OPERATING AND SERVICE MANUAL

4917A

ULTRASONIC TRANSLATOR DETECTOR

models 117/4917A

HEWLETT hp PACKARD

HP4917A

OPERATING AND SERVICE MANUAL

ULTRASONIC TRANSLATOR DETECTOR MODELS 117/4917A

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MANUAL PART NO. 04917-90000
MICROFICHE PART NO. 04917-90004

Figure 1-1. 117/4917A Ultrasonic Translator and Accessories

SECTION I

GENERAL INFORMATION

1-1. The HP Models 117/4917A have been carefully inspected both mechanically and electrically prior to being packed for shipment, and should be in perfect condition upon receipt. To confirm this, an initial inspection should be conducted at the time of receiving the instruments to assure that no damage has been caused in transit. Also check for supplied accessories (see paragraph 1-9) and electrical performance of the instruments (see paragraph 4-5).

1-2. DESCRIPTION

1-3. The HP Models 117/4917A are compact, light-weight, self-contained instruments which detect sound waves in the ultrasonic region between 36 and 44 kHz. These high-frequency, inaudible sound waves are translated into the audible range of human hearing.

1-4. Ultrasonic sound waves are created by such things as pressure and vacuum leaks, mechanical friction, high voltage arcing, etc. The 117/4917A instruments are used to pin-point the location of these trouble areas and to measure the relative intensity of the ultrasonic sound waves being detected.

1-5. The use of solid-state components throughout give the 117/4917A instruments both ruggedness and reliability. Both instruments are powered by three penlight size (AA) mercury batteries (Eveready E-12). Typical battery life is between 360 and 500 hours.

1-6. MODEL DIFFERENCES

1-7. The Delcon Model 117 and 4917A are identical in appearance and function; the 4917A, however, meets the requirements of Underwriters' Laboratories, Inc., for use in Hazardous Locations Class I Group D and is listed under their Re-examination Service.

1-8. STANDARD ACCESSORIES

1-9. The Models 117/4917A Ultrasonic Translator Detectors are furnished with (see figure 1-1): (a) General Purpose Probe, HP P/N 18020A, (b) 600 Ohm Headset, HP P/N 18017A, (c) 6 Foot Coil Cord, HP P/N 18015A, (d) Focusing Extension, HP P/N 18013A, (e) Protective Cap, HP P/N 18014A, (f) Carrying Strap, HP P/N 18022A, and (g) Utility Carrying Case, HP P/N 18019A.

1-10. AVAILABLE ACCESSORIES

1-11. The following accessories are available for the Models 117/4917A:

1-11. Cont.

a. 18002A: Quick Search Wand with 10 kV rated operator protection, on 6-foot long fiberglass pole, with ferrule to mate with telephone utilities standard tree pruner pole extender. Includes 25-foot interconnecting cord (HP P/N 18016A).

b. 18003A: Mobile Reflector with 10 kV rated operator protection on a 5-foot long fiberglass pole, with ferrule to mate with telephone utilities standard tree pruner pole extender. Includes 25-foot interconnecting cord (HP P/N 18016A).

c. 18021A: Contact Probe with 4-inch long sensing stylus.

Table 1-1. Specifications

CONSTRUCTION: Rugged aluminum chassis and case, stainless steel hardware used throughout; Mil-spec printed circuit board; quick-access battery compartment; detachable cabinet cover plates for servicing.

CIRCUITRY: Broad-range 4.5 volt transistorized circuit. Circuit gain controlled by single knob. Separate ON-OFF switch.

FREQUENCY RESPONSE: Translates frequencies between 36 and 44 kHz into audible sounds; other sounds within audio range are screened out.

PROBE AND COIL CORD: Hand-held; shielded against RF interference; output impedance 180 ohms, transistorized pre-amplifier; conical directivity of 22^{o}. Supplies with a six-foot coil cord employing latch-lock connectors. Less than 1 dB loss when used with a 100-foot connecting cable. Probe size: 1-3/8" diameter x 6-1/4" long, including protective monel-screened cap. Power to probe supplied through cord from main unit.

METER: Ultrasonic sound intensity measured by output meter; sealed and gasketed to lock out dirt and contaminants; scale length 1.75 inches; linear calibration (0-100) on upper scale for logging relative measurements; lower scale calibrated from 0-30 dB.

TEMPERATURE RANGE: Oscillator stability $\pm$ 15 Hz, and signal-to-noise ratio of translator within $\pm$ 1 dB from 0-55^{o}C.

HEADSET: 1.7 milliwatt into 600-ohm matched headset. One volt RMS minimum.

SYSTEM WEIGHT: 6 pounds; shipping weight 9 pounds.

BATTERY INFORMATION: Three Eveready E-12 (Mercury type).

BATTERY LIFE: 360-500 hours.

SECTION II

OPERATING INFORMATION

2-1. INTRODUCTION

2-2. This section contains information on the function of all controls in the Models 117 and 4917A Ultrasonic Translator detector and on the basic operation of the instrument.

2-3. CONTROLS AND CONNECTORS

2-4. Figure 2-1 identifies the controls on the Models 117 and 4917A. To aid in proper operation, paragraphs 2-5 through 2-8 provide a more extensive description.

2-5. ON-OFF power switch. This switch turns on battery power to the instrument. To obtain maximum battery life, be sure switch is OFF when the instrument is not in use.

2-6. PROBE JACK. For connection to any of the standard probes or probe accessories. In addition to receiving the signal from the probe, this connector also supplies power to the probe circuitry.

2-7. PHONE. This jack is for use with a headset having a 600-ohm impedance. A magnetic tape recorder having better than one volt RMS sensitivity may be connected to the phone jack.

2-8. VOLUME. Controls the gain of the translator amplifier.

2-9. BATTERY INSTALLATION

2-10. To install new batteries, remove the slotted plug in the bottom of the instrument (see figure 2-1). The plug is threaded with a standard right-hand thread. The batteries are held under considerable spring tension to insure reliable operation. All batteries should be inserted with the negative end pointing into the battery holder.

2-11. OPERATION

2-12. The Ultrasonic Translator detector with the General Purpose Probe is designed for use in locating gas and vacuum leaks and corona discharge. Its use, however, is certainly not limited to these types of problems since it is a general purpose detector of ultrasonic energy in the 36 to 44 kHz range. The addition of the 18021A Contact Probe gives even more versatility to the instrument.

