HP-97

PROGRAMMABLE PRINTING CALCULATOR SERVICE MANUAL

HEWLETT PACKARD

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Programmable Printing Calculator

SERVICE MANUAL

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General Information

1-1. INTRODUCTION

1-2. This manual contains the information needed to troubleshoot, disassemble and reassemble, repair, and test the HP-97 Programmable Printing Calculator.(See figure 1-1).

1-3. The repair process for this calculator is broken up into two parts, assembly-level and component-level repairs. Basic operating information, specifications, theory of operation, and maintenance information are included.

1-4. This section contains basic information and specifications for the HP-97. Improper operations leading to an error display are listed in appendix A. For operating instructions refer to the owner's handbook.

1-5. DESCRIPTION

1-6. The HP-97 is a fully programmable, desktop printing calculator. Mechanically, the HP-97 is essentially similar to the HP-91, with the addition of a card reader.

1-7. COMPATIBILITY

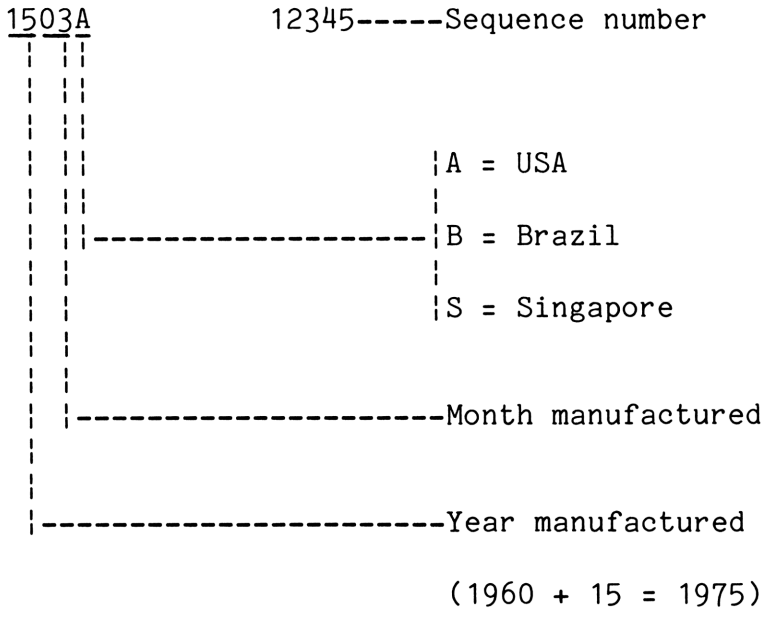
1-8. The HP-97 is compatible with the HP-67: programs recorded on a magnetic card from HP-67 can be loaded into and executed on an HP-97, and vice versa.

1-9. Programs recorded on a magnetic card from an HP-65 cannot be loaded into an HP-97; however, most programs written for an HP-65 can be manually entered into an HP-97 via the keyboard. Most programs written on an HP-97 can be used in an HP-41C/HP-41CV; however, the converse is not true.

1-10. IDENTIFICATION

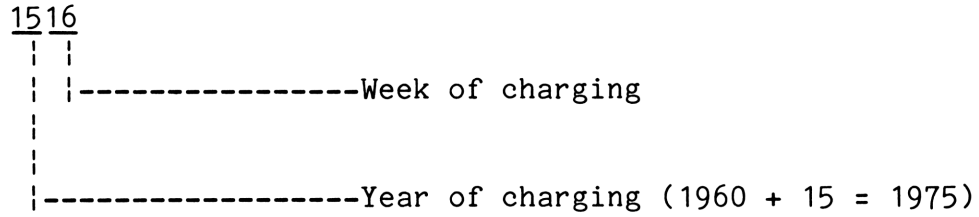
1-11. The serial number of the calculator is used for identification and warranty determination. It is located just above the battery door as the bottom of the calculator faces you. The format is described below:

Calculator Identification

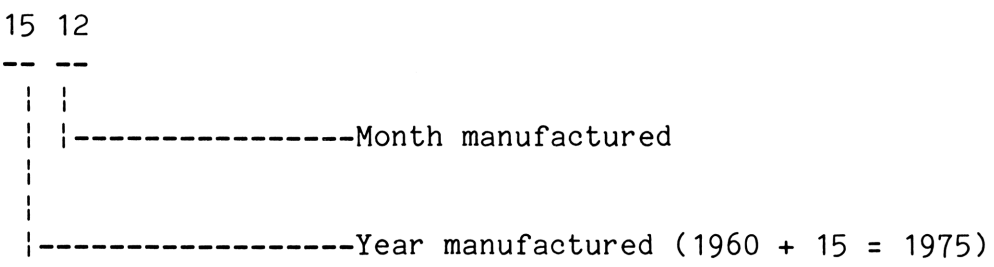


1-12. The serial numbers located on the battery and on the ac adapter/recharger are used to determine the week the unit was fully charged and the date of manufacture, respectively. The format for each is described below.

Battery Charge Date



AC Adapter/Recharger
Manufacture Date



1-13. STANDARD ACCESSORIES

1-14. The HP-97 comes complete with each of the following accessories:

* Carrying Case
* AC Adapter/Recharger
* Owner's Handbook
* Battery Pack
* Printer Paper (two rolls)
* Standard Pac
* Programming Pad

1-15. OPTIONAL ACCESSORIES

1-16. The following items are optional accessories to the HP-97 and as such are sold separately:

* HP 82044A Security Cable
* HP 82037A Reserve Power Pack
* Pocket Card Holder (part number 00097-13142)

Table 1-1. Specifications

Calculator Dimensions

* Length: 8.0 inches (20.3 centimeters).
* Width: 9.0 inches (22.9 centimeters).
* Height: 2.5 inches (6.35 centimeters).

Weight

* Calculator with battery pack: 40 ounces (1.13 kilograms).
* U.S. Recharger: 11 ounces (311 grams).

Power

* Rechargers

	HP Part Number	
United States	82059B	90-127 Vac, 50-60 Hz, 7W
Australian	82068B	200-254 Vac, 50-60 Hz, 7W
European	82069B	90-127 Vac, 50-60 Hz, 7W
	82066B	200-254 Vac, 50-60 Hz, 7W
Desktop	82067B	200-254 Vac, 50-60 Hz, 7W

* Battery
  Four cell, 4.4 to 6.0 volts, quick-charge nickel-cadmium battery pack.
  * Operating time: 3 to 7 hours.

    Note: Battery must be in place to operate the calculator.

  * Recharging time: 7 to 10 hours, calculator OFF; 17 hours, calculator ON.

* Formats:
  Fixed Point: Numbers are shown with "n" places to the right of the decimal point.

  Scientific: Numbers are shown with "n" places to the right of the decimal place.

  Engineering: Numbers are shown with "1 + n" digits and an exponent of 10 that is the nearest multiple of three.

* Special indications:
  Overflow: X-register overflow displays all nines (+ 9.999999999 99).

  Underflow: Zero in scientific notation. If in fixed notation, automatically reverts to scientific notation for small numbers that would otherwise appear as zero.

  Low Battery: LED at upper left of display lit for 30 seconds to 10 minutes before display blanks.

Table 1-1. Specifications (Continued)

Display

* Rounding to last displayed digit. Internal operations are calculated with 10 digits.

* Numeric and decimal point: Eight segment, light-emitting diode (LED). Digit and decimal point are contained within a single eight-segment LED.

* 15-digit display including two sign digits.

* Minimum/maximum display number: $+-1 \times 10^{99}$ to $+-9.999999999 \times 10^{99}$.

Other: "Error" written on display when improper operation is attempted (see appendix A). "Crd" written on display when card is expected.

Environmental Specifications

* Operating: 0 to 45C (32 to 113 F) with paper, 5% to 95% relative humidity.

* Charging: 15 to 40 C (59 to 104 F)

* Calculator Storage: -40 to 55 C (-40 to 131 F).

* Paper Storage: -40 to 30 C (-40 to 86 F); less than 60% relative humidity.

  Note: Avoid exposure to direct sunlight or artificial light sources for extended periods; keep in box or appropriate container.

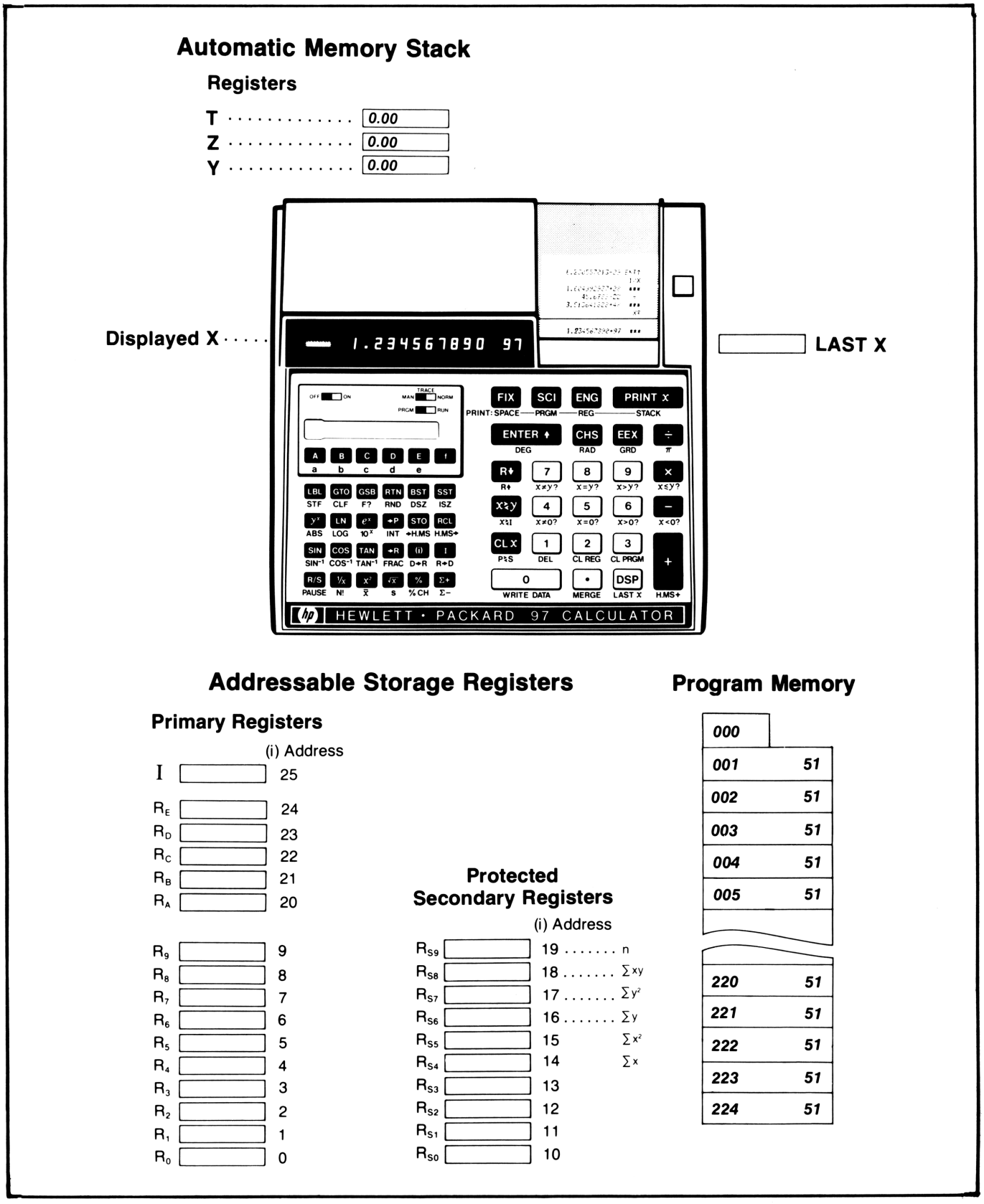


Figure 1-1. HP-97 Keyboard and Memory

SECTION
II

Theory of Operation

2-1. HP-97 LOGIC

2-2. The main functional components of the HP-97 as shown in figure 2-1 are:

a. Display

b. Power supply

c. Keyboard.

d. ACT (arithmetic, control, and timing).

e. PIK (printer interface control and keyboard buffer).

f. Printer assembly

g. ROM's (read only memories).

h. Anode buffers.

i. Cathode driver.

j. CRC (card reader chip).

k. Card Reader Assembly.

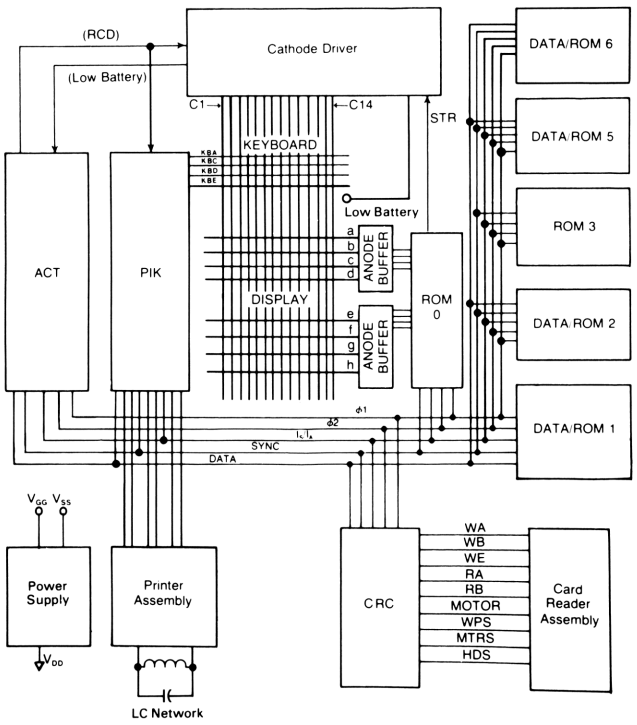


Figure 2-1. HP-97 Block Diagram

2-3. DISPLAY

2-4. The display consists of a 15-digit light emitting diode (LED) module plus a low battery indicator which are controlled in part by each of the following components:

a. ACT.

b. ROM 0.

c. Anode buffers.

d. Cathode driver.

2-5. Each digit consists of seven LED segments with an additional segment for the decimal, which makes eight segments, sequentially lettered a through h as shown below.

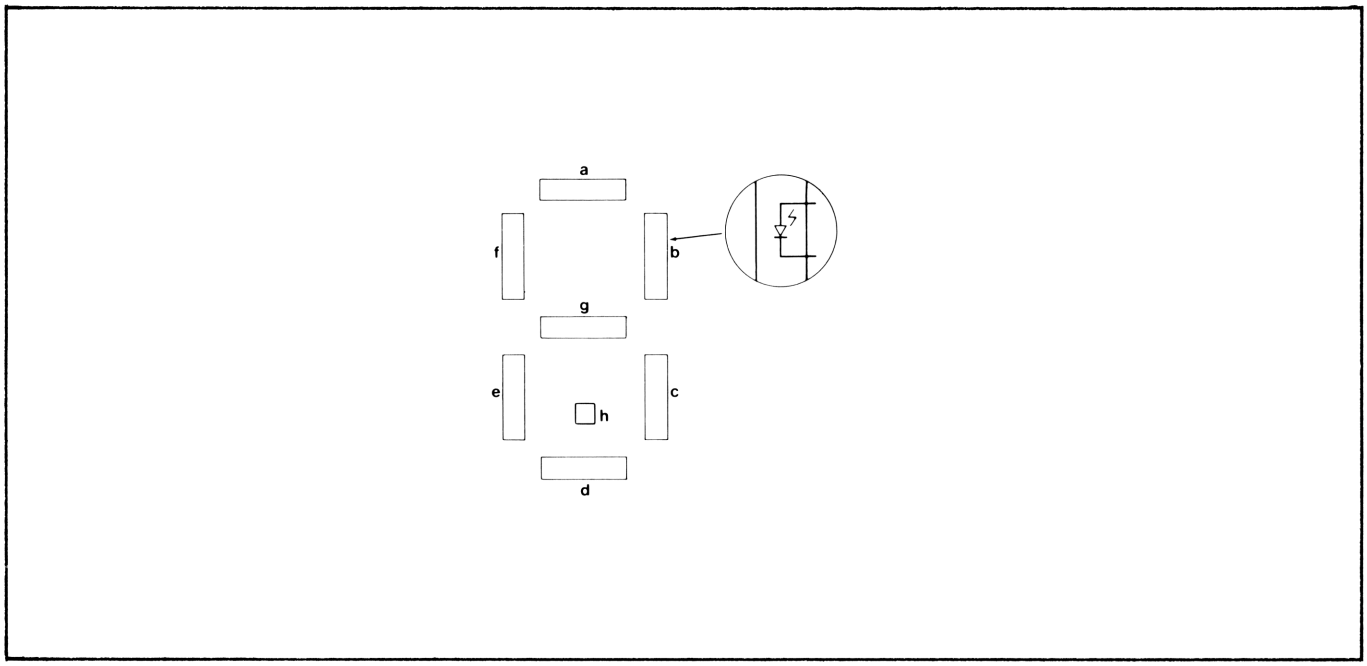


Figure 2-2. LED Digit

2-6. Since the display is a scanned diode array, both its anode and cathode must be driven in order for the segment to light. All cathodes of each digit are tied together, as shown in figure 2-3. When a cathode

driver transistor is turned on, any segment of that digit may light; the segment that lights will now be determined by which anode driver transistor is switched on. As an example, if all cathode driver transistors were switched on along with the a-segment anode driver, the a-segment of all digits across the display would light.

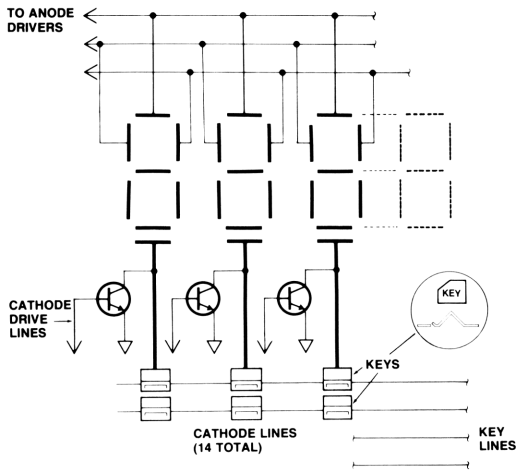


Figure 2-3. LED Display Format

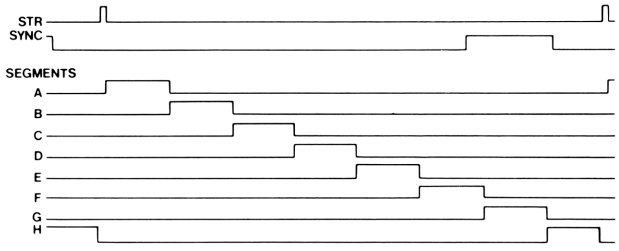


Figure 2-4. SYNC and Display Timing

2-7. By sequentially switching on each cathode driver, only one digit at a time is actually lit. This happens too fast though for the eye to detect. Each cathode driver transistor is sequentially switched on by the strobe (STR) signal provided by the display ROM (ROM Ø) and reset by reset cathode driver (RCD), which is provided by the ACT. (See figure 2-4.)

2-8. The display of the HP-97 requires a large amount of current. Though the display ROM decodes the display information given on the IS bus by the ACT to switch on the current anodes, it alone is not capable of handling the large amount of current. Anode buffer U3 and U4 are used for this purpose.

2-9. Every cathode driver in the display that is switched on returns to ground that corresponding cathode line in the keyboard buffer U4 (PIK) which will decode and store up to seven keycodes. This allows the operator to press keys very quickly without waiting for the calculator to catch up. The PIK will also hold each keycode for a short period to negate the effects of key bounce.

2-10. PERFORMING A FUNCTION

2-11. Before a key is pressed the ACT is continually asking, "Has a key been pressed?" If the ACT is not tied up in controlling a calculation, and a key has been pressed, it will service that key code and the display will return. (The display is blanked out during printing to conserve power.)

2-12. The ACT services a key code by first requesting the key code corresponding to the key that was pressed, from the PIK. The PIK returns that code to the ACT via the DATA line. The ACT finally will put the address code on the instruction address (IS) bus. This address goes to the ROM's that will now send back to the ACT the specific instructions of how to perform that function and at the same time instruct the PIK as to what function to print. The ACT will then perform that function on the numbers in the display; the printer will print (when the print mode switch is set to TRACE) the function name and the result of that operation.

2-13. TIMING

2-14. The ACT circuit produces two signals for timing purposes: SYNC for the ROM's, PIK, and CRC, and RCD for the PIK and cathode driver. Along with the connection through the SYNC line, the ACT is connected to the ROM's and PIK by the IS (instruction address) bus. The IS bus instructs the data storage IC to store data sent on the data line from the ACT, and to send data back to the ACT on the same DATA line. Figure 2-5 shows the timing relationship between the SYNC, DATA, and IS pulses.

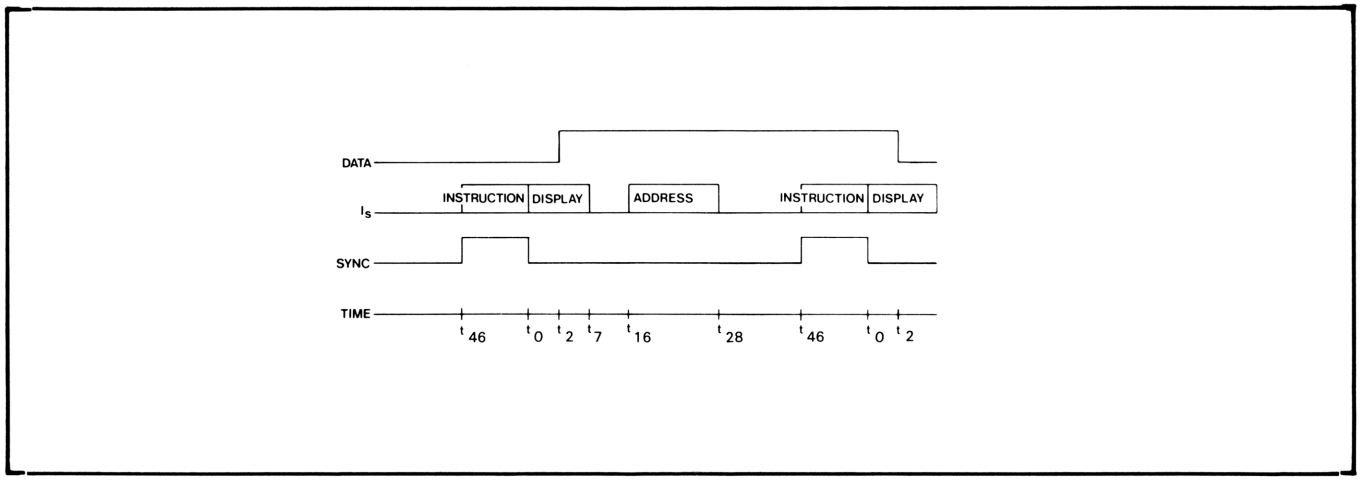


Figure 2-5. Timing Diagram

2-15. In addition to being used to synchronize the system, SYNC is also used to gate the 10-bit instruction that appears on IS at bit times t46 through t55. During this time, SYNC distinguishes instructions from addresses. Following an "IF" instruction on the IS bus, the subsequent SYNC pulse is suppressed to allow a 10-bit address to be sent on the IS bus.

2-16. At bit times t16 through t28, the IS line carries a 12-bit instruction address from the ACT to the five ROMs, while display information is carried from the ACT to the ROM during bit times t0 through t7. At bit times t0 through t3, a digit is carried from the ACT to the ROM's for decoding and display. On the following word time, the next digit is sent out. Sign, decimal point, and blanking information for the number is carried to the ROM 0 during bit times t4 through t7.

2-17. PROGRAM AND DATA ROM

2-18. The ROM (read-only memory) consist of five ROMs each containing 1K microprogrammed instructions that are used by the CPU to execute the specified operations. Most operations require instructions stored in more than one ROM. However, only one ROM is accessed at any time. When the ROM address register in each ROM receives a 10-bit address on the ISA line, the decoder in each ROM uses the four most significant bits of the addresa to determine if the addressed location is in that ROM. The proper ROM is enabled and transmits the addressed instruction on the ISA line; the remaining ROMs are disabled. A timing circuit in each ROM synchronizes the ROM's operation with the system timing using the $\Phi 1$, $\Phi 2$, and SYNC

signals from the ACT. 224 program steps of 8 bits each are stored in ROMS 1, 2, 3, and 5, which contain program memory.

2-19. Data is stored in the 24 storage registers of 56 bits each located in ROMs 1, 2, 3, and 5. ROM 1 is the primary register; ROM 6 is the secondary register.

2-20. PRINTER

2-21. The printer used in the HP-97 employs a very hot source (print head resistors) in close contact with heat sensitive paper. This paper changes color in the area of heat contact.

2-22. The print head contains seven small resistors (each about 10 ohms) that heat up when current is passed through them. Figure 2-6 shows the print head and resistors.

2-23. The head is mechanically moved across the paper by a lead-screw mechanism (see figure 6-2). By passing current through the appropriate head resistor at the correct time, as the head moves across the paper, characters are thermally printed (see figure 2-7).

2-24. Notice the slight slant of each character. This is done to decrease instaneous current demands. The printer/interface and keyboard buffer (PIK) is responsible for this operation. The PIK also controls print intensity, line width, and motor movement commands.

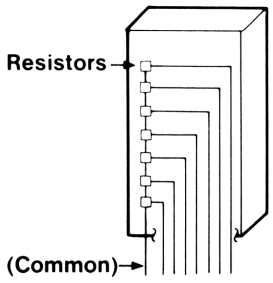


Figure 2-6. Print Head

2-25. Print Head Drivers

2-26. Each head resistor requires approximately 0.5A of current to adequately print on the heat sensitive paper. NPN transistors Q1 through Q7, driven by the PIK, act as switches to supply the head resistors with the required current and also to reduce the drive requirements from the PIK.

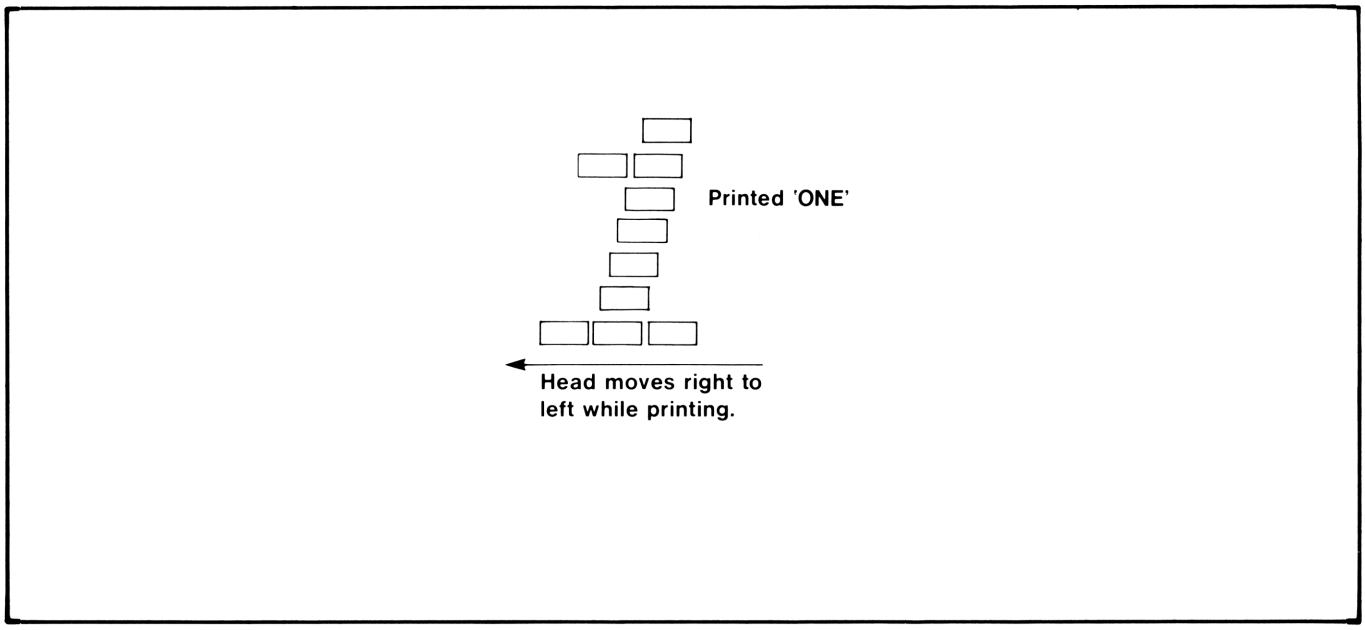


Figure 2-7. Printed Character

2-27. Printer Motor Control

2-28. A small dc motor provides the mechanical power through the action of the lead-screw and gears to move the print head. Current for the motor is controlled by the on and off action of six driver transistors Q9 through Q14.

2-29. When the PIK gives the command to move forward, transistors Q11, Q14, and Q9 turn on. Transistors Q12, Q13, and Q10 turn on to reverse the direction of head travel.

2-30. Braking action is produced by shorting the dc motor windings; when Q8 is turned on, it shorts the windings and Q10 provides a signal ground for the base current from Q8.

2-31. The printed line width and character-to-character spacing is determined by the speed of the dc motor. To control the speed of the motor, U4 samples the output voltage generated by the motor when the driver transistors are turned off and the motor is coasting. Contained within U4 is

a set of comparators, A1 through A4. A1 compares the motor output voltage with a reference voltage derived within U5. If the motor is going too slow, its output voltage will be less than the reference voltage. The A1 comparator instructs the PIK to speed up the motor. The PIK then changes the FWD signal pulse width to accomplish this. This operation occurs only during forward head movement. If the head is moving too fast, again the comparator output will change and the FWD signal pulse width will change to compensate.

2-32. Print Intensity Control

2-33. To maintain uniform print contrast, each head resistor must be energized to the same temperature, independent of battery voltage changes.

2-34. The remaining comparators in U4, along with the resistor network in U5, produce the variable duty-cycle signal STB, which is nominally 10 kHz.The STB signal will change its duty-cycle to keep its rms value constant and thus print intensity constant. By changing the value of R8, the nominal duty-cycle of STB can be changed to adjust print intensity.

2-35. CARD READER

2-36. When a card is inserted into the card reader, the motor switch is closed, grounding the MTRS signal. This signal is fed to the CRC, which tells the microprocessor (contained in the ROM's and ACT) that a card is in the card reader. The microprocessor in response tells the CRC to turn on the card reader motor. The CRC then grounds the MOTOR signal to the sense amp, which supplies power to the motor. The motor turns a roller, which passes the card through the card reader.

2-37. When the leading end of the card reaches the card reader head, the head switch is closed, grounding the HDS signal. For a read operation, flux transitions on the card are picked up by the head, amplified and converted to digital levels by the sense amp, buffered by the ACT, and then passes to the appropriate data storage registers. For a write operation this process is reversed. The microprocessor informs the CRC whether the operation is a read or write.

2-38. Information is recorded as a flux transition onto two tracks on each edge of the card. A header at the beginning of both tracks indicates whether the information on the card is a program or data. If the card contains a program, this header also contains flag and display format information and indicates whether side 1 or side 2 of the program is being read/written. At the end of the tracks is a checksum, which is used by the microprocessor to check for errors in reading. If an error is so detected, the microprocessor generates an "Error" display.

2-39. During a write operation, the CRC interrogates the write protect switch when the head switch closes to determine if the card has a clipped corner. If so, the CRC inhibits the write operation and informs the microprocessor, which generates an "Error" display.

