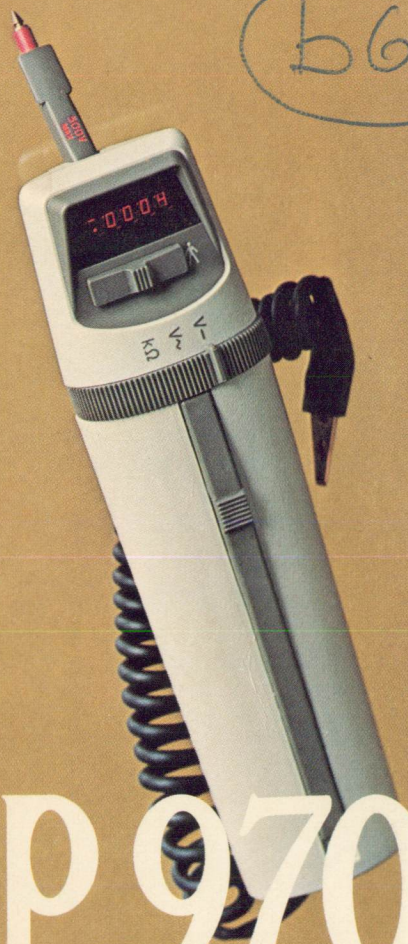


669



HEWLETT  PACKARD

HP 970A

Printed in USA



HEWLETT PACKARD

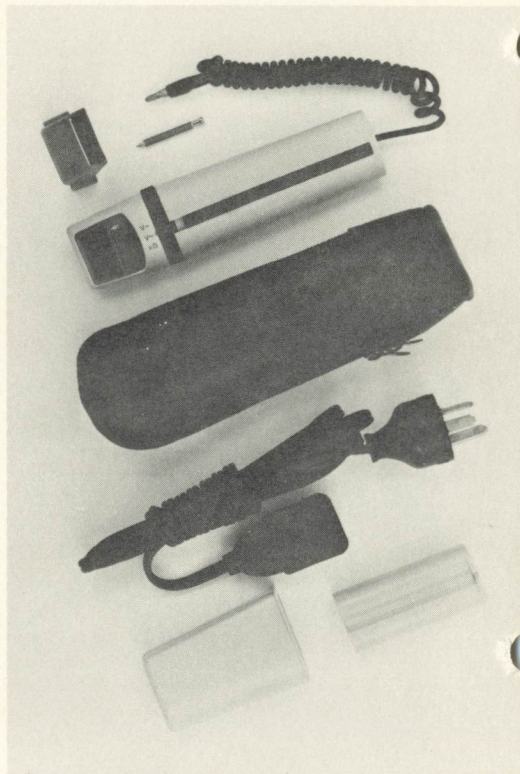
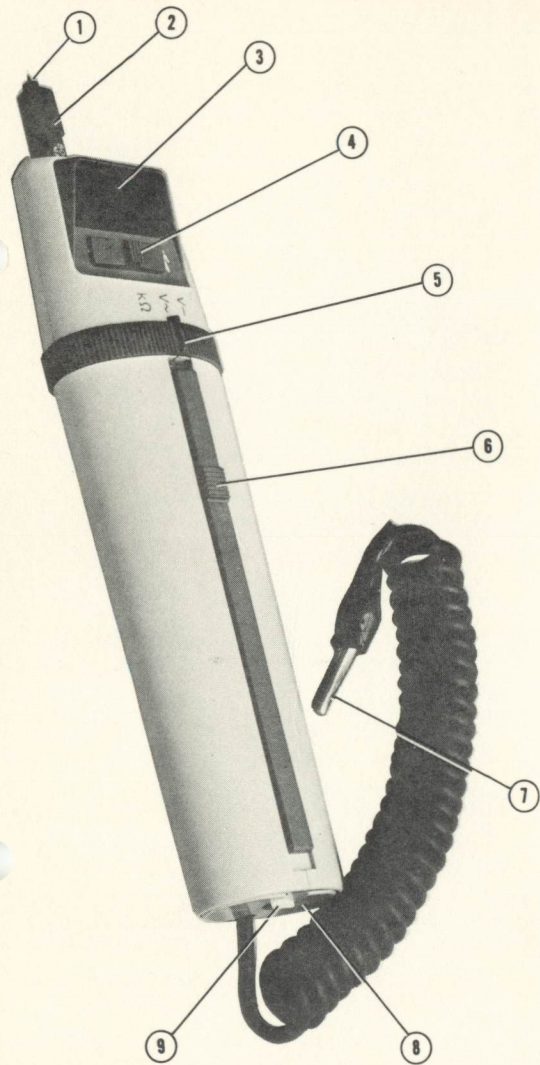
970A KIT CONTENTS