2-13. Operation with the General Purpose Probe is as easy as operating a flashlight: the probe's high directivity makes it a simple matter to pinpoint a source of ultrasonic energy by scanning the suspected area. A gas leak or corona discharge is located by the increase in hissing or sparking sound in the speaker or headset and a corresponding increase in the meter reading. To pinpoint the precise location, reduce the VOLUME control to minimize the effects of ultrasonic reflections from nearby surfaces as the ultrasonic source is approached. Maximum signal will be indicated when the probe is pointed directly toward the source.

2-14. A front panel meter is provided to measure relative intensity of ultrasonic sounds being detected. The top meter scale may be used for logging When a more critical measurement is required, adjust VOLUME control until background hiss causes meter to read either 0, 5, or 10 dB on lower meter scale, as desired, and read ultrasonic sound intensity in dB above the referenced background level. Electronic circuitry automatically provides overload protection for the meter against strong ultrasonic signals.

2-15. OPERATIONAL CHECK

2-16. The electrical operation of the instrument can easily be checked by inserting the batteries supplied (see paragraph 2-9) and connecting the general purpose probe as shown in Figure 2-1, switch ON/OFF switch to ON position and adjust VOLUME control to a comfortable background level. Hold open end of probe toward face and sniff deeply or hiss; an obvious sniffing or hissing sound from the speaker with accompanying meter deflection indicates normal operation.

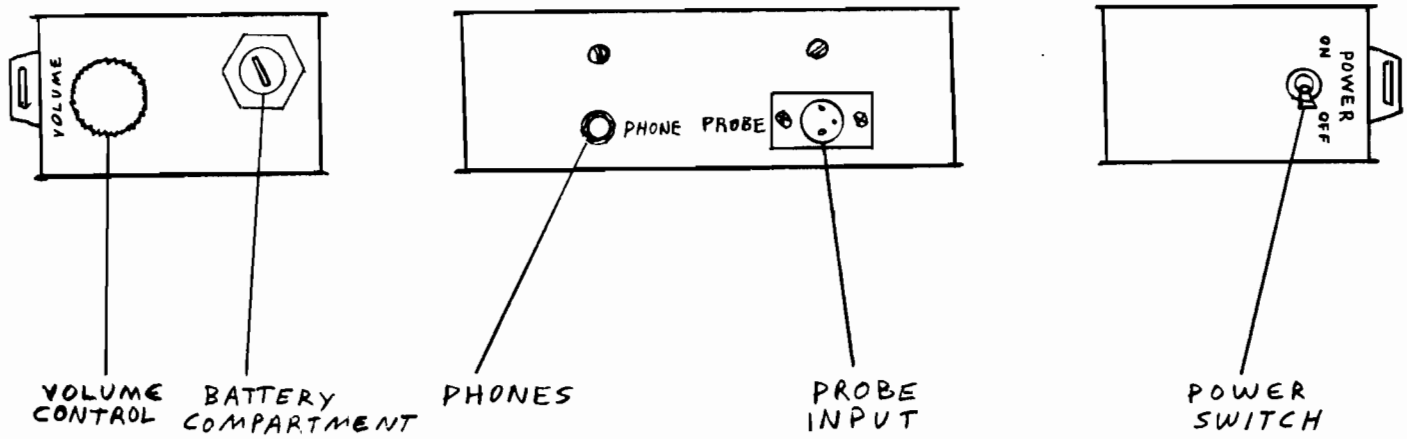


Figure 2-1. Controls and Connectors.

SECTION III

THEORY OF OPERATION

3-1. GENERAL

3-2. The HP Models 117/4917A Ultrasonic Translator detectors are essentially sensitive receivers which detect and amplify ultrasonic sound waves and translate them to audible signals. Figure 3-1 shows a simplified block diagram of the Models 117/4917A.

3-3. PROBE

3-4. The probe contains a transducer pick-up which responds primarily to a 36-44 kHz bandwidth. To insure that low-level signals are not masked by high ambient noise levels, all audio frequencies below 15 kHz are purposely removed by a high-pass filter at the transducer output. The probe also contains a two-stage preamplifier.

3-5. SIGNAL PROCESSING

3-6. Figure 4-7 is the schematic diagram of the Models 117/4917A. The 36-44 kHz output signal from the probe is applied to the Ultrasonic Translator via pin 3 of connector J1, and is passed through a low-pass filter before amplification by transistor Q1. This filter (C1, L1, C2) serves the dual purpose of matching the impedance of the probe to the input of Q1 and simultaneously filtering-out high frequency components above the 36-44 kHz band of interest. Potentiometer R8A is one of two ganged-potentiometers which control the output volume of the translator.

3-7. The output from Q1 is then applied to transistor Q2, where it is mixed with a 40 ± 0.5 kHz signal from local oscillator Q4. (The circuit containing Q4 is a simple Hartley oscillator whose frequency is adjusted by oscillator coil L4).

3-8. Mixer Q2's output is then coupled to audio power amplifier Q3 via transformer T1. (T1 is shunted by capacitor C8, which partially bypasses the unwanted 40 kHz mixing products from the audio amplifier). The secondary side of T1 feeds into a low-pass filter comprised of L3, C9, and C10, which limits the input frequencies into audio power amplifier Q3 to the 0-5 kHz audio range. Potentiometer R8B is ganged with R8A to provide output volume control.

3-9. The output of amplifier Q3 is coupled via impedance matching transformer T2 to both the headset (at terminal jack J2) and to the built-in intensity meter. The intensity meter (this is a 0-1 mA milliammeter) is calibrated with both linear and log scales. Meter calibration is adjusted with potentiometer R20. In this circuit diode CR1 rectifies the audio signal and provides the dc current to the meter. Diode CR2 acts as a current-limiter which protects the meter from overloads due to strong ultrasonic signals.

3-10. Capacitors C14, C15, and resistor R16 provide a decoupling network to prevent any of the audio output of Q3 from reaching the input stage of the translator through the probe connector J1. Pin 2 of J1 provides power voltage to the external probe.