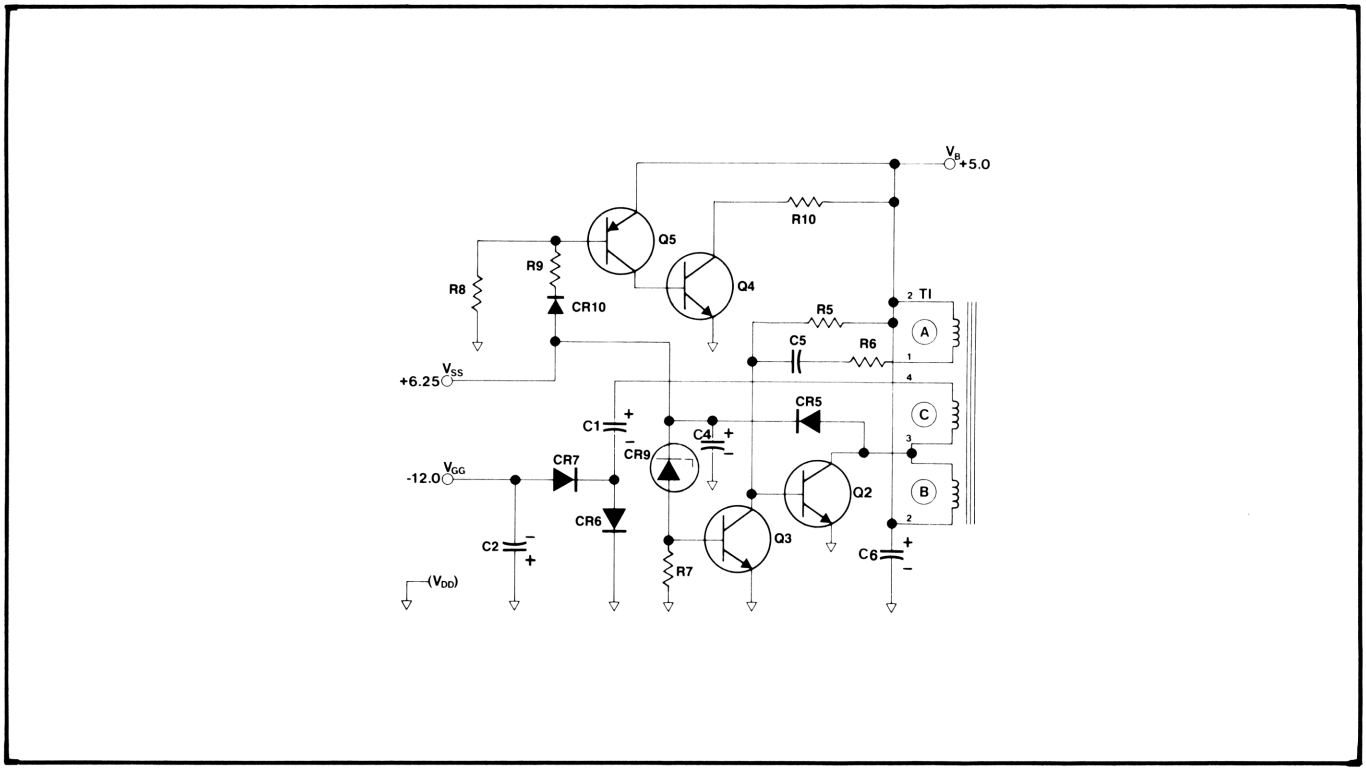


Figure 2-8. HP-97 Power Supply Circuit

2-40. POWER SUPPLY

2-41. Quick-charge nickel-cadmium batteries are the primary power source for the HP-97. The +5.0 nominal battery voltage is converted to +6.25 Vdc and to -12.0 Vdc by the transistor inverter circuit shown in figure 2-8.

2-42. Transistor Q2 and toroidal transformer T1 form the basic inverter circuit. With feedback from winding A, Q2 oscillates at a frequency of approximately 20.0 kHz. Winding B of T1 forms the transformer primary from which VSS is derived; CR5 rectifies and C4 filters the voltage from winding B. The voltage from winding C is rectified, filtered, and doubled by the combined actions of C1, C2, CR6, and CR7 to produce the output voltage VGG. Voltage regulation of VSS is provided by controlling the frequency of oscillation of Q2 through the combined action of zener diode CR9 and transistor Q3.

2-43. An over-voltage circuit consisting of Q4, Q5, and R8 through R10, as shown in figure 2-9, prevents VB (battery voltage) from rising above VSS. When VB approaches VSS, CR10 conducts, turning on transistors Q4 and Q5. Current is drawn from the battery through R10 until VB falls below VSS.

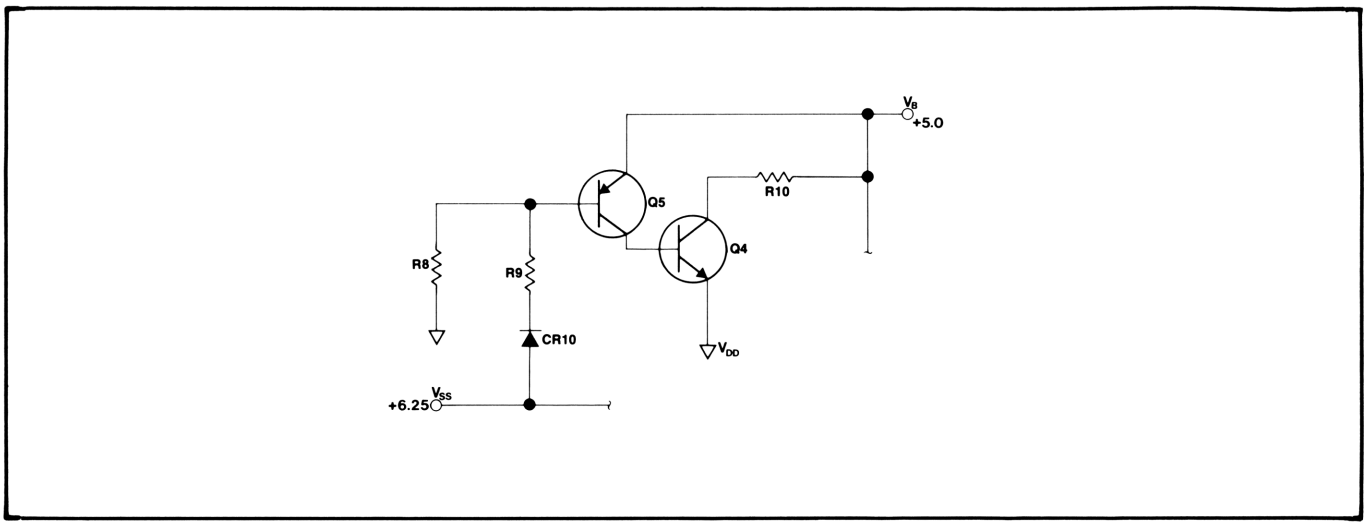


Figure 2-9. Over-Voltage Circuit

2-44. BATTERY CHARGING

2-45. Figure 2-10 illustrates the battery charging circuitry. The ac adapter/recharger is a transformer that drops the line voltage to 12.8 Vac at the input terminals of the calculator. Diodes CR1 through CR4 rectify the alternating current, and the resistor R4 limits the dc current applied to the batteries. When the ON-OFF switch is turned ON, limiting resistor R3 is shunted, and the dc voltage is applied directly to the battery pack and the calculator power supply. Transistor Q1 turns on during periods of high display current demands.

Note: The calculator will not be damaged by connecting the ac adapter/ recharger to the input terminals when the batteries are removed; however, it will not operate correctly until the batteries have been reinstalled.

2-46. POWER-ON RESET

2-47. To ensure that the logic contained within the ACT comes up in the correct logic state when power is applied to the HP-97, a power-on reset circuit is included. (See figure 2-11.)

2-48. When the power is applied, Q1 is turned off. VSS rises and the voltage across C3 also rises, resetting the ACT. If VB drops a certain level below VSS, Q1 turns on and discharges C3, forcing the ACT to reset again. This sequence repeats until VB and VSS are stable, thereby eliminating the effect of ON-OFF switch contact noise.

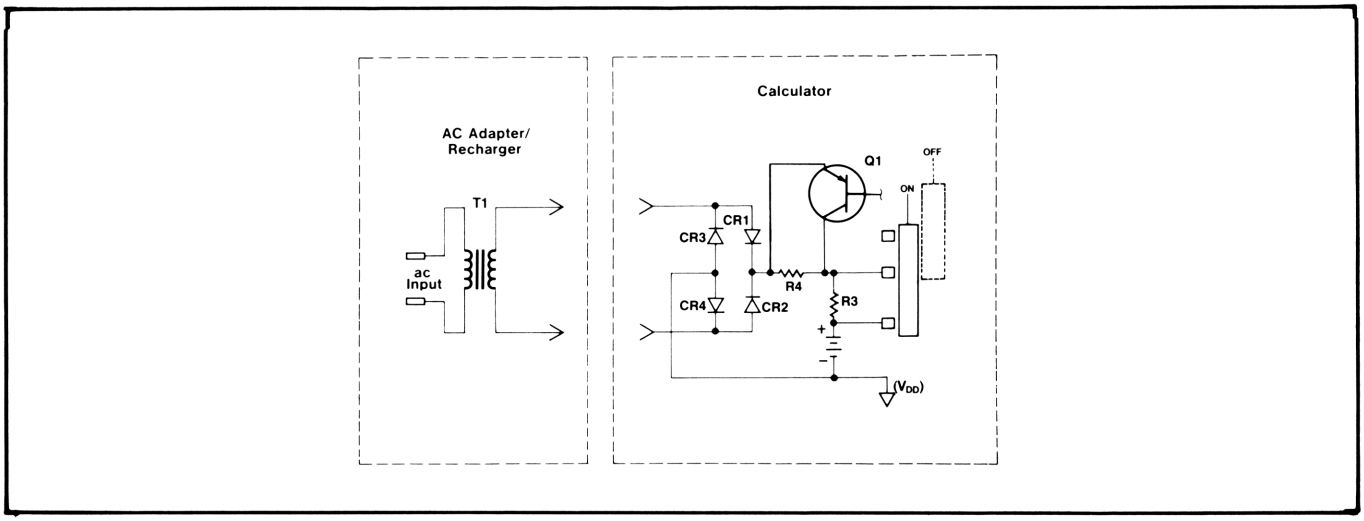


Figure 2-10. Battery Charging Circuit

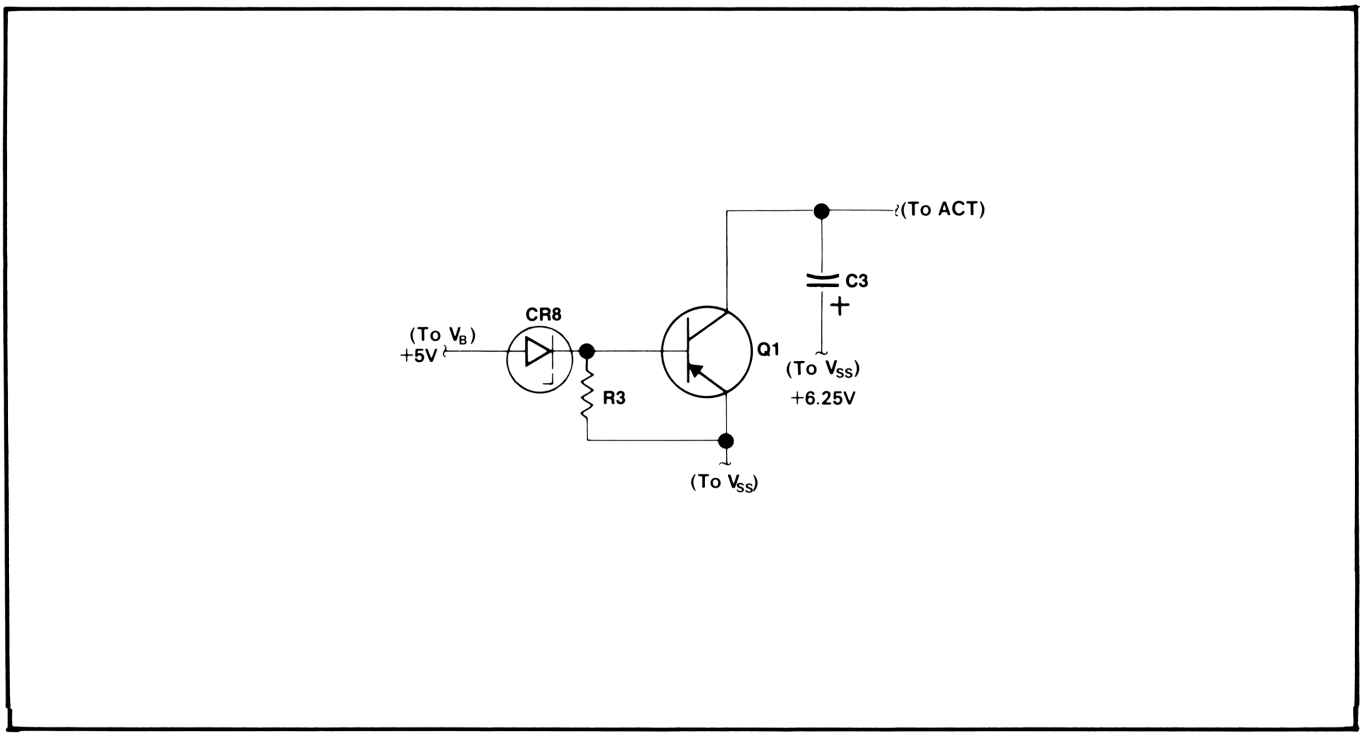


Figure 2-11. Power-On Reset Circuit

SECTION
III

Assembly-Level Maintenance

3-1. INTRODUCTION

3-2. This section includes procedures for:

a. Isolating any calculator malfunction to a replaceable assembly.

b. Disassembling the calculator to permit the faulty assembly to be replaced.

c. Replacing either the faulty assembly or certain associated components that can be replaced without desoldering.

3-3. The HP-97 Assembly-Level Troubleshooting Procedure (table 3-8) lists the step-by-step procedures for isolating a malfunction to a replaceable assembly. Refer to the HP-97 Exploded View (figure 6-1) and the HP-97 Assembly Removal and Replacement Procedures (paragraph 3-28) for aid in replacing the faulty assembly. (CAUTION: Be sure that the bench setup for trouble analysis has adequate electrostatic protection; otherwise, IC's may be damaged).

3-4. If a calculator is received with a complaint regarding only a particular inoperable function, refer to the individual key sequence tests (table 3-1) for verifying and correcting the malfunction.

3-5. After known malfunctions have been corrected and the calculator reassembled, perform the full operational test (paragraph 3-9) to ensure that all capabilities of the calculator are functioning correctly.

3-6. RECOMMENDED TOOLS AND FIXTURES

HP PART/MODEL NUMBER	DESCRIPTION
6040-0297	Silicone Lubricant
8700-0003	X-acto Knife
8700-0006	X-acto Knife Blade
8710-0026	Tweezers
8710-0549	Needle-Nose Pliers
8730-0008	Small Flat-Blade Screwdriver
8730-0020	Phillips Screwdriver
8500-0232	T.F. FREON
T-155321	Holding Nest
T-155239	HP-97 Card Reader Installation Tool
T-155435	HP-91/97 Field Service Connector Tool
00091-92137-97	Sequence PROM Assembly
ET 9613-91-M	Fold Apart Tester
ET 9613-91-A	Automatic Tester Option
ET 9610	Test System Mainframe
(See appendix C.)	Program Memory Test Program Card
(See appendix C.)	Functional Test Program Card
(See appendix C.)	Data Card 1
(See appendix C.)	Data Card 2
(See appendix C.)	Diagnostic Test,Part One,Program Card
(See appendix C.)	Diagnostic Test,Part Two,Program Card

3-7. INDIVIDUAL KEY SEQUENCE TESTS

3-8. Listed in table 3-1 are sequences of keystrokes that may be used to check for properly functioning HP-97 operations. If the calculator' display or printout does not agree with the entry in the appropriate column, the operation is not functioning properly, and the logic PCA and/or keyboard should be replaced. However, in some cases proper functioning with the indicated keystrokes does not guarantee that the operation functions properly with other acceptable key sequences. Therefore, if a calculator is received for repair with a particular operational key sequence that does not perform properly, this key sequence should be used to verify the complaint rather than the key sequence in table 3-1. After performing the key sequence test(s), return to step 13 in table 3-8.

Table 3-1. Individual Key Sequence Tests

a. Switch the calculator ON.
b. Perform the indicated keystrokes.
c. Compare the calculator display to the entry under DISPLAY and PRINT.
d. To check more than one operation (or set of related operations), switch the calculator OFF and then ON before entering the next key sequence.

OPERATION	KEYSTROKES	DISPLAY
digit entry	5	*5.*
CHS	5 CHS	*-5.*
CL x	5 CL x	*0.00*
√x	2 5 √x	*5.00*
x²	5 x²	*25.00*
1/x	5 1/x	*0.20*
R↓	5 R↓ R↓ R↓ R↓	*5.00*
R↑	5 R↓ f R↑	*5.00*
ENTER↑	5 ENTER↑ CL x R↓	*5.00*
+	5 ENTER↑ 2 +	*7.00*
−	5 ENTER↑ 2 −	*3.00*
×	5 ENTER↑ 2 ×	*10.00*
÷	5 ENTER↑ 2 ÷	*2.50*
DSP	DSP 4	*0.0000*
SCI	1 2 3 SCI	*1.23 02*
FIX	1 2 3 SCI FIX	*123.00*
ENG	1 2 3 0 ENG	*1.23 03*
EEX	EEX 9	*1. 09*
x≷y	5 ENTER↑ 2 x≷y	*5.00*
	÷	*0.40*
LAST x	5 1/x f LAST x	*5.00*
RND	1 2 • 3 4 5 6	*12.3456*
	DSP 2 f RND	*12.35*
	DSP 4	*12.3500*
ABS	5 CHS f ABS	*5.00*
INT	1 2 • 3 4 f INT	*12.00*
FRAC	1 2 • 3 4 f FRAC	*0.34*
N!	5 f N!	*120.00*
π	f π	*3.14*
%	1 5 0 ENTER↑ 6 %	*9.00*
%CH	1 5 0 ENTER↑ 1 7 0	*170.*
	f %CH	*13.33*
D→R	4 5 f D→R	*0.79*
R→D	1 f R→D	*57.30*
SIN	3 0 SIN	*0.50*
SIN⁻¹	• 5 f SIN⁻¹	*30.00*
COS	6 0 COS	*0.50*
COS⁻¹	• 5 f COS⁻¹	*60.00*
TAN	4 5 TAN	*1.00*
TAN⁻¹	1 f TAN⁻¹	*45.00*
RAD	f π f RAD COS	*-1.00*
GRD	2 0 0 f GRD COS	*-1.00*
DEG	3 0 f RAD f DEG SIN	*0.50*

Table 3-1. Individual Key Sequence Tests (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT
→H.MS	6 • 7 →H.MS	6.42	
H.MS→	6 • 4 2 f H.MS→	6.70	
H.MS+	6 • 5 6 ENTER↑	6.56	
	3 • 2 7 f H.MS+	10.23	
→P	3 ENTER↑ 4 →P	5.00	
	x≷y	36.87	
→R	3 6 • 8 7 ENTER↑	36.87	
	5 →R	4.00	
	x≷y	3.00	
e^x	1 e^x	2.72	
LN	1 e^x LN	1.00	
10^x	3 f 10^x	1000.00	
LOG	2 0 f LOG	1.30	
y^x	2 ENTER↑ 8 y^x	256.00	
PRINT x	1 PRINT x	1.00	1.00
PRINT: STACK	1 ENTER↑ 2 ENTER↑	2.00	
	3 ENTER↑ 4	4.	
	f PRINT: STACK	4.00	1.00 T 2.00 Z 3.00 Y 4.00 X
STO RCL	2 STO 5 CL x RCL 5	2.00 2.00	
PRINT: REG	1 STO 1	1.00	
	2 STO 2	2.00	
	3 STO 3	3.00	
	4 STO 4	4.00	
	f PRINT: REG	4.00	0.00 0 1.00 1 2.00 2 3.00 3 4.00 4 0.00 5 0.00 6 0.00 7 0.00 8 0.00 9 0.00 A 0.00 B 0.00 C 0.00 D 0.00 E 0.00 I
CL REG	5 STO 8 CL x RCL 8	5.00	
	f CL REG CL x RCL 8	0.00	
STO +	8 STO 1	8.00	
	2 STO + 1	2.00	
	RCL 1	10.00	
STO −	8 STO 1	8.00	
	2 STO − 1	2.00	

Table 3-1. Individual Key Sequence Tests (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT
	RCL 1	6.00	
STO ×	8 STO 1	8.00	
	2 STO × 1	2.00	
	RCL 1	16.00	
STO ÷	8 STO 1	8.00	
	2 STO ÷ 1	2.00	
	RCL 1	4.00	
P≷S	2 5 STO 4 f		
	P≷S RCL 4	0.00	
Σ+	ENTER↑ Σ+ Σ+		
Σ−	Σ+ f Σ−	2.00	
x̄	f x̄	12.50	
s	f s	17.79	
SST	SST (key down)	001	51
	(key up)	0.00	
BST	BST (key down)	224	51
	(key up)	0.00	
GTO • n n n	GTO • 1 2 3		
	PRGM RUN	123	51
GTO (i)	PRGM RUN		
(positive i)	LBL 1 LBL 2		
	LBL 3		
	PRGM RUN		
	2 STO I GTO		
	(i) PRGM RUN	002	21 02
GTO (i)	5 CHS STO I		
(negative i)	GTO (i) PRGM RUN	220	51
LBL	PRGM RUN LBL A		
	LBL B LBL C	003	21 13
GTO	PRGM RUN GTO B		
	PRGM RUN	002	21 12
	PRGM RUN LBL A		
GSB	1 2 3 GSB B +		
RTN	RTN LBL B 1 2		
	3 RTN PRGM RUN A	246.00	
x≠y?	f x≠0? 5 f x=0?		
x=y?	f x<0? f x≤y? f		
x=0?	x=y? ENTER↑ f		
x>0?	x>y? CHS f x>0?		
x<0?	f x>y? f x≠0?		
x≤y?			
x>y?	PRGM RUN	008	51
x≠0?			
	f STF 1 f STF 3		
STF	f F? 3 f F? 3		
CLF	f F? 1 f CLF 1		
	f F? 1 5 f F?		
	3 PRGM RUN	002	51
PAUSE	PRGM RUN LBL A		

Table 3-1. Individual Key Sequence Tests (continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT
	f PAUSE GTO A		
	PRGM ▬ RUN 5 A	*5.00 (blinking)*	
.	. 5	*.5*	
x≷I	5 f x≷I I	*5.00*	
	5 STO 1 STO 2 f		
	W/DATA	*Crd*	
	(insert data card 1)	*5.00*	
	OFF ▮ ON		
W/DATA	OFF ▬ ON	*0.00*	
MERGE	1 STO I f MERGE		
	(insert card again)	*1.00*	
	RCL 1	*5.00*	
	RCL 2	*0.00*	
SPACE	f PRINT: SPACE		(paper moves)
RCL Σ+	5 ENTER↑ Σ+ Σ+	*2.00*	
	RCL Σ+	*6.00*	
	x≷y	*10.00*	
STO (i)	5 STO (i) CL x RCL (i)	*5.00*	
RCL (i)	RCL 0	*5.00*	
DSZ I	1 STO I f DSZ I	*1.00*	
	PRGM ▬ RUN	*001*	*51*
ISZ I	1 CHS STO I f ISZ		
	I I	*0.00*	
	PRGM ▬ RUN	*001*	*51*

3-9. FULL OPERATIONAL TEST

3-10. The Full Operational Test is used to verify proper functioning of the assembled calculator before it is returned to the customer.

3-11. This test is comprised of the following separate tests, which should be run in the order shown.

a. Initial test

b. Program memory test.

c. Functional test.

d. Keyboard test.

e. Diagnostic test.

3-12. INITIAL TEST

3-13. To run this test:

a. Set switches as follows:

OFF ON
TRACE
MAN NORM
PRGM RUN

b. Press the keys listed in table 3-2. After each keystroke, the calculator's display and printout should be identical to the numbers indicated. If so, proceed to the program memory test (paragraph 3-14); if not, return to step 28 in table 3-8.

Table 3-2. Initial Test

KEYSTROKE	DISPLAY	PRINTOUT
9	9.	
1/x	0.11	9.00 1/X
7	7.	
×	0.78	7.00 ×
CHS	-0.78	CHS
EEX	1. 00	
7	1. 07	
6	1. 76	
÷	-7.777777777-77	1.+76 ÷
f	-7.777777777-77	
x≠I	0.00	X≠I
I	-7.777777777-77	RCL I
TAN	-1.357478307-78	TAN
f	-1.357478307-78	
TAN⁻¹	-7.777777777-77	TAN⁻¹
STO	-7.777777777-77	
1	-7.777777777-77	STO 1
f	-7.777777777-77	
ISZ	-7.777777777-77	
I	-7.777777777-77	ISZ I
CL x	0.00	CLX
(i)	-7.777777777-77	RCL i

3-14. PROGRAM MEMORY TEST

3-15. To run the program memory test, follow the procedures given in table 3-3. The displays indicated should be obtained. If so, proceed to the functional test (paragraph 3-16); if not, return to step 28 in table 3-8.

Table 3-3. Program Memory Test

STEP	PROCEDURE	DISPLAY
1	OFF ON	
2	TRACE MAN NORM	
3	PRGM RUN	
4	Read side 1 of program memory test card.	*Crd*
5	Read side 2 of program memory test card.	*0.00*
6	Press R/S	*222.00*

3-16. FUNCTIONAL TEST

3-17. To run the functional test, follow the step-by-step procedures given in table 3-4. After each step the indicated display and/or printout should be obtained. If so, assemble the calculator and proceed to the keyboard test (paragraph 3-18); if not, return to step 28 in table 3-8.

Table 3-4. Functional Test

STEP	PROCEDURE	DISPLAY	PRINTOUT
1	Set switches: OFF ON; TRACE MAN NORM; PRGM RUN		
2	Press CL x	*0.00*	
3	Read side 1 of functional test card.	*Crd*	
4	Read side 2 of functional test card.	*0.000000000 00*	
5	Switch to PRGM mode.	*000*	
6	Press BST	*224 24*	
7	Press SST	*001 00*	
8	Press f DEL	*000*	
9	Press LBL A	*001 21 11*	
10	Switch to RUN mode.	*0.000000000 00*	
11	Press A	*-7.777777777-77* *(pause)* *Crd*	
12	Feed side 1 of data card 1.	*Crd*	

Table 3-4. Functional Test (Continued)

STEP	PROCEDURE	DISPLAY	PRINTOUT
13	Feed side 2 of data card 1.	*6.000000000 00 (flashing)*	
14	Again feed side 1 of data card 1.	*Crd*	
15	Feed side 2 of data card 1.	*6.000000000 00 (pause)*	
		-1.000000000 00 (flashing)	
16	Read side 1 of data card 2.	*-1.000000000 00 (pause)*	
			-10.-12 ***
			-4.444444444-44 T
			-3.333333333-33 Z
			-2.222222222-22 Y
			-1.111111111-11 X
			51. 0
			-2.238303295+21 1
			31. 2
			-2.238303295+21 3
			4.301773670+27 4
			0. 5
			0. 6
			0. 7
			0. 8
			0. 9
			-4.444444444-44 A
			-3.333333333-33 B
			-2.222222222-22 C
			-1.111111111-11 D
			8.000000000-77 E
			-5. I
		-8.888888888-88	
17	Switch to PRGM mode.	*218 21 16 13*	
18	Press: GTO . 2 0 0	*200 -41*	
19	Press f PRINT: PRGM	*001 21 11*	
			200 X≠Y -41
			201 ÷ -24
			202 SIN⁻¹ 16 41
			203 e^x 33
			204 GSB0 23 16 13
			205 RCLA 36 11
			206 RCLB 36 12
			207 RCLC 36 13
			208 RCLD 36 14
			209 ENG -13
			210 PRTX -14
20	Immediately after line 209 appears, switch print mode to TRACE mode.		

Table 3-4. Functional Test (Continued)

STEP	PROCEDURE	DISPLAY	PRINTOUT
			211 FIX 212 PRST 213 PREG 214 SPC 215 RCLE 216 × 217 R/S 218 *LBLc 219 RCLi 220 X≠Y? 221 GTOc 222 DSZI 223 PSE 224 RTN
21	Insert side 2 of data card 2.	***Error***	***ERROR***
22	Switch to RUN mode.	***Error***	
23	Press CLx	***-8.888888888-88***	

3-18. KEYBOARD TEST

3-19. This test is used to check the operation of each key on the keyboard after the calculator is assembled.

3-20. To run this test:

a. Set switches as follows:

OFF ▬▮ ON
TRACE
MAN ▮▬ NORM
PRGM ▮▬ RUN

b. Enter the key sequence of table 3-5.

c. Switch operating mode to PRGM ▮▬ RUN

d. Press RTN f PRINT: PRGM

e. Compare resulting printout with that shown in table 3-5.

f. If printout is correct, proceed with the diagnostic test (paragraph 3-21); if not, inspect keyboard and replace if necessary, then proceed with the diagnostic test.

Table 3-5. Keyboard Test

KEYSTROKES	PRINTOUT
FIX	001 FIX
SCI	002 SCI
ENG	003 ENG
PRINT x	004 PRTX
ENTER↑	005 ENT↑
CHS	006 ENT↑
EEX	007 CHS
÷	008 EEX
R↓	009 ÷
7	010 R↓
8	011 7
9	012 8
×	013 9
x≷y	014 ×
4	015 X≷Y
5	016 4
6	017 5
−	018 6
CL x	019 −
1	020 CLX
2	021 1
3	022 2
+	023 3
0	024 +
•	025 0
DSP 0	026 .
R/S	027 R/S
1/x	028 1/X
x^2	029 X^2
√x	030 √X
%	031 %
Σ+	032 Σ+
SIN	033 SIN
COS	034 COS
TAN	035 TAN
→R	036 →R
(i)	037 RCL i
I	038 RCL I

Table 3-5. Keyboard Test (Continued)

KEYSTROKES	PRINTOUT	
y^x	039	Y^x
LN	040	LN
e^x	041	e^x
→P	042	→P
STO A	043	STOA
RCL A	044	RCLA
LBL A	045	*LBLA
GTO A	046	GTOA
GSB A	047	GSBA
RTN	048	RTN
f DSZ I	049	DSZI
f ISZ I	050	ISZI
A	051	GSBA
B	052	GSBB
C	053	GSBC
D	054	GSBD
E	055	GSBE
R/S	056	R/S

3-21. DIAGNOSTIC TEST

3-22. This test ensures that the calculator will not fail when the user runs the diagnostic program supplied with the HP-97 Standard Pac. It checks the operation of the card reader and identifies failure-prone ROMs. The test is run in two parts: part one verifies the diagnostic test program; part two tests the data ROMs, and is required only under certain conditions.

3-23. Diagnostic Test, Part One

3-24. To verify the diagnostic test program, follow the procedures shown in table 3-6. If the indicated display or printout is not obtained, or if "Error" is displayed, return to step 13 in table 3-8. If the calculator passes part one of the test, proceed with part two, if required. Otherwise return to step 13 in table 3-8.

3-25. Diagnostic Test, Part Two

3-26. To identify failure-prone data ROMs follow the procedures shown in table 3-7. The test should be conducted at a temperature, T, that should be as close to 40 degrees C as possible. (The limits on T are Room temperature < T < 40 degrees C.) The test should be conducted for a minimum of 4 hours and a maximum of 24 hours. (The 24 hour maximum may be exceeded if required by test conditions.) The diagnostic test, part two, is mandatory under the following conditions:

a. The logic ICs are replaced.

b. Reported failures can not be repeated.

c. No failure has been reported or is apparent.

The test may be conducted under other conditions if it is considered desirable to do so.

3-27. If the calculator fails the test, proceed to the component-level tests of paragraph 4-10. If the calculator passes the test, repeat the diagnostic test, part one.

Table 3-6. Diagnostic Test, Part One

STEP	PROCEDURE	DISPLAY	PRINTOUT
1	Set switches: OFF ON TRACE MAN NORM PRGM RUN		
2	Read side 1 of diagnostic test part one card.	CRD	
3	Read side 2 of diagnostic test part one card.	0.00	
4	Press A	(flashing) -8.888888888-88	-886.9-90 *** -8.889-88 *** -8.888888888-88 ***

Table 3-7. Diagnostic Test, Part Two

STEP	PROCEDURE	DISPLAY	PRINTOUT
1	Set switches: OFF ■▒ ON TRACE MAN ▒■ NORM PRGM ■▒ RUN		
2	Read side 1 of diagnostic test part two card.	CRD	
3	Read side 2 of diagnostic test part two card.	0.00	
4	Press A*	(flashing)	1.0000000 *** 2.0000000 *** 3.0000000 *** 4.0000000 *** 5.0000000 *** 6.0000000 *** 7.0000000 *** 8.0000000 *** 9.0000000 *** 10.0000000 *** 11.0000000 ***

* The first line is printed after the program is run continuously for one hour. Each subsequent line is printed at hourly intervals. Numbers therefore indicate the number of hours the test has run.

Note: Refer to paragraph 3-26 for temperature requirements.

3-28. HP-97 ASSEMBLY REMOVAL AND REPLACEMENT PROCEDURES

3-29. The following procedures describe in detail removal and replacement of the HP-97 assemblies. Follow all directions as given, step by step, to detach and replace any HP-97 assembly. In most cases it will be necessary to perform first the previous steps as indicated.