- Basic Probe
- Charger
- Power Cord (outside U.S.)
- Rechargeable Battery Pack
- Belt Carrying Case
- Short Probe Tip
- Sunlight Hood
- Operating and Service Manual

ACCESSORIES AVAILABLE

- | | |
|----------------------------|-------------|
| Protective Combining Case | 1540-0264 |
| Long Probe Tip | 8710-0557 |
| Cupped Probe Tip | 5040-7616 |
| Current Shunt/Bench Cradle | 97002A |
| Rechargeable Battery Pack | 97001A |
| Belt Carrying Case | 1540-0257 |
| RF Adapter | 97003A |
| Conductive Wrist Band | 00970-67900 |

(continued on inside of rear cover)



97004A Kit

Part No.	Qty.	Description
0330-0029	1	Insulator Clip
1251-0029	1	Connector, Male
1251-0533	1	Adapter, Pin Tip
1251-3890	1	Adapter, Spade Lug
1251-3891	1	Splice, Female Plug
1400-0046	1	Clip Alligator
1540-0264	1	Case, Accessory
5040-7616	1	Probe Tip, Concave
7120-2627	1	Label, Info.
7120-3644	1	Plate, I.D.
7120-3689	1	Label, Blank
8120-2083	1	Patch Cord
8710-0557	1	Probe Tip, Long
8710-0648	1	Probe, Needle Tip

*Charger and Power Cord

90 - 130 V	97010A
200 - 270 V	97020B

See Operation Section of manual for detailed identification.



MANUAL CHANGES

-hp- Model 970A
PROBE MULTIMETER
Serials Prefixed: All

Inside Front Cover. Under "Kit Contents" delete "(Outside U.S.)".

Page 6. Delete the sentence referring to Model 97000A.

Replace the plug configuration figure with the following:



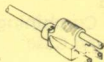
00970-61601



8120-0683



8120-0681



8120-0684

The last plug listed as part number 8120-0698 is not available. The American plug 8120-0684 will be shipped in its place.

Page 15. The Slide Switch Adjustment applies to serial numbers 1320A03576 and up.

Page 19. Change MECHANICAL PARTS LIST as follows:

Description	Part No.
Rechargeable Battery Pack	97001A
Battery Charger, 90—130 V	97010A
Battery Charger, 200—270 V	97020B
Power Cords (see Page 6 for part numbers)	
Battery Charger 97010A/cord 8120-0684	97010-60002
Battery Charger 97010A/cord 8120-0681	97010-60003
Battery Charger 97010A/cord 00970-61601	97010-60004
Battery Charger 97010A/cord 8120-0683	97010-60005
Battery Charger 97020B/cord 8120-0684	97020-60002
Battery Charger 97020B/cord 8120-0681	97020-60003
Battery Charger 97020B/cord 00970-61601	97020-60004
Battery Charger 97020B/cord 8120-0683	97020-60005
Sun Shield	5040-7592
Protective Combining Case	1540-0264
Belt Carrying Case	1540-0257

Inside Back Cover. Delete "and power cord."

The following changes apply to Serial Number 1320A22466 ± 100 and greater.

