRUMENTS. Table 5-1 lists the test 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: 50 Ω , 600 Ω , 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. PERFORMANCE 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.

Table 5-1. Test Equipment Required

No.	Description	Important Specifications	Use	Recommended Equipment
1	Signal Generator	Output: 1 volt into 50 Ω, 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: ±3% 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 Sensitivity: .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 50 Ω	Adjust pulse and high frequency response	Tektronix 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	

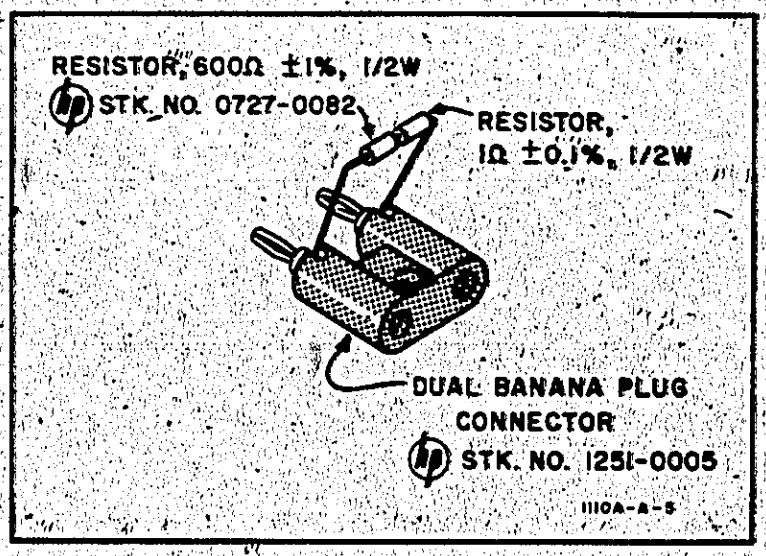


Figure 5-1. Special 600 Ω Load

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 Ω load.

e. Set Oscillator output for a Voltmeter reading of 0.1 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.

j. 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.

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 μSEC/CM, SWEEP 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 peak-to-peak, which corresponds to less than 100 μa 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.

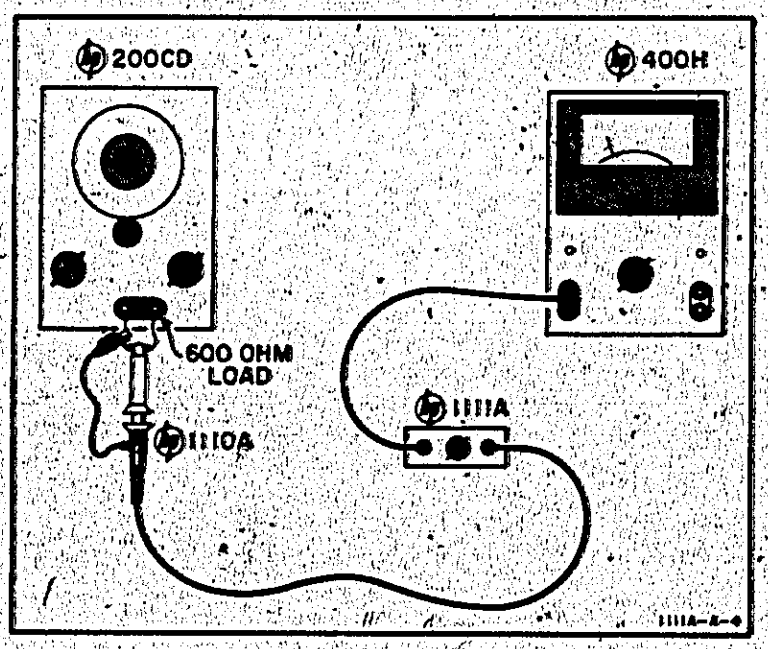


Figure 5-2. Oscillator-Voltmeter Test Setup

Table 5-2. Sensitivity and Accuracy Check

Model 1111A Sensitivity, MA/CM	Voltmeter Range, Volts	Voltmeter Reading, Volts
1	.1	0.1 ±3%
2	.1	0.05 ±3%
5	.03	0.02 ±3%
10	.01	0.01 ±3%
20	.01	0.005 ±3%
50	.003	0.002 ±3%

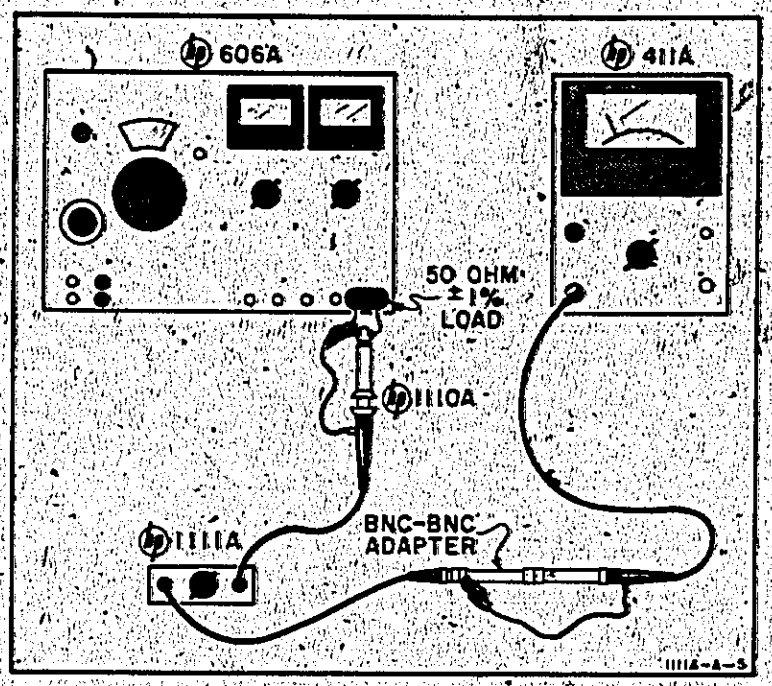


Figure 5-3. Signal Generator - RF Millivoltmeter Test Setup

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 FREE RUN and switch on SYNC PULSE.

c. Set Model 1111A 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 reading of 0.1 volts.