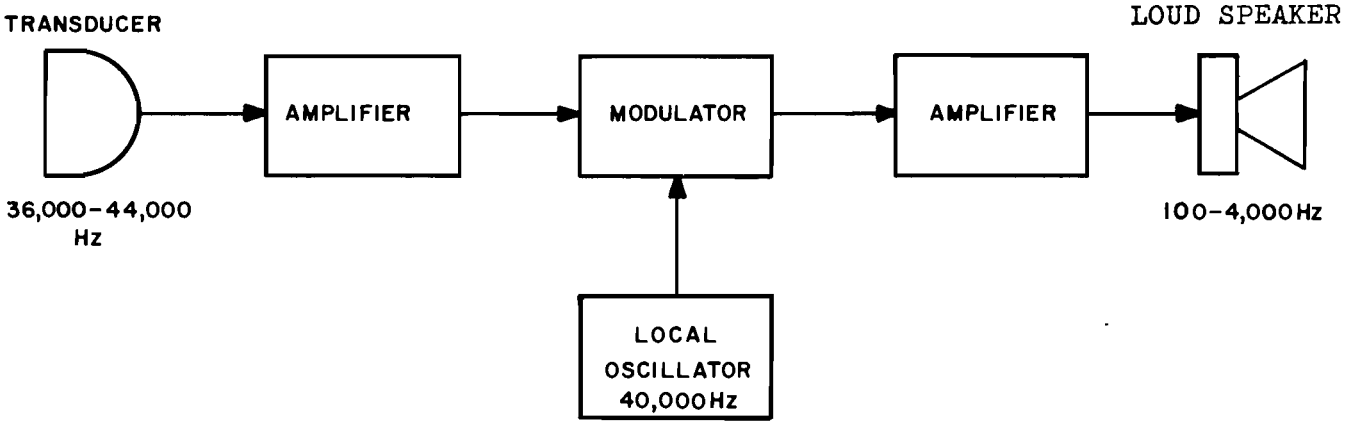


FIG. 3-1 SIMPLIFIED BLOCK DIAGRAM MODELS 117/4917A

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

4-2. This section contains information necessary for the proper maintenance of the HP Models 117/4917A Ultrasonic Translator detectors. The necessary Performance Checks, Adjustment and Calibration Procedures, and Troubleshooting Techniques required to accomplish the above objectives are provided.

4-3. TEST EQUIPMENT REQUIRED

4-4. The test equipment required to perform the operations outlined in this section is listed in Table 4-2. This table describes the type of instrument required, critical specifications, type of operation to be conducted, and the recommended model. If the specific model recommended is not available, equipment which meets or exceeds the critical specifications listed may be substituted.

4-5. PERFORMANCE CHECKS

4-6. The performance checks presented in this section are front panel procedures designed to compare the Models 117/4917A with their published specifications. These operations may be incorporated in periodic maintenance, post-repair, or incoming quality control checks. The performance checks should be conducted before any attempt is made to adjust or calibrate the instruments.

4-7. OSCILLATOR FREQUENCY CHECK

a. Figure 4-1 shows the recommended test setup. A wide range oscillator (HP Model 200 CD), a shielded attenuator (HP Model 350D) and an electronic counter (HP Model 5221A) are required to perform this test. Figure 4-2 shows the recommended test cord for use in connecting the attenuator output to the Model 117/4917A input.

b. Set the attenuator to 90 dB and adjust the wide range oscillator to 38.5 kHz.

c. Turn on the Model 117/4917A and adjust the VOLUME control to mid-position. Adjust the wide range oscillator output level for a 15 dB reading on the 117/4917A meter. The output tone should be approximately 1.5 kHz.

d. Tune the wide range oscillator toward 40 kHz until a null is obtained on the Model 117/4917A meter. The frequency should be 40 $\pm$ 0.5 kHz.

4-8. SENSITIVITY CHECK (without probe)

a. Figure 4-3 shows the recommended test setup. A wide range oscillator (HP Model 200 CD), a shielded attenuator (HP Model 350D), an A-C vacuum tube voltmeter (HP Model 400D) and an electronic counter (HP Model 5221A) are required for this test.

b. Set the wide range oscillator output level to 100 millivolts rms, and its frequency to 38.5 kHz (adjust for 1.5 kHz on the electronic counter).

c. With the attenuator 90 dB and the 117/4917A GAIN control at maximum, the A-C vacuum tube voltmeter should read 100 to 300 millivolts rms at the PHONES jack with a 600 ohm load connected to the jack.

4-9. ADJUSTMENT AND CALIBRATION PROCEDURES

4-10. The following is a complete adjustment and calibration procedure for the Models 117/4917A. These operations should be conducted only if it has been established by Performance Checks, Paragraph 4-5, that the Models 117/4917A are out of adjustment. Indiscriminate adjustment of the instrument controls to "refine" readings may actually cause more difficulty. If the procedures outlined below do not rectify any discrepancies that may exist, and all connections and settings have been rechecked, refer to Paragraph 4-14, Troubleshooting Techniques, for possible cause and recommended corrective action.

4-11. There are just two adjustments on the Models 117/4917A. The first is the oscillator frequency adjustment, and the second is the meter calibration. To perform either adjustment, the Model 117/4917A cover plates must be removed. Do this by removing the two screws in the rear of the case as shown in Figure 4-4.

4-12. OSCILLATOR FREQUENCY ADJUSTMENT

a. Connect an electronic counter (HP 5221A) to the emitter of Q4.

b. Adjust the slug in transformer L4 to give a reading of 40 kHz on the counter.

4-13. METER CALIBRATION

a. Figure 4-5 shows the test setup recommended for this adjustment. A wide range oscillator (HP Model 200 CD), a shielded attenuator (HP Model 350D), and an A-C vacuum tube voltmeter (HP Model 400D) are required for this adjustment.

b. Set the wide range oscillator output level to 100 millivolts rms, and set the attenuator to 90 dB.

c. Adjust the widr range oscillator frequency to 38.5 kHz.

d. Adjust the Model 117/4917A VOLUME control for a reading of 15 dB on the Model 117/4917A meter.

e. Decrease attenuator setting to 80 dB, and adjust R20 for a reading of exactly 25 dB on the Model 117/4917A meter.

f. Return attenuator setting to 90 dB. If the meter no longer reads 15 dB, repeat steps d and e.

4-14. TROUBLESHOOTING TECHNIQUES

4-15. This section contains procedures designed to assist in the isolation of malfunctions. These operations should be undertaken only after it has been established that the difficulty cannot be eliminated by the Adjustment and Calibration Procedures, Paragraph 4-9. An investigation should also be made to insure that the trouble is not a result of conditions external to the Models 117/4917A. It is assumed that the trouble has already been isolated to the translator itself and is not in the probe, which is covered in a separate manual.

4-16. The instrument cover plates must be removed for troubleshooting. After doing this, check the batteries and battery holder. (Corrosion caused by battery leakage is a common source of trouble.) To remove the cover plates, remove the two screws in the rear as shown in Figure 4-4.