With revision K of the A1 printed circuit board assembly, S2C1 (C: Fxd 0.047 μ F, P/N 0160-4068), and S2R1 (R: Fxd 22 M Ω , P/ 698-6749) are transferred to the P.C. board from the function switch. They are now designated A1C6 and A1R32, respectively.

Page 18. Add the fore-mentioned descriptions, Part Numbers and *revised* designators to the "Electronics Parts List."

SPECIFICATIONS ■

OPERATION ■

MAINTENANCE ■

OPERATING & SERVICE MANUAL

HP 970A PROBE MULTIMETER

Manual Part No. 00970-90007
Microfiche Part No. 00970-90057

Serials Prefixed: 1320A-

Copyright Hewlett-Packard Company 1973
P.O. Box 301, Loveland, Colorado 80537 U.S.A.

Revised Print Date: February 1975

HP-

CERTIFICATION

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

WARRANTY AND ASSISTANCE

The Hewlett-Packard Model 970A Probe Multimeter and its accessories are fully warranted against defects in materials and workmanship for a period of one year from the date of shipment. During the second and third years from the date of shipment, Hewlett-Packard will subsidize repairs, based on their then current service policy. However, the Model 97001A Rechargeable Battery Pack is warranted for ninety (90) days from the date of shipment. Hewlett-Packard will, at its option, repair or replace without charge, any product which proves to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. Hewlett-Packard is not liable for consequential damages.

For assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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D.C. VOLTMETER

Ranges: 0.1 V, 1 V, 10 V, 100 V, 1000 V (500 V max. input).

Accuracy: (20°C to 30°C) $\pm(0.7\%$ of reading + 0.2% of range).

Input Resistance: 10 M Ω \pm 5%.

Input Protection: \geq 750 V Peak.

Temperature Coefficient: $\pm(.05\%$ of reading + .02% of range)/°C.

A.C. VOLTMETER

Ranges: 0.1 V, 1 V, 10 V, 100 V, 1000 V (500 V rms sinewave max. input).

RANGES	ACCURACY (20°C to 30°C)	
	45 Hz to 1 kHz	1 kHz to 3.5 kHz
1 V thru 1000 V	$\pm(2\%$ of reading + 0.5% of range)	$\pm(3\%$ of reading + 0.5% of range)
0.1 V (> 3 mV)	$\pm(2\%$ of reading + 0.5% of range)	$\pm(5\%$ of reading + 0.5% of range)

Input Resistance: 10 M Ω , \pm 5%.

Input Capacitance: < 30 pF.

Input Protection: \geq 750 V Peak.

Temperature Coefficient: $\pm(.05\%$ of reading + .05% of range)/°C.

HP-

OHMMETER

Ranges: 1 k Ω , 10 k Ω , 100 k Ω , 1000 k Ω , 10,000 k Ω .

Accuracy: (20°C to 30°C)

$\pm(1.5\%$ of reading + 0.2% of range)

Input Voltage Protection (Resistor Fused):

≤ 115 V rms for up to 1 minute.

≤ 250 V rms for up to 10 seconds.

Temperature Coefficient: $\pm(.05\%$ of reading + .02% of range)/°C.

TYPICAL PERFORMANCE CHARACTERISTICS

Ranging: Automatic

Sample Rate: 3/sec.

Overrange: 10%.

AC Volts: Average Responding.

A/D Conversion: Dual Slope.

Operating Temperature: from 0°C to 40°C.

Power: rechargeable batteries.

Operating Time using fully charged battery: 2.5 hour continuous at 25°C.

Battery Charging Time: 14 hours (Indefinite charging will not damage battery.)

Battery Range: 8.5 to 11 volts.

Net Weight: 7 oz (200 g).

Shipping Weight: 4 lb (1.8 kg).

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ACCESSORY SPECIFICATIONS

-hp- 97002A CURRENT SHUNT/BENCH CRADLE

D.C. Ammeter (20° C - 30° C).

Ranges: .1 mA, 1 mA, 10 mA, .1 A, 1 A.

Accuracy: $\pm(2.5\%$ of reading + 0.2% of range).