3-30. For a list of replaceable assemblies, refer to section VI. To reassemble the HP-97, follow the removal-replacement procedures in reverse order. The removal-replacement procedures are given in the following order:

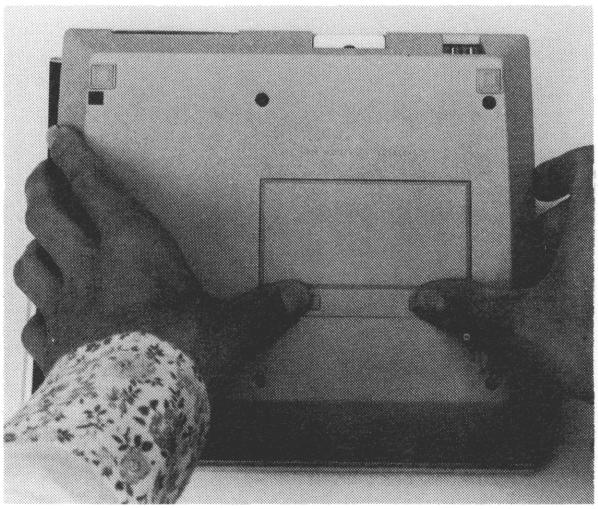
a. Battery pack removal.

b. Battery door latch removal/replacement.
c. Bottom case assembly removal.
d. Rubber feet replacement.
e. Printer assembly removal.
f. Logic printed-circuit assembly removal.
g. Support plate assembly removal.
h. Card reader assembly removal/replacement.
i. Keyboard printed-circuit assembly removal.
j. Spacers, spring strips and slide switch replacement.
k. Key and key spring replacement.
l. Paper advance switch assembly replacement.

1. Battery Pack Removal

a. Lay the calculator upside down in a support fixture, part number T-155321.

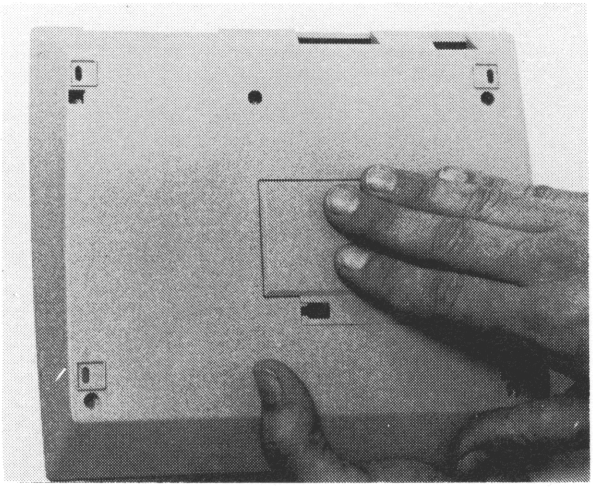
b. While grasping the sides of the calculator, place each thumb firmly over the ridged door latches as shown.



c. Slide both latches inward with thumbs until they click.

d. Place one hand under the calculator (on the keyboard) and the other hand over the battery door.

e. Rotate the calculator to the face up position and allow the battery door and battery pack to fall into your hand.



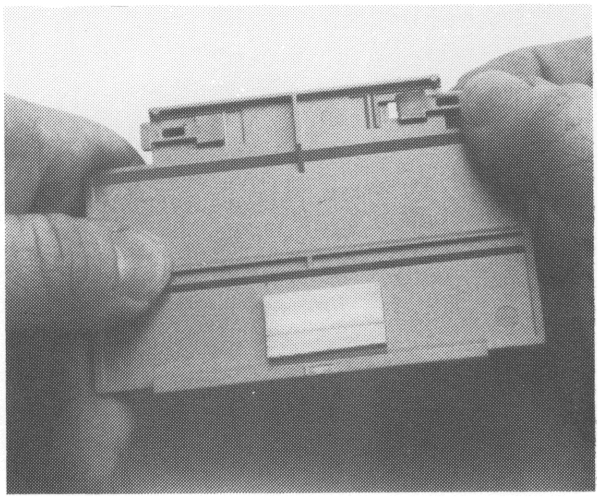
2. Battery Door Latch Removal/Replacement

a. Perform removal step 1.

b. Lift inside tab over ridge and slide latch out.

c. To replace latch, slide latch into slot until it snaps over ridge.

Note: Make certain the foam tape is securely in place on the door. It holds the battery firmly in place.

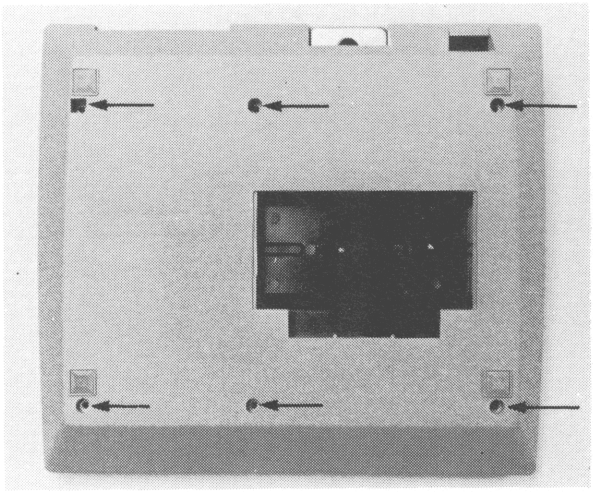


3. Bottom Case Assembly Removal

a. Perform removal/replacement procedure 1.

b. Remove the six Phillips screws as shown.

c. Lift off the bottom case.

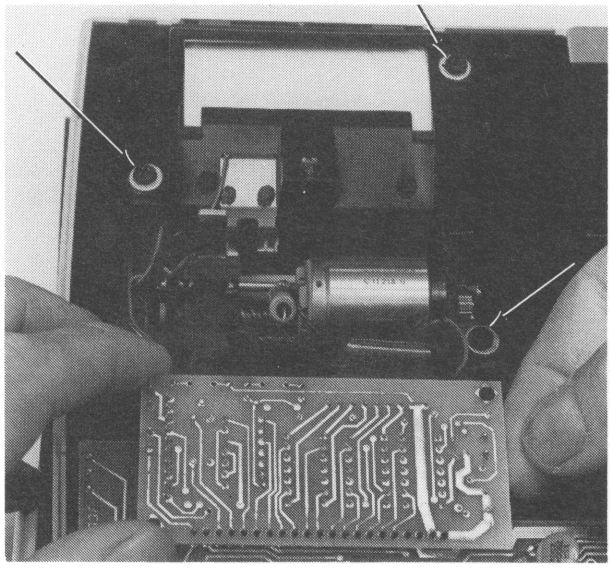


4. Rubber Feet Removal/Replacement

a. Grasp each rubber foot firmly with needle-nose pliers.
b. Pull out firmly to remove.
c. Firmly press in new feet while being careful not to damage bottom case.
d. Cut off excess rubber.

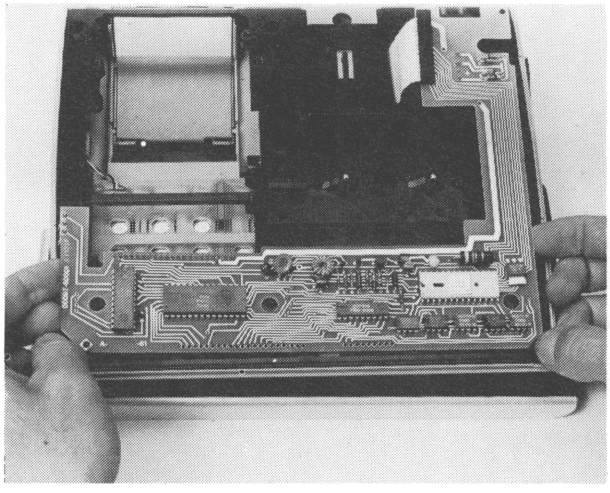
5. Printer Assembly Removal

a. Perform removal/replacement procedures 1 and 3.
b. Remove the three printer supporting screws.
c. Carefully disconnect printer PCA from logic board.
d. Carefully lift out the printer assembly from calculator.

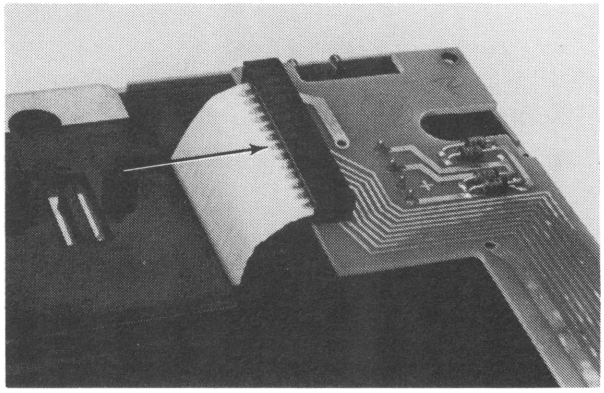


6. Logic Printed-Circuit Assembly Removal

a. Pull up-alternating pressure between left hand and right-on the logic PCA until it is free of the 18- and 9-pin connectors on the keyboard PCA.



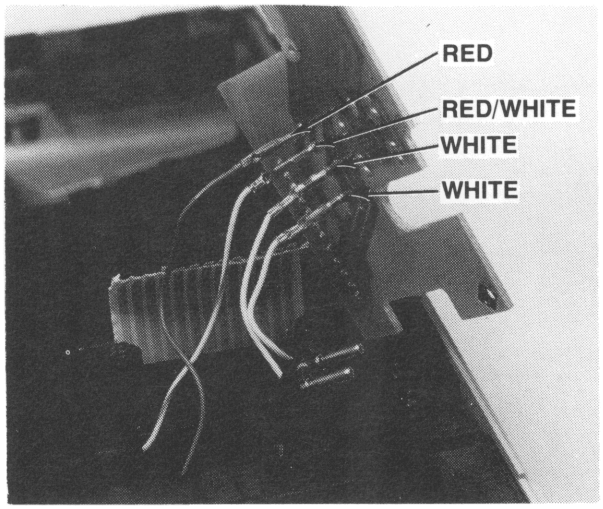
b. Remove the card reader cable from the connector on the logic board by inserting the large end of the connector tool (T-155435) into the connector and then pulling the cable free.



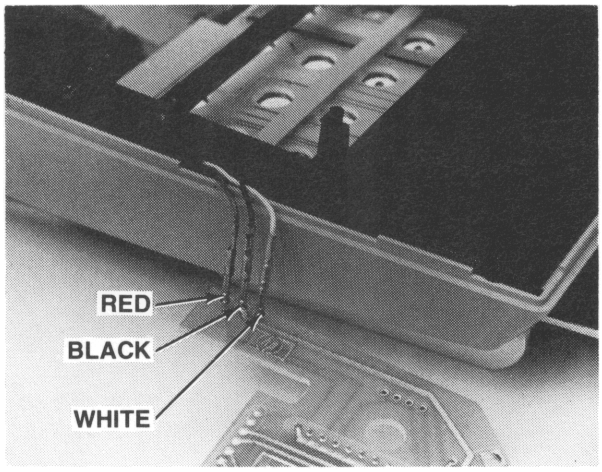
During reassembly, insert the cable together with the connector tool into the connnector; then remove the cable tool.

Note: The cable should be positioned with its contacts facing the top of the connector, and the connector tool should be positioned between these contacts and the connector.

c. Carefully disconnect the battery leads (one red/white and one red) from one side of the logic printed-circuit board, and the three paper advance switch leads (one red, one black, and one white) from the other side of the board.



d. Lift off the logic printed-circuit assembly.



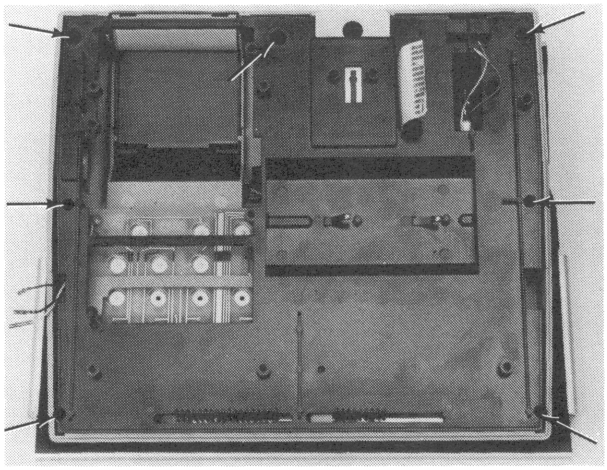
7. Support Plate Assembly Removal

a. Perform removal/replacement procedures 1, 3, 5, and 6.

b. Remove the seven support plate retaining screws.

c. Lift off support plate.

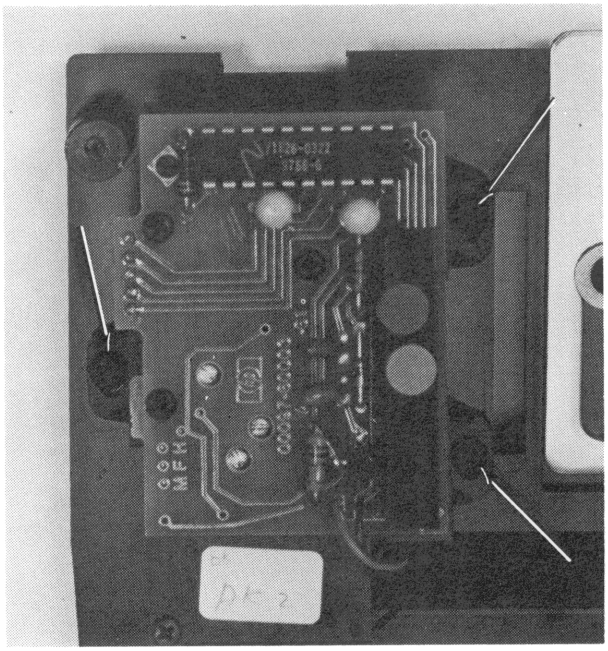
d. Lift off paper cover.



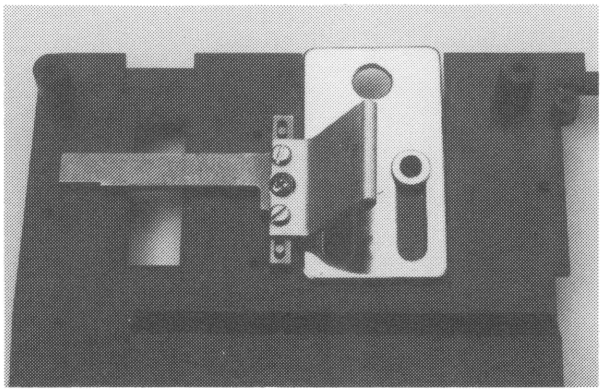
8. Card Reader Assembly Removal/ Replacement

a. Perform removal/replacement procedures 1, 3, and 5 through 7.

b. Remove the three Phillips screws indicated and lift the card reader assembly off the support plate.

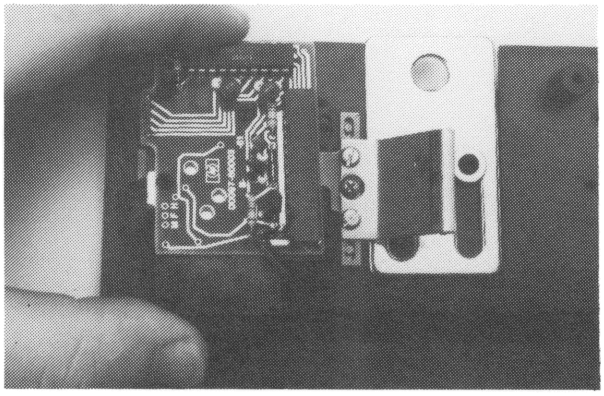


c. To replace the card reader assembly, first remove the card reader cable using the connector tool as in step 6b.



d. Place the card reader installation tool (part number T-155239) into the card reader cable slot as shown.

e. Place the card reader assembly onto the support plate straddling the tool as shown, and insert screws into the slots of the three feet of the card reader support.



f. Rotate the card reader assembly clockwise to position the two feet against opposite sides of the long arm of the tool.

g. Tighten the three screws while holding the card reader assembly in the position described in step f.

h. Insert the card reader cable into the connector as in step 6b.

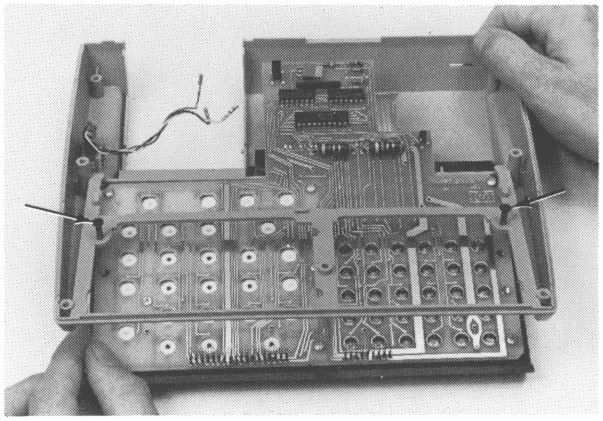
9. Keyboard Printed-Circuit Assembly Removal

a. Perform removal/replacement procedures 1, 3, 5, 6, and 7.

b. Apply light upward pressure to top case as shown.

c. Press inward on red display window to separate from top case.

d. Remove the two keyboard support screws.



Note: Be careful not to bend the connector and plastic guide pins that are located on the bottom.

e. Lightly press outward on the keyboard and remove.

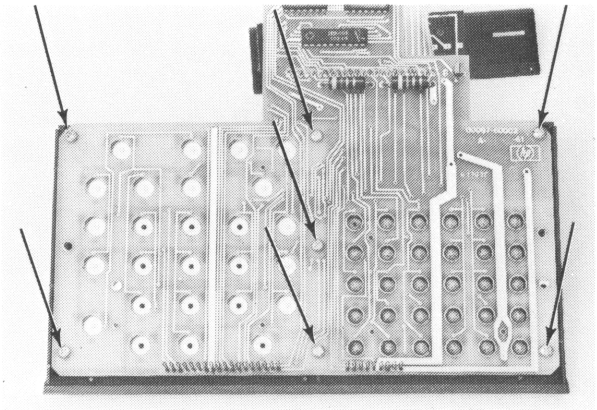
CAUTION
Do not put any sharp bends in the display cable as it may fracture and break.

10. Spacers, Spring Strips and Slide Switch Replacement

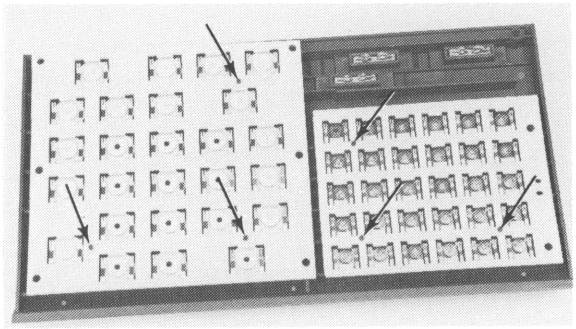
a. Perform removal/replacement procedures 1, 3, 5, 6, 7, and 9.

b. Remove the seven Phillips retaining screws.

c. Carefully lift off circuit board.



d. Note position of guide pins and holes for the next operation.



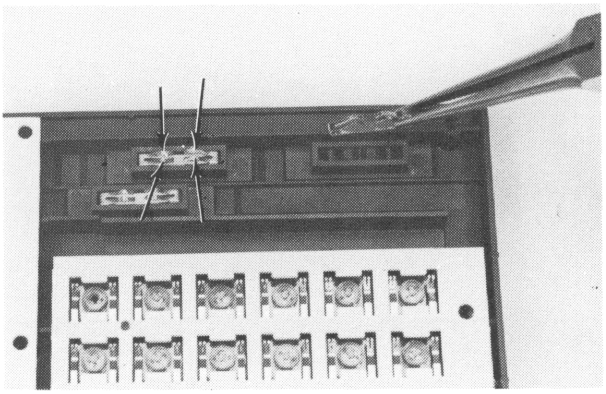
e. Lift off upper spacers.

f. Lift off key spring strips.

g. Lift off lower spacers.

h. To replace key spring strips and spacers, carefully replace each in reverse order to that described above.

i. To replace a spring contact or slide switch, lift it out with a tweezers or needle-nose pliers as shown. When replacing a spring contact, clean it with FREON and apply a small amount of Silicone lubricant on the keyboard PCA switch contacts before reassembly.

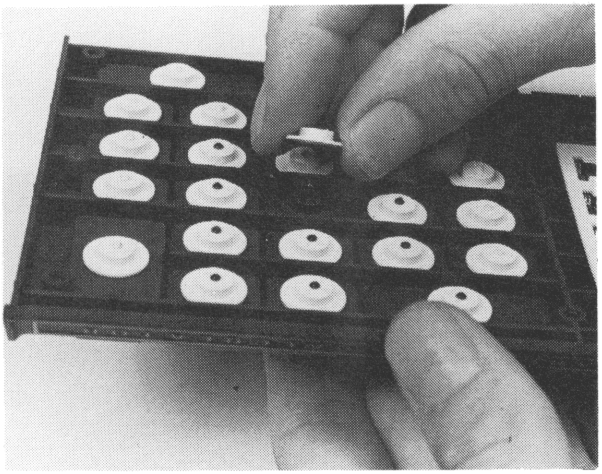


11. Hat, Key, and Key Spring Replacement

a. Push key to be replaced so that hat is elevated.

b. Pull off hat and allow key and key spring to fall out.

c. To replace, align key and spring properly, then push the hat onto the key stem until it snaps into place.



12. Paper Advance Switch Assembly Replacement

a. Perform removal/replacement procedures 1, 3, 5, 6, and 7.

b. With needle-nose pliers firmly grasp the paper advance key, pressing the tabs on the switch cover inwards.

c. Firmly pull out to remove.

d. Remove spring.

e. With needle-nose pliers, remove switch retaining nut.

f. Replace paper advance switch assembly.

Table 3-8. Assembly Level Troubleshooting Procedure

Use this procedure to isolate a malfunction to a replaceable assembly.

STEP	ACTION
1.	
a. Unplug the AC Adapter/Recharger from the calculator.	If VOUT is between VMIN and VMAX, go to step 2.
b. Measure the AC voltage at the power outlet, VIN.	If VOUT is outside VMIN and VMAX, replace the AC Adapter/ Recharger. Then go to step 2.
c. Measure the AC voltage at the output of the Adapter/Recharger, VOUT.	
d. Calculate VMIN and VMAX as follows: For VIN=230 Vac approx. VMIN=VIN/21.10 VMAX=VIN/15.65 For VIN=115 VAC approx. VMIN=VIN/10.55 VMAX=VIN/7.82	
2.	
a. Connect an 11 ohm, 5%, 5W load resistor across output of the AC Adapter/Recharger.	If VOUT is between 6.2 and 7.4 Vac, and the display is blank, go to step 3.
b. Measure VOUT across the load resistor.	If VOUT is less than 6.2 or more than 7.4V replace the Adapter/Recharger. If the display is blank, go to step 3.
3.	
Replace the battery pack. (Save the old pack for future checkout.)	If the display is not blank, charge the battery for least 10 minutes, and then go to step 7.

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

STEP	ACTION
	If the display is blank, go to step 4.
4. Replace the logic PCA.	If the display is not blank, charge the battery for at least 10 minutes, and then go to step 7. If the display is blank, go to step 5.
5. a.Return the original logic PCA. b.Replace the printer assembly.	If the display is not blank, charge the battery for at least 10 minutes, and then go to step 7. If the display is blank, go to step 6.
6. a.Return the original printer. b.Replace the keyboard PCA.	If the display is not blank, charge the battery for at least 10 minutes, and then go to step 7. If the display is blank, send the calculator to Special Handling.

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

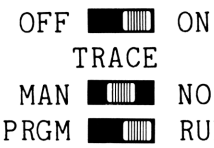
STEP	ACTION
7. Set the switches as follows:  	
8. Key in -8.888888888-88. The display should read -8.888888888-88. Possible problems include: o digit over bright on display. o digit turns on next digit, causing a ghost image to appear. o one digit missing segments. o all digits missing same segments. o single digits missing from display. o segments of digits shorted.	If the display is satisfactory, go to step 9. If the display is blank, go to step 14.
9. Press [PRINT x]. The printer should print -8.888888888-88. Check for acceptable print intensity.	If the printer operates satisfactorily, go to step 10. If the printer does not operate satisfactorily, go to step 16.
10. Press all the keys.	If the keys "feel positive", go to step 11. If the keys do not feel positive, go to step 20.

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

STEP	ACTION
11. Read the data card 2. Check for the following: o "ERROR" displayed. o card reader motor noisy. o motor doesn't turn on. o motor turns on but card doesn't feed. o card feeds, but is not read correctly. o card is not written on correctly. o card with cutoff corner is overwritten. o card sticks in card reader.	If the card is read correctly, go to step 12. If the card is not read correctly, go to step 27.
12. Test individual function operation by pressing the function keys (refer to paragraph 3-7).	If the functions operate correctly, go to step 13. If the functions do not operate correctly, replace the logic PCA and the keyboard PCA in order. Then go to step 13.
13. Run the full operational test. (Refer to paragraph 3-9.)	If the test is satisfactory, the calculator is repaired. STOP TESTING HERE. If the test is not satisfactory, go to step 28.

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

STEP	ACTION
14. Replace the logic PCA (unless it was replaced in a previous step in which case go to step 15).	If the display is blank, go to step 15. If the display is not blank, return to step 9.
15. a. Return the original logic PCA, if necessary.	
b. Replace the keyboard PCA.	If the display is blank, send the calculator to Special Handling. If display is not blank, return to step 9.
16. Replace the logic PCA (unless it was replaced in a previous step in which case go to step 17).	
17. Key in -8.888888888-88.	
18. Press [PRINT x].	If the printer operates satisfactorily, return to step 10. If the printer does not operate satisfactorily, go to step 19.
19. a. Return the original logic PCA, if necessary.	
b. Replace the printer assembly.	Return to step 10.

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

STEP	ACTION
20.	
a.Replace the defective keys.	
b.Press all the keys.	If the key(s) "feel positive", return to step 11. If the key(s) do not feel positive, go to step 21.
21.	
a.Return the original key(s).	
b.Replace the spring(s).	
c.Press the key(s).	If the key(s) "feel positive", return to step 11. If the key(s) do not feel positive, go to step 22.
22.	
a.Return the original spring(s).	
b.Replace the hat(s).	
c.Press the key(s).	If the key(s) "feel positive", return to step 11. If the key(s) do not feel positive, go to step 23.
23.	
a.Return the original hat(s).	
b.Replace the spacer(s).	
c.Press the key(s).	If the key(s) "feel positive", return to step 11. If the key(s) do not feel positive, go to step 24.

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

STEP	ACTION
24.	
a.Return the original spacer(s).	
b.Replace the switch contact(s).	
c.Press the key(s).	If the key(s) "feel positive", return to step 11. If the key(s) do not feel positive go to step 25.
25.	
a.Return the original switch contact(s).	
b.Replace the keyboard PCA.	Return to step 11.
26.	
a.Replace the logic PCA (unless it was replaced in a previous step in which case go to step 27).	
b.Read the data card 2.	If the card was read satisfactorily, return to step 12. If the card was not read satisfactorily, go to step 27.
27.	
a.Return the original logic assembly, if necessary.	
b.Replace the card reader assembly.	Return to step 12.

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

STEP	ACTION
28. Replace the logic PCA (unless it was replaced in a previous step in which case go to step 29).	
29. Run the full operational test. (Refer to paragraph 3-9.)	If the operational test is satisfactory, the calculator is repaired. STOP TESTING HERE. If the operational test is not satisfactory, go to step 30.
30. a. Return the the original logic PCA, if necessary. b. Replace the printer assembly. c. Run the full operational test. (Refer to paragraph 3-9.)	If the operational test is satisfactory, the calculator is repaired. STOP TESTING HERE. If the operational test is not satisfactory, go to step 31.
31. a. Return the original printer assembly.	

Table 3-8. Assembly Level Troubleshooting Procedure (Continued)

STEP	ACTION
b.Replace the keyboard PCA.	
c.Run the full operational test. (Refer to paragraph 3-9.)	If the operational test is satisfactory, the calculator is repaired. STOP TESTING HERE. If the operational test is not satisfactory, go to step 32.
32. a.Return the original keyboard.	
b.Replace the card reader assembly.	If the operational test is satisfactory, the calculator is repaired.
c.Run the full operational test. (Refer to paragraph 3-9.)	If the operational test is not satisfactory, send the calculator to Special Handling.

SECTION
IV

Component-Level Maintenance

4-1. INTRODUCTION

4-2. This section includes procedures, schematic and assembly diagrams, and material lists for use in trouble-shooting and repairing assemblies of the HP-97 calculator. After the procedures of section III have shown a particular assembly to be malfunctioning, refer to the appropriate section below:

a. Logic printed-circuit assembly, including the power supply circuitry--paragraph 4-4.
b. Printer assembly--paragraph 4-21.
c. Keyboard assembly--paragraph 4-28.
d. Display circuitry--paragraph 4-30.
e. Card reader assembly--paragraph 4-36.

4-3. RECOMMENDED TOOLS AND FIXTURES

HP PART/MODEL NUMBER	DESCRIPTION
0960-0062	Continuity Tester
6040-0329	Lubricant
8690-0060	Desoldering Tool
8690-0082	Desoldering Tool Tip
8690-0129	Soldering Iron
8690-0132	Soldering Iron Stand
8700-0003	X-acto Knife
8700-0006	X-acto Knife Blade
8710-0026	Tweezers
8710-0549	Needle-Nose Pliers
8730-0008	Small Flat-Blade Screwdriver
8730-0020	Phillips Screwdriver
8500-0232	T.F. FREON
8500-0790	MAGNA-SEE
T-155321	Holding Nest
T-155435	HP-91/97 Field Service Connector Tool
T-155428	HP-67/97 Field Service Card Speed Gauge
00091-92137-97	Sequence PROM Assembly

* or equivalent

HP PART/MODEL NUMBER	DESCRIPTION
ET-9613-91-M	Fold Apart Tester
ET-9613-91-A	Automatic Tester Option
ET-9610	Test System Mainframe
HP 180C/1801A/1820C*	Oscilloscope. Measures pulse at 0.50 us Maximum amplitude 13 Vdc.
HP 6213C*	Power Supply. Variable output rated at 10 Vdc at 5A. (Add a 0.1 uf ceramic capacitor across output terminals).
HP 3469B*	Multimeter. Accurate to 0.01 Vdc.
HP 10004*	Oscilloscope Probe.
---	Soft Rubber Pencil Eraser
---	Retaining Ring Applicator, 1/16"
---	Retaining Ring Applicator, 3/32"
(See appendix C.)	Program Memory Test Program Card
(See appendix C.)	Functional Test Program Card
(See appendix C.)	Data Card 1
(See appendix C.)	Data Card 2
(See appendix C.)	Diagnostic Test, Part One, Program Card
(See appendix C.)	Diagnostic Test, Part Two, Program Card

* or equivalent

4-4. LOGIC PCA TROUBLESHOOTING

4-5. To troubleshoot and repair the logic PCA, follow the step-by-step procedures given in table 4-13. See also the logic PCA component location diagram (figure 4-9) and schematic diagram (figure 4-10).

4-6. POWER SUPPLY TROUBLESHOOTING

4-7. Troubleshooting of the power supply circuitry- which is located on the logic PCA- is included in the logic PCA troubleshooting procedure, table 4-13.

4-8. FAULTY FUNCTION VERIFICATION AND REPAIR

4-9. To verify (and repair if necessary) a suspected faulty function on the HP-97, follow the procedures of figure 4-1, which refers to table 4-1.