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 least ringing 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

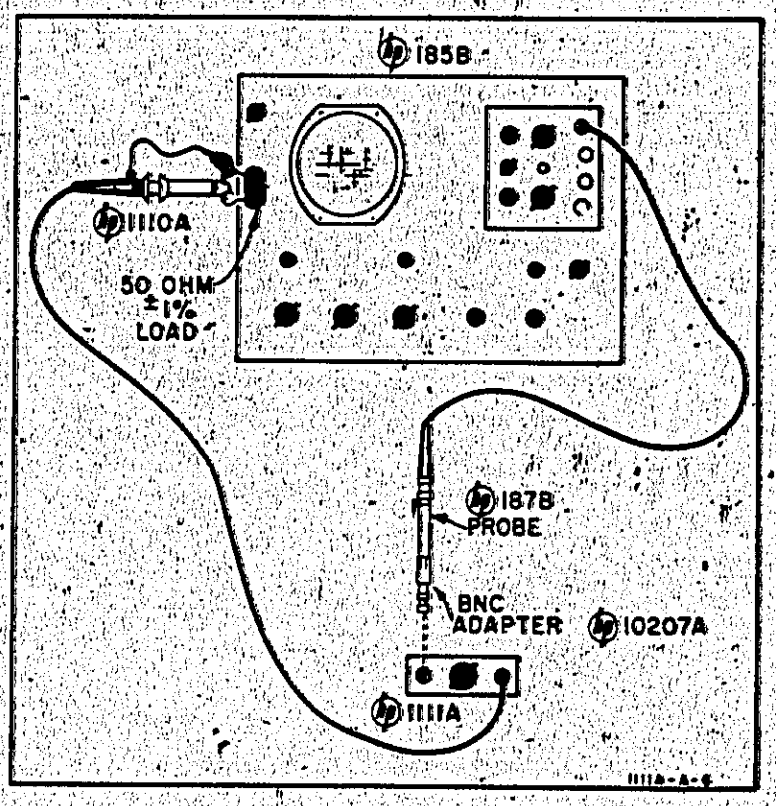


Figure 5-4. Rise Time Check Setup

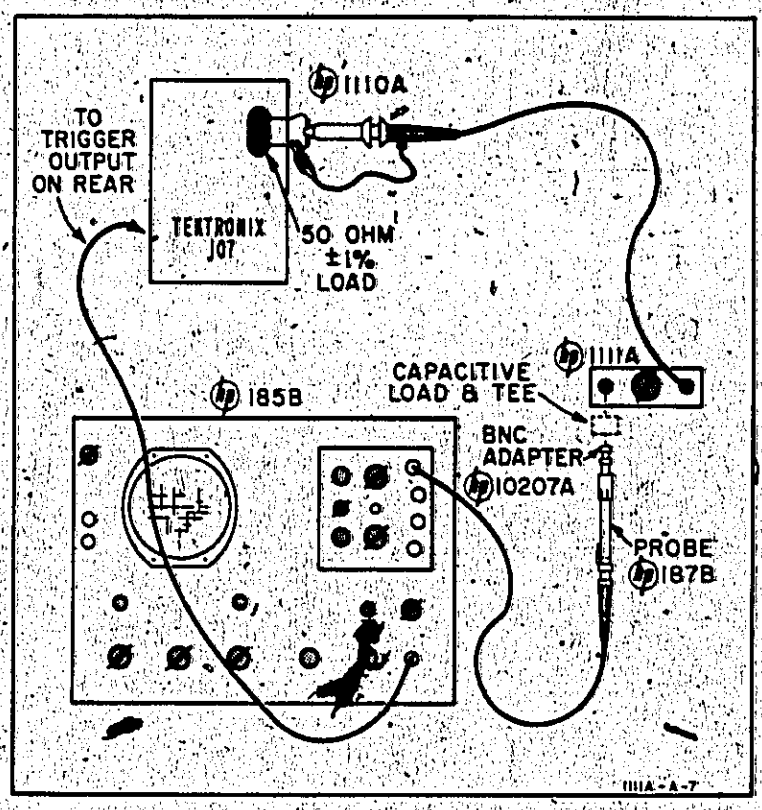


Figure 5-5. Pulse and High Frequency Response Test Setup

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 sensitivity to 1 MA/CM, X1.

d. Set Oscilloscope and plug-in controls as follows: TIME SCALE to 200 NSEC/CM, TIME SCALE MAGNIFIER to X2, TRIGGER SLOPE to -, SENSITIVITY 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).

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 SENSITIVITY 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 Ω.

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 amplifier may occur). These measurements will help determine if the DC voltage supplies are operating properly. Use a DC voltmeter (e.g. Model 410C or Model 412A) and check voltages with respect to instrument

Table 5-3. Power Supply Voltage Checks

Measurement Point	Typical Voltage to Ground	Allowable Range
White lead of power cord	+41V	-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

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.