Full Range Insertion Voltage: < 0.25 V

A.C. Ammeter (20° C - 30° C, > 3% of range)

Ranges: .1 mA, 1 mA, 10 mA, .1 A, 1 A.

Accuracy: $\pm(4\%$ of reading + 0.5% of range)

45 Hz-1 kHz

$\pm(7\%$ of reading + 0.5% of range)

1 kHz-3.5 kHz.

Full Range Insertion Voltage: < 0.25 V

Ammeter Input Protection: 2 A fast blow fuse

ACV, DCV, Ohms: Same as 970A.

This operating procedure for the -hp- 970A Probe Multi-meter is keyed to the illustration that appears inside the front cover. Unfold the illustration when reading the procedure.

① **PROBE TIP.** The cupped Probe Tip holds a firm connection to pointed contacts such as wire wrap terminals. The pointed tips were designed for use on broader surfaces such as printed circuit pads. The groove at the end of the tip can be used to help extend or remove the tip, or to keep the Probe Tip from slipping off bare wire leads.

② **PROBE TIP SOCKET.** The Probe Tip can be partially pulled out of its socket to alter its length. When the Probe Tip is completely removed, the socket will accept a banana plug or alligator clip.

The Probe Tip Socket can be used in any position between fully open and fully closed. Three convenient detents are provided: one detent keeps the Probe Tip fully open and the remaining two are 30° and 60° from the fully open position.

③ **DISPLAY.** The Display always indicates input in either volts or kilohms. For example, a 50 ohm resistor is read as .050 kΩ. Overrange is indicated by a series of dashes (-----).

970A

OPERATION

④ **DISPLAY INVERT SWITCH.** This switch electronically inverts the display so that it can be conveniently read with the Probe Tip pointing either up or down. Always set the Display Invert Switch to expose a "Human Symbol" that appears upright.

⑤ **FUNCTION SWITCH.** Turn the Function Switch to the appropriate position to measure resistance ($k\Omega$), ac volts ($V\sim$), or dc volts ($V-$). For resistance measurements, the Probe Tip voltage is positive with respect to the Clip Lead.

⑥ **POWER SWITCH.** The Power Switch can be set to three positions: (a) ON (continuous) when positioned toward the display; (b) PRESS-TO-READ when set to the center position; (c) and OFF when positioned away from the display. Press-To-Read operation conserves battery energy.

⑦ **CLIP LEAD.** Connect the Clip Lead to the low or ground connection of the circuit under test.

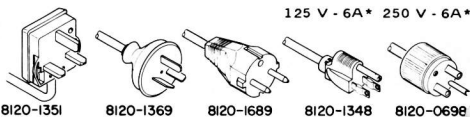
⑧ **RECHARGEABLE BATTERY PACK.** The Rechargeable Battery Pack provides two to three hours of continuous operation. The Model 970A battery power will normally last for 2000 readings if the Press-To-Read bar is used. The time needed to make a measurement is typically less than 5 seconds.

As the Battery approaches the end of its power reserve, the display will begin to dim.

⑨ **BATTERY LATCH.** Push the latch toward the center of the Model 970A to release the battery pack.

CHARGER AND POWER CONNECTION. The -hp- battery charger provides proper charging current for the Rechargeable Battery Pack. Indefinite charging by an -hp- Charger that is connected to its specified line voltage will not damage the battery.

The -hp- Model 97000A Battery Charger is plugged directly into a wall outlet and does not require a power cord. A power cord is supplied with the Models 97020B and 97010A Battery Chargers. The various plug configurations are identified by part number in the accompanying illustration.



*UL LISTED FOR USE IN THE UNITED STATES OF AMERICA

To recharge the battery pack, slide it into the Charger until the latch engages and the battery pack is flush with the Charger. Plug the Charger into a power outlet that supplies the voltage shown on the Charger. A completely discharged battery will be fully charged after overnight charging.