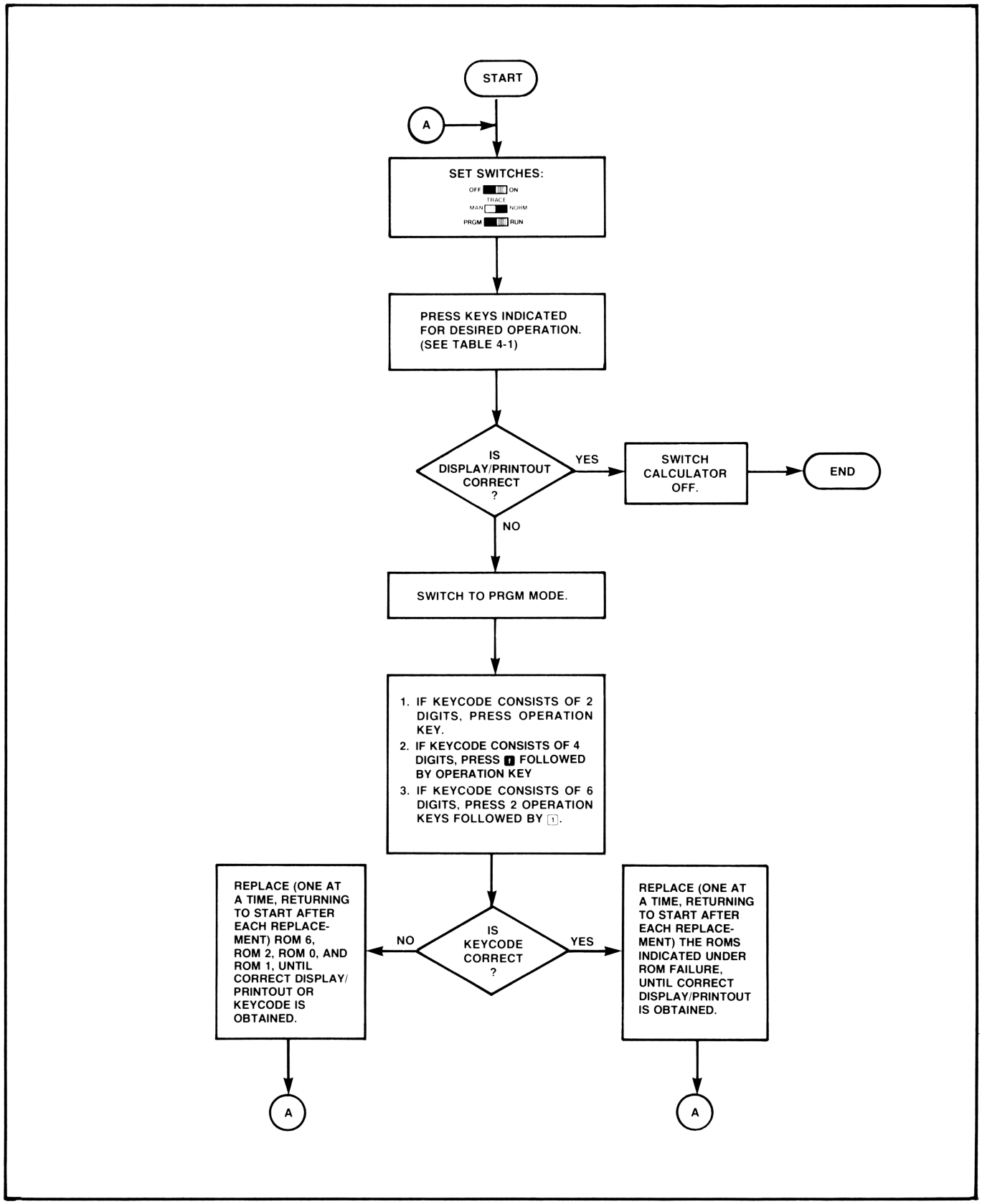


Figure 4-1. Faulty Function Verification and Repair

Table 4-1. Faulty Function Repair

OPERATION	KEYSTROKES	DISPLAY	PRINT	KEYCODE	ROM FAILURE
digit entry	5	*5.*		05	3, 0, 6
CHS	5 CHS	*-5.*		-22	3, 0
CL x	5 CL x	*0.00*		-51	3, 0
$\sqrt{x}$	2 5 $\sqrt{x}$	*5.00*		54	1, 3, 0
x^2	5 x^2	*25.00*		53	1, 3, 0
1/x	5 1/x	*0.20*		52	1, 3, 0
R↓	5 R↓ R↓ R↓ R↓	*5.00*		-31	3, 0
R↑	5 R↓ f R↑	*5.00*		16-31	3, 0
ENTER↑	5 ENTER↑ CL x R↓	*5.00*		-21	3, 0
+	5 ENTER↑ 2 +	*7.00*		-55	1, 3, 0
−	5 ENTER↑ 2 −	*3.00*		-45	1, 3, 0
×	5 ENTER↑ 2 ×	*10.00*		-35	1, 3, 0
÷	5 ENTER↑ 2 ÷	*2.50*		-24	1, 3, 0
DSP	DSP 4	*0.0000*		63 04	3, 6, 0
SCI	1 2 3 SCI	*1.23*	*02*	-12	3, 1, 6, 0
FIX	1 2 3 SCI FIX	*123.00*		-11	3, 1, 6, 0
ENG	1 2 3 0 ENG	*1.23*	*03*	-13	3, 1, 6, 0
EEX	EEX 9	*1.*	*09*	-23	3, 0
x≷y	5 ENTER↑ 2 x≷y	*5.00*		-41	3, 0
	÷	*0.40*			
LAST x	5 1/x f LAST x	*5.00*		16-63	3, 0
RND	1 2 • 3 4 5 6	*12.3456*		16 24	1, 3, 0
	DSP 2 f RND	*12.35*			
	DSP 4	*12.3500*			
ABS	5 CHS f ABS	*5.00*		16 41	3, 0
INT	1 2 • 3 4 f INT	*12.00*		16 34	3, 0
FRAC	1 2 • 3 4 f FRAC	*0.34*		16 44	3, 0
N!	5 f N!	*120.00*		16 52	2, 3, 0
π	f π	*3.14*		16-24	3, 2, 0
%	1 5 0 ENTER↑ 6 %	*9.00*		55	1, 3, 0
%CH	1 5 0 ENTER↑ 1 7 0	*170.*		16 55	1, 3, 0
	f %CH	*13.33*			
D→R	4 5 f D→R	*0.79*		16 45	2, 3, 0
R→D	1 f R→D	*57.30*		16 46	2, 3, 0
SIN	3 0 SIN	*0.50*		41	2, 3, 0
SIN^{-1}	• 5 f SIN^{-1}	*30.00*		16 41	2, 3, 0
COS	6 0 COS	*0.50*		42	2, 3, 0
COS^{-1}	• 5 f COS^{-1}	*60.00*		16 42	2, 3, 0
TAN	4 5 TAN	*1.00*		43	2, 3, 0
TAN^{-1}	1 f TAN^{-1}	*45.00*		16 43	2, 3, 0
RAD	f π f RAD COS	*-1.00*		16-22	3, ACT, 0
GRD	2 0 0 f GRD COS	*-1.00*		16-23	3, ACT, 0
DEG	3 0 f RAD f DEG SIN	*0.50*		16-21	3, ACT, 0
→H.MS	6 • 7 f →H.MS	*6.42*		16 35	1, 3, 0
H.MS→	6 • 4 2 f H.MS→	*6.70*		16 36	1, 3, 0
H.MS+	6 • 5 6 ENTER↑	*6.56*		16-55	1, 3, 0
	3 • 2 7 f ENG f H.MS→	*10.23*			

Table 4-1. Faulty Function Repair (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT	KEYCODE	ROM FAILURE
→P	3 ENTER↑ 4 →P	*5.00*		34	2, 1, 3, 0
	x≷y	*36.87*			
→R	3 6 • 8 7 ENTER↑	*36.87*		44	2, 1, 3, 0
	5 →R	*4.00*			
	x≷y	*3.00*			
e^x	1 e^x	*2.72*		33	1, 2, 3, 0
LN	1 e^x LN	*1.00*		32	2, 1, 3, 0
10^x	3 f 10^x	*1000.00*		16 33	1, 2, 3, 0
LOG	2 0 f LOG	*1.30*		16 32	2, 1, 3, 0
y^x	2 ENTER↑ 8 y^x	*256.00*		31	1, 2, 3, 0
PRINT X	1 PRINT X	*1.00*	1.00	-14	0, PIK, 3
PRINT: STACK	1 ENTER↑ 2 ENTER↑	*2.00*			
	3 ENTER↑ 4	*4.*			
	f PRINT: STACK	*4.00*	1.00 T 2.00 Z 3.00 Y 4.00 X	16-14	0, PIK, 3
STO RCL	2 STO 5 CL X RCL 5	*2.00* *2.00*		35 05 36 05	3, 0 3, 0
PRINT: REG	1 STO 1	*1.00*		16-13	0, PIK, 3
	2 STO 2	*2.00*			
	3 STO 3	*3.00*			
	4 STO 4	*4.00*			
	f PRINT: REG	*4.00*	0.00 0 1.00 1 2.00 2 3.00 3 4.00 4 0.00 5 0.00 6 0.00 7 0.00 8 0.00 9 0.00 A 0.00 B 0.00 C 0.00 D 0.00 E 0.00 I		
CL REG	5 STO 8 CL X RCL 8	*5.00*		16-53	3, 1, 0
	f CL REG CL X RCL 8	*0.00*			
STO +	8 STO 1	*8.00*		35-55 01	3, 1, 0
	2 STO + 1	*2.00*			
	RCL 1	*10.00*			

Table 4-1. Faulty Function Repair (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT	KEYCODE	ROM FAILURE
STO −	8 STO 1	*8.00*		35-45 01	3, 1, 0
	2 STO − 1	*2.00*			
	RCL 1	*6.00*			
STO ×	8 STO 1	*8.00*		35-35 01	3, 1, 0
	2 STO × 1	*2.00*			
	RCL 1	*16.00*			
STO ÷	8 STO 1	*8.00*		35-24 01	3, 1, 0
	2 STO ÷ 1	*2.00*			
	RCL 1	*4.00*			
P≷S	2 5 STO 4 f			16-51	3, 0, 1, 6
	P≷S RCL 4	*0.00*			
Σ+	ENTER↑ Σ+ Σ+			56	1, 3, 0
Σ−	Σ+ f Σ−	*2.00*		16 56	1, 3, 0, 6
x̄	f x̄	*12.50*		16 53	1, 3, 0, 6
s	f s	*17.79*		16 54	1, 3, 0, 6
SST	SST (key down)	*001* *51*			0, 1, 5, CRC
	(key up)	*0.00*			
BST	BST (key down)	*224* *51*			0, 1, 5, CRC
	(key up)	*0.00*			
GTO • n n n	GTO • 1 2 3				6, 1
	PRGM RUN	*123* *51*			
GTO (i)	PRGM RUN			22 45	3, 2, 5, 6, 0
(positive i)	LBL 1 LBL 2				
	LBL 3				
	PRGM RUN				
	2 STO I GTO				
	(i) PRGM RUN	*002* *21 02*			
GTO (i)	5 CHS STO I			22 45	3, 1, 2, 5, 6, 0
(negative i)	GTO (i) PRGM RUN	*220* *51*			
LBL	PRGM RUN LBL A			21 11	3, 0
	LBL B LBL C	*003* *21 13*			
GTO	PRGM RUN GTO B			22 12	3, 2, 5, 6, 0
	PRGM RUN	*002* *21 12*			
	PRGM RUN LBL A				
GSB	1 2 3 GSB B +			23 12	3, 2, 5, 6, 0
RTN	RTN LBL B 1 2			24	3, 0, 6
	3 RTN PRGM RUN A	*246.00*			
x≠y?	f x≠0? 5 f x=0?			16-32	3, 0
x=y?	f x<0? f x≤y? f			16-33	3, 0
x=0?	x=y? ENTER↑ f			16-43	3, 0
x>0?	x>y? CHS f x>0?			16-44	3, 0
x<0?	f x>y? f x≠0?			16-45	3, 0
x≤y?	PRGM RUN	*008* *51*		16-35	3, 1, 0
x>y?				16-34	3, 1, 0
x≠0?				16-42	3, 0

Table 4-1. Faulty Function Repair (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT	KEYCODE	ROM FAILURE
STF CLF	f STF 1 f STF 3 f F? 3 f F? 3 f F? 1 f CLF 1 f F? 1 5 f F? 3 PRGM RUN	*002 51*		21 01 22 01	3, 6, 0 3, 6, 0
PAUSE	PRGM RUN LBL A f PAUSE GTO A PRGM RUN 5 A	*5.00 (blinking)*		16 51	0, 3, CRC
•	• 5	*.5*		-62	3, 0, 6
x≷I	5 f x≷I I	*5.00*		16–41	3, 1, 0
W/DATA MERGE	5 STO 1 STO 2 f W/DATA (insert data card 1) OFF ON OFF ON 1 STO I f MERGE (insert card again) RCL 1 RCL 2	*Crd* *5.00* *0.00* *1.00* *5.00* *0.00*		16–61 16-62	6, CRC, 3, 0, 3, 0, CRC
SPACE	f PRINT: SPACE		(paper moves)	16–11	0, PIK, 3
RCL Σ+	5 ENTER↑ Σ+ Σ+ RCL Σ+ x≷y	*2.00* *6.00* *10.00*		36 56	3, 0
STO (i) RCL (i)	5 STO (i) CL x RCL (i) RCL 0	*5.00* *5.00*		35 45 36 45	3, 0 3, 0
DSZ I	1 STO I f DSZ I PRGM RUN	*1.00* *001 51*		16 25 46	3, 1, 0
ISZ I	1 CHS STO I f ISZ I I PRGM RUN	*0.00* *001 51*		16 26 46	3, 1, 0

4-10. LOGIC PCA OPERATIONAL TEST

4-11. This test is used to identify faulty integrated circuits on the logic PCA. It is comprised of the following separate tests, which should be run in the order shown:

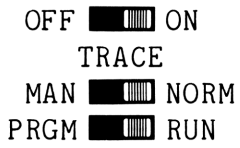
a. Initial test.
b. Program memory test.
c. Functional test.

NOTE: If an integrated circuit is replaced, the diagnostic test part two must be run on the completed calculator before shipment.

4-12. INITIAL TEST

4-13. To run this test:

a. Set switches as follows:



b. Enter the key sequence of table 4-2. After each keystroke, compare the number in the calculator display to that in the DISPLAY column. If they are not the same, one of the ROM's indicated by number in the ROM FAILURE column is probably faulty. Replace these ROM's in the order indicated; after each replacement, return to the beginning of the test and run it again, replacing addtional ROM's as indicated until the number in the calculator's display agrees with that in the DISPLAY column.

c. Compare the calculator printout to the PRINTOUT column of table 4-2. If they are not identical, replace (one at a time) ROM 5, ROM 0, and the PIK chip until the proper printout is obtained when the entire initial test is run after each replacement. (ROM contents are described in table 4-3.)

4-14. PROGRAM MEMORY TEST

4-15. To run the program memory test, follow the procedures detailed in the flowchart of figure 4-2.

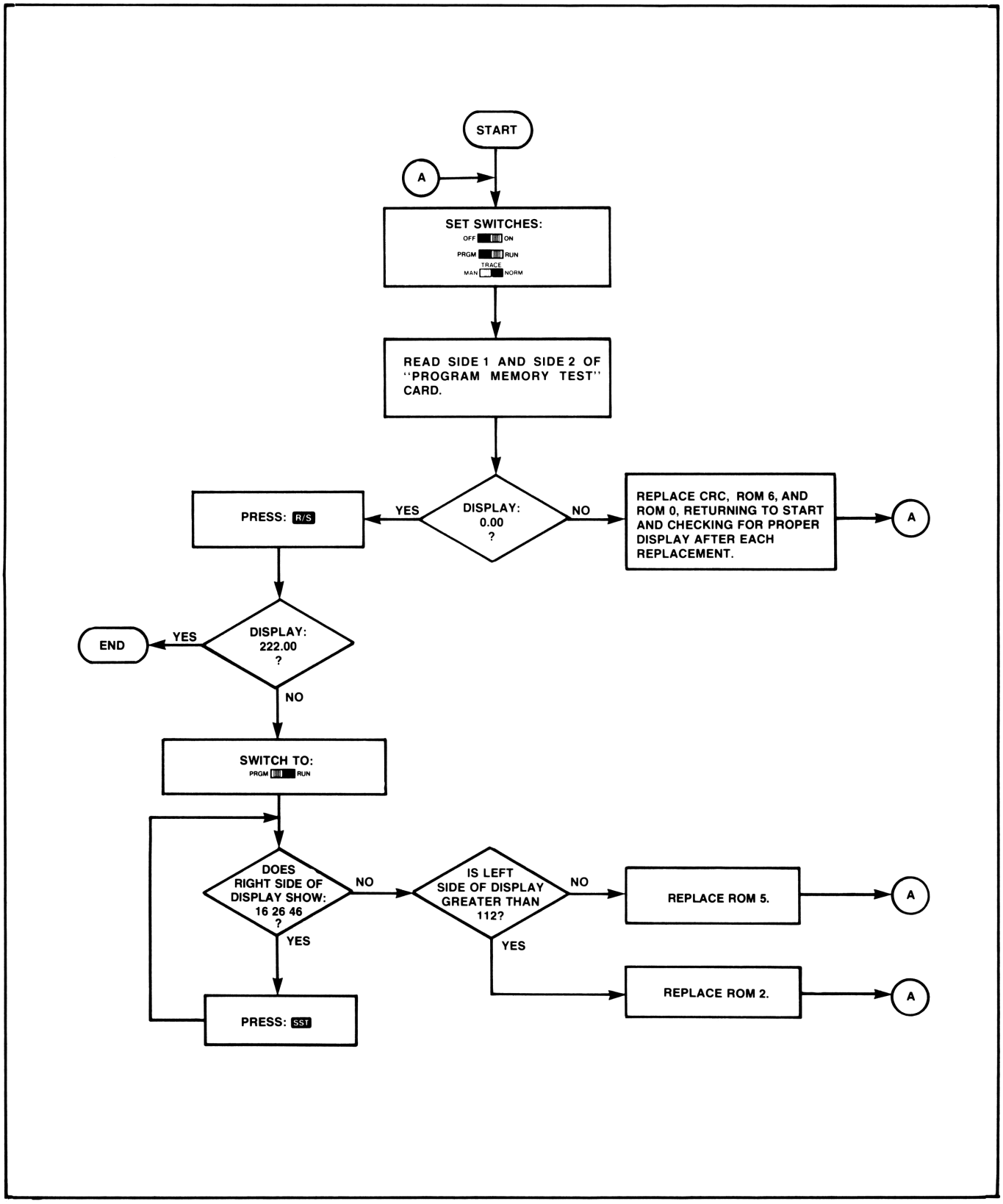


Figure 4-2. Program Memory Test

Table 4-2. Initial Test

KEYSTROKE	DISPLAY	ROM FAILURE	PRINTOUT
9	*9.*	3, 6, 0	
1/x	*0.11*	1, 3, 6, 0	*9.00 1/X*
7	*7.*	3, 6, 0	
×	*0.78*	1, 3, 6, 0	*7.00 ×*
CHS	*-0.78*	3, 6, 0	*CHS*
EEX	*1. 00*	3, 6, 0	
7	*1. 07*	3, 6, 0	
6	*1. 76*	3, 6, 0	
÷	*-7.777777777-77*	1, 3, 6, 0	*1.+76 ÷*
f	*-7.777777777-77*	6, 0	
X≷I	*0.00*	3, 6, 0	*X≷I*
I	*-7.777777777-77*	1, 3, 6, 0	*RCLI*
TAN	*-1.357478307-78*	2, 3, 6, 0	*TAN*
f	*-1.357478307-78*	6, 6, 0	
TAN⁻¹	*-7.777777777-77*	2, 3, 6, 0	*TAN-¹*
STO	*-7.777777777-77*	6, 0	
1	*-7.777777777-77*	3, 6, 0	*STO1*
f	*-7.777777777-77*	6, 0	
ISZ	*-7.777777777-77*	6, 0	
I	*-7.777777777-77*	3, 1, 6, 0	*ISZI*
CL x	*0.00*	3, 6, 0	*CLX*
(i)	*-7.777777777-77*	3, 1, 6, 0	*RCLi*

Table 4-3. ROM Contents

REFERENCE DESIGNATION	HP PART NUMBER	COMPONENT	CONTENTS
U1	*1820-1812	ACT	STACK
	*1820-1596		LAST X
			TRIG SCRATCH
U2	*1818-0225	ROM 0	
	*1818-0267		INITIALIZES SEQUENCES/ FUNCTIONS DISPLAY SEGMENTS
U3	1820-1751	CRC	CARD READ/WRITE
U4	1820-1723	PIK	PRINTING
	1820-1952		KEY ENTRY

Table 4-3. ROM Contents (Continued)

REFERENCE	HP PART	COMPONENT	CONTENTS
U5	**1818-0228 +1818-0550	ROM 1	PRIMARY REGISTERS 0-9, A-E, I H.MS → & H.MS +
U6	**1818-0226 +1818-0551	ROM 2	PROGRAM STEPS 113-224 TRIG FUNCTIONS EXPONENTIAL FUNCTIONS LOGARITHMIC FUNCTIONS R→D, D←R P→R, R←P DEL
U7	1818-0233	ROM 3	PRINTER (INSTRUCTION/FUNCTION NAMES)
U8	1818-0229	ROM 5	PROGRAM STEPS 000-112 PRINTER MNEMONICS KEY CODE DISPLAY
U9	1818-0230	ROM 6	SECONDARY REGISTERS 10-19 DISPLAY FORMAT FLAG STATUS PROGRAM COUNTER SUB-ROUTINE RETURN STACK DIGIT ENTRY SCRATCH

* Part number 1818-0267 ROM 0 must be used if American Micro-systems, Inc. part number 1820-1596 ACT is used.

** Part number 1818-0228 ROM 1 must be used with part number 1818-0226 ROM 2 only.

\+ Part number 1818-0550 ROM 1 must be used with part number 1818-0551 ROM 2 only.

4-16. FUNCTIONAL TEST

4-17. To run the functional test, follow the step-by-step procedures shown in table 4-4.

4-18. When the indicated display is not obtained, replace IC's (CRC, PIK, or ROM's designated by number) one at a time. After each replacement, return to step 1 of the functional test and reiterate, replacing the indicated IC's until the proper display is obtained.

4-19. Before using data card 1 in step 12, erase it using the following procedures (to save time, a number of cards can be erased at the same time and all labeled data card 1 for use in later repairs):

a. Switch a working calculator ON.

b. Switch to PRGM mode.

c. Feed both sides of data card 1 through the card reader.

4-20. Steps 16A, 16B, and 16C are checkpoints to identify the point at which the functional test program halts or begins to loop endlessly. This location is needed to isolate the probable ROM failure, as given in table 4-5. The numbers are displayed only to indicate these checkpoints and need not be checked for accuracy; this is done internally by the functional test program.

Table 4-4. Functional Test

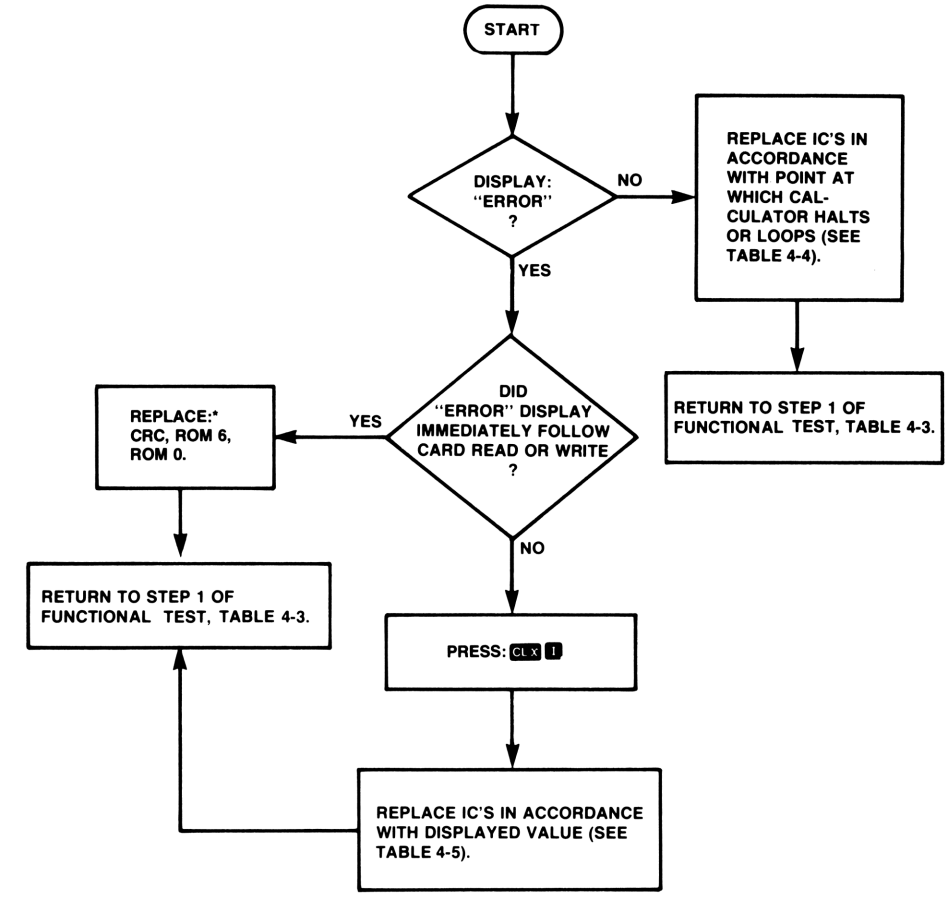
STEP	PROCEDURE	DISPLAY	PRINTOUT	IC REPLACEMENT
1	Set switches: OFF ▮ ON TRACE MAN ▮ NORM PRGM ▮ RUN			
2	Press CL x	*0.00*		
3	Read side 1 of functional test card.	*Crd*		
4	Read side 2 of functional test card.	*0.000000000 00*		CRC, 0
5	Switch to PRGM mode.	*0.00*		CRC, 1, 0
6	Press BST	*224 24*		0, 5, 1, CRC
7	Press SST	*001 00*		0, 5, 1, CRC
8	Press f DEL	*000*		0, 2
9	Press LBL A	*001 21 11*		0, 2, 1, 6, 5
10	Switch to RUN mode.	*0.000000000 00*		2, 1, 0
11	Press A	*-7.777777777-77* *(pause)* *Crd*		See Fig. 4-3 See Fig. 4-3

Table 4-4. Functional Test (Continued)

STEP	PROCEDURE	DISPLAY	PRINTOUT	IC REPLACEMENT
12	Feed side 1 of data card 1.	*Crd*		
13	Feed side 2 of data card 1.	*6.000000000 00 (flashing)*		See Fig. 4-3
14	Again feed side 1 of data card 1.	*Crd*		
15	Feed side 2 of data card 1.	*6.000000000 00 (pause)*		
		-1.000000000 00 (flashing)		See Fig. 4-3
16	Read side 1 of data card 2.	*-1.000000000 00 (pause)*		See Fig. 4-3
16A		*30.88997250 (pause)*		See Fig. 4-3
16B		*-2.238303285 21 (pause)*		See Fig. 4-3
16C		*4.301773670 27 (pause)*		See Fig. 4-3
			-10.-12 ***	0, PIK, 3, 1
			-4.444444444-44 T	
			-3.333333333-33 Z	
			-2.222222222-22 Y	
			-1.111111111-11 X	
			51. 0	
			-2.238303285+21 1	
			31. 2	
			-2.238303285+21 3	
			4.301773670+27 4	
			0. 5	
			0. 6	
			0. 7	0, PIK, 3, 1
			0. 8	
			0. 9	
			-4.444444444-44 A	
			-3.333333333-33 B	
			-2.222222222-22 C	
			-1.111111111-11 D	
			8.000000000-77 E	
			-5. I	

Table 4-4. Functional Test (Continued)

STEP	PROCEDURE	DISPLAY	PRINTOUT	IC REPLACEMENT
16D		-8.888888888-88		See Fig. 4-3
17	Switch to PRGM mode.	218 21 16 13		5, 0, 1
18	Press: GTO . 2 0 0	200 -41		5, 1, 0
19	Press: f PRINT: PRGM	001 21 11		5, 1, 0
			200 X≠Y -41 201 ÷ -24 202 SIN⁻¹ 16 41 203 e^x 33 204 GSBc 22 16 13 205 RCLA 36 11 206 RCLB 36 12 207 RCLC 36 13 208 RCLD 36 14 209 ENG -13 210 PRTX -14	5, 0, 3, PIK
20	Immediately after line 209 appears, switch print mode to TRACE mode.			CRC (if format of printout does not change as shown)
			211 FIX 212 PRGT 213 PREG 214 SPC 215 RCLE 216 `x 217 R/S 218 #LBLc 219 RCLi 220 X≠Y? 221 GTOa 222 DSZI 223 PSE 224 RTN	5, 0, 3, PIK
21	Insert side 2 of data card 2.	Error		0, 6, CRC
			ERROR	0, PIK
22	Switch to RUN mode.	Error		0, CRC
23	Press CLx	-8.888888888-88		3, 6, 0



*REPLACE THE INDICATED IC'S ONE AT A TIME, RETURNING TO STEP 1 OF FUNCTIONAL TEST AFTER EACH REPLACEMENT. CONTINUE REPEATING THE FUNCTIONAL TEST, REPLACING IC'S UNTIL ERROR DISPLAY IS NOT GENERATED.

NOTE: THE DIAGNOSTIC TEST, PART TWO (PARAGRAPH 3:25) MUST BE CONDUCTED ON ANY UNIT IN WHICH IC'S HAVE BEEN REPLACED.

Figure 4-3. IC Replacement Flowchart, Functional Test

Table 4-5. IC Replacement, Calculator Halted or Looping

BETWEEN STEPS	IC REPLACEMENT*
11 → 16A	6, 3, 0
16A → 16B	1, 3, 0
16B → 16C	2, 1, 3, 0
16C → 16D	5, 3, 0

*Replace the indicated IC's (designated by ROM number) one at a time, returning to step 1 of functional test after each replacement. Continue repeating the functional test, replacing IC's until proper display is obtained.

Table 4-6. IC Replacement, Error Display

DISPLAYED VALUE**	IC REPLACEMENT*
−5	5, 0, 3
−4	2, 1, 3, 0
−3	1, 3, 0
−2	3, 1, 0
−1	CRC, 6, 0, 3
0 → 9	1, 3, 0
10 → 19	6, 3, 0
20 → 23	1, 3, 0
24	3, 1, 0
any other value	3, 2, 1, 0

*Replace IC's (CRC, or ROM's designated by number) one at a time, returning to Step 1 of functional test after each replacement. Continue repeating the functional test, replacing the indicated IC's until "Error" display is not generated.

**Display format for value may vary.

Table 4-7.Logic Printed-Circuit Assembly A1 (00097-60015) Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER OLD	NEW	DESCRIPTION
C1,3	0180-0575		CAPACITOR, fxd, 2.2 uf
C2	0180-2933		CAPACITOR, fxd, 68 uf
C4	0180-2615		CAPACITOR, fxd, 22uf
C5	0160-4697		CAPACITOR. fxd, 3900 pf
C6	0180-2602		CAPACITOR, fxd, 47 uf
CR1 thru CR4	1901-0704		DIODE, silicon
CR5 thru CR7, 10	1901-1098		DIODE, silicon

Table 4-7.Logic Printed-Circuit Assembly A1 (00097-60015) Replaceable Parts (Continued)

REFERENCE DESIGNATION	HP PART NUMBER OLD*	NEW**	DESCRIPTION
CR8	1902-1324		DIODE, zener
CR9	1902-1314		DIODE, zener
R3,7	0683-1025		RESISTOR, fxd, 1K, 5%
R4	0683-2215		RESISTOR, fxd, 220 ohm
R5	0683-1525		RESISTOR, fxd, 1.5K, 5%
R6	0683-1515		RESISTOR, fxd, 150 ohm
R8	0683-1035		RESISTOR, fxd, 10K, 5%
R9	0683-3915		RESISTOR, fxd, 390 ohm
R10	0811-1674		RESISTOR, fxd, 4.7 ohm, 2W
Q1,5	1853-0395		TRANSISTOR, PNP
Q2	1854-0668		TRANSISTOR, NPN
Q3	1854-0071		TRANSISTOR, NPN
Q4	1854-0713		TRANSISTOR, NPN
T1	9100-3594		TRANSFORMER, toroidal
U1	1820-1812	1820-1596+	INTEGRATED CIRCUIT, ACT
U2	1818-0225++	1818-0267	INTEGRATED CIRCUIT, ROM 0
U3	1820-1751		INTEGRATED CIRCUIT, CRC
U4	1820-1723	1820-1952	INTEGRATED CIRCUIT, PIK
U5	1818-0228	1818-0550+++	INTEGRATED CIRCUIT, ROM 1
U6	1818-0226	1818-0551+++	INTEGRATED CIRCUIT, ROM 2
U7	1818-0233		INTEGRATED CIRCUIT, ROM 3
U8	1818-0229		INTEGRATED CIRCUIT, ROM 5
U9	1818-0230		INTEGRATED CIRCUIT, ROM 6
J1-5	1251-0600		CONNECTOR, 1-pin
J8	1251-4426		CONNECTOR, 13-pin
P1	1251-4289		CONNECTOR, 21-pin
	00097-80015		BOARD, etched

* Old parts appear on Logic PCA 00097-60001 only.

** Order new part numbers only.

\+ 1820-2530 may be used if 1820-1596 is not available.

++ The Mostek IC, part number 1818-0225, is not compatible with American Microsystems, Inc. IC, part number 1820-1596.

+++ U5 and U6 must be part numbers 1818-0228 and 1818-0226 OR part numbers 1818-0550 and 1818-0551. DO NOT MIX OLD AND NEW PART NUMBERS.