4-17. Conduct a visual check of the Models 117/4917A for possible burned or loose components, loose connections, corrosion of the battery holder, or any other obvious conditions which suggest a source of trouble.

4-18. Check the battery voltage by measuring the terminal voltage (J1-Pin 1: gnd, J1-Pin 2) with the unit turned on, VOLUME control at maximum, and no signal input. The voltage should be at least -3.2 volts.

4-19. Check battery current drain by placing a 0-100 mA milliammeter across the terminals of the power switch with the switch in its OFF position. (Be sure to have a phone plug inserted in the PHONE jack to actuate the interlock switch.) With the VOLUME control at maximum and no signal input, the current drain should be 6 to 10 mA.

4-20. Almost any source of trouble in the Model 117/4917A can be isolated by simple signal tracing techniques. Use the test setup of Figure 4-5 while referring to the waveforms shown in Figure 4-6. Table 4-1 is a list of nominal d-c voltages throughout the circuit.

Table 4-1. Nominal DC Voltages

Check Point	Voltage
Emitter Q1	-0.70v
Collector Q1	-3.40v
Base Q1	-0.85v
Emitter Q2	-0.80v
Collector Q2	-3.10v
Base Q2	-0.85v
Emitter Q3	-0.70v
Collector Q3	-3.90v
Base Q3	-0.85v
Emitter Q4	-0.55v
Collector Q4	-3.60v
Base Q4	-0.60v

(1) The voltages in table 4-1 are nominal.

(2) Voltages in table 4-1 should be measured with probe connected and volume control set to minimum.

Table 4-2. Test Equipment Required

INSTRUMENT	CRITICAL SPECIFICATIONS	USE	RECOMMENDED
D-C Voltmeter	Accuracy: ±2% Input Resistance: 10 megohm	Performance Check Troubleshooting	HP 427A
Oscillator	Output Impedance: 600 ohms Frequency Range: > 40 kHz.	Performance Check Calibration & Adj. Troubleshooting	HP 200CD
Attenuator	Accuracy: ±0.5 dB Impedance: 600 ohms	Performance Check Calibration & Adj. Troubleshooting	HP 350D
Electronic Counter	Accuracy: 0.1% Speed: > 40 kHz	Performance Check Calibration & Adj.	HP 5221A
A-C Vacuum Tube Voltmeter	Sensitivity: better than 100 mV full scale. Accuracy: ± 2% Input Impedance: 10 megohm shunted by 25 pF	Performance Check Calibration & Adj.	HP 400D
Oscilloscope	Sensitivity: 10 mV/CM. Input Impedance: 1 meg shunted by 50 pF Range: 5mSec/CM 200 uSec/CM	Performance Check Calibration & Adj. Troubleshooting	HP 120B

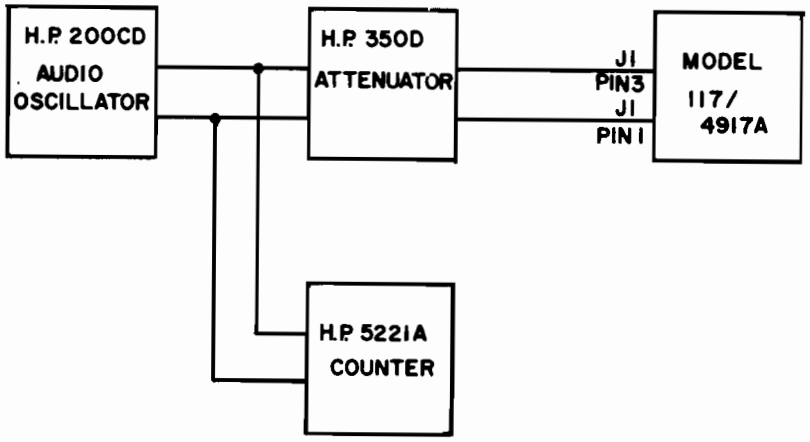


FIG. 4-1 TEST SET UP FOR OSCILLATOR FREQUENCY CHECK.