ATTENTION

If a Nickel-Cadmium battery is charged and lightly discharged in regular cycles, a decrease in the operation period of the battery may result. If this should happen, charge the battery for at least 14 hours, turn on the Model 970A with battery installed for 4 hours to discharge the battery, and then recharge the battery for at least 14 hours.

If the battery has been excessively discharged, the operation period of the battery will be reduced. Frequently this problem may be corrected by charging the battery for 36 to 48 hours.

SEMICONDUCTOR PN JUNCTION TEST.

NOTE

When the Function Switch is set to $k\Omega$, the Probe Tip voltage is positive with respect to the Clip Lead.

- a. Set the Function Switch to $k\Omega$.
- b. Connect the anode to the Probe Tip and the cathode to the Clip Lead.
- c. Momentarily place a short across the junction (this downranges the probe).
- d. Remove the short across the junction. The probe will uprange to an appropriate range. Readings for good junctions will typically be near $5 k\Omega$ and $1.7 k\Omega$ for silicon and germanium respectively.

- e. Connect the cathode to the Probe Tip and the anode to the Clip Lead.
- f. Read ohms overrange (----) for a silicon junction. A germanium junction may cause the ohmmeter to autorange between overrange and one of the upper ranges. This is caused by the larger leakage current of the germanium junction.

CURRENT SHUNT/BENCH CRADLE. Set the probe to $V\sim$ or $V-$ to indicate ac or dc current respectively. Then remove the Probe Tip, insert the 970A tip socket into the Current Shunt/Bench Cradle, connect the Clip Lead, and use the current shunt as you would an ammeter. Full range indication is .1000 for all ranges.

When the range switch is set to " $V\ k\Omega$ ", the 970A's operation is unaffected by the Current Shunt/Bench Cradle except that signals are input through the binding posts.

For more detail refer to the 97002A Operating and Service Note.

970A

This section contains information necessary to maintain the Model 970A. The following paragraphs describe the Performance Tests, Assembly and Disassembly Instructions, an Adjustment Procedure, and Troubleshooting.

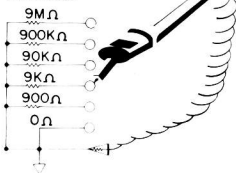
PERFORMANCE TESTS

This section contains procedures to verify proper operation of the Model 970A. For these tests, the Model 970A should be operated at an ambient temperature of 20° to 30°C and with a freshly charged battery. It is recommended that the performance of the 970A be tested upon receipt and at 12 month intervals thereafter. If the 970A is found to be out of specifications at any point, refer to the Adjustment Procedure.

Required Test Equipment.

Instrument Type	Required Specifications	Recommended Model
DC Standard	Accuracy: $\pm .05\%$ Range: 0.1 V to 500 V	-hp- Model 740B DC Standard
Decade Resistor	Accuracy: $\pm 0.1\%$ Range: 1 k Ω to 10 M Ω	General Radio, Model 1433-H, Decade Resistor
AC Standard	Accuracy: $\pm 0.2\%$ Range: 0.1 to 500 V 40 Hz to 3.5 kHz	-hp- Models 745A, 746A AC Standard

DECADE RESISTOR



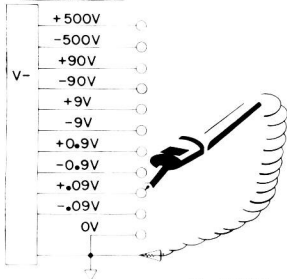
970A READINGS

8840	to	9160K Ω
884	to	916K Ω
88.4	to	91.6K Ω
8.84	to	9.16K Ω
.884	to	.916K Ω
.000	to	.002K Ω

k Ω TEST

1. Set the 970A function switch to k Ω .
2. Connect the 970A to a Decade Resistor.
3. Set the Decade Resistor to the values shown in the above table and read resistance on the 970A within the listed limits.