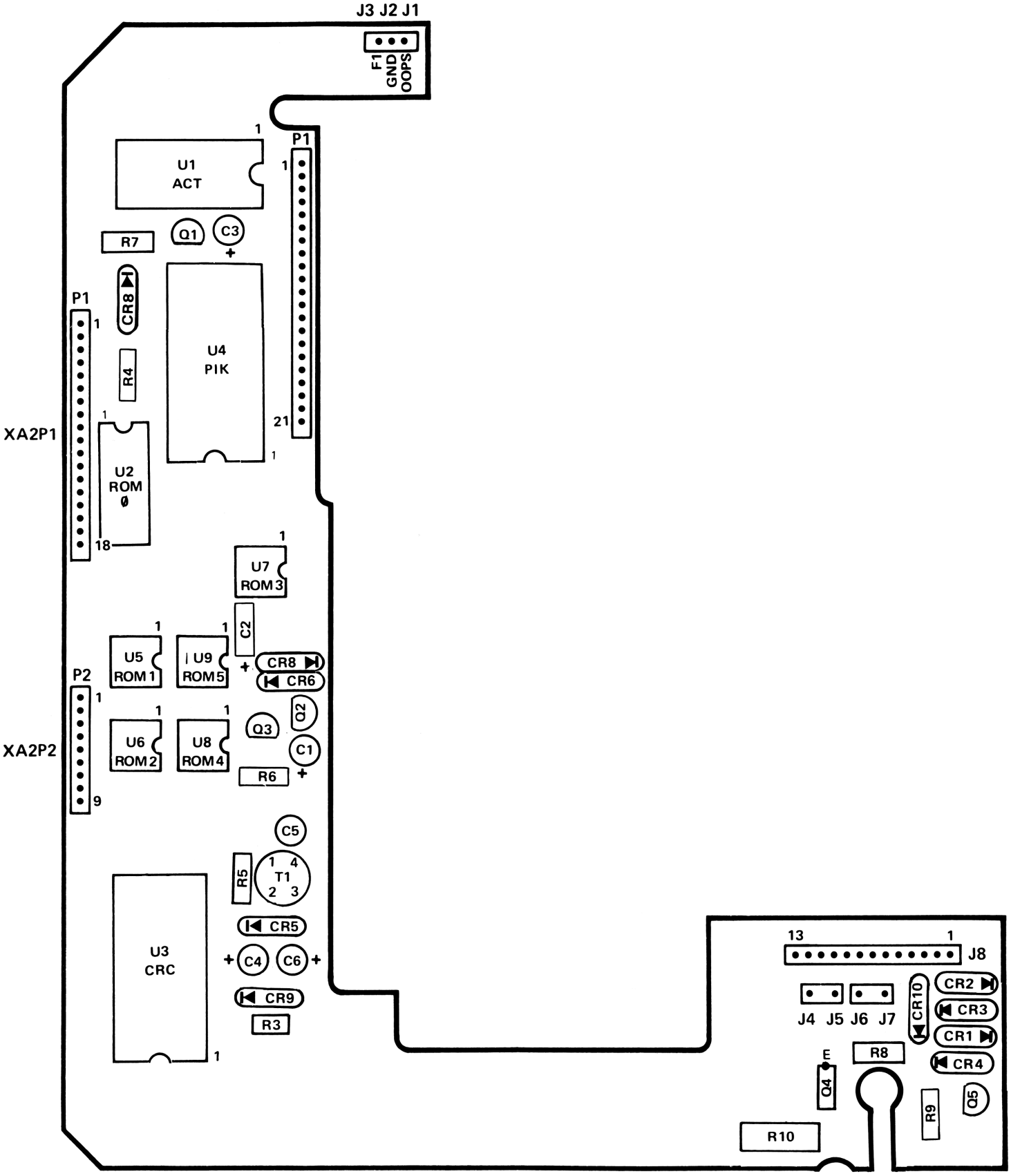


Figure 4-4. Logic PCA (A1) (00097-60015) Component Location Diagram

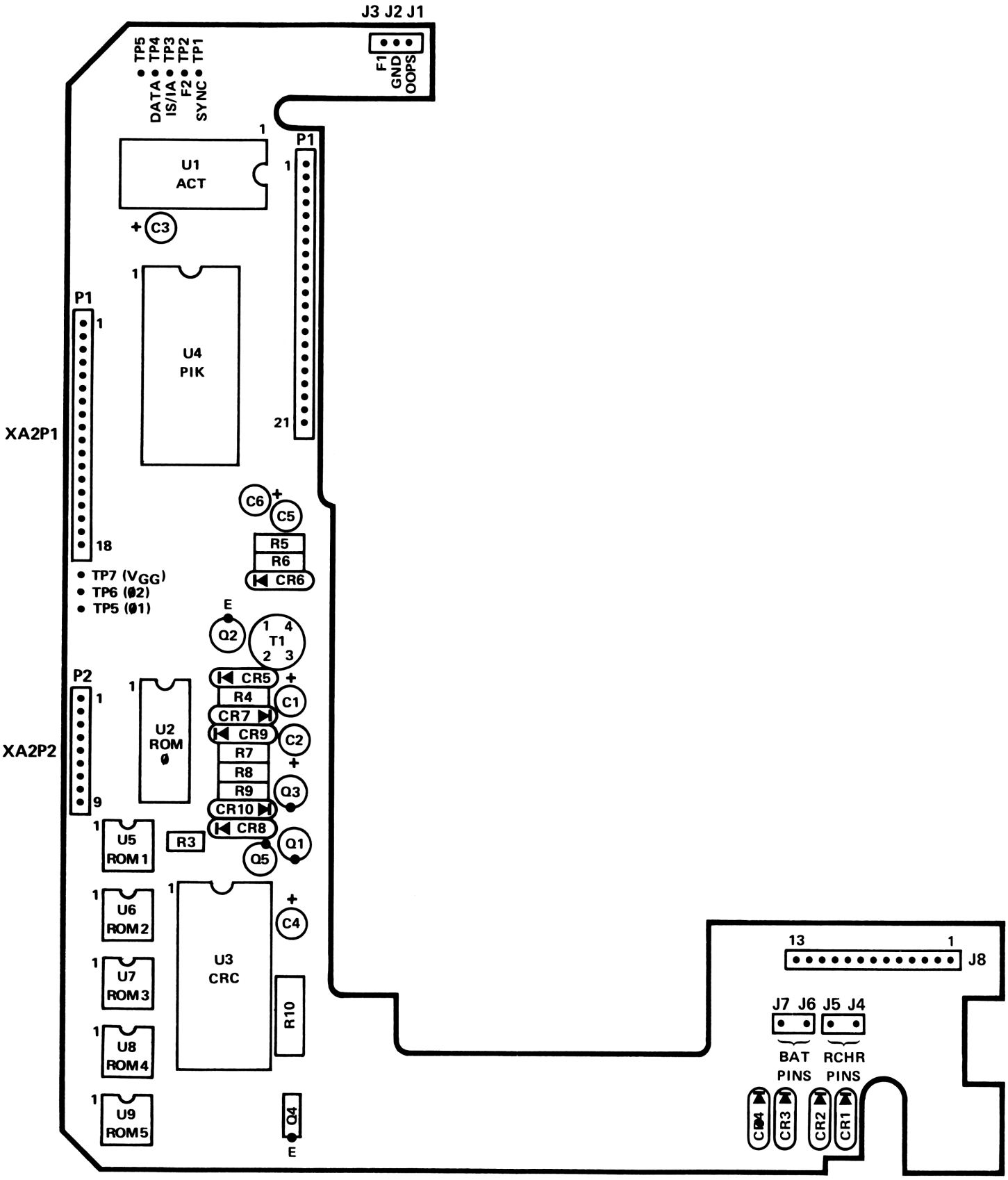
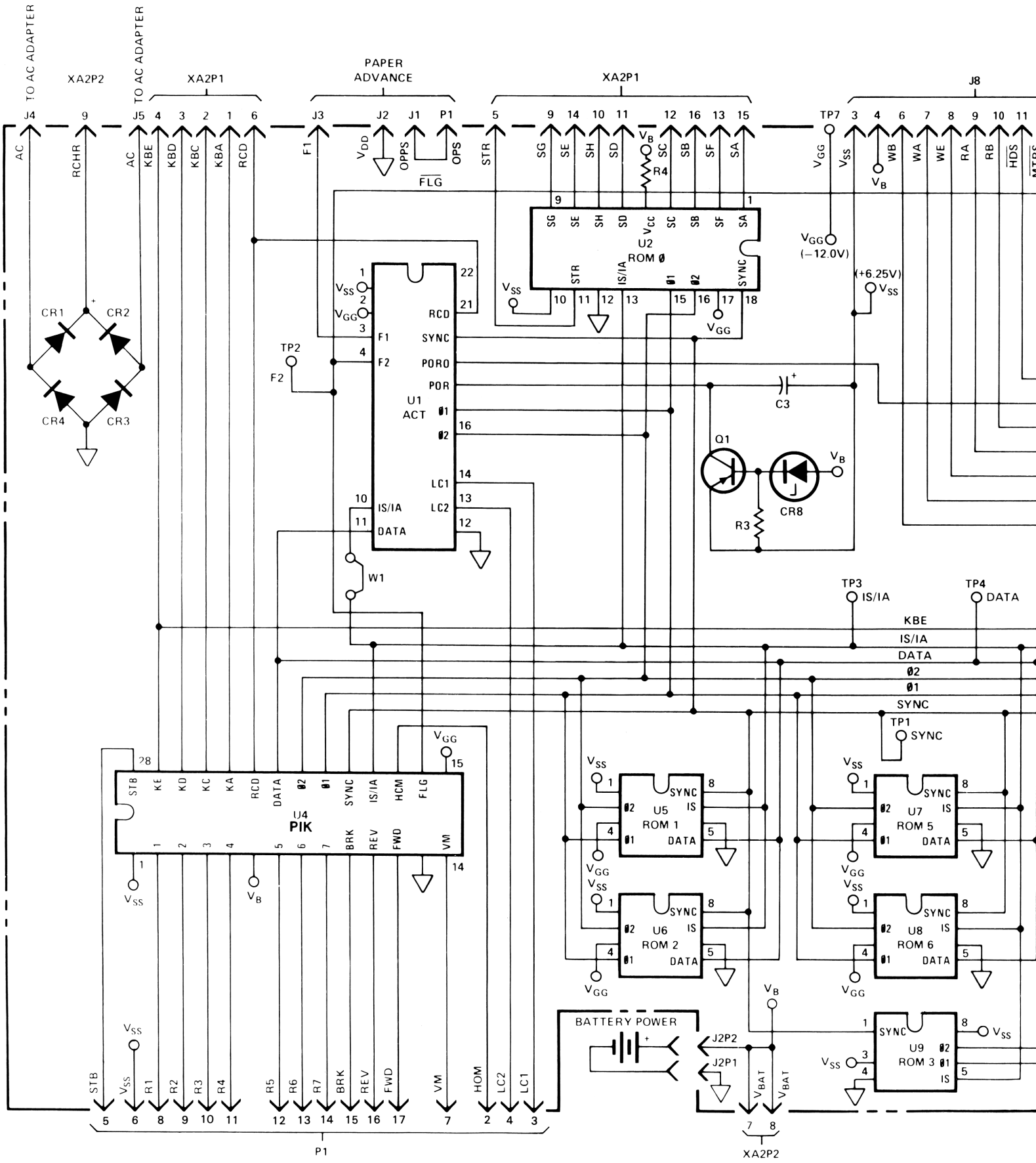


Figure 4-4 (Continued). Logic PCA (A1) (00097-60001) Component Location Diagram


TO AC ADAPTER
XA2P2
TO AC ADAPTER
XA2P1
PAPER ADVANCE
XA2P1
J8
J4
9
J5
4 3 2 1 6
J3
J2
J1
P1
5
9 14 10 11
12 16 13 15
TP7
3 4 6 7 8 9 10 11
AC
RCHR
AC
KBE KBD KBC KBA RCD
F1
VDD
OPPS
OPS
FLG
STR
SG SE SH SD VB SC SB SF SA
R4
VGG
VSS
VB
WB WA WE RA RB HDS MTRS
U2
ROM Ø
VCC
STR IS/IA Ø1 Ø2 SYNC
VGG (−12.0V)
(+6.25V)
VSS
CR1 CR2 CR4 CR3
U1
ACT
RCD
SYNC
PORO
POR
Ø1
Ø2
LC1
LC2
IS/IA
DATA
F2
TP2
C3
Q1
CR8
R3
W1
TP3 IS/IA
TP4 DATA
KBE
IS/IA
DATA
Ø2
Ø1
SYNC
TP1 SYNC
U4
PIK
STB KE KD KC KA RCD DATA Ø2 Ø1 SYNC IS/IA HCM FLG
BRK REV FWD VM
U5 ROM 1
U7 ROM 5
U6 ROM 2
U8 ROM 6
U9 ROM 3
SYNC IS Ø2 Ø1 DATA
BATTERY POWER
J2P2
J2P1
VBAT
XA2P2
STB R1 R2 R3 R4 R5 R6 R7 BRK REV FWD VM HOM LC2 LC1
5 6 8 9 10 11 12 13 14 15 16 17 7 2 4 3
P1

Fig

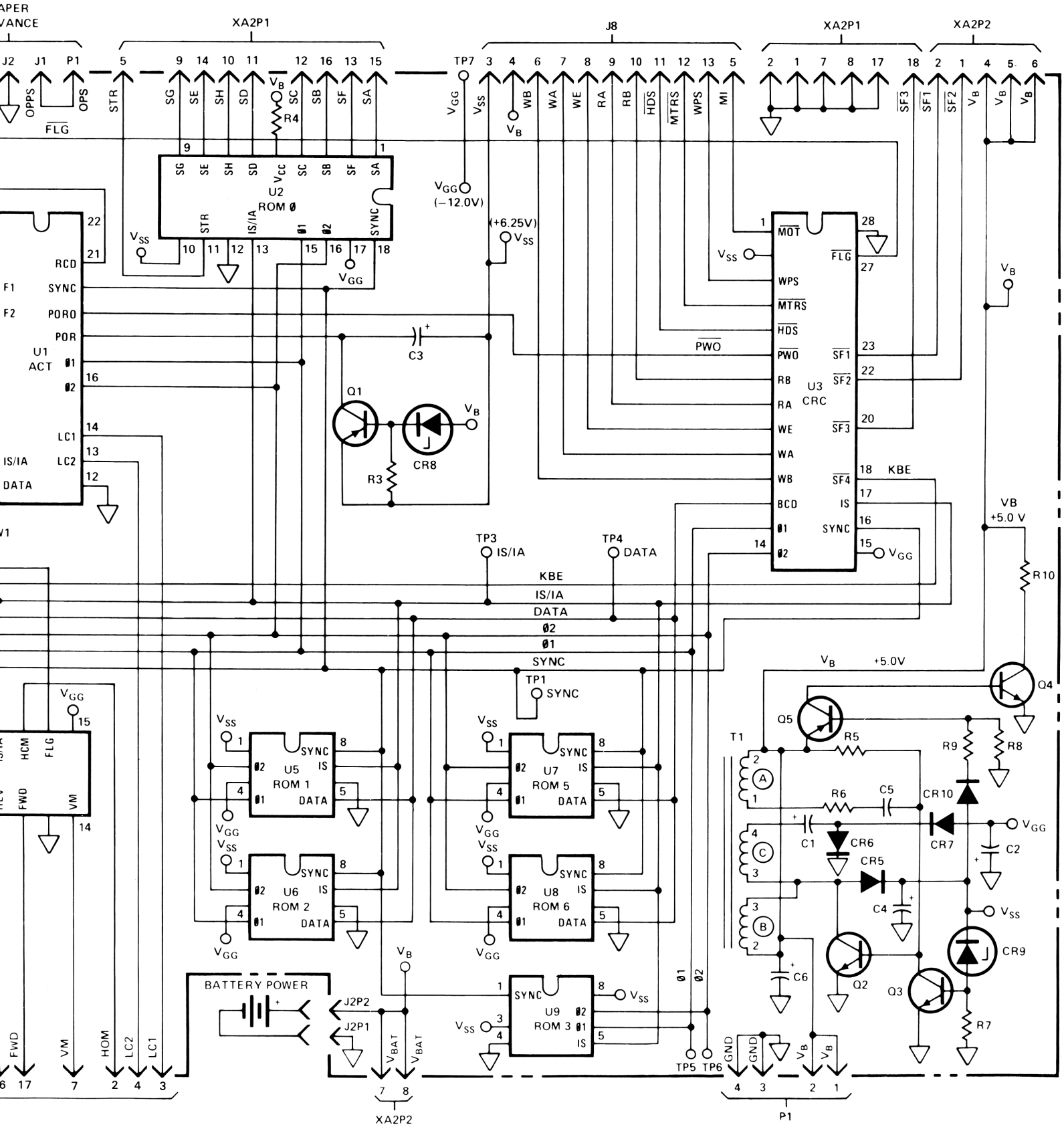
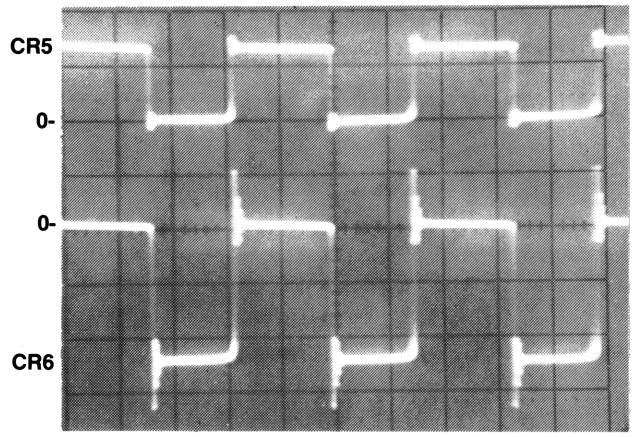
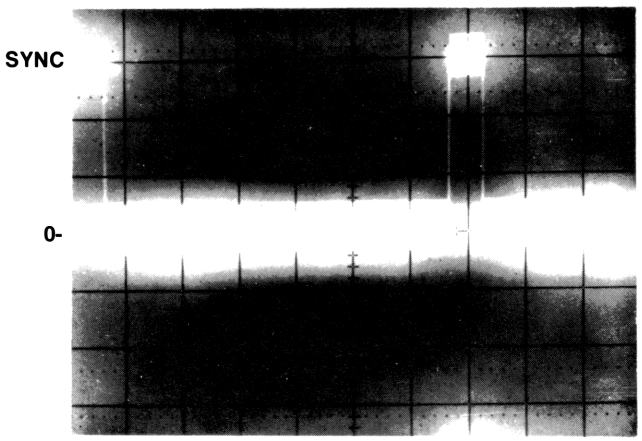


Figure 4-5. Logic PCA (A1) Schematic Diagram



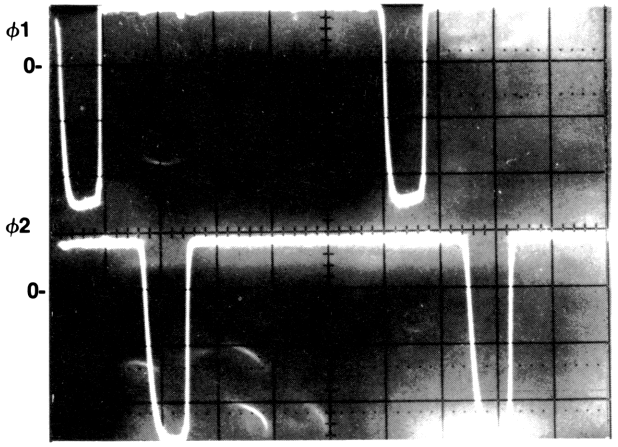
Test points: Anodes of CR5 and CR6
Oscilloscope time base: 2 us/cm
Vertical gain: 5 V/cm

Figure 4-6. CR5 and CR6 Anode Waveforms*



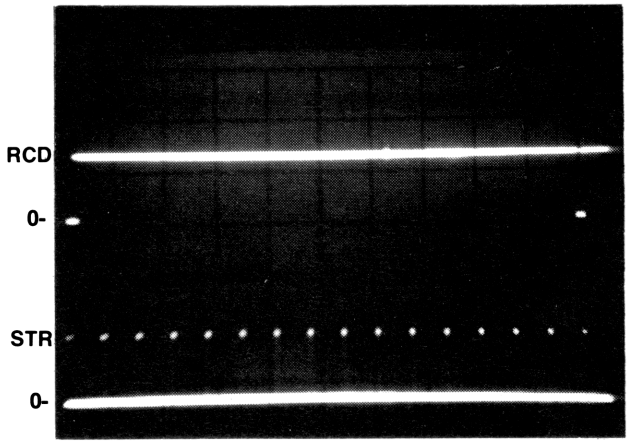
Test point: TP1
Time base: 0.1 ms/cm
Vertical: 2 V/cm

Figure 4-8. SYNC Waveform



Test points: TP5 (Φ1) and TP6 (Φ2)
Oscilloscope time base: 1 us/cm
Vertical gain: 5 V/cm

Figure 4-7. Φ1 and Φ2 Waveforms*



Test points: RCD: Pin 21 of ACT (U1)
STR: Pin 11 of ROM 0 (U2)
Time base: 0.5 ms/cm
Vertical gain: 2 V/cm

Figure 4-9. RCD and STR Waveforms*

* These waveforms are seen with an HP 182C oscilloscope, HP 1804A Vertical Amplifier Plug-In. Vertical bandwidth 50 MHz. Calculator ON, with 0.00 in display.

4-21. PRINTER ASSEMBLY MAINTENANCE

4-22. The maintenance procedures for the HP-97 printer assembly are divided into two sections; printer mechanical maintenance and printer electrical maintenance. It is very important that the mechanical portion of the printer assembly (print head, dc motor, reed switch, head cable connector, gears and associated parts) be repaired before the mechanical and electrical portions are connected together and a print command is given. Printer mechanical assembly parts replacement is accomplished with the aid of the exploded view drawing of the assembly. (See figure 6-2).

4-23. Once the mechanical portion of the printer assembly has been repaired, reconnect the head connector, motor leads, and reed switch leads to the printer printed-circuit assembly and follow the electrical troubleshooting and adjustment procedures as outlined in table 4-14.

4-24. Printer Mechanical Maintenance

4-25. To perform printer mechanical maintenance perform the following steps:

a. Test the out-of-paper switch as follows:

(1) Remove paper from the printer and press PRINT x. The display should show "Error," and the printer should not attempt to print. If the out-of-paper switch passes this test, proceed to step b; otherwise, continue troubleshooting the problem at step (2).

(2) If the out-of-paper switch does not inhibit printing as described above, disconnect the two red leads from the printer PCA near the "0" (see figure 4-11) and insert a continuity tester between them. If the tester does not light with paper out of the printer, clean or- if necessary- replace the out-of-paper switch after disassembling the printer using steps b and c and figure 6-2.

(3) If step (2) shows the out-of-paper switch to be functioning properly, disconnect the red and black leads to the paper advance switch from the logic PCA (see step 6 of the HP-97 assembly removal and replacement procedures, paragraph 3-28) and insert a continuity tester between them. If the tester does not light (when the paper advance switch is not pressed), replace the switch by following the procedures given in step 12 of the procedures referenced above, paragraph 3-28.

(4) If steps (2) and (3) show the out-of-paper switch and the paper advance switch to be functioning properly, replace ROM 0 on the logic PCA.

b. Disconnect the dc motor leads (one red and one black), out-of-paper switch leads (two red), and reed switch leads (two white) from the printer PCA. (See figure 4-10.)

> CAUTION
> Do not put any sharp bends in the head cable, motor leads, or reed and out-of-paper switch leads. Do not bend or scratch any printer parts. To do so would degrade printer performance.

c. Disconnect the head cable from the printer PCA by inserting the small end of the connector tool into the head connector, positioned between the connector pins and the cable, and pulling out the cable. (See figure 4-11.) To reinsert the cable, place the connector tool in the fold of the cable and carefully insert them together into the connector with the fold facing the circuit side of the board (see figure 4-12). Ensure that the cable contacts are properly aligned with the connector contacts as shown in figure 4-13. Remove the connector tool.

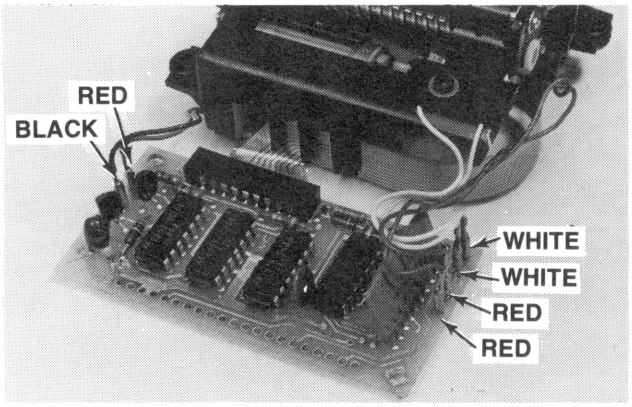


Figure 4-10. Printer PCA Lead Location

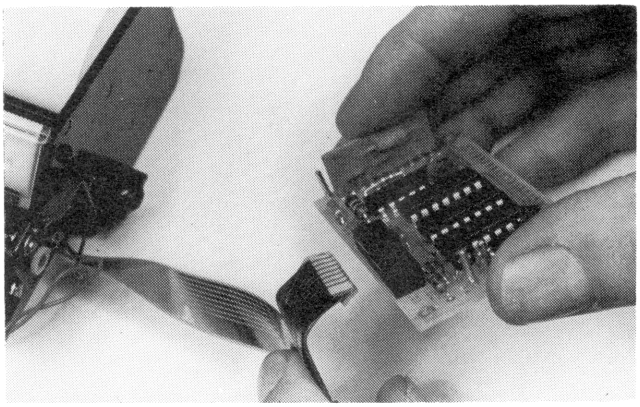


Figure 4-12. Print-Head Cable Insertion

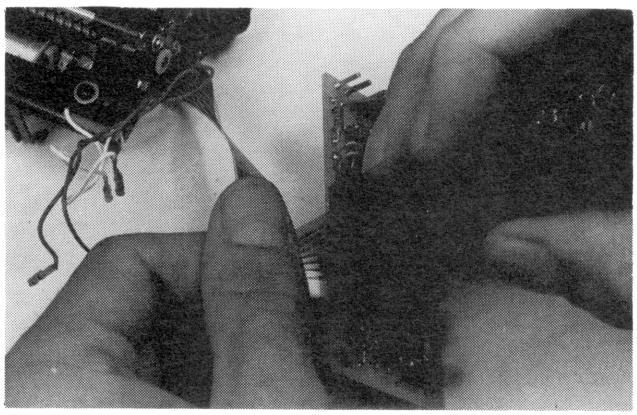


Figure 4-11. Print-Head Cable Removal

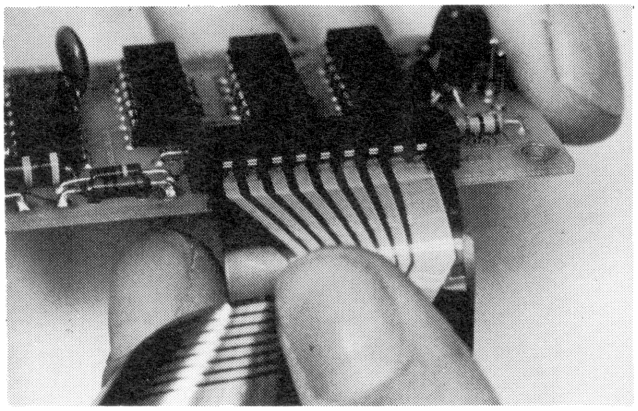


Figure 4-13. Print-Head Cable Contacts

d. Visually inspect the unit for:

(1) Worn or defective gears.

(2) Broken/bent leads.

(3) Stretched or missing springs.

(4) Excessive lead-screw end-play.

(5) Excessive play in the paper advance assembly.

e. Replace any worn or defective parts.

f. When reassembling the printer, be sure to lubricate the four points indicated in figure 6-2.

g. Test the home position reed switch:

(1) Manually rotate the lead-screw until the head carriage is positioned near, but not touching, the right-hand wall as shown in figure 4-15.

(2) Connect an ohmmeter to the reed switch leads. When the head carriage is positioned near the right-hand wall as shown in figure 4-15, the ohmmeter should measure less than 1 ohm.

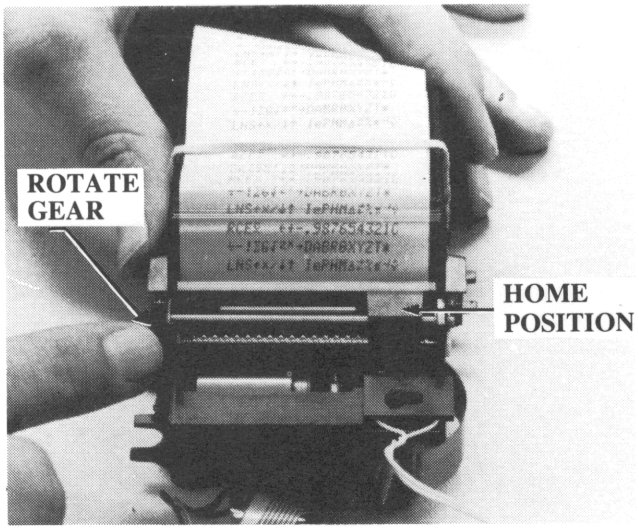
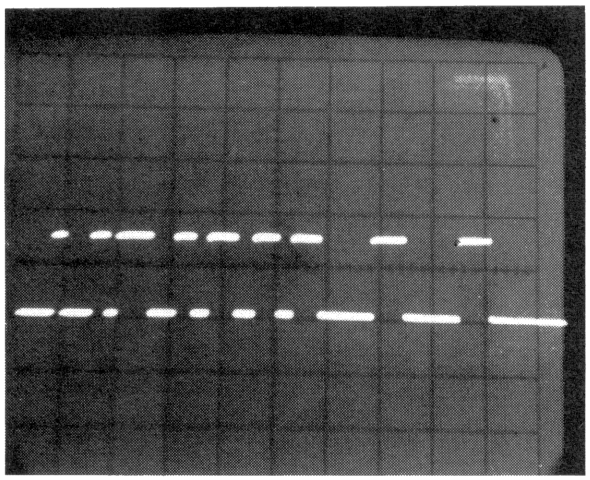


Figure 4-14. Head Carriage Home Position

h. Test the motor for open or shorted windings and/or open or shorted C2. Connect an ohmmeter to the dc motor leads. If the meter reads less then 9.0 ohms, carefully disconnect one lead of C2 and measure again. Replace the defective capacitor/dc motor assembly if necessary.

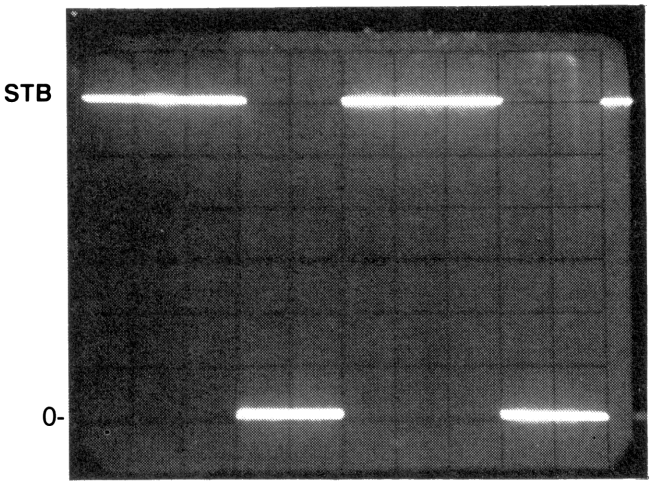
4-26. Printer Electrical Maintenance

4-27. To test the electrical portion of the printer assembly, follow the procedures as outlined in table 4-14.



Test point: FWD (Pin 17 of XA1P1)
Time base: 2 ms/cm
Vertical gain: 1 V/cm

Figure 4-15. FWD Waveform



Test point: STB (Pin 5 of XA1P1)
Time base: 20 us/cm
Vertical gain: 1 V/cm

Figure 4-16. STB Waveform

Table 4-8.

Printer Printed-Circuit Assembly A4A1 (00097-60019) Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION
C1	0160-4292	CAPACITOR, fxd, 330 pF, 5%
C3	0180-2602	CAPACITOR, fxd, 47 uF, 20%
C4	0160-3456	CAPACITOR, fxd, 1000 pF, 10%
R1,2	0683-2015	RESISTOR, fxd, 200 ohm, 5%
R3	0698-3155	RESISTOR, fxd, 4.64K, 1%
R4	0683-4725	RESISTOR, fxd, 4.7K, 5%
R5	0698-3157	RESISTOR, fxd, 19.6K, 1%
R6	0757-0288	RESISTOR, fxd, 9.09K
R7*	0698-4474	RESISTOR, fxd, 8.45K, 1%, 1/8W
R7*	0757-0751	RESISTOR, fxd, 7.50K, 1%, 1/8W
R7*	0698-3226	RESISTOR, fxd, 6.49K, 1%, 1/8W
R7*	0757-0200	RESISTOR, fxd, 5.62K, 1%, 1/8W
R7*	0698-4444	RESISTOR, fxd, 4.87K, 1%, 1/8W
R7*	0698-3154	RESISTOR, fxd, 4.22K, 1%, 1/8W
R7*	0698-3496	RESISTOR, fxd, 3.57K, 1%, 1/8W
R7*	0757-0273	RESISTOR, fxd, 3.01K, 1%, 1/8W
R7*	0757-0431	RESISTOR, fxd, 2.43K, 1%, 1/8W
R7*	0698-4430	RESISTOR, fxd, 1.91K, 1%, 1/8W
R7*	0698-4424	RESISTOR, fxd, 1.4K, 1% 1/8W
R7*	0757-0422	RESISTOR, fxd, 909 ohms, 1%, 1/8W
R8*	0698-3453	RESISTOR, fxd, 196K, 1%, 1/8W
R8*	0757-0466	RESISTOR, fxd, 110K, 1%, 1/8W
R8*	0757-0464	RESISTOR, fxd, 90.9K, 1%, 1/8W
R8*	0757-0462	RESISTOR, fxd, 75.3K, 1%, 1/8W
R8*	0757-0459	RESISTOR, fxd, 56.2K, 1%, 1/8W
R8*	0698-3450	RESISTOR, fxd, 42.2K, 1%, 1/8W
R8*	0757-0123	RESISTOR, fxd, 34.8K, 1%, 1/8W
Q13,14	1853-0393	TRANSISTOR, PNP
U1,2,3	1858-0044	TRANSISTOR, quad
U4	1826-0287	INTEGRATED CIRCUIT, comparator
U5	1810-0236	NETWORK, passive
L1	9100-3850	INDUCTOR, 140 uH
J1	1251-4143	CONNECTOR, cable
J2 thru J7	1251-0600	CONNECTOR, 1-pin male
	00091-80001	BOARD, etched

* Values of R7 and R8 are selected.