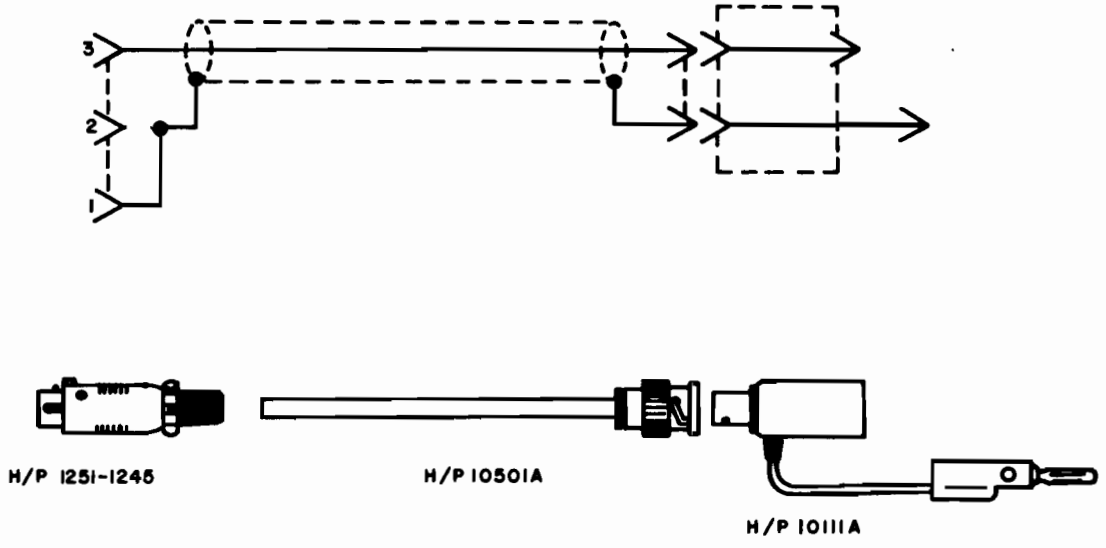


FIG. 4-2 RECOMMENDED TEST CORD FOR TESTING THE MODEL 117/4917A

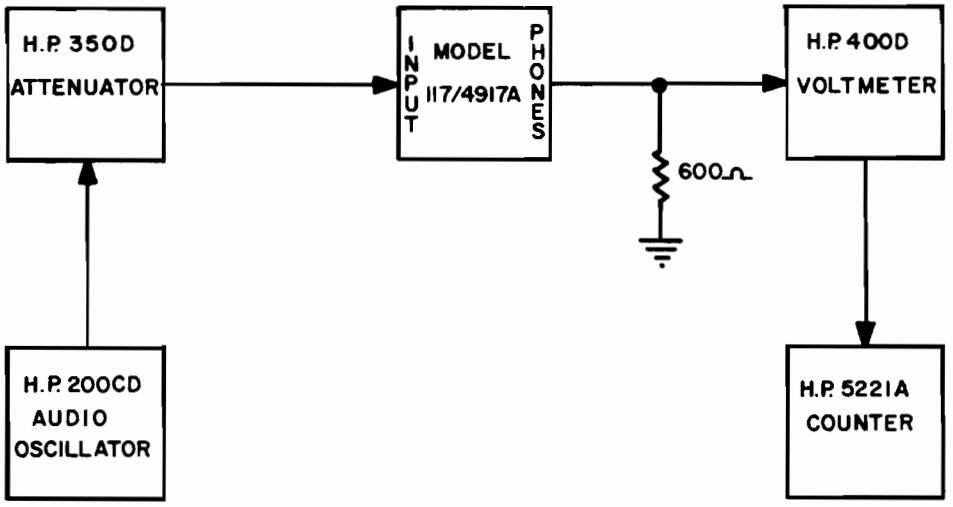
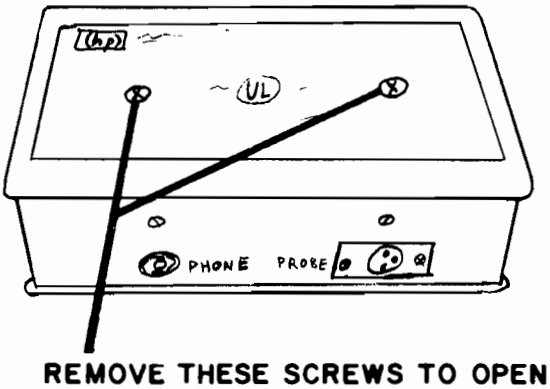


FIG. 4-3 TEST SETUP FOR SENSITIVITY CHECK



REMOVE THESE SCREWS TO OPEN COVERS.

FIG. 4-4 REMOVAL OF COVER PLATES

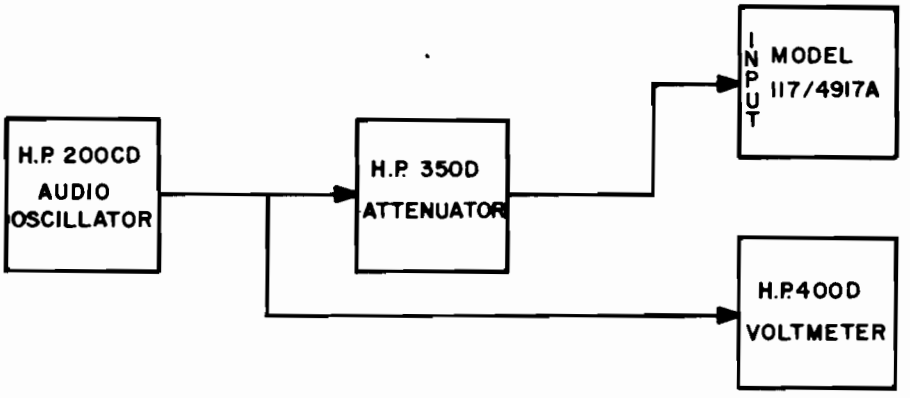
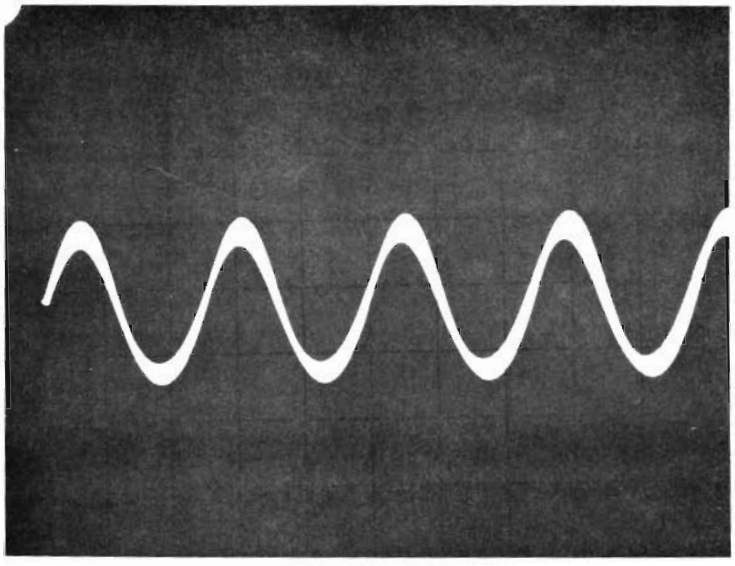
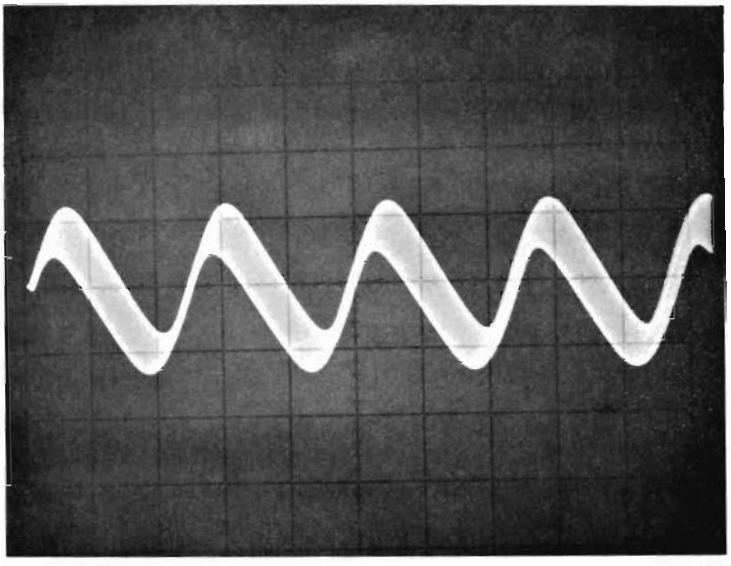