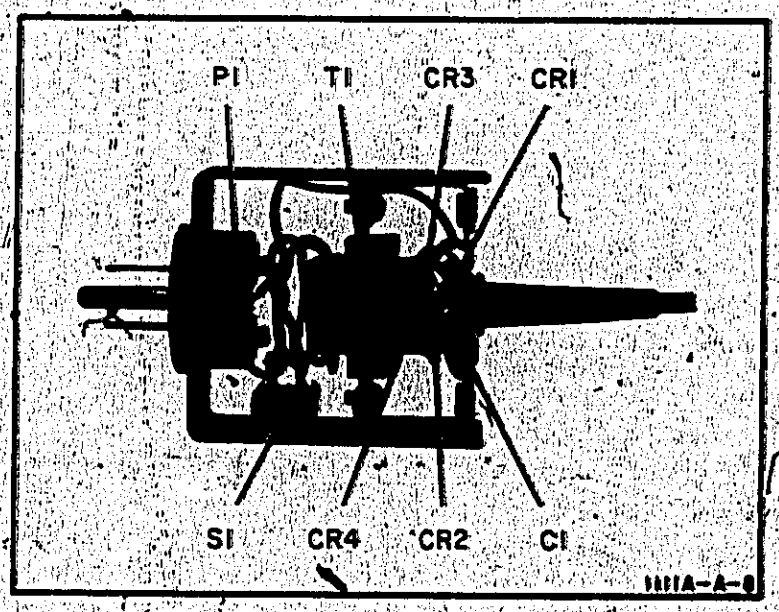


Figure 5-6. Power Supply Assembly

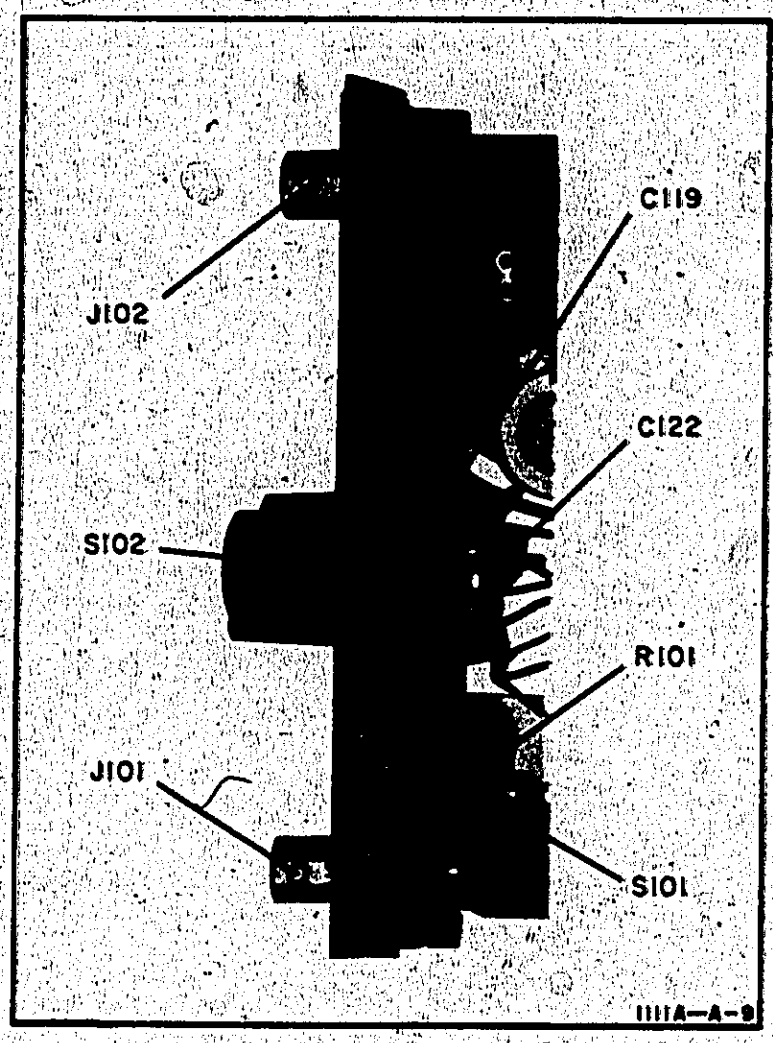


Figure 5-7. Front Panel and Sensitivity Switch Components

5-25. REPLACING ETCHED CIRCUIT BOARD 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

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, 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.

Table 5-4. Calibration and Component Replacement Record
For Hewlett-Packard Company Model 1111A Current Amplifier
Instrument Serial No. _____ – _____