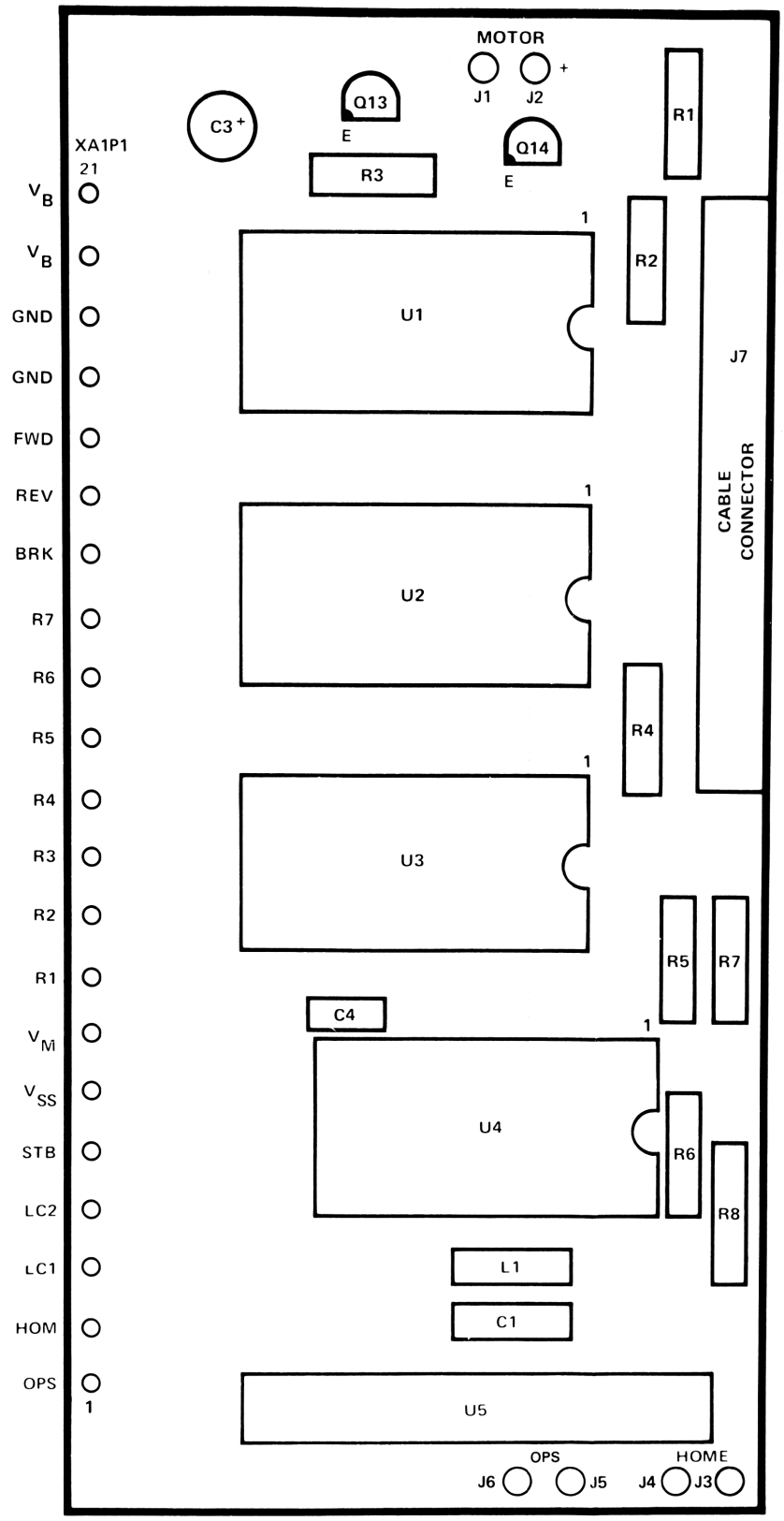


Figure 4-17. Printer PCA (A4A1) Component Location Diagram

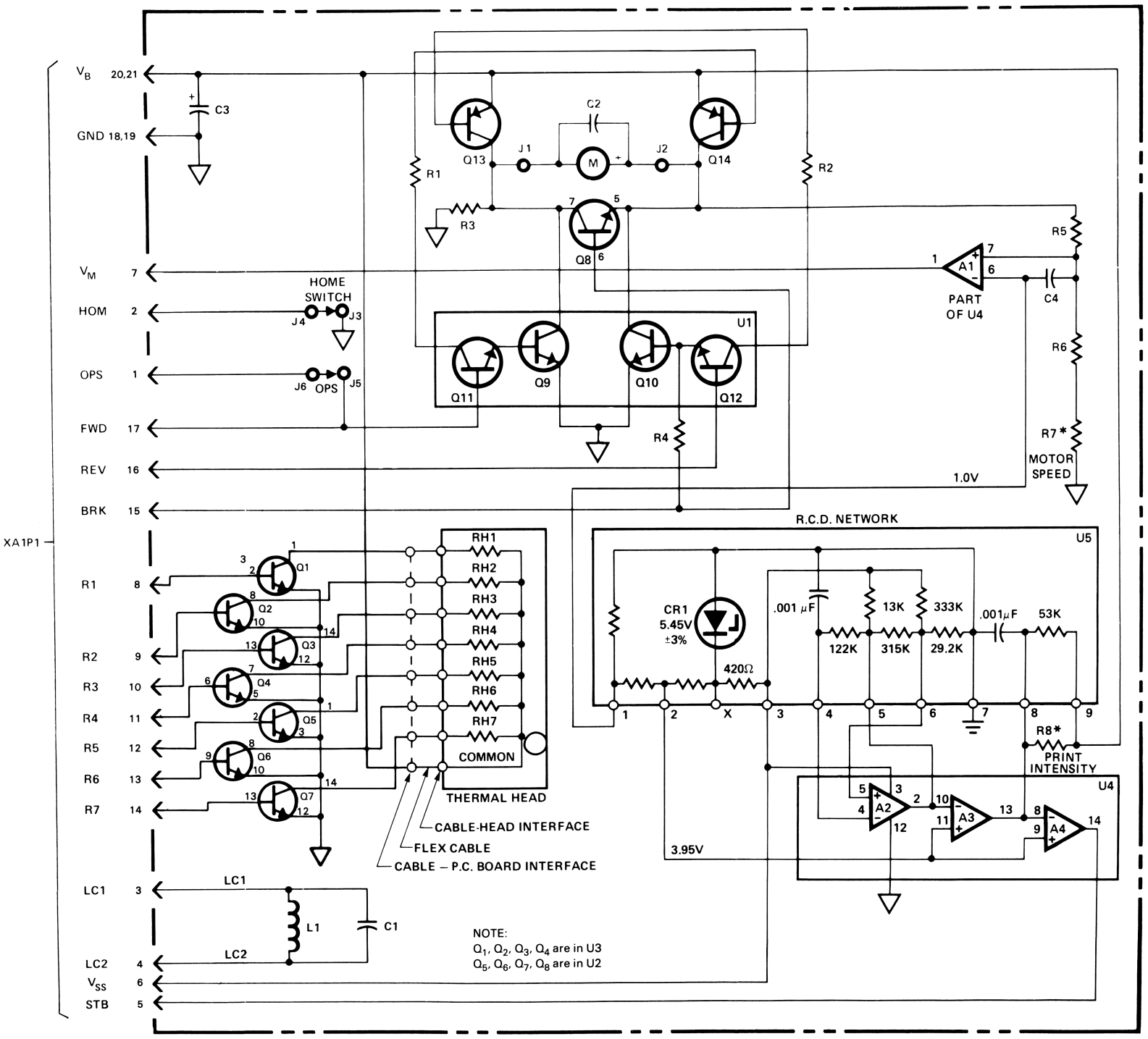


Figure 4-18. Printer PCA (A4A1) Schematic Diagram

4-28. KEYBOARD TROUBLESHOOTING

4-29. If keyboard does not respond when any key is pressed check for:

(1) Bad connection between logic board and keyboard.

(2) Bent connector pins.

(3) Bad keyboard.

If pressing a key apparently results in the entering of a function of some other key, check for bowed or damaged key spring strips.

4-30. DISPLAY TROUBLESHOOTING

4-31. Figure 4-19 shows the LED digit structure. To test, key in -8.888888888-88. Display should correspond to the numbers keyed in. Possible problems as shown in figure 4-20 are:

A. Digit overly bright or dim.
B. Digit has tendency to turn on another digit, causing ghost image to appear.
C. One digit missing segment(s).
D. All digits missing same segment(s).
E. Single digit missing. (Refer to paragraph 4-33).
F. Same segment of all digits added.
G. Segment has tendency to turn on another segment, causing ghost image to appear.

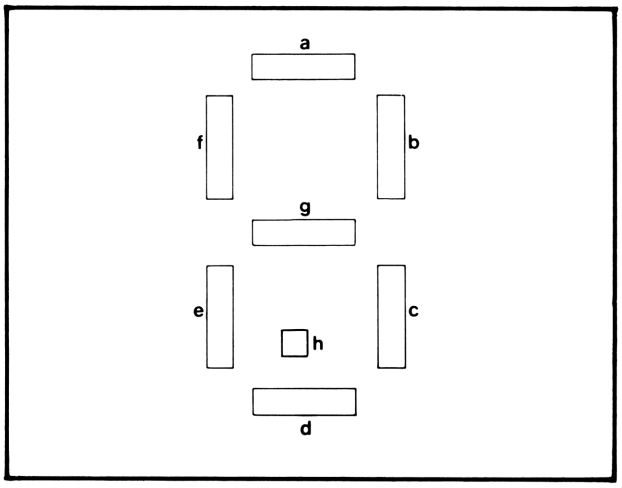


Figure 4-19. LED Digit

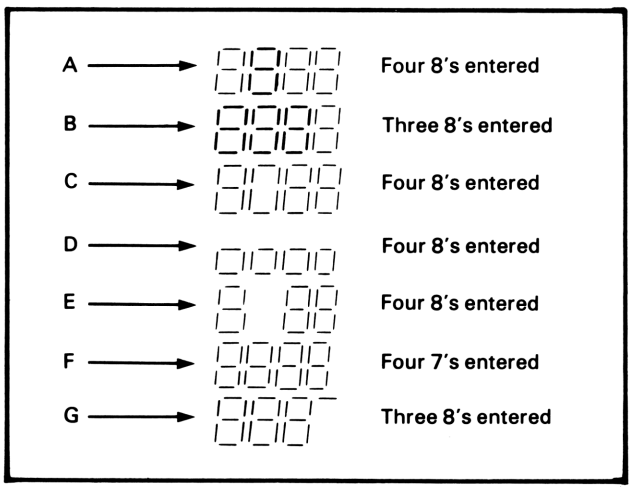


Figure 4-20. Display Problems

4-32. Probable causes for problems listed above are:

Problem Item	Caused By
d, f	ROM 0
a, b, e	Cathode Driver. (See paragraph 4-33)
c, d, e, f	LED Module.
d, g	Anode Buffers: (1) Segments a,b,c,or d missing - replace U4. (2) Segments e,f,g, or h missing - replace U3.
d, e	Bad connection to cable W1

4-33. If a digit position does not light when -8.888888888-88 is keyed into the display, refer to table 4-9 and press the key(s) indicated following the unlit position. If the calculator display agrees with that shown, the LED display is faulty; if not the cathode driver U1 is faulty.

Table 4-9. Missing Digit Troubleshooting

DIGIT POSITION	KEY(S)	DISPLAY
1 (mantissa sign)	[2]	2.
2	[3] [0] [TAN]	0.58
3	[e^x]	1.00
4	[2] [ENTER] [3] [y^x]	8.00
5	[0]	0.
6	[4] [$\sqrt{x}$]	2.00
7	[4] [1/x]	0.25
8	[4]	4.
9	[2] [ENTER] [+]	4.00
10	[0] [COS]	1.00
11	[3]	3.
12	[1]	1.
13 (exponent sign)	[2] [EEX]	2.
14	[2] [ENTER] [-]	0.00
15	[2] [ENTER] [X]	4.00

4-34. CATHODE DRIVER IC REPLACEMENT

4-35. After replacing cathode driver integrated circuit U1, a new value for resistor R2 may have to be selected. Refer to table 4-10.

Table 4-10. Cathode Driver Resistor Selection Chart

U1 Category	I	J	K
Resistor Values (kilohms)	200	330	no resistor

Table 4-11.

Keyboard Printed-Circuit Assembly A2A1 (00097-60910) Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION
C1*	0180-0575	CAPACITOR, fxd, 2.2 uf, 20% 16V
R1	0683-4715	RESISTOR, fxd, 470 ohm
R2+	0683-2045	RESISTOR, fxd, 200K
R2+	0684-3341	RESISTOR, fxd, 330K
R3	0811-3496	RESISTOR, fxd, 8.2 ohm, 2W, fusible
R4	0811-1674	RESISTOR, fxd, 4.7 ohm 2W
R5	0698-8691	RESISTOR, fxd, 4.0 ohm 1%
R6	0683-1835	RESISTOR, fxd, 18K, 5%, 1/4W
R7	0683-3915	RESISTOR, fxd, 390 ohm
CR1	1990-0450	LED, low battery indicator
Q1	1853-0393	TRANSISTOR, PNP
Q2	1853-0446	TRANSISTOR, PNP
Q3	1853-0374	TRANSISTOR, PNP
Q4	1854-0071	TRANSISTOR, PNP
U1	1820-1629	INTEGRATED CIRCUIT, cathode driver
U2	1990-0595	DISPLAY, numeric
U3,4	1858-0044	INTEGRATED CIRCUIT, quad transistors
U5	1810-0252	INTEGRATED CIRCUIT, resistor network
P1,2	1251-3955	CONNECTOR, 9-pin
W1	8120-2206	CABLE, 24-conductor
	00097-80002	BOARD, etched
	5040-9229	

* Capacitor C1 is not on all keyboard PCAs earlier than level D. If present, it is located on the circuit side of the PCA connected between pin 16 of U1 and ground.

+ Value of R2 is selected.

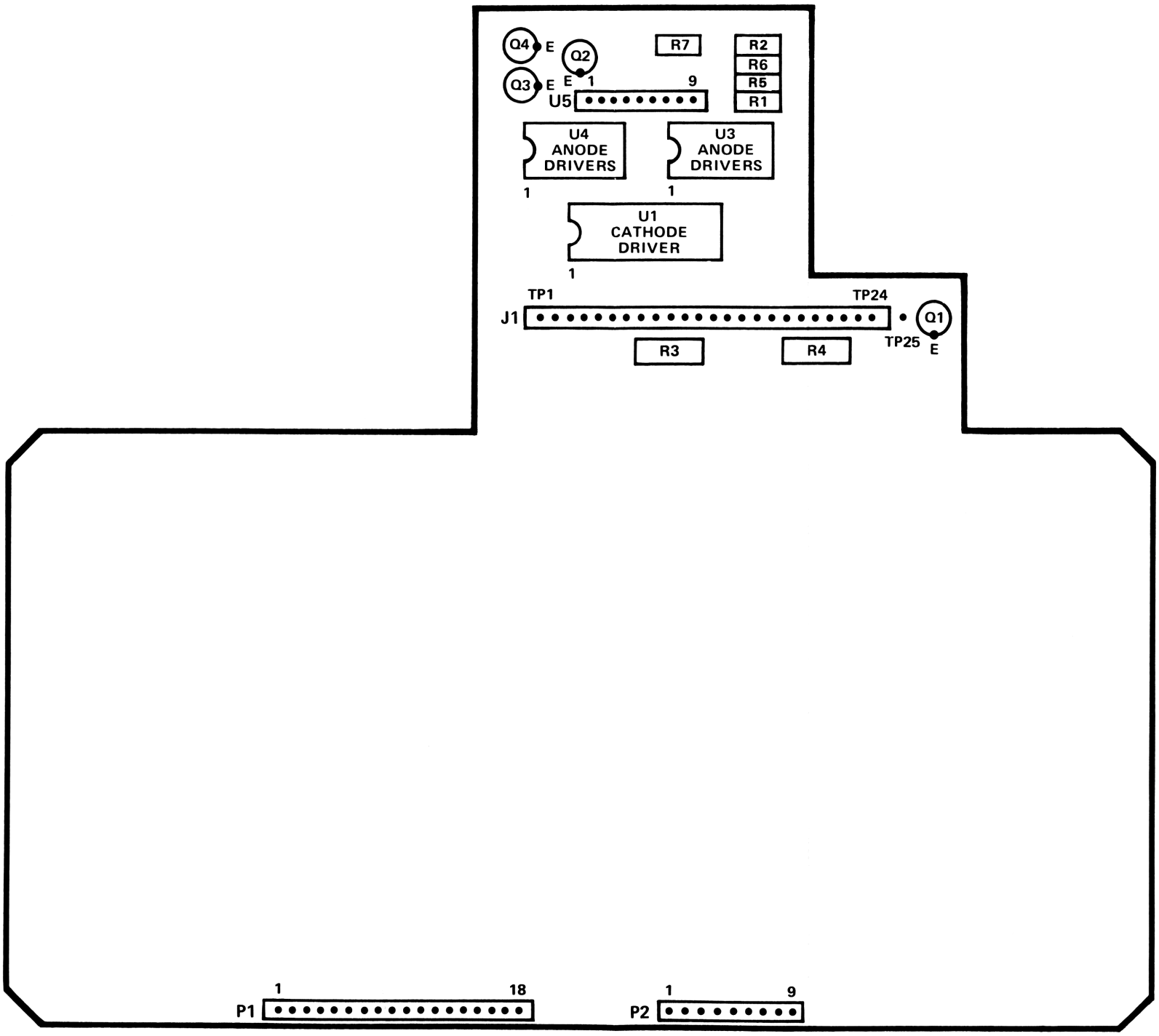


Figure 4-21. Keyboard PCA (A2A1) Component Location Diagram

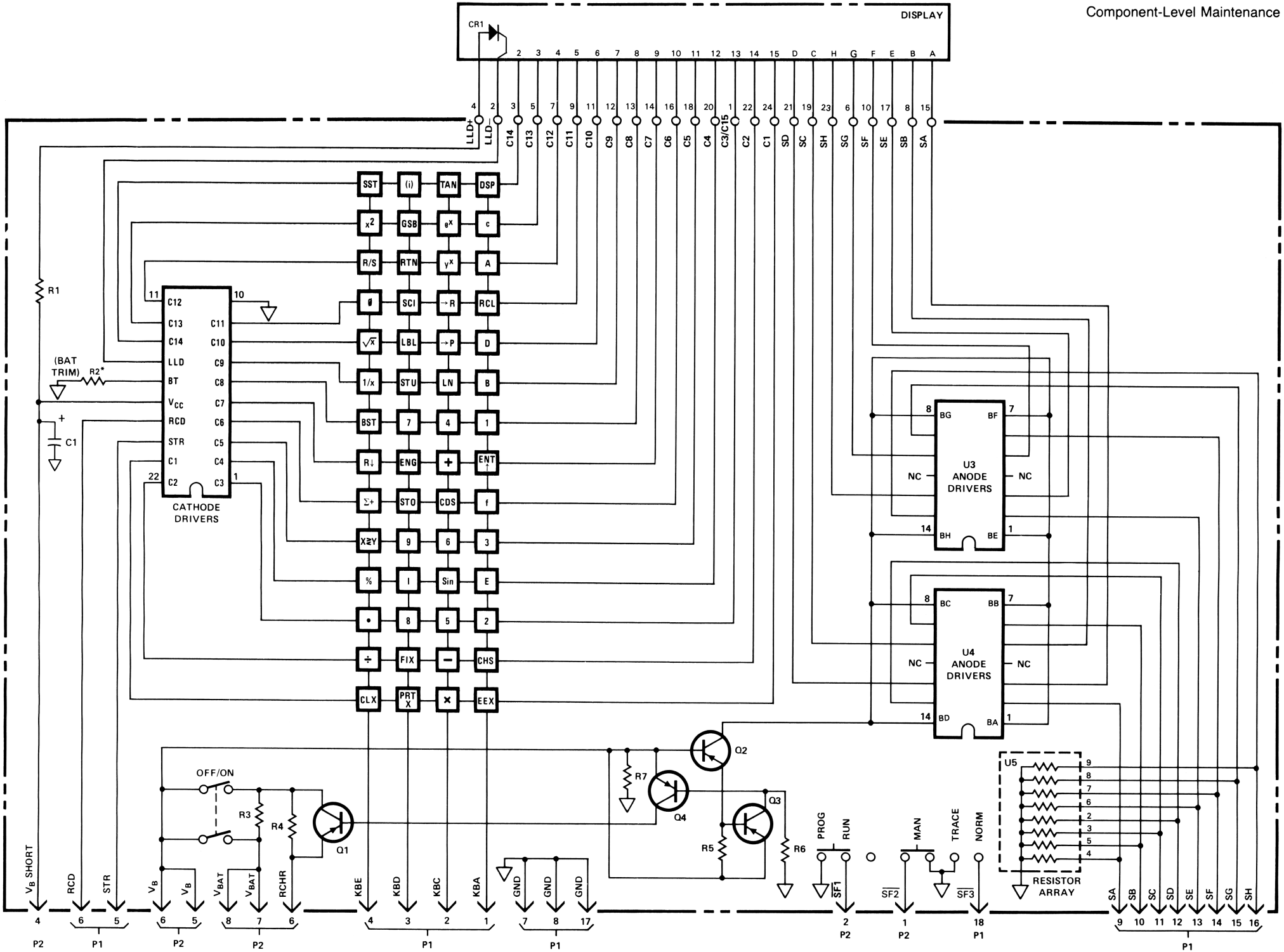


Figure 4-22. Keyboard PCA (A2A1) Schematic Diagram

4-36. CARD READER TROUBLESHOOTING

4-37. To repair a malfunctioning card reader follow the troubleshooting procedure given in table 4-15. Refer to the card reader exploded view in figure 6-3 for aid in disassembly.

4-38. When removing or reinserting the card reader cable, use the HP-91/97 connector tool (part number T-155435) as described in section 3-24, step 6b.

4-39. Note that the HP-97 card reader is a precision electromechanical assembly comtaining several small and delicate parts, HANDLE WITH CARE! During disassembly and reassembly, be sure the card reader motor is facing upward; otherwise small parts may fall out,

4-40. Avoid excessive handling of the leaf switch contacts on the card reader frame assembly: dirt or grease on them prevents proper electrical contact. During reassembly, clean them while the head assembly is separate from the card reader support by lighly rubbing the contacts with a soft pencil eraser. Rub each only toward the end of the ccontact. If any of the switch contacts are bent, replace the leaf switch contacts rather than attempting to bend them into place.

4-41. When the card reader motor speed cannot be adjusted to within proper limits, as described in the procedures of table 4-15, the eccentric cam must be replaced and/or adjusted as follows;

a. Carefully unsolder the red motor lead from the card-read printed circuit assembly and connect a current meter between the lead and its pad.

b. Insert a card into the card reader slot until the motor engages and starts to pull the card, but do not allow the card to be pulled through.

c. Adjust the eccentric cam (see figure 6-3) until the current meter reads 180 +-20 mA.

d. Perform the fine adjustment of motor speed using the procedures of table 4-15.

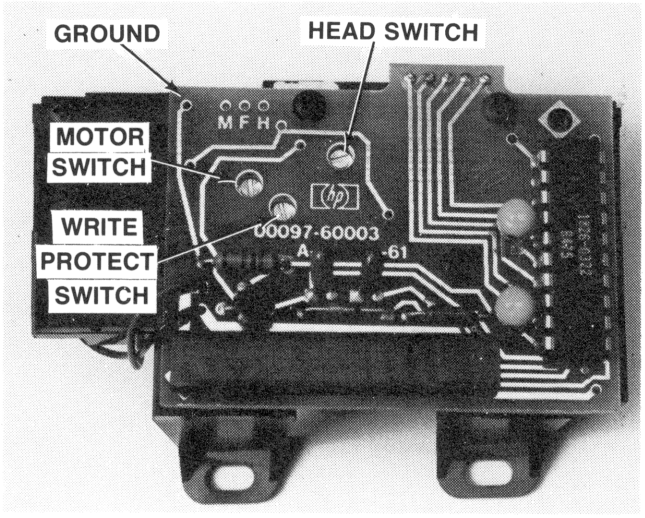
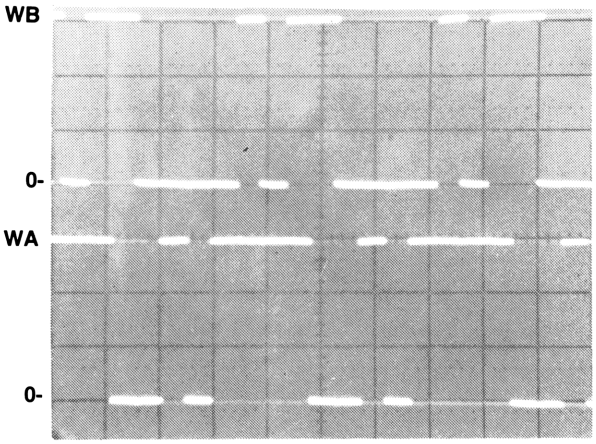


Figure 4-23. Card Reader Switch Adjustment Screws and Test Points

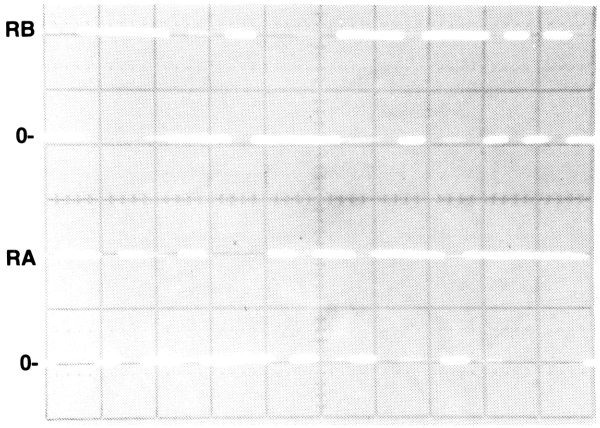


Test points: Pins 11(WB) and 10(WA) of CRC (A1U3)

Oscilloscope time base: 2 msec/div

Vertical gain: 2 V/div

Figure 4-24. WA and WB Waveforms



Test points: Pins 7(RB) and 8(RA) of CRC (A1U3)

Oscilloscope time base: 2 msec/div

Vertical gain: 2 V/div

Figure 4-25. RA and RB Waveforms

Table 4-12. Card Reader Printed-Circuit Assembly (00097-60004) Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION
R1*	0698-3151	RESISTOR, fxd, 2.8K
R1*	0757-0279	RESISTOR, fxd, 3.1K
R1*	0757-0433	RESISTOR, fxd, 3.32K
R1*	0698-3152	RESISTOR, fxd, 3.48K
R1*	0757-0434	RESISTOR, fxd, 3.65K
R1*	0698-3153	RESISTOR, fxd, 3.83K
R1*	0698-5808	RESISTOR, fxd, 4.0K
R1*	0698-3154	RESISTOR, fxd, 4.22K
R1*	0698-4442	RESISTOR, fxd, 4.42K
R1*	0698-3155	RESISTOR, fxd, 4.64K
R1*	0698-4444	RESISTOR, fxd, 4.87K
R1*	0757-0438	RESISTOR, fxd, 5.11K
R1*	0698-3258	RESISTOR, fxd, 5.36K
R1*	0757-0200	RESISTOR, fxd, 5.62K
R1*	0698-3515	RESISTOR, fxd, 5.9K
R1*	0757-0290	RESISTOR, fxd, 6.19K
R1*	0698-3226	RESISTOR, fxd, 6.49K
R1*	0757-0439	RESISTOR, fxd, 6.81K
R1*	0698-4471	RESISTOR, fxd, 7.15K
R1*	0757-0440	RESISTOR, fxd, 7.50K
R1*	0698-3259	RESISTOR, fxd, 7.87K
R1*	0757-0441	RESISTOR, fxd, 8.25K
R1*	0757-0288	RESISTOR, fxd, 9.09K
R2	0757-0927	RESISTOR, fxd, 1.3K, 2%
R3	0757-0940	RESISTOR, fxd, 4.7K, 2%
C1,2	0180-2615	CAPACITOR, fxd, 22 uf
C3	0180-2664	CAPACITOR, fxd, 3.3 uf
C4	0180-2663	CAPACITOR, fxd, 6.8 uf
CR1	1901-1098	DIODE, silicon
Q1	1854-0071	TRANSISTOR, NPN
U1	1826-0322	INTEGRATED CIRCUIT, sense amp
J1	1251-4426	CONNECTOR, 13 pin
	00097-80003	BOARD, etched

* Value of R1 is selected.