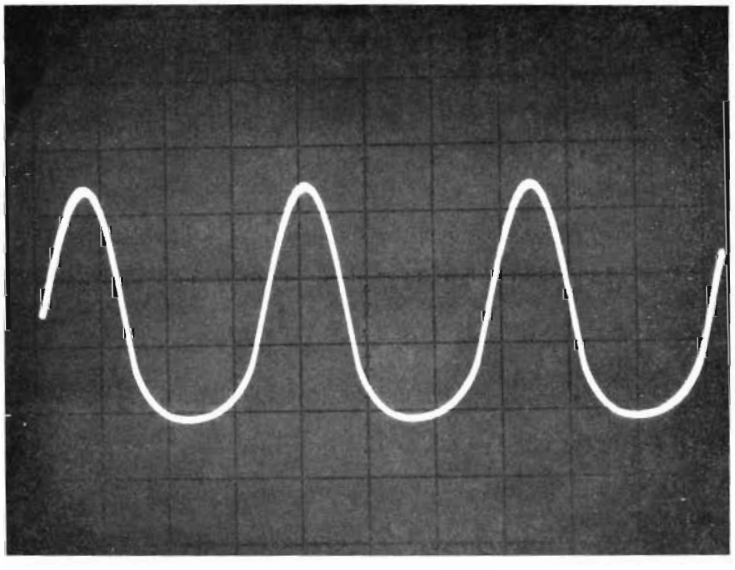
FIG. 4-5 TEST SETUP FOR METER CALIBRATION



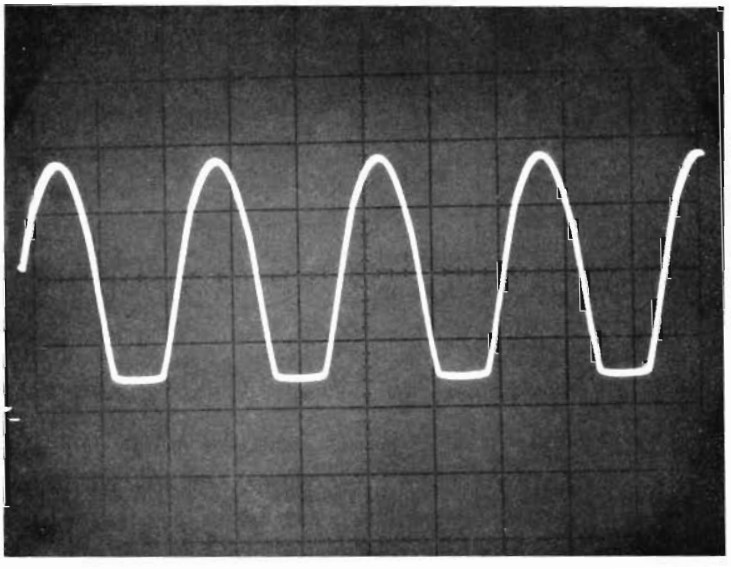
Q1C 50mV/cm, 0.01ms/cm
3V input through 90db Att.



Q2C 1V/cm 0.01ms/cm
1Vrms input through 90db Att.

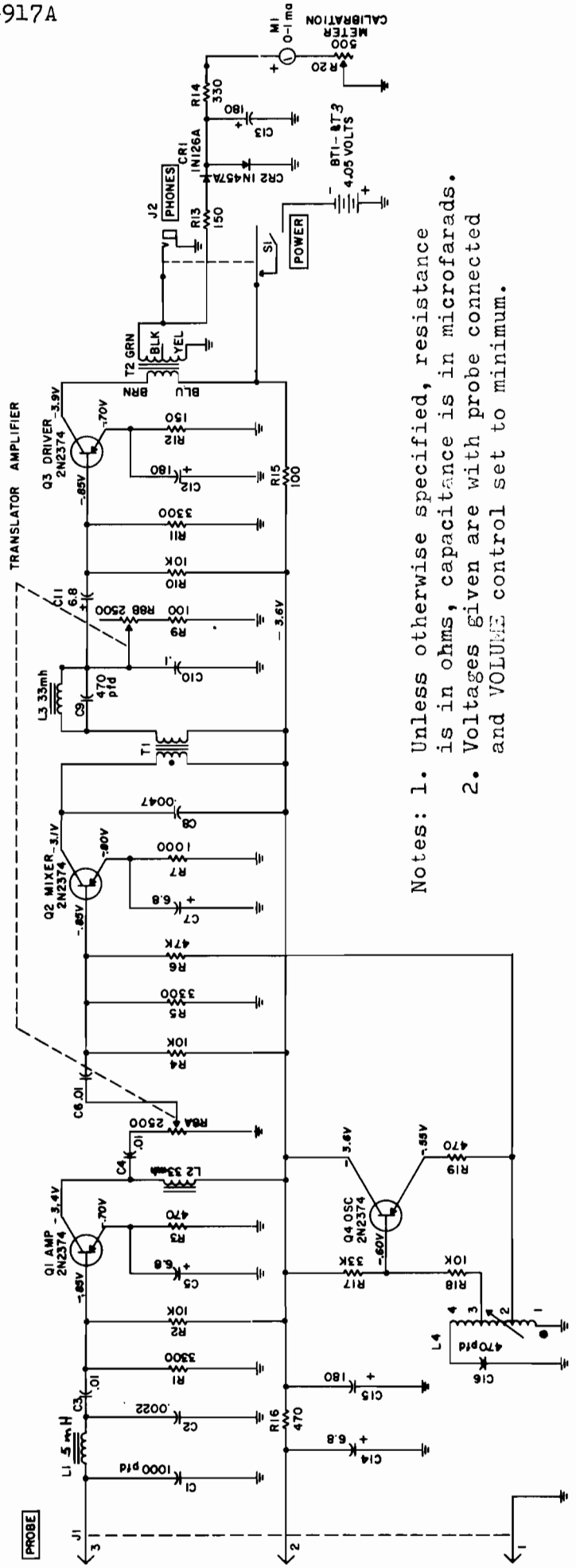


Q3C 1V/cm 0.2ms/cm
1Vrms input through 90db Att.



Q4E 2V/cm 0.01ms/cm

Figure 4-6. Waveforms - Models 117/4917A



Notes: 1. Unless otherwise specified, resistance is in ohms, capacitance is in microfarads.
2. Voltages given are with probe connected and VOLUME control set to minimum.