DC STANDARD



970A READING

494	to	506	V
-494	to	-506	V
89.2	to	90.8	V
-89.2	to	-90.8	V
8.92	to	9.08	V
-8.92	to	-9.08	V
.892	to	.908	V
-.892	to	-.908	V
.0892	to	.0908	V
-.0892	to	-.0908	V
.0000	to	\pm .0002	V

V-TEST

1. Set the 970A function switch to V-.
2. Connect the 970A to a DC Standard.
3. Set the Standard to output the voltages shown in the above table and read voltage on the 970A within the listed limits.

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MAINTENANCE

AC STANDARD

500V, 3.5KHz
90V, 3.5KHz
9V, 3.5KHz
.9V, 3.5KHz
.09V, 3.5KHz
500V, 1KHz
90V, 1KHz
9V, 1KHz
.9V, 1KHz
.09V, 1KHz
.09V, 45 Hz
0V

970A READINGS

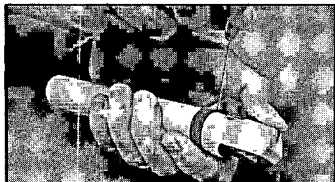
480	to	520	V
86.8	to	93.2	V
8.68	to	9.32	V
.868	to	.932	V
.0850	to	.0950	V
485	to	515	V
87.7	to	92.3	V
8.77	to	9.23	V
.877	to	.923	V
.0877	to	.0923	V
.0877	to	.0923	V
.0000	to	.0030	V

V~TEST

1. Set the 970A function switch to V~.
2. Connect the 970A to an AC Standard.
3. Set the AC Standard to output the voltages and frequencies shown in the above table and read voltage on the 970A within the listed limits.

DISASSEMBLY INSTRUCTIONS

First remove the battery from the 970A.



Brace the probe as shown above and press with the thumb

until a catch releases. Insert the edge of a small coin into the space that appears at the joint of the 970A.

CAUTION

Wear clean cotton gloves when working on the circuit board or switch. Contamination or fingerprints will reduce the accuracy of the instrument.

MOS circuits in the 970A may be permanently damaged by static discharge from a hand or tool when the 970A is disassembled. Procedures that should be followed are:

1. Ground the hand while opening and working on the 970A. Conductive wristbands (-hp- Part No. 00970-67900) are available for this purpose.
2. Touch tools to ground to remove static charges before using them on the 970A.
3. Use only a soldering iron with grounded tip.



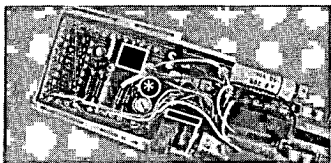
Brace the other side of the probe as shown above to release the second catch.

970A



Pull outward on the exposed edge of the display bezel assembly as shown above.

ASSEMBLY INSTRUCTIONS



Route wires away from the outlined areas (*except the two wires terminating here) before assembling the 970A.



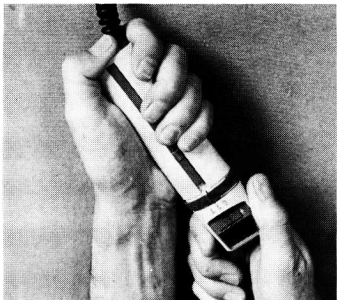
Carefully engage the tabs and slots in the edges of the two plastic assemblies until they are ready to snap together as shown above. When everything is properly positioned, very little pressure is necessary to snap the bezel to the backbone.

Insure that the Clip Lead is pressed firmly into its groove in the backbone.



Set the function switch hub to its center position. Slip the function switch band onto the probe shell with the pointer set to the V~ position. Set the power switch bar to the power off position.

Using thumb and forefinger, press both tabs as shown above. Use the body of the hand to push the display module about 1/4 inch (6 mm) into the shell.



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Move the function switch band toward the display of the 970A. Insure the tab on the inside of the band engages the slot in the hub, then work the display module into the shell as illustrated.

ADJUSTMENT PROCEDURES

Adjustment of R9.

1. Perform the V- Performance Test except for the 0 V test.
2. If, at any point, the 970A does not read within the listed limits, adjust R9 for the best possible accuracy at all of the listed dc voltages. Counterclockwise rotation of R9 increases the reading equally for all ranges for both polarities.
3. If the 970A still does not read within the listed limits, check the battery and switches as described in the Troubleshooting Information.