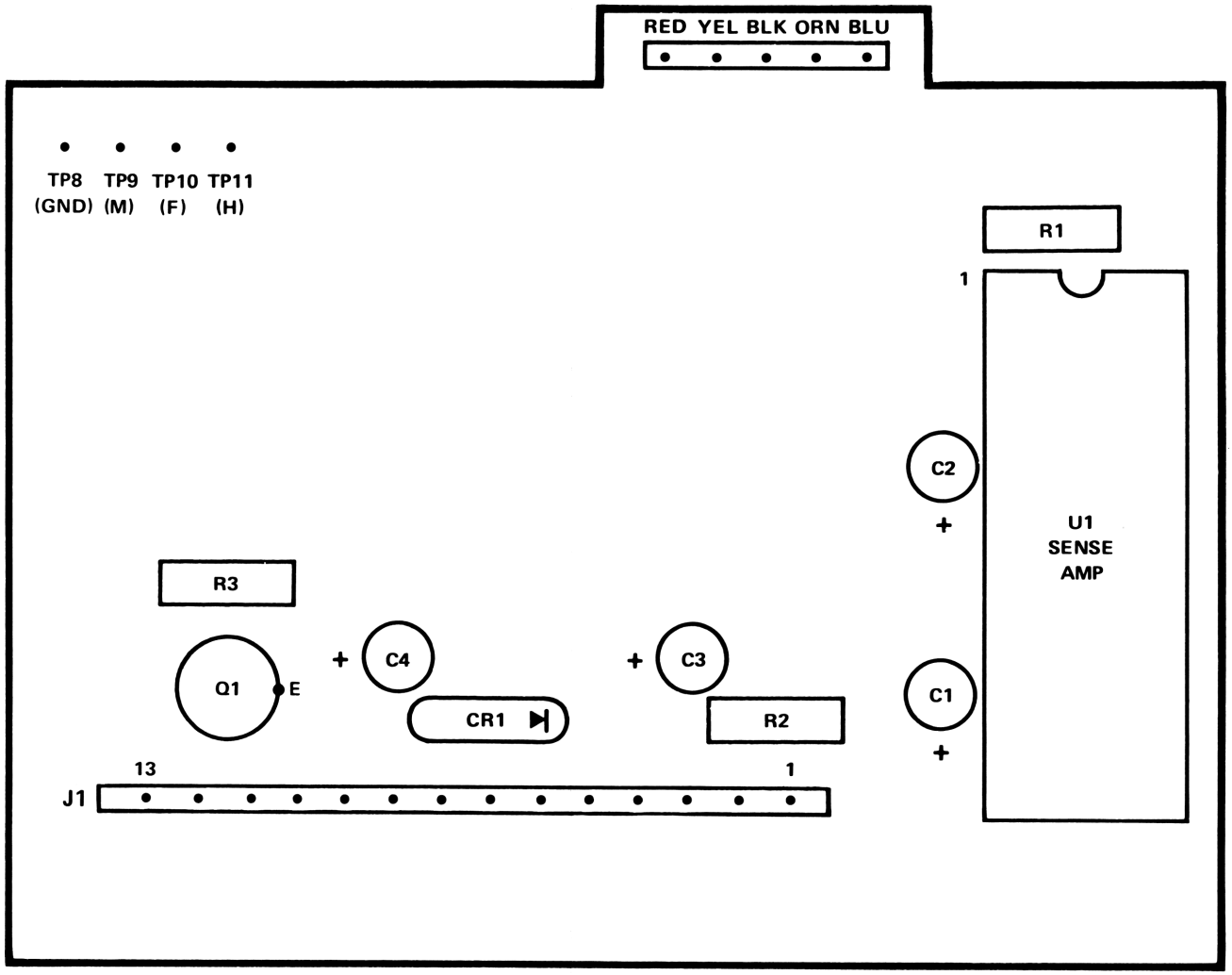


Figure 4-26. Card Reader PCA (A3A1) Component Location Diagram

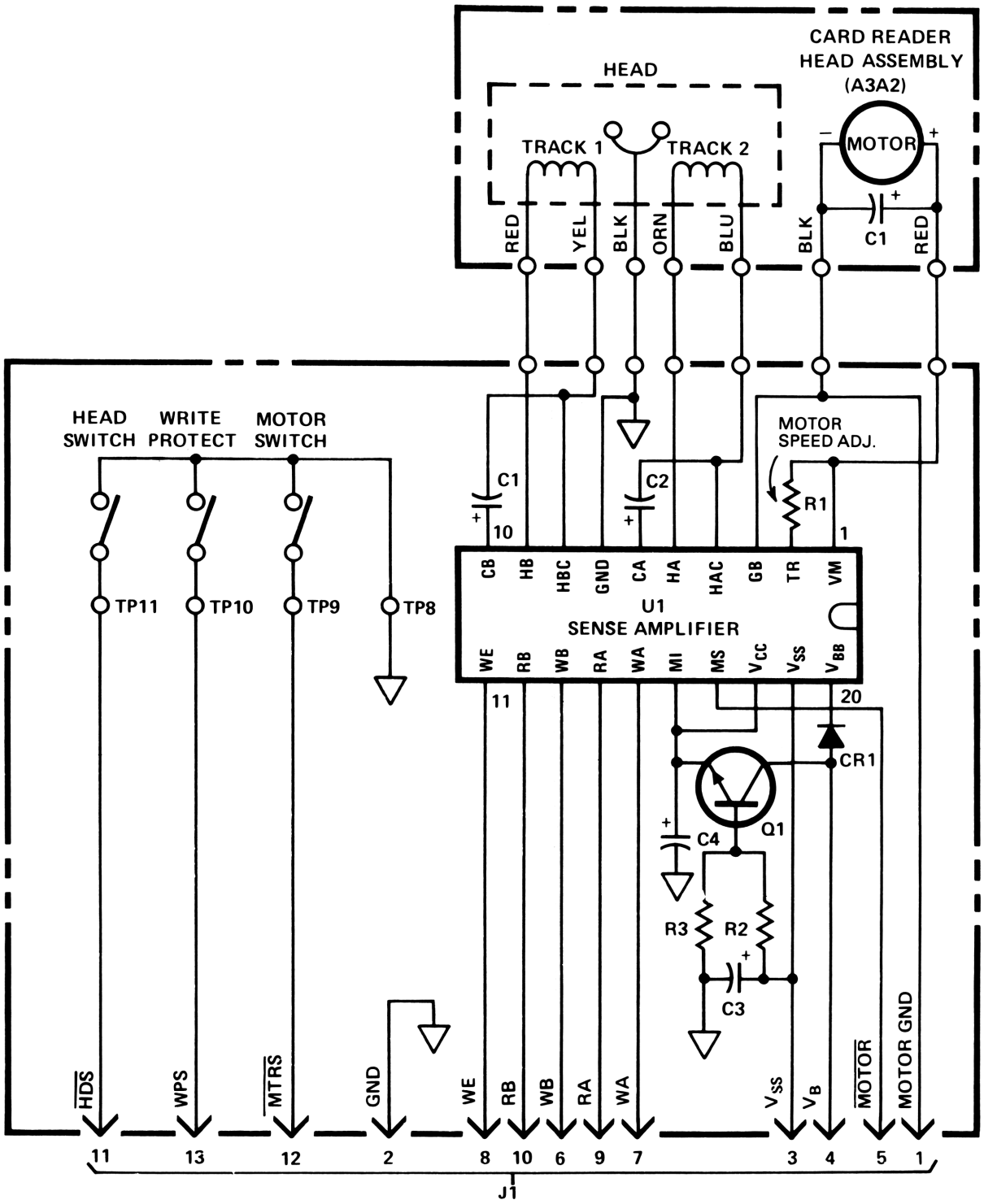


Figure 4-27. Card Reader PCA (A3A1) Schematic Diagram

Table 4-13. Logic PCA Troubleshooting Procedure

Use this procidure to isolate a malfunction in the logic PCA.	
STEP	ACTION
1. Set the switches as follows: OFF ▬▮ ON TRACE MAN ▮▬ NORM PRGM ▬▮ RUN	
2. Press [PRINT x].	It the display shows 0.00 and the printer prints 0.00, go to step 3. If the display shows 0.00, but the printer does not print 0.00, go to step 5. If the display does not show 0.00 and the printer does not print 0.00, go to step 6.
3. Test individual functions as considered necessary (refer to appropriate key sequence tests in figure 4-1 and table 4-1).	Repair individual keys as required.
4. Run logic PCA operational test (refer to paragraph 4-10).	If the logic PCA operational test is satisfactory, the logic PCA is repaired. STOP TESTING. If not, return to step 1.
5. Replace, one at a time, the ROM 0,PIK, and ROM 3. (Return to step 1 after each replacement.)	When the proper display and print are obtained return to step 3.

Table 4-13. Logic PCA Troubleshooting Procedure (Continued)

STEP	ACTION
6. Measure VSS and VB.	If VB is not between 4.4 and VSS Vdc, go to step 11. If VB is between 4.4 and VSS Vdc and VSS is between 6.0 and 6.5 Vdc, go to step 7. If VSS is not between 4.4 and 6.5 Vdc, go to step 15.
7. Measure both the DC and ripple voltage of VGG.	If VGG=0, go to step 12. If 0>VGG>-11 Vdc, go to step 13. If VGG =< -11 Vdc and ripple on VGG > 200 mV, go to step 14. If VGG =< -11 Vdc and ripple on VGG =< 200 mV, go to step 8.
8. Check waveforms Φ1, Φ2, SYNC, RCD and STR (see figures 4-5 through 4-7).	If all waveforms are satisfactory, go to step 9. If not, check for open or shorted traces. Then replace one at a time the ACT, PIK, ROM 0, CRC, ROM 1, ROM 2, ROM 3, ROM 5, ROM 6, Q1, CRS, R3, C4 and R4 until all the waveforms are correct.(Return to step 8 after each replacement.)

Table 4-13. Logic PCA Troubleshooting Procedure (Continued)

STEP	ACTION
9. Replace one at a time ROM 0, ROM 1, and ROM 3, until the calculator shows the proper display.	If the display does not show 0.00, check for shorted or open traces and/or defective discrete components, and repair as required. If the display shows 0.00 and the printer prints 0.00, return to step 1 and repeat the test. If the printer does not print 0.00, replace the PIK. If the printer still does not print 0.00, check for shorted or open traces and/or defective discrete components and repair as required.
10. Replace remaining ICs until the printer operates satisfactorily.	Return to step 1 and repeat the entire test.
11. Check for open or shorted traces.	Return to step 6.
12. Check CR6 and CR7.	Return to step 6.
13. Replace ICs until VGG is between -11.0 and -13.0 Vdc.	Return to step 6.
14. Check capacitors C1 and C2 and diodes CR6 and CR7.	Return to step 6.
15. Check waveforms at anodes of CR5 and CR6. (See figure 4-4.)	If waveforms are not satisfactory, check Q2. Then return to step 6.

Table 4-13. Logic PCA Troubleshooting Procedure (Continued)

STEP	ACTION
	If waveforms are satisfactory, and VSS > 6.5 Vdc, check Q3 and CR9. Then return to step 6.
	If 6.0 =< VSS =< 6.5 Vdc measure the ripple on VSS.
	If ripple is greater than 200 mV, go to step 16.
	If VSS < 6.0 Vdc, go to step 17.
16. Check CR5, C4 and the traces between the VSS line and C4.	Repair as required. Then return to step 6.
17. Replace ICs as required.	When VSS > 6.0 Vdc, return to step 6.

Table 4-14. Printer PCA Troubleshooting Procedure

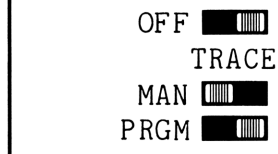
Use this procedure to isolate a malfunction in the printer PCA.	
STEP	ACTION
1. Switch the calculator on. Do not attempt to print until instructed to do so.	
2. Set the switches as follows:  	If the display shows 0.00, go to step 3. If the display does not show 0.00, replace L1 and/or C1. Then go to step 3.
3. Switch calculator off.	
4. Connect a working printer to the printer PCA. Measure the resistance of each head resistor from the head connector to ground.	If each head resistor measures > 9.0 ohms, go to step 5. If any head resistor measures < 9.0 ohms, replace the appropriate transistor pack (U2 and/or U3) until all resistors measure > 9.0 ohms. Then go to step 5.
5. Switch the calculator on. Press the paper advance switch.	If the paper advances, go to step 11. If not, go to step 6.

Table 4-14. Printer PCA Troubleshooting Procedure (Continued)

STEP	ACTION
6. Turn the calculator off. Measure the resistance across the motor.	If the motor resistance is 10+-1 ohms, go to step 7. If not, replace U2. Then go to step 7.
7. Turn the calculator on. Measure the reference voltage at U5, pin 1.	If the reference voltage is -1+-0.025 Vdc, go to step 9. If not, replace U4 and/or U5. Then go to step 8
8. Press the paper advance switch.	If the paper advances go to step 9. If not, go to step 11.
9. Check pin 17 of the board for the FWD signal.	If the signal of 1.5 millisecond duration is present, replace in order Q14, U1, Q13, R1, R2. Then go to step 11. If not, replace U5 and U4 in order until the 1.5 millisecond signal appears. Then go to step 10.

Table 4-14. Printer PCA Troubleshooting Procedure (Continued)

STEP	ACTION
10. Press the paper advance switch.	If the paper advances, go to step 11. If not, replace in order Q14, U1, Q13, R1, R2. Then go to step 11.
11. Check to see if the motor reverses.	If so, go to step 12. If not, replace in order Q13, U1, R1 and R2. Then go to step 12.
12. Press 0, 1, 2,....9 [PRINT x]	If the print intensity is acceptable, go to step 14. If not, go to step 13.
13. a. Check pin 5 of the board for the STB signal.	STB signal should be of 100+-15 microseconds duration.
b. Measure pin 2 of U5.	Pin 2 should measure 3.95+-0.05 Vdc. If both are so, select value of R8 for acceptable print intensity. For darker print, increase resistance.(Refer to table 4-7) For lighter print, decrease resistance. Then go to step 14. If not, replace U4, U5, and R8 in order. Then go to step 14.

Table 4-14. Printer PCA Troubleshooting Procedure (Continued)

STEP	ACTION
14. Enter -8888888888-88 [SCI] 9 [PRINT x] Measure print length.	The printed line length at 5.70 volts should be 1.47 to 1.54 inches (3.73 to 3.91 cm) measured from a point 0.33 inches (0.84 cm) from the right hand wall. For longer line decrease resistance; for shorter line increase resistance. (See table 4-7.) If satisfactory, go to step 16. If not, measure the voltage on pin 1 of U5.(1.0+-0.025 Vdc) If the voltage is correct, go to step 15. If not, replace U5. Then go to step 15.
15. Replace in order U4, and R4 through R7.	When print length is set correctly, go to step 16.
16. Check to make sure that the head carrier does not hit the left-hand wall.	If the head carrier action is satisfactory, go to step 17. If not, replace U2 and R4 and check the homeswitch alignment. Then go to step 17.
17. Check line-to-line line length uniformity.	If satisfactory, the printer is repaired. If not, replace C2. The printer is then repaired.

Table 4-15. Card Reader Troubleshooting Procedure

Use this procedure to isolate malfunctions in the card reader.	
STEP	ACTION
1. Insert a card.	If motor turns on, go to step 2. If not, go to step 9.
2. Switch to run mode and read any program.	
3. Switch to write program mode and record on a blank card.	
4. Hold the card with tweezers and dip into Magna-see. Allow the Magna-see to dry.	If both tracks are recorded and the motor is not excessively noisy, go to step 5. If the motor is excessively noisy, go to step 19. If both tracks are not recorded, go to step 21.
5. Energize the motor from a 3.5 Vdc supply. Measure the current in the red motor lead.	If the current is 180+-20 mA, go to step 6. If not, set the current within limits by adjusting the eccentric cam on the drive roller and/or the motor mount screws while holding a card stationary in the card slot. Then go to step 6.

Table 4-15. Card Reader Troubleshooting Procedure (Continued)

STEP	ACTION
6. Record any program on a blank card.	
7. Hold the card with tweezers and dip in Magna-see. Allow Magna-see to dry. Measure the length of recording from the leading edge of the card.(Tool 155428 may be used.)	If the length, L=5.7+-0.6 cm, go to step 8. If not, replace R1 with a value selected from table 4-10.(Each value of R1 provides for approximately 3mm of record length.) Then return to step 6.
8. Try to write on a protected card.	If "ERROR" is displayed, the card reader is repaired. END OF TEST. If not, go to step 13 and perform part b. Then return to step 6.
9. Monitor the MTRS pin of the CRC with a voltmeter or oscilloscope. Insert a card.	If MTRS = 0, go to step 10. If not, go to step 13.
10. Monitor the motor pin of the CRC. Insert a card.	If MOTOR = 0, go to step 11. If not, replace the CRC. Then go to step 12.

Table 4-15. Card Reader Troubleshooting Procedure (Continued)

STEP	ACTION
11. Monitor the voltage across the motor. Insert a card.	If the motor voltage, VM > 2V, replace the motor. Then go to step 12. If not, replace the sense amp. Then go to step 12.
12. Insert a card.	If the motor starts, return to step 2. If not, replace ROM 6. Insert a card. If the motor starts, return to step 2. If not, check the traces. Then return to step 9.
13. Perform the following procedures in sequence using an oscilloscope set to 2 V/div vertical gain and 1 msec sweep.	
a. Monitor the head switch (TP11 to TP8). Turn the head switch adjusting screw until the trace goes off the screen. Then back the screw off 1/8 turn.	If the oscilloscope shows clean switch action, go to step 13b. If not, see note below.
b. Monitor the protect switch (TP10 to TP8). Turn the protect switch adjusting screw until the trace goes off the screen. Then back the screw off 1/8 turn.	If the oscilloscope shows clean switch action, go to step 13c. If not, see note below.

Table 4-15. Card Reader Troubleshooting Procedure (Continued)

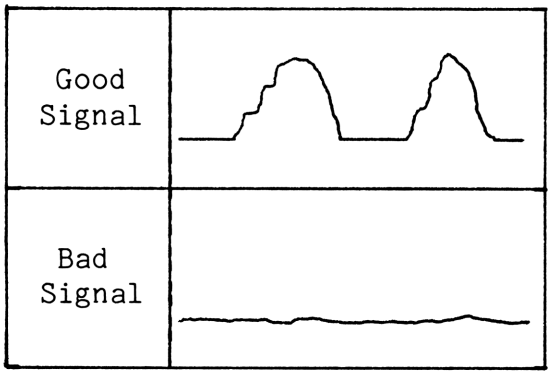
STEP	ACTION
c. Monitor the motor switch (TP9 to TP8). Turn the motor switch adjusting screw until the trace goes off the screen. Then back the screw off 1/2 turn.	If the oscilloscope shows clean switch action, go to step 14. NOTE After checking all three switches, if any switch did not show clean switch action, remove the PC board: o clean the contact points with a soft pencil eraser; o degrease the contacts with Freon FT or denatured alcohol. Wipe with a soft tissue. o If any of the contacts are bent, replace the whole leaf. o Reassemble the PC board. o Repeat step 13.
14. Mount the card reader on a fold-apart tester ET-9613-91M. Measure the head resistance.	Across HA -- 40 to 60 ohms; Across HB -- 40 to 60 ohms. The difference between HA and HB =< 3 ohms. HA to ground => 1.65 Kohms HB to ground => 1.65 Kohms If the resistances are within limits, go to step 15. If not, replace the head.Then go to step 15.

Table 4-15. Card-Reader PCA Troubleshooting Procedure (Continued)

STEP	ACTION
15. Measure the resistance across each of the capacitors C1 and C2.	If the resistance is > 10 kohms, go to step 16. If not, replace the capacitor(s). Then go to step 16.
16. Monitor the RA and RB pins of the CRC while reading side 1 of data card 2.	If RA and RB are rectangular waveforms with amplitudes at least equal to 3.0 Vdc (see figure 4-20) go to step 17. If not, replace the sense amp. and repeat step 16. If the waveforms are still not correct, replace the CRC and repeat step 16. If the waveforms are still not correct, check the traces. Then return to step 14.
17. Replace the CRC.	
18. Read side 1 of data card 2.	If "ERROR" is not displayed, return to step 2. If so, replace ROM 6 and read side 1 of data card 2. If "ERROR" is not displayed, return to step 2. If so, check traces and discrete components. Then return to step 14.

Table 4-15. Card-Reader Troubleshooting Procedure (Continued)

STEP	ACTION
19. Remove the motor from the card reader.	Apply moly-disulphide (Moly-Kote G, or equivalent) to the thrust bearing at the end of the worm gear. Check for: o bent worm gear; o bad couplers; o bad drive roller and gear; o bad motor bearings; Replace as required. Go to step 20.
20. Reinstall the motor in the card reader.	Return to step 5.
21. Monitor the head signals across HA and HB with an oscilloscope set to 0.05 V/div vertical gain and 1 msec sweep, while reading a prerecorded card.	If good signals appear at both HA and HB, replace U1. Return to step 14. If good signals do not appear at both HA and HB, replace the head. Then return to step 2.



SECTION
V

Accessories

5-1. INTRODUCTION

5-2. This section identifies the accessories available for use with the HP-97. Replacement is recommended except at facilities where repair is feasible.

5-3. HP 82033A BATTERY PACK

5-4. Figure 5-1 shows the HP 82033A battery pack. A checkout procedure is given in figure 3-1.

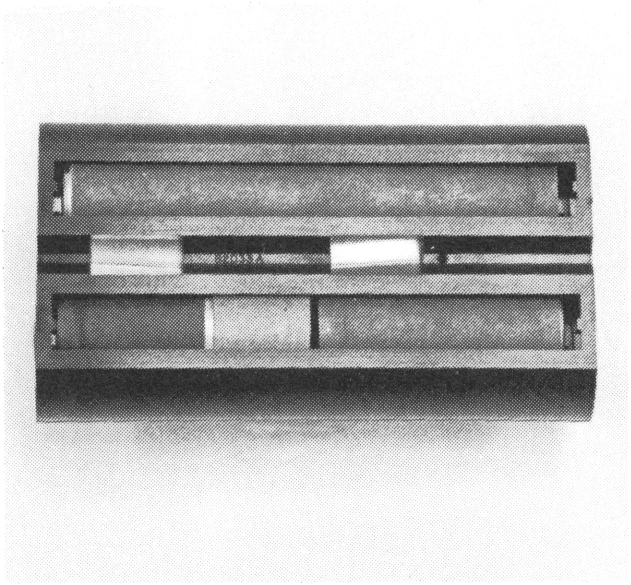


Figure 5-1. HP 82033A Battery Pack

5-5. AC ADAPTER/RECHARGER

5-6. Table 5-1 lists the various ac adapter/rechargers available for use with the HP-97. Figure 5-2 shows the plug configuration and location of the part number. A checkout procedure is given in figure 3-1.

Table 5-1. AC Adapter/Rechargers

HP MODEL NUMBER	VOLTAGE*	IDENTIFICATION
82066B **	230	European
82067B **	230	UK desktop
82067B Opt 001**	230	UK with RSA plug
82068B **	230	Australian
82059B **	115	US
82069B **	115	European

* Indicates nominal voltage; acceptable ranges are 200 to 254 Vac and 90 to 127 Vac.
** Provided with fully slotted output connector.

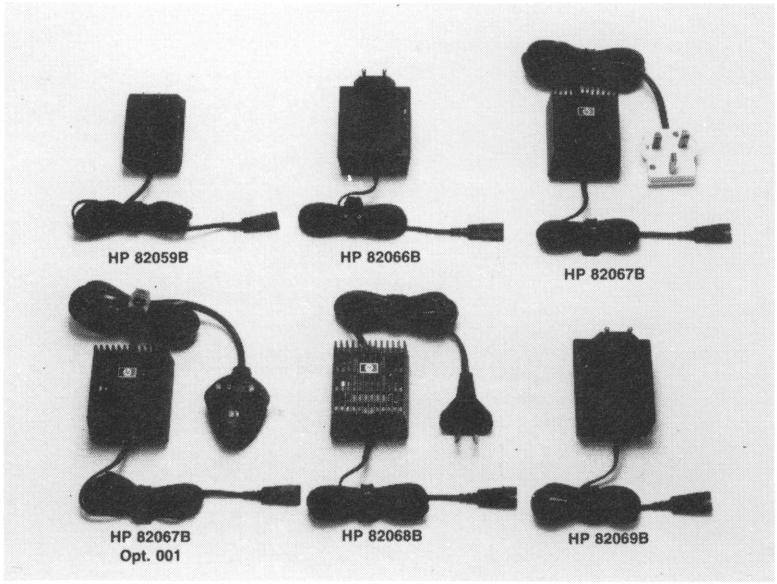


Figure 5-2. AC Adapter/Rechargers

5-7. HP 82044A SECURITY CABLE AND LOCK

5-8. Description

5-9. Located on the back of the HP-97 is a permanently mounted slideout hasp. This hasp provides a convenient, strong point of attachment to the calculator. The use of the HP82044A security cable and lock connected to the HP-97 hasp, securely ties down the calculator to prevent theft. (See figure 5-3.)

5-10. Conditions of Replacement

5-11. Replace when cable, lock or hasp is broken.

5-12. HP does not stock replacement keys. For replacement, consult local locksmith.

5-13. HP 82037A RESERVE POWER PACK

5-14. Description

5-15. The HP 82037 Reserve Power Pack:

a. Allows spare battery recharge while calculator is in use.

b. Is especially useful where calculator is in constant field use.

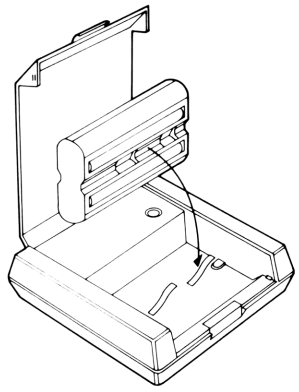


Figure 5-3. HP 82037A Reserve Power Pack

c. Attaches to standard ac adapter/recharger.

d. Built-in indicator shows battery is charging. Uses standard battery pack (one supplied).

e. Allows charging extra packs for extended usage of calculator.

f. Provides extra portability around the user's facility.

5-16. Specifications

5-17. The following are specifications for the HP 82037 Reserve Power Pack:

a. Dimensions: length 4.63 inches, width 3.81 inches, height 1.38 inch.

b. Weight: 3 1/2 ounces (including battery pack).

c. Material: High-impact plastic.

d. Battery Charging Indicator: Light-emitting diode (LED).

e. Temperature Operating Range 15 to 40 C (59 to 104 F).

f. Power Input: From ac adapter/recharger.

5-18. Service Support

5-19. Complete replacement is recommended.

5-20. Conditions of Replacement or Repair

5-21. Replace plastic parts if cracked or broken. If unit is damaged beyond repair, consider a replacement unit.

Note: Keep in mind repair cost versus that of a new unit.

5-22. Operation

5-23. Guide battery pack into reserve power pack so that the exposed metal battery contacts face the metal contacts in the reserve power pack. Plug the two-prong female connecor from an ac adapter/recharger into the bottom of the reserve power pack. Then plug the ac adapter/recharger into wall outlet.

5-24. A red light (LED) will glow when the proper connections have been made and the batteries are charging. The light does not go out when charging is complete.

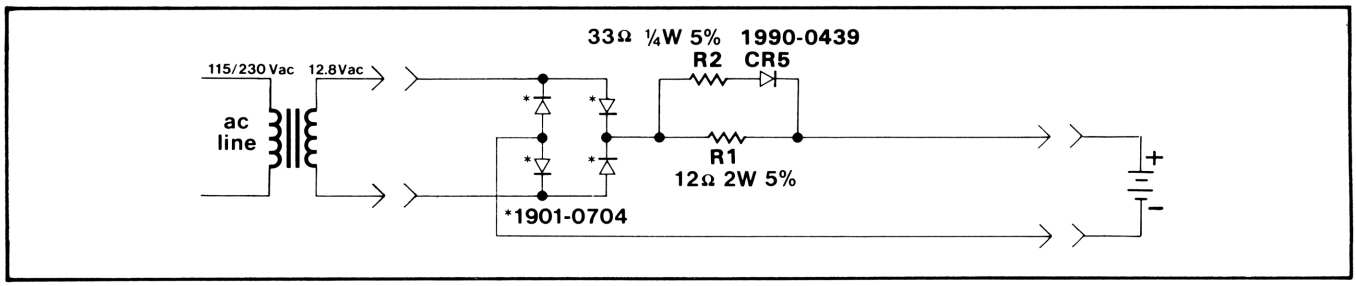


Figure 5-4. Reserve Power Pack Schematic Diagram

SECTION
VI

Replaceable Parts

6-1. INTRODUCTION

6-2. This section contains information pertaining to the parts used in the HP-97. Parts descriptions, quantities, HP stock numbers, reference designations (where applicable) and assembly breakdowns are given.

6-3. Symbols used in the schematics may be identified by using figure B-1. Table B-1 lists reference designations and abbreviations.

6-4. Replaceable parts for the logic PCA, printer PCA, keyboard PCA, and card reader PCA are listed for convenience alongside each appropriate schematic diagram in section IV.

6-5. ORDERING INFORMATION

6-6. To order replacement assemblies, address order or inquiry to Corporate Parts Center, Parts Center Europe, or International Operations. Specify the following information for each part ordered:

a. Calculator model and serial number.

b. Hewlett-Packard stock number for each part.

c. Description of each part.

d. Circuit reference designation (if applicable).

6-7. Assemblies listed without an HP part number are named for reference only and cannot be ordered as assembled units. If needed, the parts comprising them can be ordered individually using the part numbers given in the appropriate table.

Table 6-1. HP-97 Replaceable Parts

FIGURE & INDEX NUMBER	HP PART NUMBER	DESCRIPTION	QTY
6-1			
1	00097-60015	PCA A1, logic (refer to table 4-7)	1
2	00097-60019	ASSEMBLY A2,keyboard (refer to table 6-2)	1
	8120-2301	* CABLE, wire	1
	1990-0595	* DISPLAY, light emitting diode	1
	5040-9229	* WINDOW, red	1
3	00097-60004	ASSEMBLY A3,card reader (refer to table 6-4)	1
4	00097-60010	ASSEMBLY A4,printer (refer to table 6-4)	1
5		ASSEMBLY A5, bottom case	1
	00091-60013	* ASSEMBLY, power pack	1
	5040-9202	* CASE, bottom	1
	5040-9204	* DOOR, battery	1
	5040-9207	* FOOT	4
	5040-9440	* LATCH, battery door	2
6	00097-60907	ASSEMBLY A6, support plate	1
	1600-0525	* HASP, security	1
	5040-9206	* PLATE, support	1
	0624-0354	* SCREW, 4-20 X 0.5	2
	3050-0227	* WASHER, 0.149 ID	2
7		ASSEMBLY A7, top case	1
	00091-60016	* ASSEMBLY, paper advance switch	1
	5040-9213	* BUTTON, paper advance switch	1
	5040-9709	* CASE, top	1
	1460-1465	* SPRING, compression	1
	00092-60903	ASSEMBLY, AC input plug	1
	5040-9208	COVER, paper	1
	0400-0009	GROMMETT, vinyl	3
	82045A	PAPER, thermal	1/6
	0624-0354	SCREW, 4-20 X 0.5	20
	0624-0355	SCREW, 4-20 X 0.375	8
	2190-0891	WASHER	3

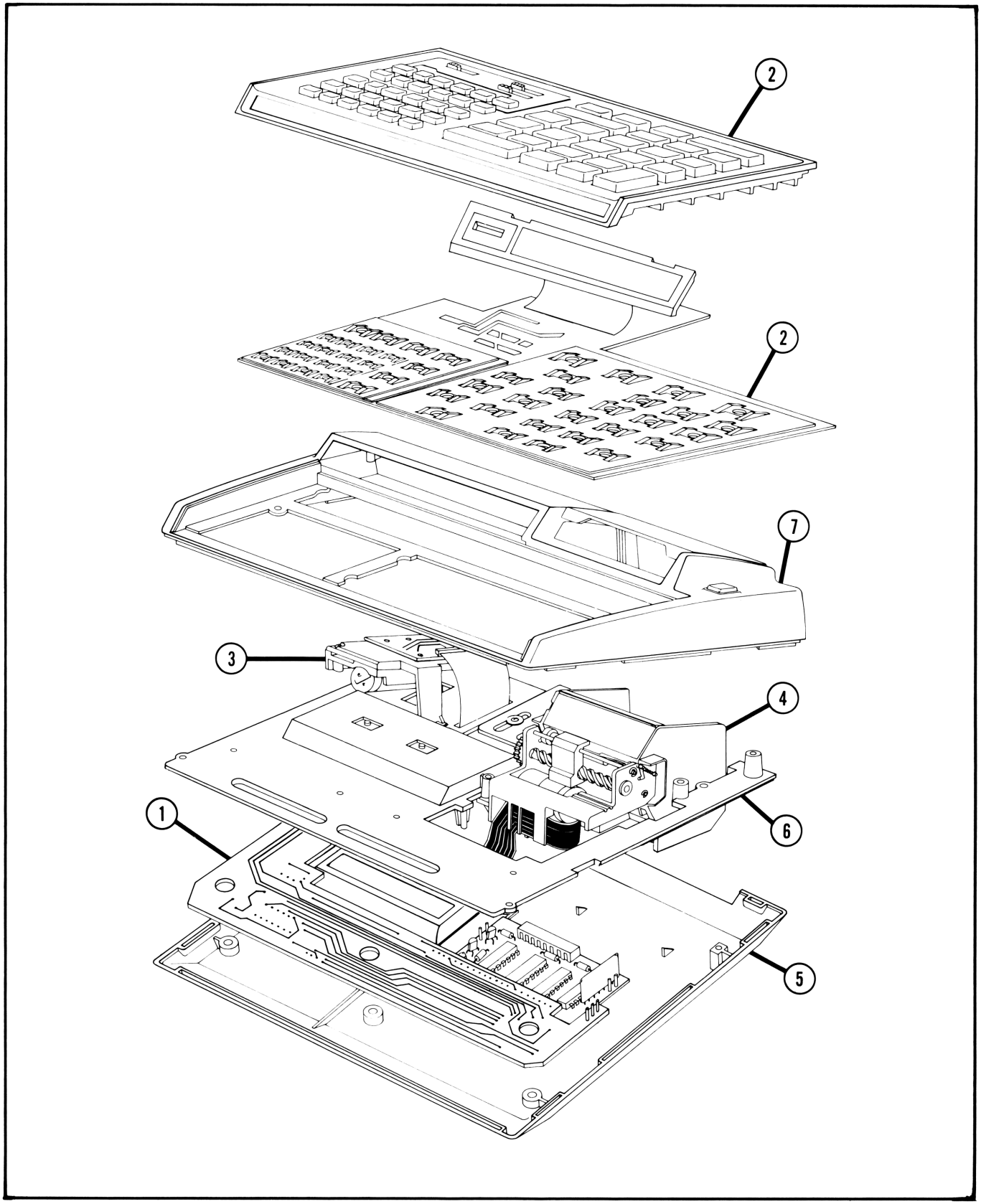


Figure 6-1. HP-97 Exploded View

Table 6-2. Keyboard Assembly (A2) Replaceable Parts

HP PART NUMBER	DESCRIPTION	QTY
00097-60910	PCA A2A1, keyboard,service (refer to table 4-11)	1
00097-60013	KEYBOARD	1
5040-9229	WINDOW	1
4040-1054	SPACER,large	2
4040-1086	SPACER, small	2
5020-9230	CONTACT, switch, 6-row	1
5020-9233	CONTACT, switch, 5-row	1
1460-1465	SPRING, compression	26
1460-1487	SPRING, compression	30
5040-9210	HAT, large	26
5040-9300	HAT, small	30
5040-9209	SWITCH	3
1460-1471	SPRING, switch	3
7120-5385	LABEL, ID, US	1
5040-9256	* KEY, CLx	1
5040-9257	* KEY, x><y	1
5040-9258	* KEY, EEX	1
5040-9259	* KEY, R	1
5040-9260	* KEY, CHS	1
5040-9261	* KEY, :	1
5040-9262	* KEY, X	1
5040-9263	* KEY, -	1
5040-9264	* KEY, ENTER	1
5040-9265	* KEY, PRINT x	1
5040-9266	* KEY, +	1
5040-9267	* KEY, 1	1
5040-9268	* KEY, 2	1
5040-9269	* KEY, 3	1
5040-9270	* KEY, 4	1
5040-9271	* KEY, 5	1
5040-9272	* KEY, 6	1
5040-9273	* KEY, 7	1
5040-9274	* KEY, 8	1
5040-9275	* KEY, 9	1
5040-9276	* KEY, .	1
5040-9278	* KEY, 0	1
5041-1127	* KEY, F	1
5041-1151	* KEY, Sigma Plus	1
5041-1122	* KEY, A	1
5041-1123	* KEY, B	1
5041-1124	* KEY, C	1
5041-1125	* KEY, D	1