CALIBRATION

Date	Description of Calibration Made	Paragraph Procedure(s) Used

COMPONENT REPLACEMENT

Date	Component Designator	Nature of Failure

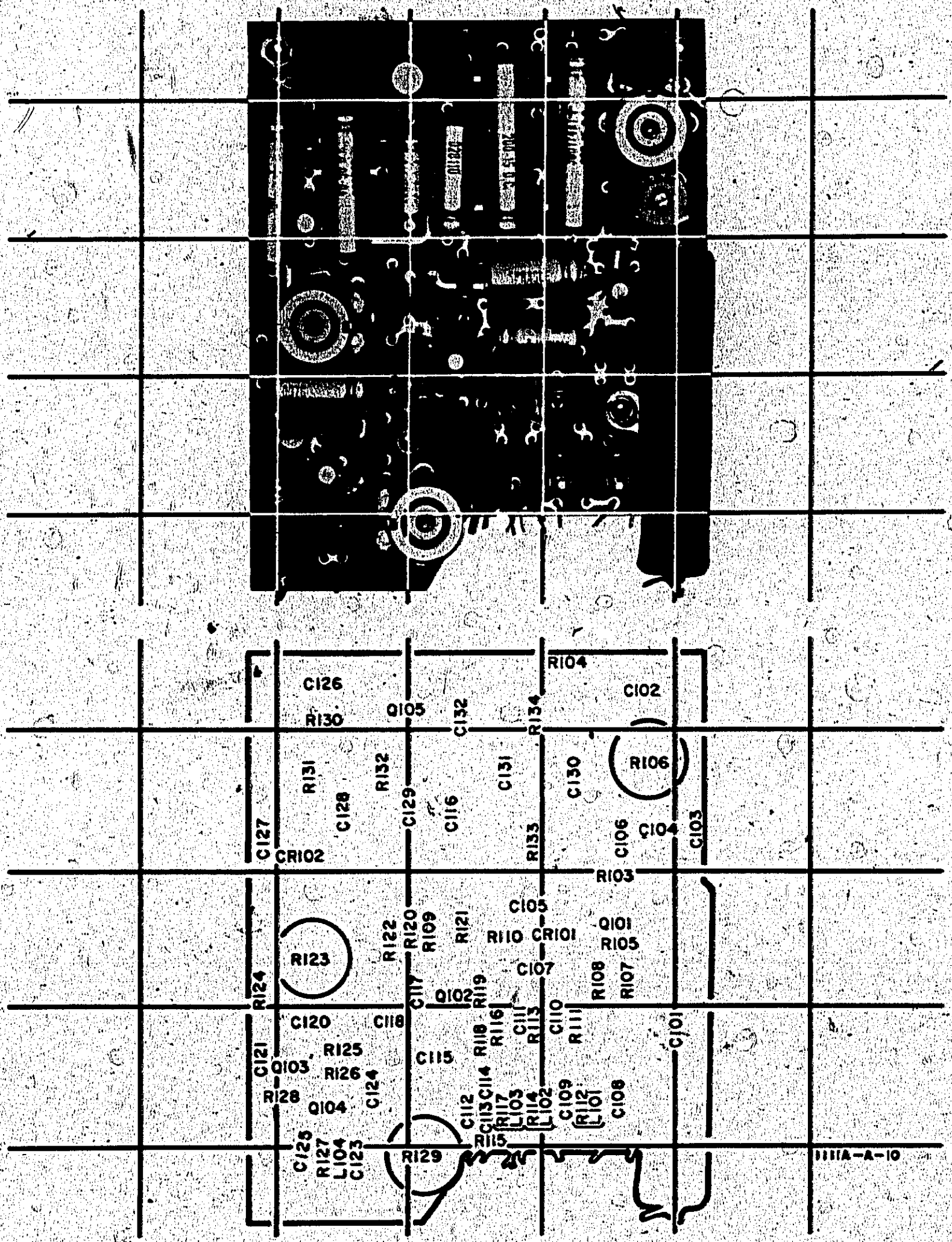


Figure 5-8. Etched Circuit Board Components

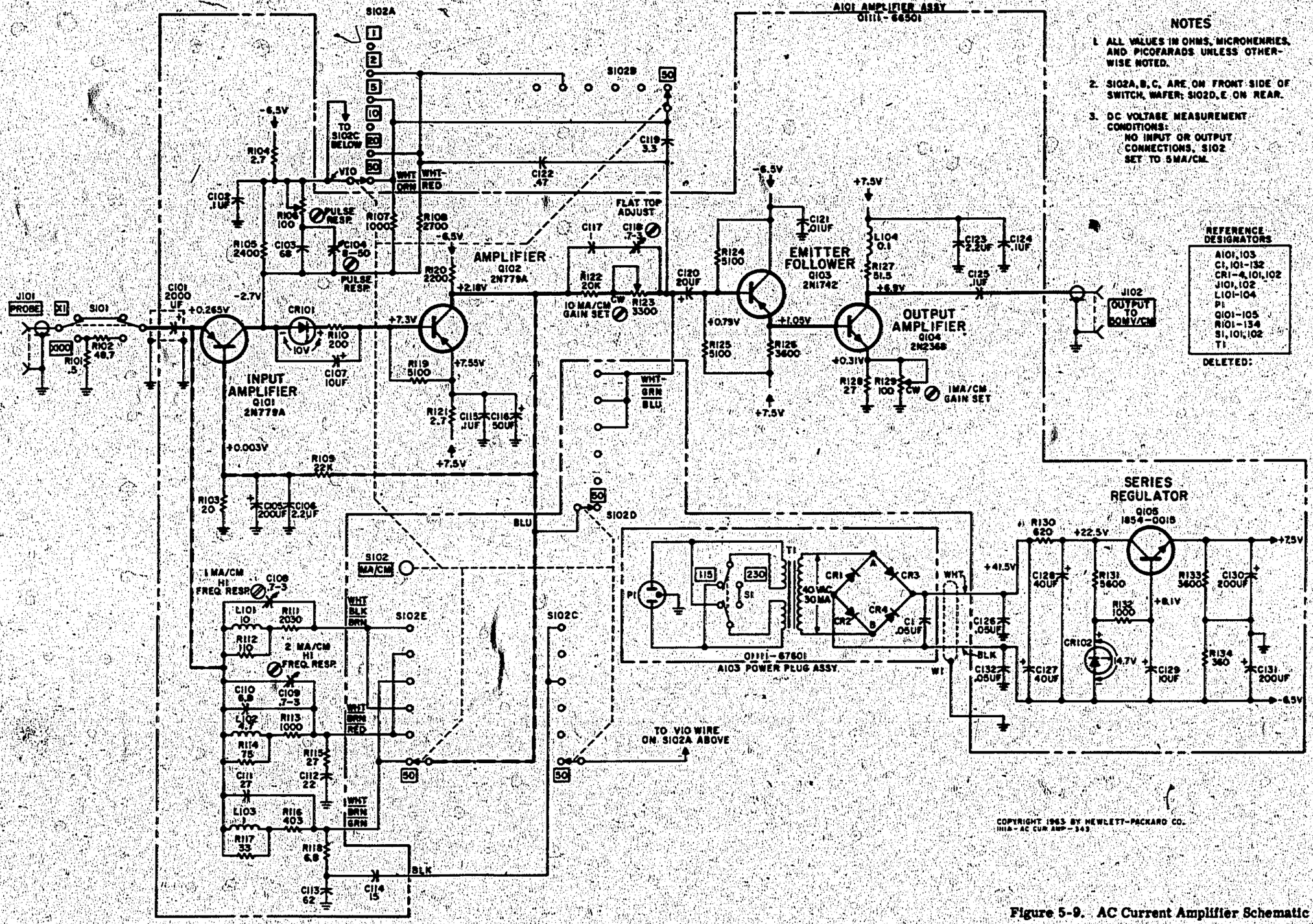


Figure 5-9. AC Current Amplifier Schematic

PARTS LIST

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

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

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	F = fuse	P = plug	V = vacuum tube, neon bulb, photocell, etc.
B = motor	FL = filter	Q = transistor	W = cable
C = capacitor	J = jack	R = resistor	X = socket
CR = diode	K = relay	RT = thermistor	Y = crystal
DL = delay line	L = inductor	S = switch	Z = network
DS = device signaling (lamp)	M = meter	T = transformer	
E = misc electronic part	MP = mechanical part		

ABBREVIATIONS

A = amperes	F = farads	NC = normally closed	S-B = slow-blow
BP = bandpass	FXD = fixed	NE = neon	SE = selenium
BWO = backward wave oscillator	GE = germanium	NO = normally open	SECT = section(s)
	GL = glass	NPO = negative positive zero (zero temperature coefficient)	SI = silicon
CER = ceramic	GRD = ground(ed)		SIL = silver
CMO = cabinet mount only			SL = slide
COEF = coefficient	H = henries	NSR = not separately replaceable	SPL = special
COM = common	HG = mercury		TA = tantalum
COMP = composition	HR = hour(s)	OBD = order by description	TD = time delay
CONN = connection	IMPG = impregnated	OX = oxide	TI = titanium dioxide
CRT = cathode-ray tube	INCD = incandescent		TOG = toggle
DEPC = deposited carbon	INS = insulation(ed)	P = peak	TOL = tolerance
EIA = Tubes or transistors meeting Electronic Industries' Association standards will normally result in instrument operating within specifications; tubes and transistors selected for best performance will be supplied if ordered by ◊ stock numbers.	K = kilo = 1000	PC = printed circuit board	TRIM = trimmer
	LIN = linear taper	PF = picofarads = 10^{-12} farads	TWT = traveling wave tube
	LOG = logarithmic taper	PP = peak-to-peak	U = micro = 10^{-6}
	MEG = meg = 10^{6}	PIV = peak inverse voltage	VAC = vacuum
	M = milli = 10^{-3}	POR = porcelain	VAR = variable
	MINAT = miniature	POS = position(s)	W/ = with
	METFLM = metal film	POLY = polystyrene	W = watts
	MFR = manufacturer	POT = potentiometer	WW = wirewound
	MOM = momentary		W/O = without
	MTG = mounting	RECT = rectifier	* = optimum value selected at factory, average value shown (part may be omitted)
	MY = mylar	ROT = rotary	
ELECT = electrolytic		RMS = root-mean-square	
ENCAP = encapsulated		RMO = rack mount only	