Figure 4-7. 117/4917A Schematic Diagram

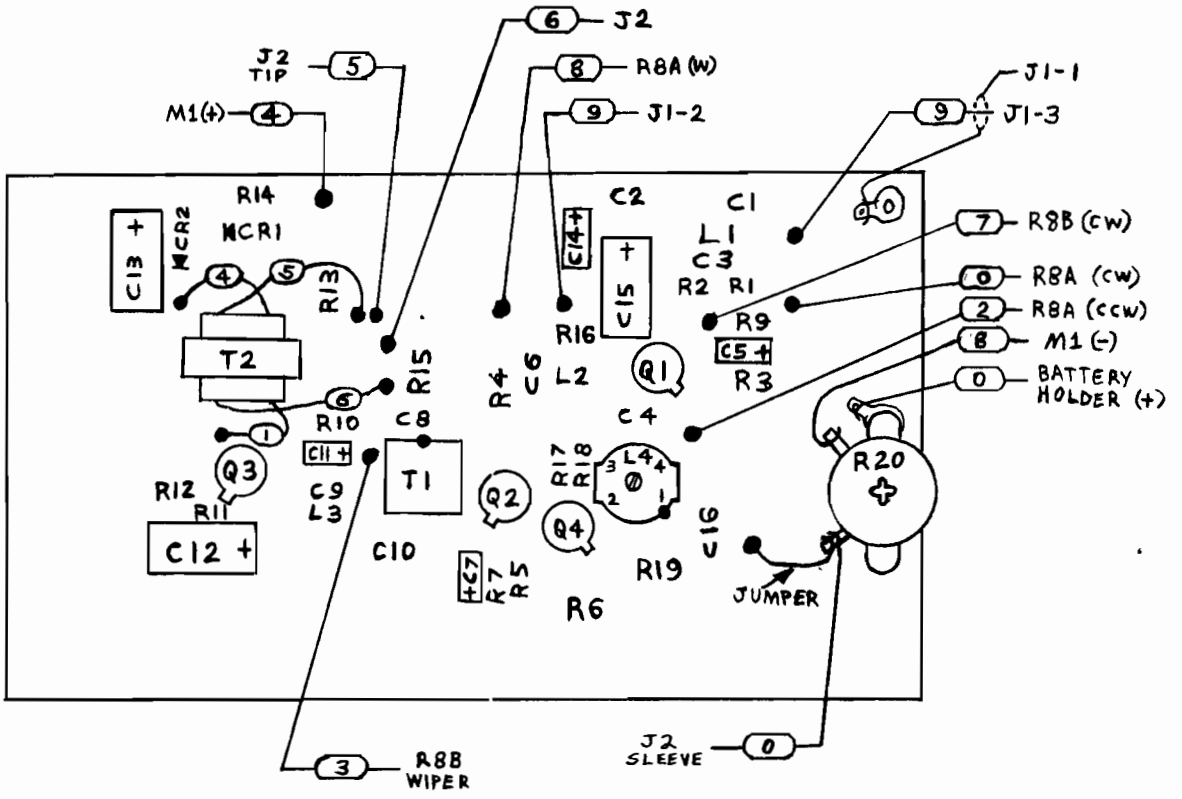


Figure 4-8. Models 117/4917 Circuit Board

Table 4-3. Printed Circuit Board Assembly A1 (04917-63808)

Replaceable Parts

Ref.	HP P/N	Description	TQ
C1	0160-0938	C:Fxd Mica 1000 pfd. ±5% 100V	1
C2	0160-0154	C:Fxd .0022 mfd ±10% 200V	1
C3	0160-0161	C:Fxd .01 mfd ±10% 200V	3
C4	0160-0161	C:Fxd .01 mfd ±10% 200V	
C5	0180-1701	C:Fxd 6.8 mfd ±20% 6V	4
C6	0160-0161	C:Fxd .01 mfd ±10% 200V	
C7	0180-1701	C:Fxd 6.8 mfd ±20% 6V	
C8	0160-0157	C:Fxd .0047 mfd ±10% 200V	1
C9	0140-0149	C:Fxd 470 pfd ±5% 300V	2
C10	0160-0168	C:Fxd .1 mfd ±10% 200V	1
C11	0180-1701	C:Fxd 6.8mfd ±20% 6V	
C12	0180-1702	C:Fxd 180 mfd ±20% 6V	3
C13	0180-1702	C:Fxd 180 mfd ±20% 6V	
C14	0180-1701	C:Fxd 6.8 mfd ±20% 6V	
C15	0180-1702	C:Fxd 180 mfd ±20% 6V	
C16	0140-0149	C:Fxd 470 pfd ±5% 300V	
CR1	1910-0016	Diode, 1N126A	1
CR2	1901-0033	Diode, 1N457A	1
L1	9100-1670	Inductor - 5 mH	1
L2	9100-1681	Inductor - 33 mH	2
L3	9100-1681	Inductor - 33 mH	
L4	9100-1605	Inductor - Oscillator Coil	1
Q1	1850-0109	Transistor, 2N2374	4
Q2	1850-0109	SAME AS Q1	
Q3	1850-0109	SAME AS Q1	
Q4	1850-0109	SAME AS Q1	
R1	0684-3321	R:Fxd Comp., 3300 ohm ±10% 1/4 watt	3
R2	0684-1031	R:Fxd Comp., 10 K ohm ±10% 1/4 watt	4

Table 4-3. Printed Circuit Board Assembly A1 (04917-63808)

Replaceable Parts (continued)

Ref.	HP P/N	Description	TQ
R3	0684-4711	R:Fxd Comp., 470 ohm ±10% 1/4 watt	3
R4	0684-1031	R:Fxd Comp., 10K ohm ±10% 1/4 watt	
R5	0684-3321	R:Fxd Comp., 3300 ohm ±10% 1/4 watt	
R6	0684-4731	R:Fxd Comp., 47K ohm ±10% 1/4 watt	1
R7	0684-1021	R:Fxd Comp., 1000 ohm ±10% 1/4 watt	1
R9	0684-1011	R:Fxd Comp., 100 ohm ±10% 1/4 watt	2
R10	0684-1031	R:Fxd Comp., 10 K ohm ±10% 1/4 watt	
R11	0684-3321	R:Fxd Comp., 3300 ohm ±10% 1/4 watt	
R12	0684-1511	R:Fxd Comp., 150 ohm ±10% 1/4 watt	2
R13	0684-1511	R:Fxd Comp., 150 ohm ±10% 1/4 watt	
R14	0684-3311	R:Fxd Comp., 330 ohm ±10% 1/4 watt	1
R15	0684-1011	R:Fxd Comp., 100 ohm ±10% 1/4 watt	
R16	0684-4711	R:Fxd Comp., 470 ohm ±10% 1/4 watt	
R17	0684-3331	R:Fxd Comp., 33 K ohm ±10% 1/4 watt	1
R18	0684-1031	R:Fxd Comp., 10 K ohm ±10% 1/4 watt	
R19	0684-4711	R:Fxd Comp., 470 ohm ±10% 1/4 watt	
R20	2100-0384	R:Var Comp., 500 ohm ±20%	1
T1	9100-1602	Transformer	1
T2	9100-1689	Transformer, 500 ohm to 600 ohm Imped. Ratio	1