SLIDE SWITCH ADJUSTMENT

If the slide switch is intermittent when in the *on* position or if the display is always in the "*press to turn on*" position a small adjustment can correct this.

- a. Remove the probe shell as outlined on Page 11, Disassembly Instructions.
- b. On the backbone of the probe you will find a number six allen screw.
- c. Adjust screw *in* if the slide switch is intermittent in the *on* position. Adjust *out* if Probe is on in "*Press to turn on*" position.

- d. Assemble Probe and test all positions of switch.
- e. Repeat Steps a through d until the switch works properly.

TROUBLESHOOTING INFORMATION

Most 970A failures are traced to a discharged battery. Tests for the battery, for the two mechanical switches, and for the resistor fuse are included in these procedures. If the trouble is not found in one of these four parts, replace the entire circuit board assembly.

NOTE: A service card has been included with the 970A. The card must be filled out and accompany the 970A when the probe is sent to Hewlett-Packard for repair.

Battery Charge Test.

1. Remove the battery from the 970A.
2. Measure at least 9.5 volts across the battery.
3. Load the battery with 200 ohms. If there is greater than 9.5 volts across the loaded battery, the battery will adequately power the 970A.

Power Switch Test.



Wear clean cotton gloves when working on the circuit board. Contamination or fingerprints will reduce the accuracy of the instrument. Use low flux content solder (-hp- Part No. 8090-0512) when replacing components. Do not permit traces of flux to form on the circuit board.

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MAINTENANCE

1. Find the three power switch contacts on the back of the board.
2. Measure resistance across the two contacts that have traces connected to them.
3. With the switch button pressed, the resistance should be less than 0.2 ohms.

Function Switch Test.

1. Set the Function Switch to V—.
2. Remove the display bezel assembly to access the circuit board.
3. Find the 9 wires that lead from the function switch to the circuit board.
4. Measure less than 0.2 ohms between the white wire, the blue wire and the brown wire. Measure less than 0.2 ohm between the orange wire and the yellow wire.
5. Switch to V~ and test the gray, blue, and the brown wires as above.
6. Switch to k Ω and test the green, violet, and brown wires as above.
7. Test the red and orange wires as above.

Fuse Test.

1. Remove one lead of the fuse resistor from its clip.
2. Measure within 1% of 8.87 k Ω across the fuse resistor.

Fuse Replacement.

Use long nose pliers to remove and replace the fuse resistor. Cut the fuse resistor leads as close to the clips as possible.

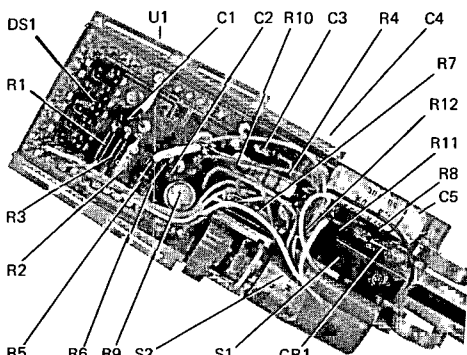
ELECTRONIC PARTS LIST

DES.	DESCRIPTION	PART NO.
A1	Main Electrical Assembly	00970-66506
	Rebuilt	00970-69506
C1	C: Fxd 1.0 μ F	0180-0472
C2	C: Fxd .047 μ F	0160-4068
C3	C: Fxd 18 μ F	0180-0404
C4	C: Fxd .01 μ F 1 kV	0150-0012
C5	C: Fxd 1.8 μ F	0160-0577
CR1*	Diode: Bkdn 6.49 V	1902-3119
DS1	Display: Digital LED	00970-69510
R1	R: Fxd 1.1 M Ω	0698-6589
R2*	R: Fxd 976 k Ω	0698-6588
R3*	R: Fxd 10 M Ω	0698-6591
R4	R: Fxd 10 M Ω	0698-6590
R5	R: Fxd 100 k Ω	0757-0465
R6	R: Fxd 10 M Ω	0698-8412
R7*	R: Fxd 10 M Ω	0698-6419
R8	R: Fxd 2550 Ω	0698-3179
R9	R: Var 200 Ω	2100-2061
R10	R: Fuse (8.87 k Ω , 1% met flm 1/2W)	0698-4135
R11*	R: Thermister	0837-0085
R12	R: Fxd 10 k Ω	0684-1031
S1	Switch: Power (Cherry E63-07AM)	3101-0614
S2	Switch: Function (with hub)	00970-69505