01194-7

Table 6-1. Reference Designation Index

Circuit Reference	# Stock No.	Description	Note
A1	01111-86003	INDUCTOR/RESISTOR:10 UH/110 OHM	
A2	01111-86002	INDUCTOR/RESISTOR:4.7 UH/75 OHM	
A3	01111-86001	INDUCTOR/RESISTOR:1.0 UH/33 OHM	
A4 THRU A100		NOT ASSIGNED	
A101	01111-66501	ASSY:AMPLIFIER	
A102	01111-61901	ASSY:SWITCH	
A103	01111-67601	ASSY:POWER PLUG	
C1	0150-0096	C:FXD CER 0.05 UF 100VDCW	
C2 THRU C100		NOT ASSIGNED	
C101	01111-80701	ASSY:CAPACITOR 2000 UF	
C102	0150-0084	C:FXD CER .1 UF +80-20% 50VDCW	
C103	0140-0192	C:FXD MICA 68 PF 5% 300VDCW	
C104	0130-0017	C:VAR CER 8-50 PF N750	
C105	0180-0060	C:FXD ELECT 200 UF +100-10% 3VDCW	
C106	0160-0128	C:FXD CER 2.2 UF 20% 25 VDCW	
C107	0180-0059	C:FXD ELECT 10 UF +100-10% 25VDCW	
C108	0132-0005	C:VAR POLY 0.7-3 PF 350VDCW	
C109	0132-0005	C:VAR POLY 0.7-3 PF 350VDCW	
C110	0150-0047	C:FXD TI 6.8 PF 10% 500VDCW	
C111	0140-0042	C:FXD MICA 27 PF 5% 500VDCW	
C112	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
C113	0140-0205	C:FXD MICA 62 PF 5% 300VDCW	
C114	0140-0101	C:FXD MICA 15 PF 5% 500VDCW	
C115	0150-0084	C:FXD CER .1 UF +80-20% 50VDCW	
C116	0180-0058	C:FXD ELECT 50 UF +100-10% 25VDCW	
C117	0150-0029	C:FXD TI 1 PF 10% 500VDCW	
C118	0132-0005	C:VAR POLY 0.7-3 PF 350VDCW	
C119	0150-0059	C:FXD CER 3.3 PF +/-NPO 600VDCW	
C120	0180-0076	C:FXD ELECT 20 UF 25VDCW	
C121	0150-0012	C:FXD CER 0.01 UF 20% 1KV	
C122	0150-0021	C:FXD TI 0.47 PF 5% 500VDCW	
C123	0160-0128	C:FXD CER 2.2 UF 20% 25VDCW	
C124	0150-0084	C:FXD CER .1 UF +80-20% 50VDCW	
C125	0150-0084	C:FXD CER .1 UF +80-20% 50VDCW	
C126	0150-0052	C:FXD CER 0.05 UF 20% 400VDCW	
C127	0180-0050	C:FXD ELECT 40 UF +100-15% 50VDCW	
C128	0180-0050	C:FXD ELECT 40 UF +100-15% 50VDCW	
C129	0180-0059	C:FXD ELECT 10 UF +100-10% 25VDCW	
C130	0180-0104	C:FXD ELECT 200 UF 15VDCW	
C131	0180-0104	C:FXD ELECT 200 UF 15VDCW	
C132	0150-0092	C:FXD CER 0.05 UF 20% 400VDCW	
CR1	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
CR2	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
CR3	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
CR4	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
CR5 THRU CR100		NOT ASSIGNED	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
CR101	1902-0025	SEMICON DEVICE:DIODE ZENER 10V	
CR102	1902-0078	SEMICON DEVICE:DIODE ZENER 14.7V	
J101	1250-0123	CONNECTOR:BNC	
J102	1250-0123	CONNECTOR:BNC	
L101		N.S.R. PART OF A1	
L102		N.S.R. PART OF A2	
L103		N.S.R. PART OF A3	
L104	01111-86004	INDUCTOR:0.1 UH	
P1	1251-0348	PLUG:POWER	
Q101	1850-0075	TRANSISTOR:GE 2N779A PNP	
Q102	1850-0075	TRANSISTOR:GE 2N779A PNP	
Q103	1850-0055	TRANSISTOR:GE 2N1742 PNP	
Q104	1854-0019	TRANSISTOR:2N2368	
Q105	1854-0015	TRANSISTOR:SI 2N375 NPN	
R101	0727-0899	R:FXD DEPC .5 OHM 2% 1/2W (DISC RESISTOR)	
R102	0721-0028	R:FXD DEPC 48.7 OHM 1% 1/8W	
R103	0683-2005	R:FXD COMP 20 OHM 5% 1/4W	
R104	0699-0001	R:FXD COMP 2.7 OHM 10% 1/2W	
R105	0683-2425	R:FXD COMP 2400 OHM 5% 1/4W	
R106	2100-0108	R:VAR COMP 100 OHM 10% LIN 1/3W	
R107	0683-1025	R:FXD COMP 1.0K OHM 5% 1/4W	
R108	0683-2725	R:FXD COMP 2.7K OHM 5% 1/4W	
R109	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
R110	0683-2015	R:FXD COMP 200 OHM 5% 1/4W	
R111	0727-0116	R:FXD DEPC 2.03K OHM 1% 1/2W	
R112		N.S.R. PART OF A1	
R113	0727-0100	R:FXD DEPC 1K OHM 1% 1/2W	
R114		N.S.R. PART OF A2	
R115	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R116	0727-0072	R:FXD DEPC 403 OHM 1% 1/2W	
R117		N.S.R. PART OF A3	
R118	0683-0685	R:FXD COMP 6.8 OHM 5% 1/4W	
R119	0683-5125	R:FXD COMP 5.1K OHM 5% 1/4W	
R120	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	
R121	0699-0001	R:FXD COMP 2.7 OHM 10% 1/2W	
R122	0727-0173	R:FXD DEPC 20K OHM 1% 1/2W	
R123	2100-0182	R:VAR COMP 3.3K OHM 10% LIN 3/10W	
R124	0683-5125	R:FXD COMP 5.1K OHM 5% 1/4W	
R125	0683-5125	R:FXD COMP 5.1K OHM 5% 1/4W	
R126	0683-3625	R:FXD COMP 3.6K OHM 5% 1/4W	
R127	0727-0025	R:FXD DEPC 51.5 OHM 1% 1/2W	
R128	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R129	2100-0108	R:VAR COMP 100 OHM 10% LIN 1/3W	
R130	0689-6215	R:FXD COMP 620 OHM 5% 1W	
R131	0687-5621	R:FXD COMP 5.6K OHM 10% 1/2W	
R132	0687-1021	R:FXD COMP 1K OHM 10% 1/2W	
R133	0686-3625	R:FXD COMP 3.6K OHM 5% 1/2W	
R134	0686-3615	R:FXD COMP 360 OHM 5% 1/2W	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Ⓗ Stock No.	Description	Note
S1	3101-0033	SWITCH:SLIDE DPDT	
S2 THRU S100		NOT ASSIGNED	
S101	3101-0070	SWITCH:SLIDE DPDT	
S102	3100-0427	SWITCH:ROTARY 1 SECTION,6 POSITION	
T1	9100-0183	TRANSFORMER:POWER	
		MISCELLANEOUS	
	0370-0104	KNOB:MA/CM	
	01111-07601	COVER FOR PLUG ASSEMBLY A103	
	01111-46101	TERMINAL BOOT:CABLE	
	01111-61601	CABLE:POWER	
	5000-0023	BODY:CABINET	
	5000-0082	PLATE:CABINET SIDE	