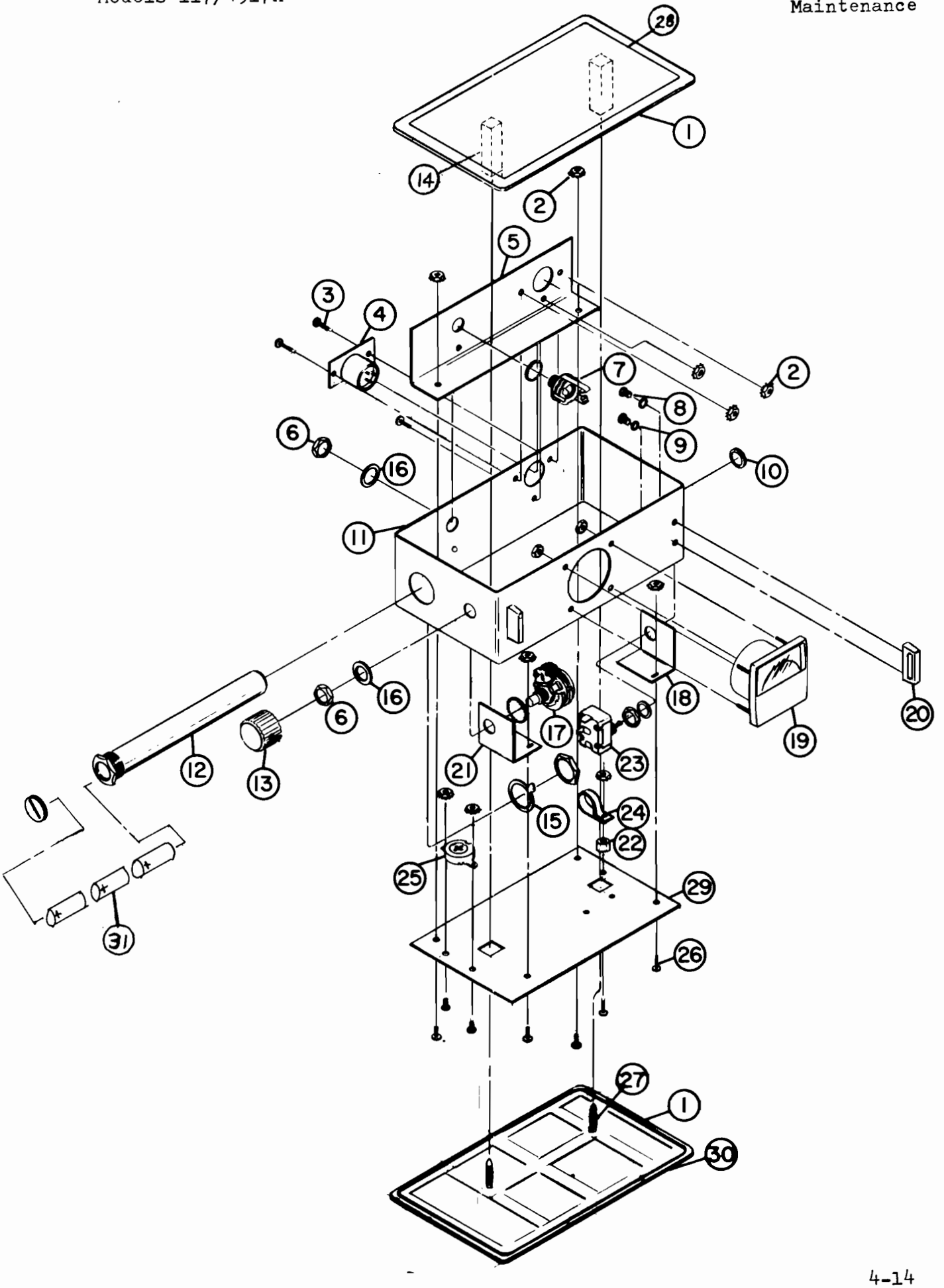


Figure 4-9. Mechanical Parts

Table 4-4. Mechanical Parts

Ref.	HP P/N	Description	TQ
1	0050-1186	Casting, Side Panel	2
2		Nut, 4-40	11
3		Screw, 4-40 x 1/4	2
4	1251-1246	Connector, 3 Contact, Wall Mtg.(J1)	1
5	04917-03807	Bracket, P.C. Bd. Bottom	1
6		Nut, 3/8-32 x 1/2	3
7	1251-1187	Connector, Phone Jack (J2)	1
8		Screw, 8-32 x 1/4	4
9		Washer, Lock, #8	4
10	0590-0012	Nut, Knurled, 15/32-32	1
11	7120-2216	Wraparound	1
12	5060-7110	Battery Holder Assy.	1
13	0370-0186	Knob	1
14	0380-1021	Standoff, Square	2
15		Solder Lug, 7/8 ID	1
16		Washer, Flat	2
17	2100-1546	Resistor, Adj., Comp., Dual, 2500 Ohms (R8)	1
18	04917-03805	Bracket, P.C. Bd., Switch	1
19	1120-1188	Meter, 0-1 mA (M1)	1
20	0050-1187	Strap Anchor	2
21	04917-03806	Bracket, P.C. Bd., Volume Control	1
22	0380-0118	Standoff, Round	1
23	3101-0173	Switch, Toggle, SPDT (S1)	1
24	1400-0016	Clamp, Cable, 3/4" ID	1
25	2100-0384	Resistor, Adj., Comp., ±20%, 500 ohms (R20)	1
26		Screw, 4-40 x 1/4	8
27		Screw, 10-32 x 1/2 FH	4
28	7120-2213	Decal, Side Plate, Front	1
29	04917-63808	P.C. Bd., Assy. (A1)	1
30	7120-2200	Decal, Side Plate, Rear	1
31	1420-0024	Battery, Mercury, 1.4V (BT1,BT2,BT3)	3

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CERTIFICATION

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

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery. Batteries are not included in this warranty. We will repair or replace products which prove to be defective during the warranty period, provided the proper preventative maintenance procedures, as listed herein, are followed. No other warranty is expressed or implied. We are not liable for consequential damages.

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MICROFICHE PART NO. 04917-90004

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