*These parts were adjusted to work with the hybrid circuit.
Do not replace individually.

970A

MAINTENANCE

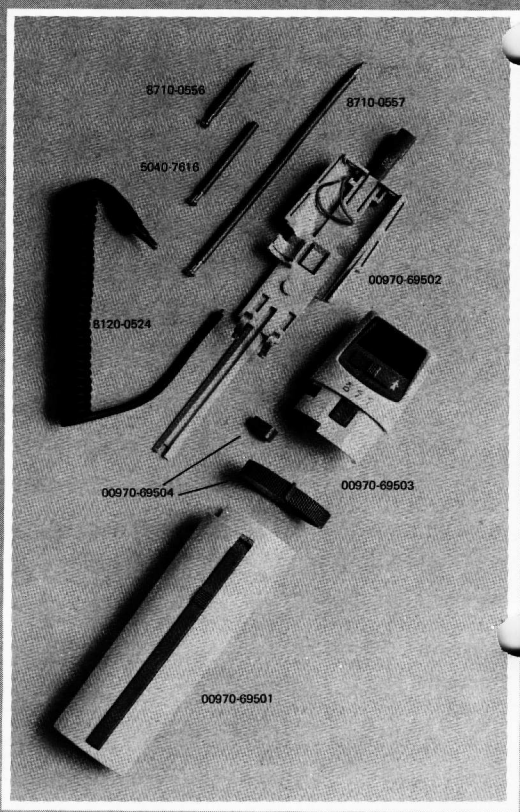


ELECTRONIC PARTS

MECHANICAL PARTS LIST

DESCRIPTION	PART NO.
Rechargeable Battery Pack	97001A
Battery Charger and Power Cord, 200-270 V	97020B
Battery Charger and Power Cord, 90-130 V	97010A
Power Cords (see Page 6)	
Sun Shield	5040-7592
Protective Combining Case	1540-0264
Belt Carrying Case	1540-0257

MAINTENANCE



SALES & SERVICE OFFICES

UNITED STATES

ALABAMA

P.O. Box 4207
2003 Byrd Spring Road S.W.
Huntsville 35802
Tel: (205) 881-4591
TWX: 810-726-2204

ARIZONA

E. Magnolia St.
Phoenix 85034
Tel: (602) 244-1361
TWX: 910-951-1330

5737 East Broadway
Tucson 85711
Tel: (602) 298-2313
TWX: 910-952-1162

CALIFORNIA

1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000
TWX: 910-592-1288

3939 Lankershim Boulevard
North Hollywood 91604
Tel: (213) 877-1282
TWX: 910-499-2170

6305 Arizona Place
Los Angeles 90045
Tel: (213) 649-2511
TWX: 910-328-6148

1101 Embarcadero Road
Palo Alto 94303
Tel: (415) 327-6500
TWX: 910-373-1280

2220 Watt Ave.
Sacramento 95825
Tel: (916) 482-1463
TWX: 910-367-2092

9606 Aero Drive
San Diego 92123
Tel: (714) 279-3200
TWX: 910-335-2000

COLORADO

7965 East Prentice
Englewood 80110
Tel: (303) 771-3455
TWX: 910-935-0705

CONNECTICUT

12 Lunar Drive
New Haven 06525
Tel: (203) 389-6551
TWX: 710-465-2029

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2806 W. Oakland Park Blvd.
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