See introduction to this section

Table 6-2. Replaceable Parts

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	RS
0130-0017	C:VAR CER 8-50 PF N750	28480	0130-0017	1	1
0132-0005	C:VAR POLY 0.7-3 PF 350 VDCW	72982	535-031-4R	3	1
0140-0042	C:FXD MICA 27 PF 5% 500VDCW	00853	TYPE DR1427 E5	1	1
0140-0101	C:FXD MICA 15 PF 5% 500VDCW	00853	RCM15C 150J	1	1
0140-0145	C:FXD MICA 22 PF 5% 500VDCW	04062	DM15C 220J	1	1
0140-0192	C:FXD MICA 68 PF 5% 300VDCW	04062	DM15E 680J	1	1
0140-0205	C:FXD MICA 62 PF 5% 300VDCW	04062	DM15E 620J 300V	1	1
0150-0012	C:FXD CER 0.01 UF 20% 1KV	56289	H 1038	1	1
0150-0021	C:FXD TI 0.47 PF 5% 500VDCW	78488	TYPE GA	1	0
0150-0029	C:FXD TI 1 PF 10% 500VDCW	78488	TYPE GA 1.0 PF	1	1
0150-0047	C:FXF TI 6.8 PF 10% 500VDCW	78488	TYPE GA	1	1
0150-0052	C:FXD CER 0.05 UF 20% 400VDCW	05729	20X503 MC4	2	1
0150-0059	C:FXD CER 3.3 PF +/-NPO 600VDCW	72982	301 000 C0J0 339C	1	1
0150-0084	C:FXD CER .1 UF +80-20% 50VDCW	56289	33C41	4	1
0150-0096	C:FXD CER 0.05 UF 100VDCW	91418	TA	1	1
0160-0128	C:FXD CER 2.2 UF 20% 25VDCW	56289	5C15	2	1
0180-0050	C:FXD ELECT 40 UF +100-15% 50VDCW	56289	D 32538	2	1
0180-0058	C:FXD ELECT 50 UF +100-10% 25VDCW	56289	TYPE 300186A1	1	1
0180-0059	C:FXD ELECT 10 UF +100-10% 25VDCW	56289	300 106G 025	2	1
0180-0060	C:FXD ELECT 200 UF +100-10% 3VDCW	56289	300116 A1	1	1
0180-0076	C:FXD ELECT 20 UF 25VDCW	56289	400 181 A2	1	1
0180-0104	C:FXD ELECT 200 UF 15VDCW	56289	300174A1	2	1
0370-0104	KNOB	28480	0370-0104	1	1
0683-0685	R:FXD COMP 6.8 OHM 5% 1/4W	01121	CB 68G5	1	1
0683-1025	R:FXD COMP 1.0K OHM 5% 1/4W	01121	CB 1025	1	1
0683-2005	R:FXD COMP 20 OHM 5% 1/4W	01121	CB 2005	1	1
0683-2015	R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015	1	1
0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225	1	1
0683-2235	R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235	1	1
0683-2425	R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425	1	1
0683-2705	R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705	2	1
0683-2725	R:FXD COMP 2.7K OHM 5% 1/4W	01121	CB 2725	1	1
0683-3625	R:FXD COMP 3.6K OHM 5% 1/4W	01121	CB 3625	1	1
0683-5125	R:FXD COMP 5.1K OHM 5% 1/4W	01121	CB 5125	3	1
0686-3615	R:FXD COMP 360 OHM 5% 1/2W	01121	EB 3615	1	1
0686-3625	R:FXD COMP 3.6K OHM 5% 1/2W	01121	EB 3625	1	1
0687-1021	R:FXD COMP 1K OHM 10% 1/2W	01121	EB 1021	1	1
0687-5621	R:FXD COMP 5.6K OHM 10% 1/2W	01121	EB 5621	1	1
0689-6215	R:FXD COMP 620 OHM 5% 1W	01121	GB 6215	1	1
0699-0001	R:FXD COMP 2.7 OHM 10% 1/2W	01121	GB 27G1	2	1
0721-0028	R:FXD DEPC 48.7 OHM 1% 1/8W	19701	DC1/8A	1	1
0727-0025	R:FXD DEPC 51.5 OHM 1% 1/2W	19701	DC1/2CR5	1	1
0727-0072	R:FXD DEPC 403 OHM 1% 1/2W	19701	DC1/2CR5	1	1
0727-0100	R:FXD DEPC 1K OHM 1% 1/2W	19701	CD1/2CR5	1	1
0727-0116	R:FXD DEPC 2.03K OHM 1% 1/2W	19701	DC1/2CR5	1	1
0727-0173	R:FXD DEPC 20K OHM 1% 1/2W	19701	DC1/2CR5	1	1
0727-0899	R:FXD DEPC .5 OHM 2% 1/2W	28480	0727-0899	1	1
1250-0123	CONNECTOR:BNC	91737	UG-1094/U	2	1
1251-0348	PLUG:POWER	02660	160-11	1	0
1850-0055	TRANSISTOR:GE 2N1742 PNP	87216	2N1742	1	1
1850-0075	TRANSISTOR:GE 2N779A PNP	87216	2N779A	2	2
1854-0015	TRANSISTOR:SI 2N375 NPN	28480	1854-0015	1	1
1854-0019	TRANSISTOR:2N2368	07263	S-5781	1	1

See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	RS
1901-0025	SEMICON DEVICE:DIODE JUNCTION	28480	1901-0025	4	0
1902-0025	SEMICON DEVICE:DIODE SI ZENER 10V	28480	1902-0025	1	1
1902-0078	SEMICON DEVICE:DIODE ZENER 14.7 V	28480	1902-0078	1	1
01111-07601	COVER FOR PLUG ASSEMBLY A103	28480	01111-07601	1	0
01111-46101	TERMINAL BOOT:CABLE	28480	01111-46101	1	0
01111-61601	CABLE:POWER	28480	01111-61601	1	0
01111-61901	ASSY:SWITCH	28480	01111-61901	1	0
01111-66501	ASSY:AMPLIFIER	28480	01111-66501	1	0
01111-67601	ASSY:POWER PLUG	28480	01111-67601	1	0
01111-80701	ASSY:CAPACITOR 2000 UF	28480	01111-80701	1	0
01111-86001	INDUCTOR/RESISTOR:1.0 UH/33 OHM	28480	01111-86001	1	0
01111-86002	INDUCTOR/RESISTOR:4.7 UH/75 OHM	28480	01111-86002	1	0
01111-86003	INDUCTOR/RESISTOR:10 UH/110 OHM	28480	01111-86003	1	0
01111-86004	INDUCTOR:0.1 UH	28480	01111-86004	1	0
2100-0108	R:VAR COMP 100 OHM 10% LIN 1/3W	11237	WPE 70	2	1
2100-0182	R:VAR COMP 3.3K OHM 10% LIN 3/10W	28480	2100-0182	1	1
3100-0427	SWITCH:ROTARY 1 SECTION,6 POSITION	28480	3100-0427	1	0
3101-0033	SWITCH:SLIDE DPDT	42190	4633	1	0
3101-0070	SWITCH:SLIDE DPDT	79727	126-8	1	0
5000-0023	BODY:CABINET	28480	5000-0023	1	0
5000-0082	PLATE:CABINET SIDE	28480	5000-0082	2	0
9100-0183	TRANSFORMER:POWER	28480	9100-0183	1	0

See introduction to this section

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

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.

Code No.	Manufacturer	Address
00136	McCoy Electronics	Mount Holly Springs, Pa.
00334	Humidaire Co.	Colton, Calif.
00335	Westrex Corp.	New York, N. Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N. J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N. J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00868	Goe Engineering Co.	Los Angeles, Calif.
00891	Clark E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	Pacific Semiconductors, Inc.	Culver City, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassis-Trak Corp.	Indianapolis, Ind.
01585	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01963	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferrocube Corp. of America	Saugerties, N. Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N. J.
02777	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02779	Hopkins Engineering Co.	San Fernando, Calif.
03508	G. E. Semiconductor Products Dept.	Syracuse, N. Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N. J.
03956	Arc Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04062	Elmenco Products Co.	New York, N. Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S. C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04630	Sylvania Electric Prods., Inc., Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Litton Co., Inc., Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04777	Automatic Electric Sales Corp.	Northlake, Ill.
04796	Sequoia Wire & Cable Co.	Redwood City, Calif.
04870	P. R. Mater Company	Chicago 44, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05624	Barber Colman Co.	Rockford, Ill.
05729	Metropolitan Telecommunications Corp., Metro Cap. Division	Brooklyn, N. Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
06004	The Bassick Co.	Bridgeport, Conn.
06136	Ward-Leonard Electric	Los Angeles, Calif.
06179	Bausch and Lomb Optical Co.	Rochester, N. Y.
06402	E. T. A. Products Co. of America	Chicago, Ill.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N. H.
06751	U. S. Semcon Division of Nuclear Corp. of America	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07115	Corning Glass Works, Electronic Components Dept.	Bradford, Pa.
07126	DeJur Co.	Pasadena, Calif.
07133	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N. Y.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07700	Technical Wire Products	Springfield, N. J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07968	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N. J.
08145	U. S. Engineering Co.	Los Angeles, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co., Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C. B. S., Inc.	Lowell, Mass.
08988	Mal Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09664	The Bristol Co.	Waterbury, Conn.
10216	General Transistor Western Corp.	Los Angeles, Calif.
10413	T-Tak, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N. Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11536	Duncan Electronic, Inc.	Santa Ana, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N. J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Welabs, Inc.	Palo Alto, Calif.
12697	Clarostat Mfg. Co.	Dover, N. H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13396	Telefunken (G. M. B. H.)	Hannover, Germany
14099	Sem-Tech	Newbery Park, Calif.
14152	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N. J.
15909	The Daven Co.	Livingston, N. J.
16688	De Jur-Amsco Corporation	Long Island City 1, N. Y.
16758	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.
16873	E. I. DuPont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N. J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N. J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N. Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N. J.
24446	General Electric Co.	Schenectady, N. Y.
24455	G. E., Lamp Division Nela Park	Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N. Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N. J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G. E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Minature Precision Bearings, Inc.	Keene, N. H.
42190	Meter Co.	Chicago, Ill.
43990	C. A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Baltimore, Md.
54294	Shallcross Mfg. Co.	Selma, N. C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N. Y.
55938	Speer Carbon Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N. Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
60741	Tripplett Electrical Inc.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N. Y.
64959	Western Electric Co., Inc.	New York, N. Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N. J.
66295	Witek Manufacturing Co.	Chicago 23, Ill.
66346	Wollensak Optical Co.	Rochester, N. Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co. Inc.	New York, N. Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N. Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N. Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N. J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71476	Cinema Engineering Co.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71528	Standard-Thomson Corp., Clifford Mfg. Co. Div.	Waltham, Mass.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71700	The Cornish Wire Co.	New York, N. Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A. O. Smith Corp., Cloverly Div.	West Orange, N. J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72092	Eitel-McCullough, Inc.	San Bruno, Calif.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
71707	Cole Corl Co., Inc.	Providence, R. I.
72354	John E. Fast & Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N. Y.
72656	General Ceramics Corp.	Keasbey, N. J.
72699	General Instrument Corp., Semiconductor Div.	Newark, N. J.
72758	Gisser-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Ohio Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Philips Co, Inc.	Hicksville, N. Y.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Products Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74455	J. H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R. F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E. F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75373	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N. Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C. W. Marwedel	San Francisco, Calif.
76423	Micamold Electronic Mfg. Corp.	Brooklyn, N. Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J. W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N. J.
77638	Radio Receptor Co., Inc.	Brooklyn, N. Y.
77764	Resistance Products Co.	Harrisburg, Pa.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N. Y.
78290	Struthers-Dunn Inc.	Pitman, N. J.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Uemite Co.	Newtonville, Mass.
79142	Veeder, Root, Inc.	Hartford, Conn.
79251	Waco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N. Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N. J.
80120	Schnitzer Alloy Products	Elizabeth, N. J.
80130	Times Facsimile Corp	New York, N. Y.
80131	Electronic Industries Association, Any brand tube meeting EIA standards	Washington, D. C.
80207	Unirman Switch, Div. of U. L. Marsan Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N. Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80583	Hammerlund Co., Inc.	New York, N. Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.
81349	Military Specification	.....
81415	Wilbur Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Amphe Products Co.	Cambridge, Mass.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs, Inc.	Clifton, N. J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N. J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N. Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N. H.
83125	Pyramid Electric Co.	Darlington, S. C.
83148	Electra Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Union, N. J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N. J.
83315	Hubbell Corp.	Woodstock, Ill.
83330	Smith, Herman H., Inc.	Brooklyn, N. Y.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N. J.
83740	Eveready Battery	New York, N. Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronics, Inc.	New York, N. Y.
84396	A. J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good-All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N. J.
85471	A. B. Boyd Co.	San Francisco, Calif.
85478	R. M. Bracamonte & Co.	San Francisco, Calif.
85660	Kaiser Metals, Inc.	New Haven, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products	Clifton Heights, Pa.
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N. J.

From F. S. C. Handbook Supplements
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APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

Code No.	Manufacturer	Address
07216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
07473	Western Fibrous Glass Products Co.	San Francisco, Calif.
07668	Van Waters & Rogers Inc.	Seattle, Wash.
08140	Cutler-Hammer, Inc.	Lincoln, Ill.
08220	Gould-National Batteries, Inc.	St. Paul, Minn.
09472	General Electric Distributing Corp.	Schenectady, N.Y.
09636	Carter Parts Div., of Economy Baler Co.	Chicago, Ill.
09665	United Transformer Co.	Chicago, Ill.
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	August Brothers, Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Philadelphia, Pa.
91737	Gemar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91929	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Ill.
92196	Universal Metal Products, Inc.	Bassett, Puente, Calif.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93943	Ingalls-Van Norman Ind., Inc., Electronic Division	Manchester, N.H.
94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.
94148	Scientific Radio Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94310	The Ohio Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.
94682	Worcester-Pressed Aluminum Corp.	Worcester, Mass.
95022	Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lorco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Chicago, Ill.
95987	Wechessen Co.	Chicago, Ill.
96087	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Division of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
97979	Ohm Resistor Corp.	Yonkers, N.Y.
98141	Axel Brothers Inc.	Jamaica, N.Y.
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Cairad Corp.	Redwood City, Calif.
98421	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Cohu Inc Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Rexbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

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

C0000	JFD Electronics Corp.	Van Nuys, Calif.
G0000	Traex Company	Mountain View, Calif.
I0000	Western Devices, Inc.	Inglewood, Calif.
J0000	Winchester Electronics, Inc.	Santa Monica, Calif.

Code No.	Manufacturer	Address
0000F	Maico Tool and Die	Los Angeles, Calif.
0000M	Western Coil Div., of Automatic Ind., Inc.	Redwood City, Calif.
0000N	Nahm-Bros. Spring Co.	San Leandro, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000T	Texas Instruments, Inc. Metals and Controls Div.	Versailles, Ky.
0000U	Tower Mfg. Corp.	Providence, R.I.
0000W	Webster Electronics Co. Inc.	New York, N.Y.
0000X	Spruce Pine Mica Co.	Spruce Pine, N.C.
0000Y	Midland Mfg. Co. Inc.	Kansas City, Kans.
0000Z	Willow Leather Products Corp.	Newark, N.J.
0001A	British Radio Electronics Ltd.	Washington, D.C.
0001B	ETA	England
0001C	Indiana General Corp., Electr. Div.	Indiana
0001E	Precision Instrument Components Co.	Van Nuys, Calif.
0001G	Computer Diode Corp.	Lodi, N.J.
0001H	A. Williams Manufacturing Co.	San Jose, Calif.
0001J	Gasket Die Cutting Service	Goshen, Ind.
0001K	Rubbercraft Corp.	Torrance, Calif.
0001L	Butcher Corporation, Industrial Division	Monterey Park, Calif.
0001N	Amatom	New Rochelle, N.Y.
0001S	Avery Labels	Monrovia, Calif.
0001M	Rubber Eng. & Development	Hayward, Calif.
0001R	A "N" O Manufacturing Co.	San Jose 27, Calif.
0001P	Alpha Electronics	Sun Valley, Calif.
0001Q	Coilcraft	Oakland, Calif.
0001R	Radio Industries	Des Plaines, Ill.
0001S	Control of Elgin Watch Co.	Burbank, Calif.
0001T	Thomas & Betts Co., The	Elizabeth 3, N.J.
0001W	California Eastern Lab.	Burlingame, Calif.
0001X	Methode Electronics, Inc.	Chicago 32, Ill.
0001Y	T.K. Smith Co.	Los Angeles 45, Calif.

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H4-1 Dated Supplement 22
H4-2 Dated April 1962

WARRANTY

All our products are warranted against defects in materials and workmanship for one year from 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.

For assistance of any kind, including help with instruments under warranty, contact your authorized Sales Representative for instructions. Give full details of the difficulty and include the instrument model and serial numbers. Service data or shipping instructions will be promptly sent to you. There will be no charge for repair of instruments under warranty, *except transportation charges*. Estimates of charges for non-warranty or other service work will always be supplied, if requested, before work begins.

CLAIM FOR DAMAGE IN SHIPMENT

Your instrument should be inspected and tested as soon as it is received. The instrument is insured for safe delivery. If the instrument is damaged in any way or fails to operate properly, file a claim with the carrier or, if insured separately, with the insurance company.

SHIPPING

On receipt of shipping instructions, forward the instrument prepaid to the destination indicated. You may use the original shipping carton or any strong container. Wrap the instrument in heavy paper or a plastic bag and surround it with three or four inches of shock-absorbing material to cushion it firmly and prevent movement inside the container.

GENERAL

Your authorized Sales Representative is ready to assist you in any situation, and you are always welcome to get directly in touch with Hewlett-Packard service departments:

CUSTOMER SERVICE
Hewlett-Packard Company
395 Page Mill Road
Palo Alto, California, U.S.A.
Telephone: (415) 326-3950
TWX No. PAL AL 117-U
Cable: "HEWPACK"

OR (In Western Europe)
Hewlett-Packard S.A.
54 Route Des Acacias
Geneva, Switzerland
Telephone: (022) 42. 81. 50
Cable: "HEWPACKSA"

SERVICE NOTES

1111A-1A

SERVICE NOTE

SUPERSEDES:
1111A-1

HP MODEL 1111A AMPLIFIER

ALL SERIALS

PREFERRED REPLACEMENT FOR A2CR7 AND A2R16

The preferred replacement zener diode (A2CR7) and resistor (A2R16) are HP part numbers 1902-1173 and 0684-1021 respectively. This change provides for the use of a conventional low noise zener diode.

Make the appropriate changes to the Operating and Service Manual.

DM/bw

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For more information, call your local HP-Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181
West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, 1217 Meyrin-Geneva

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