Table 6-2. Keyboard Assembly (A2) Replaceable Parts (Continued)

HP PART NUMBER	DESCRIPTION	QTY
5041-1126	* KEY, E	1
5041-1128	* KEY, LBL	1
5041-1129	* KEY, GTO	1
5041-1130	* KEY, GSB	1
5041-1131	* KEY, RTN	1
5041-1132	* KEY, BST	1
5041-1133	* KEY, SST	1
5041-1134	* KEY, Y to the X	1
5041-1135	* KEY, LN	1
5041-1136	* KEY, E to the X	1
5041-1137	* KEY, TO P	1
5041-1138	* KEY, STO	1
5041-1139	* KEY, RCL	1
5041-1140	* KEY, SIN	1
5041-1141	* KEY, COS	1
5041-1142	* KEY, TAN	1
5041-1143	* KEY, TO R	1
5041-1144	* KEY, (I)	1
5041-1145	* KEY, I	1
5041-1146	* Key, R/S	1
5041-1147	* Key, 1/X	1
5041-1148	* Key, X Squared	1
5041-1149	* Key, X Sq Rt	1
5041-1150	* Key, Percent	1
5040-9482	* Key, DSP	1
5040-9483	* Key, ENG	1
5040-9484	* Key, FIX	1
5040-9485	* KEY, SCI	1

Table 6-3. Printer Assembly (A4) Replaceable Parts

FIGURE & INDEX NUMBER	HP PART NUMBER	DESCRIPTION	QTY
6-2			
	00097-60019	PCA A4A1, printer (refer to table 4-8)	1
1	00091-60009	ASSEMBLY A4A2, print head	1
2	00091-60025	ASSEMBLY, head carrier	1
3	00091-60015	ASSEMBLY A4A3, motor	1
4	00091-60026	ASSEMBLY A4A4, reed switch	1
5	00091-60014	ASSEMBLY, paper feed cam	1
6	5040-8995	GEAR, lead screw	1
7	5041-1169	GEAR	1
8	5040-8997	PUSHER, platen	1
9	5040-8998	HOLDER, platen pusher	1
10	5040-8999	BAR, tear	1
11	82143-40018	HOUSING, printer	1
12	5040-9227	BUSHING	2
13	5040-9228	ROLLER, pinch	2
14	5040-9745	PLATEN, lapped	1
15	0510-0261	RING, retaining, 3/32"	7
16	0510-0810	RING, retaining, 1/16"	2
17	0515-0033	SCREW, m2 X 0.40, 5 mm	3
18	0517-0010	SCREW, 1-72 X 0.312 in.	2
19	0624-0303	SCREW, 2-28 X 0.312 in.	3
20	1460-1461	SPRING, extension	2
21	1460-1696	SPRING, pusher	2
22	1480-0436	PIN, dowel	4
23	1500-0465	SHAFT, idler	1
24	1500-0466	ROD, guide	2
25	1500-0468	SHAFT, pinch roller	1
26	1530-1872	CLAMP, head	1
27	1600-0539	CONTACT, sensor	1
28	1600-0540	SENSOR	1
29	3050-0626	WASHER, flat	1
30	5020-9234	LEAD SCREW, microsealed	1
31	0180-2598	CAPACITOR, 1 uf 207.	1

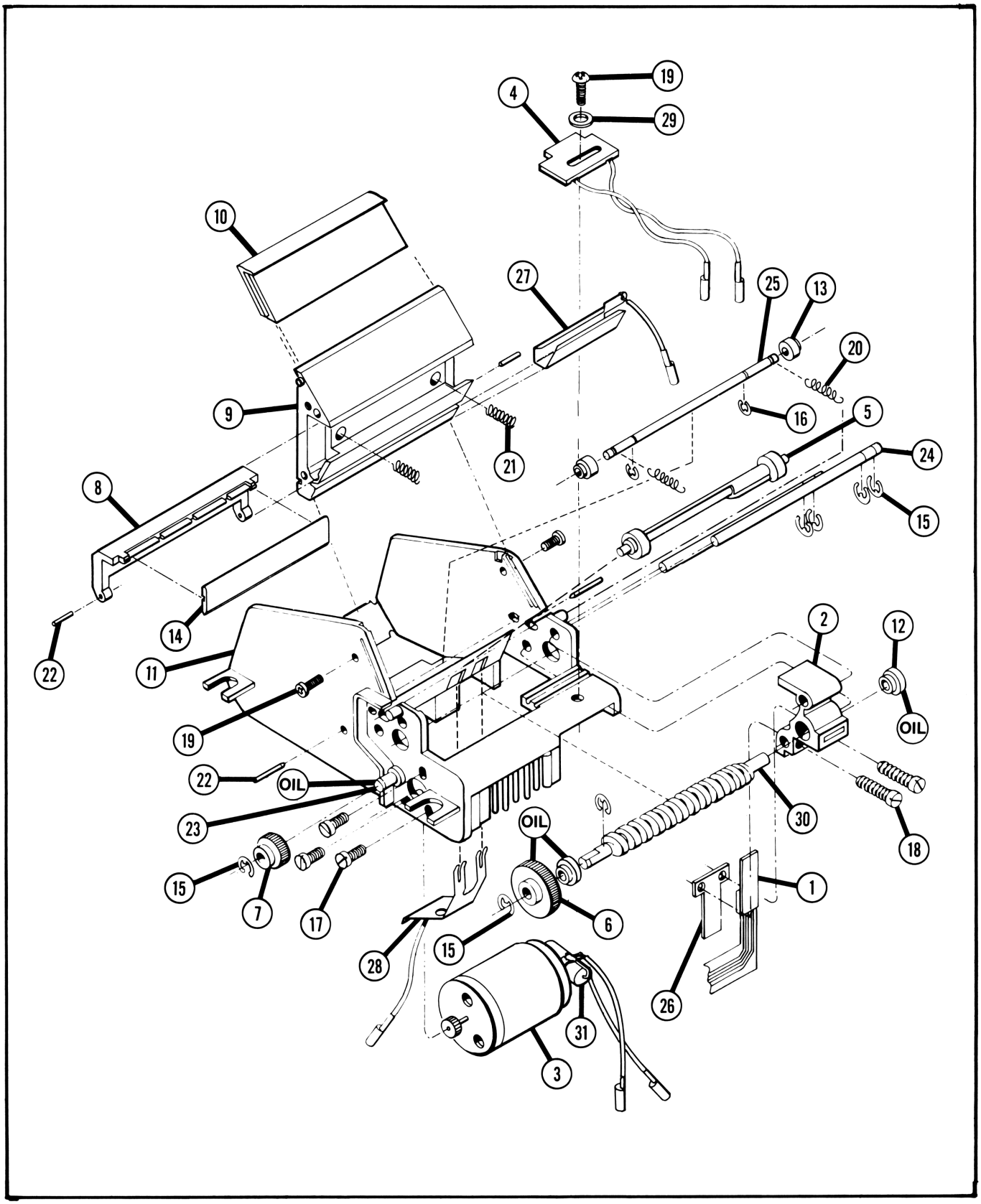


Figure 6-2. Printer Assembly Exploded View

Table 6-4 Card Reader Assembly (A3) Replaceable Parts

FIGURE & INDEX NUMBER	HP PART NUMBER	DESCRIPTION	QTY
6-3			
	00097-60004	PCA A3A1, card reader (refer to table 4-12)	1
	8120-2301	CABLE, interconnecting	1
1	00067-60913	ASSEMBLY, motor, service	1
2	00065-00230	ASSEMBLY, A3A2, head service	1
3	00067-60910	ASSEMBLY, drive roller, service	1
4	5040-9479	SUPPORT, card reader	1
5	4040-1488	ROLLER	1
6	0516-0073	SCREW, machine	2
7	5040-9797	CAM, eccentric	1
8	0624-0393	SCREW, 2-28 X 0.375	3
9	0624-0307	SCREW, 2-28 X 0.250	3
10	0624-0308	SCREW, 0-48 X 0.085	5
11	00097-00001	SWITCH, card reader	1
12	1410-0848	BEARING, ball	4
13	1460-0558	SPRING, side load	2

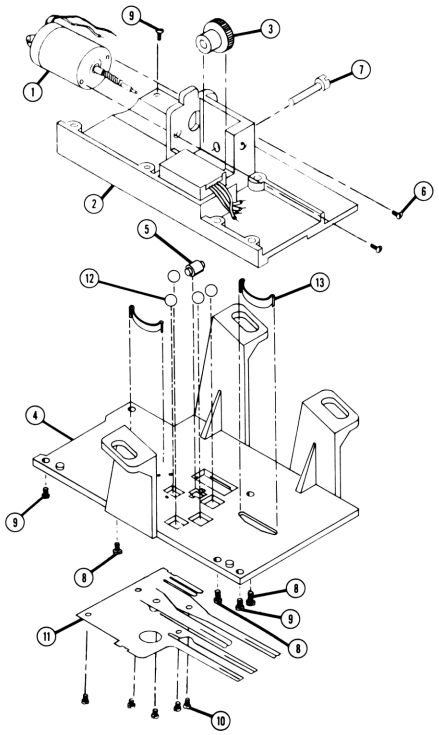


Figure 6-3. Card Reader Exploded View

APPENDIX
A

Improper Operations

If you attempt a calculation containing an improper operation - say, division by zero - the calculator display will show Error. In addition, if the Print Mode switch TRACE is set to NORM or MAN NORM TRACE, the word Error will be printed (unless the calculator is out of paper). The following are improper operations:

[÷]	where x = 0
[y^x]	where y = 0 and x < 0
[y^x]	where y < 0 and x is non-integer
[$\sqrt{x}$]	where x < 0
[1/x]	where x = 0
[LOG]	where x < 0
[LN]	where x < 0
[SIN-1]	where |x| is > 1
[COS-1]	where |x| is > 1
[STO] [÷]	where x = 0
[$\bar{x}$]	where n = 0
[s]	where n =< 1
[% CH]	where y = 0
[DSP] [(i)]	where ABS (INT I) > 9
[STO] [(i)]	where ABS (INT I) > 25
[RCL] [(i)]	where ABS (INT I) > 25
[ISZ] [(i)] [DSZ] [(i)]	where ABS (INT I) > 25
[GTO] [(i)] [GSB] [(i)]	where -999 > INT I > 19

[STO] [+] [.], [STO] [-] [.], [STO] [x] [.], [STO] [÷] [.], where magnitude of number in storage register [.] would then be larger than $9.999999999 \times 10^{99}$.

[STO] [+] [(i)], [STO] [-] [(i)], [STO] [x] [(i)], [STO] [÷] [(i)], where ABS (INT I) > 25, or where magnitude of number in storage register addressed by I would be larger than $9.999999999 \times 10^{99}$.

Card Reader malfunction.

[PRINT x], PRINT: [PRGM], PRINT: [STACK], PRINT: [REG], PRINT: [SPACE], where there is no paper in calculator.

Attempting to record on a protected side of a magnetic card.

APPENDIX
B

Symbols and Abbreviations

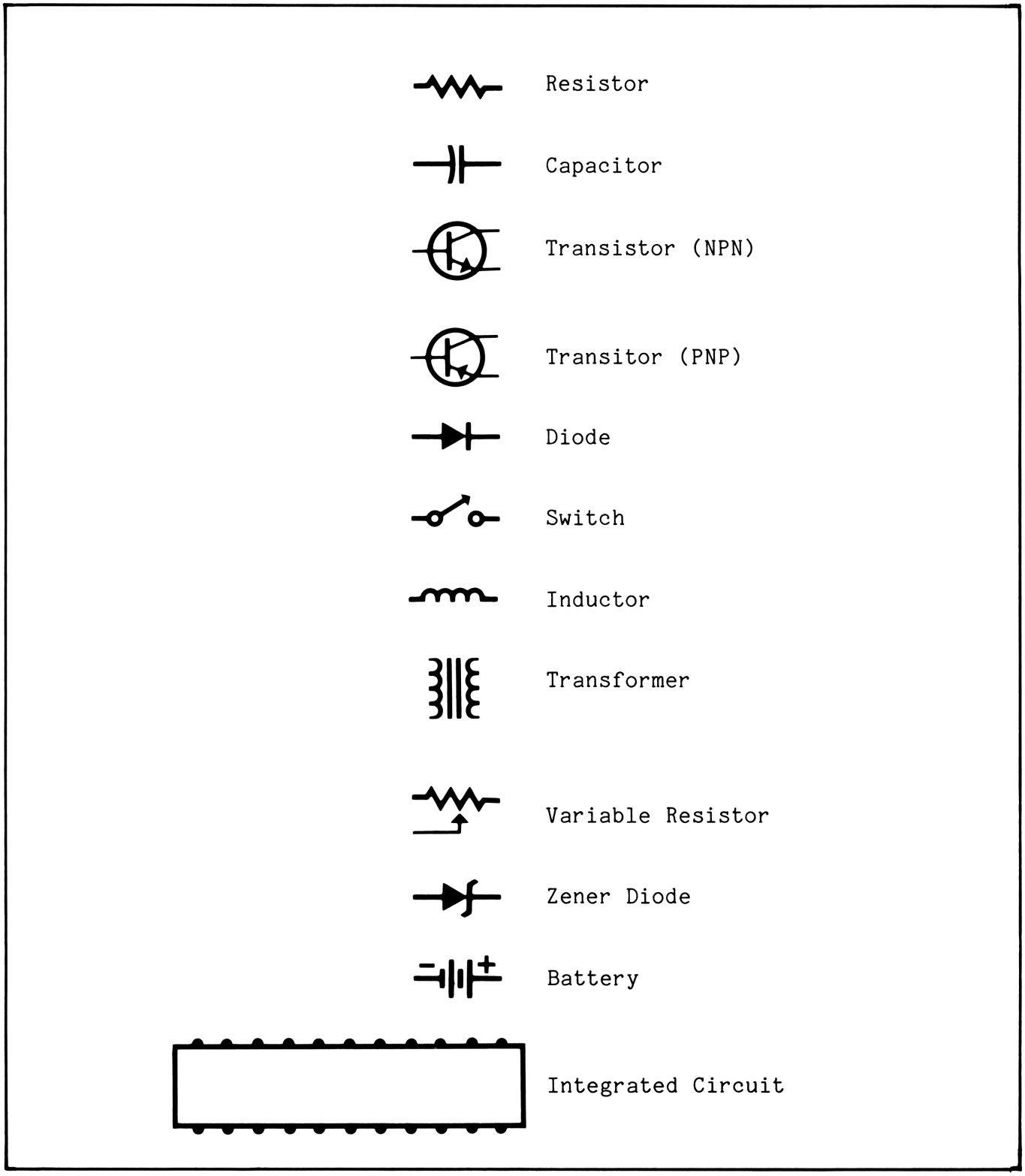


Figure B-1. Symbol Identification

Table B-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS		
A = assembly	K = relay	TB = terminal board
B = motor, synchro	L = inductor	TP = test pointnt
BT = battery	M = meter	U = integrated circuit non-repairable assembly
C = capacitor	P = plug connector	
CB = circuit breaker	Q = semiconducter device other than diode or integrated circuit	V = vacuum tube, photocell, etc.
CR = diode		
DL = delay line		
DS = indicator	R = resistor	VR = voltage regulator
E = Misc electrical parts	RT = thermistor	W = jumper wire
F = fuse	S = switch	X = socket
FL = filter	T = transformer	Y = crystal
J = receptacle connector		Z = tuned cavity, network

ABBREVIATIONS		
FA = amperes	gra= gray	p = pico (10 to -12)
ac = alternating current	grn= green	PC = printed circuit
Ag = silver		PCA= printed-circuit assembly
Al = aluminum	H = henries	
ar = as required	Hg = mercury	PWB= printed-wiring board
adj= adjust	hr = hour(s)	phh= phillips head
assy= assembly	Hz = hertz	pk = peak
	hdw= hardware	p-p= pead-to-peak
b = base	hex= hexagon,hexagonal	pt = point
bp = bandpass		prv= peak inverse voltage
bpi= bits per inch	ID = inside diameter	PNP= positive-negative-positive
blk= black	IF = intermediate frequency	
blu= blue		pww= peak working voltage
brn= brown	in.= inch, inches	porc= porcelain
brs= brass	I/O= input/output	posn= position(s)
Btu= British thermal unit	int= internal	pozi= pozidrive
BeCu= beryllium copper	incl= include(s)	
	insul= insulation, insulated	rf = radio frequency
cpi= characters per inch	impgrg= impregnated	rdh= round head
coll= collector	incand= incandescent	rms= root-mean-square
cw = clockwise	ips= inches per second	rww= reverse working voltage
ccw= counterclockwise		rect= rectifier
cer= ceramic	k = kilo (10 to 3), kilohm	r/min= revolutions per minute
com= common		
crt= cathode-ray tube		

ABBREVIATIONS (Continued)

CTL= complementary-transistor logic
cath= cathode
Cdpl= cadmium plate
comp= composition
conn= connector
compl= complete

dc = direct current
dr = drive
DTL= diode-transistor logic
depc= depositesd carbon
dpdt= double-pole, double-throw
dpst= double-pole, single-throw

em = emitter
ECL= emitter-coupled logic
ext= external
encap= encapsulated
elctlt= electrolytic

F = farads
FF = flip-flop
flh= flat head
flm= film
fxd= fixed
filh= fillister head

G = giga (10 TO 9)
Ge = germanium

gl = glass
gnd= ground(ed)

lp = low pass

m = mili (10 to-3)
M = mega (10 to 6), megohm
My = Mylar
mfr= manufacturer
mom= momentary
mtg= mounting
misc= miscellaneous
met.ox.= metal oxide
mintr= miniature

n = nano (10 to-9)
nc = normally closed or no connection
Ne = neon
no.= number
n.o.= normally open
np = nickel plated
NPN= negative-positive-negative
NPO= negative-positive-zero (zero temperature coefficient)
NSR= not separately replaceable
NRFR= not recommended for field replacement

OD = outside diameter
OBD= order by description
orn= orange
ovh= oval head
oxd= oxide

RTL= resistor-transitor logic

s = second
SB,TT= Slow blow
Se = selenium
Si = silicon
scr= silicon controlled rectifier
sst= stainless steel
stl= steel
spcl= special
spdt= single-pole, double throw
spst= single-pole, single throw

Ta = tantalum
td = time delay
TT = titanium
tgl= toggle
thd= thread
tol= tolerance
TTL= transistor transitor logic

U(u)= micro (10 to-6)

V = volt(s)
var= variable
vio= violet
Vdcw= direct current working volts
W = watts
ww = wirewound
wht= white
WIV= working inverse voltage
yel= yellow

APPENDIX
C

Service Cards

C-1. INTRODUCTION

C-2. The HP-97 is a powerful and complex electronic device containing many components, including nine IC's which are used by the calculator's internal programming in a sophisticated, systematic manner. Accordingly, the HP-97 is liable to malfunction due to faults in one or more of a number of components (primarily the IC's). Identifying which of these IC's is responsible for a particular malfunction can be costly (in both parts and labor) if the trial-and-error approach to troubleshooting is used on this complex calculator.

C-3. Fortunately, this inherent sophistication enables the calculator effectively to perform diagnostic trouble shooting upon itself, with the aid of suitable programmed procedures. Use of them will expedite the diagnostic process of isolating a calculator malfunction to a particular IC failure.

C-4. The following magnetic cards are required to conduct certain test procedures in this manual:

a. Program memory test program card.

b. Functional test program card.

c. Data card 1.

d. Data card 2.

e. Diagnostic test, part one, program card.

f. Diagnostic test, part two, program card.

C-5. These cards should be prepared by writing onto them, using either an HP-97 or an HP-67, the program or data given in the remainder of this appendix.

C-6. PROGRAM MEMORY TEST PROGRAM CARD

C-7. The program memory test program is used to check for improper program storage and (during component-level troubleshooting) to isolate this malfunction to a failure in one of two ROM'S.

C-8. The program memory test program card may be prepared from the listing shown in figure C-1. Steps 1 through 222 all contain the instruction ISZI.

```
001     ISZI
002     ISZI
003     ISZI
004     ISZI
005     ISZI
006     ISZI
007     ISZI
008     ISZI
009     ISZI
010     ISZI
011     ISZI
012     ISZI
 *       *
 *       *
220     ISZI
221     ISZI
222     ISZI
223     RCLI
224     R/S
```

Figure C-1. Program Memory Test Program

C-9. FUNCTIONAL TEST PROGRAM CARD

C-10. The functional test program is used to check for improperly operating functions and (during component-level troubleshooting) to isolate such malfunctions to a failure in one of the ROM's.

C-11. The functional test program card may be prepared from the listing shown in Table C-1.

Table C-1. Functional Test Program

001	0	057	CF3	113	GTO1	169	SIN
002	CLRG	058	MRG	114	GTO2	170	LOG
003	9	059	PSE	115	R/S	171	×
004	1/X	060	F3?	116	*LBL1	172	X≠Y
005	7	061	RTN	117	GTOi	173	1/X
006	×	062	GTOb	118	*LBL2	174	Y^X
007	CHS	063	*LBL2	119	%CH	175	TAN^{-1}
008	EEX	064	DSZI	120	X≠Y	176	D→R
009	7	065	X>0?	121	Σ+	177	D→R
010	6	066	GTOa	122	X^2	178	SIN
011	÷	067	X=0?	123	X≠Y	179	COS^{-1}
012	STOI	068	GTOa	124	CHS	180	$\sqrt{X}$
013	2	069	X>Y?	125	$\sqrt{X}$	181	Y^X
014	4	070	GTOa	126	÷	182	X≠Y
015	X≠I	071	F0?	127	÷	183	10^X
016	GSB4	072	GTOa	128	1/X	184	÷
017	GSB4	073	SF1	129	Σ-	185	LSTX
018	GSB4	074	F1?	130	$\bar{x}$	186	×
019	GSB4	075	GTO1	131	HMS+	187	SIN
020	GSBi	076	GTOa	132	S	188	LSTX
021	GTO2	077	*LBL1	133	LSTX	189	RAD
022	*LBL4	078	ABS	134	×	190	COS
023	GSB1	079	X≤Y?	135	DSP5	191	GRAD
024	GSB1	080	GTOa	136	RND	192	TAN^{-1}
025	GSB1	081	X<0?	137	X≠Y	193	×
026	GSB1	082	GTOa	138	÷	194	→P
027	GSB1	083	X=Y?	139	→HMS	195	Y^X
028	RTN	084	GTOa	140	-	196	LN
029	*LBL1	085	X≠0?	141	HMS→	197	→R
030	STOi	086	GTO1	142	X≠Y	198	CHS
031	RCLi	087	GTOa	143	DSP0	199	→P
032	X≠Y?	088	*LBL1	144	RND	200	X≠Y
033	GTOa	089	P≠S	145	N!	201	÷
034	DSZI	090	RCL3	146	×	202	SIN^{-1}
035	RTN	091	X≠0?	147	$\sqrt{X}$	203	e^X
036	RTN	092	GTOa	148	RCLΣ	204	GSBc
037	*LBL2	093	P≠S	149	LSTX	205	RCLA
038	PSE	094	CLX	150	×	206	RCLB
039	WDTA	095	RCL0	151	×	207	RCLC
040	6	096	INT	152	ST+1	208	RCLD
041	STO6	097	LSTX	153	ST×1	209	ENG
042	GSBb	098	FRC	154	ST-1	210	PRTX
043	RCL6	099	×	155	ST÷1	211	FIX
044	X≠Y?	100	FIX	156	CLX	212	PRST
045	GTOa	101	RAD	157	RCL1	213	PREG
046	RCL2	102	R↓	158	GSBc	214	SPC
047	RCL1	103	CLX	159	Pi	215	RCLE
048	X≠Y?	104	R↑	160	COS	216	×
049	GTOa	105	ENT↑	161	R→D	217	R/S
050	EEX	106	X≠Y	162	TAN	218	*LBLc
051	2	107	GSBc	163	COS^{-1}	219	RCLi
052	X≠I	108	ENT↑	164	X≠Y	220	X≠Y?
053	GSBb	109	Σ+	165	CHS	221	GTOa
054	X≠I	110	+	166	LN	222	DSZI
055	GTO2	111	%	167	+	223	PSE
056	*LBLb	112	Σ+	168	DEG	224	RTN

C-12. DATA CARD 1

C-13. Data card 1 is used in conjunction with the functional test and also during troubleshooting of the card reader assembly. This card is employed to check writing and reading capability and therefore should be blank when used.

C-14. A number of cards can be erased at one time for use in later repair as data card 1 using the following procedures:

a. Switch a working calculator ON.

b. Switch to PRGM mode.

c. Feed both sides of the card through the card reader.

C-15. DATA CARD 2

Table C-2. Data Card 2

REGISTER	NUMBER
0	5.061779945+01
1	0.000000000+00
2	3.088997250+01
3	-2.238303285+21
4	4.301773670+27
5	0.000000000+00
6	0.000000000+00
7	0.000000000+00
8	0.000000000+00
9	0.000000000+00
A	-4.444444444-44
B	-3.333333333-33
C	-2.222222222-22
D	-1.111111111-11
E	0.000000000-77
I	-3.000000000+00

C-16. Data card 2 is used in conjunction with the functional test. It may be prepared using the following procedures:

a. Switch a working calculator ON.

b. Enter the numbers shown in table C-2 into the indicated registers.

c. Press [f][W/DATA].

d. Feed side 1 of the card through the card reader.

e. Clip both notched corners of the card.

C-17. DIAGNOSTIC TEST PROGRAM CARDS

C-18. The diagnostic test, part one, program is used to ensure that the calculator will not fail when the user runs the diagnostic program supplied as part of the HP-97 Standard Pac.

C-19. The diagnostic test, part one, program card may be prepared from the listing shown in table C-3.

C-20. The diagnostic test, part two, program is used to identify failure-prone ROMs.

C-21. The diagnostic test, part two, program card may be prepared from the listing shown in table C-4.

Table C-3. Diagnostic Test Program, Part One

001	*LBL0	057	GSBe	113	*LBL8	169	LSTX
002	CLRG	058	R↑	114	DSZI	170	INT
003	P≠S	059	ST+1	115	F1?	171	+
004	CLRG	060	RTN	116	GTO9	172	X^2
005	RTN	061	*LBL1	117	GTO5	173	GSBa
006	*LBLa	062	GSBe	118	*LBL9	174	D→R
007	TAN⁻¹	063	STOI	119	DSZI	175	R→D
008	RCLI	064	RCLI	120	F2?	176	GSBa
009	X≠Y?	065	X≠Y	121	GTO5	177	EEX
010	R/S	066	X≠Y?	122	GSB2	178	2
011	*LBL2	067	RTN	123	DSP7	179	X≠Y
012	DSZI	068	GSB2	124	DEG	180	%
013	*LBL5	069	3	125	SIN	181	GSBa
014	RCLI	070	GTO3	126	SIN⁻¹	182	DSP1
015	RTN	071	RTN	127	GSBa	183	*LBLb
016	*LBLc	072	*LBL6	128	COS	184	RCLI
017	RCLi	073	GSB2	129	COS⁻¹	185	STOi
018	RCLI	074	RCL4	130	GSBa	186	DSZI
019	X≠Y?	075	RTN	131	TAN	187	GTOb
020	R/S	076	GSB2	132	TAN⁻¹	188	2
021	ST+0	077	X≠I	133	GSBa	189	4
022	DSZI	078	RTN	134	→P	190	X≠I
023	GTOc	079	GSB2	135	→R	191	GSBc
024	3	080	X>0?	136	GSBa	192	GSB0
025	EEX	081	GTOC	137	SIN	193	*LBLd
026	2	082	RTN	138	→HMS	194	DSZI
027	RCL0	083	*LBL4	139	HMS→	195	RCLI
028	RCL0	084	ISZI	140	SIN⁻¹	196	ABS
029	R/S	085	GTOE	141	GSBa	197	STOi
030	TAN	086	GTO5	142	LOG	198	2
031	*LBLe	087	DSZI	143	10^x	199	4
032	1	088	F1?	144	GSBa	200	X≠Y?
033	-	089	GTO1	145	LN	201	GTOd
034	RTN	090	DSZI	146	e^x	202	STOI
035	*LBLA	091	F3?	147	GSBa	203	GSBc
036	5	092	GTO6	148	√X	204	9
037	7	093	GTO1	149	X^2	205	EEX
038	GSB0	094	*LBL6	150	GSBa	206	8
039	PSE	095	DSZi	151	ENT↑	207	7
040	GSBe	096	F0?	152	Y^x	208	1/X
041	ENT↑	097	GTO7	153	LSTX	209	8
042	ENG	098	STO5	154	1/X	210	CHS
043	PSE	099	*LBL7	155	Y^x	211	x
044	R↑	100	STOC	156	GSBa	212	SF0
045	R↑	101	SF1	157	ENT↑	213	CF1
046	X≠Y	102	DSP8	158	+	214	SF3
047	ST+7	103	DSZI	159	LSTX	215	RAD
048	X≠0?	104	ENT↑	160	-	216	DSP3
049	X≠Y?	105	GTO5	161	GSBa	217	ENG
050	RTN	106	DSZI	162	ENT↑	218	PRTX
051	GSBe	107	F0?	163	x	219	SCI
052	X>Y?	108	*LBL5	164	LSTX	220	PRTX
053	RTN	109	DSZI	165	÷	221	DSP1
054	GSBe	110	F2?	166	GSBa	222	FIX
055	X=Y?	111	GTO8	167	√X	223	PRTX
056	RTN	112	GTO5	168	FRC	224	R/S

Table C-4. Diagnostic Test Program, Part Two

001	R/S	045	R/S	089	→P	133	R→D
002	0	046	CF1	090	→R	134	GSBd
003	STO0	047	SF3	091	RND	135	EEX
004	*LBLA	048	F3?	092	GSBd	136	2
005	GSBe	049	F0?	093	SIN	137	X≷Y
006	1	050	R/S	094	→HMS	138	%
007	GTO0	051	F2?	095	HMS→	139	GSBd
008	R/S	052	F1?	096	SIN⁻¹	140	GTO7
009	*LBL0	053	R/S	097	GSBd	141	R/S
010	+	054	SF0	098	GTO6	142	*LBL7
011	ISZI	055	F0?	099	R/S	143	RCLI
012	RCLI	056	GTO4	100	*LBL6	144	e^x
013	X=Y?	057	R/S	101	LN	145	STOI
014	GTO1	058	*LBL4	102	e^x	146	DSZI
015	R/S	059	F2?	103	RND	147	GTO7
016	*LBL1	060	R/S	104	GSBd	148	2
017	GSBc	061	SF2	105	X^2	149	4
018	2	062	SF3	106	√X	150	X≷I
019	2	063	CF2	107	GSBd	151	GSBa
020	÷	064	CF3	108	ENT↑	152	GSBe
021	PSE	065	F2?	109	Y^x	153	GSBc
022	PSE	066	R/S	110	LSTX	154	GTO8
023	FRC	067	F3?	111	1/X	155	R/S
024	X≠0?	068	R/S	112	Y^x	156	*LBL8
025	GTO2	069	SF3	113	RND	157	ISZI
026	LSTX	070	F1?	114	GSBd	158	RCLI
027	PRTX	071	R/S	115	ENT↑	159	e^x
028	GTO2	072	3	116	+	160	STOI
029	R/S	073	8	117	LSTX	161	GTO9
030	*LBL2	074	STOI	118	-	162	R/S
031	F3?	075	GSBd	119	GSBd	163	*LBL9
032	F2?	076	PSE	120	ENT↑	164	LN
033	R/S	077	GTO5	121	x	165	2
034	F0?	078	R/S	122	LSTX	166	4
035	GTO3	079	*LBL5	123	÷	167	X≠Y?
036	R/S	080	SIN	124	GSBd	168	GTO8
037	*LBL3	081	SIN⁻¹	125	√X	169	0
038	F1?	082	GSBd	126	FRC	170	GSBa
039	R/S	083	COS	127	LSTX	171	GSBe
040	CF0	084	COS⁻¹	128	INT	172	PSE
041	SF1	085	GSBd	129	+	173	GSBc
042	SF2	086	TAN	130	X^2	174	GTOA
043	F1?	087	TAN⁻¹	131	GSBd	175	R/S
044	F3?	088	GSBd	132	D→R		

APPENDIX
D

Service Notes

Number	Title	Manual Reference
97-101	Card Reader Repair Procedures	pages 4-42 to 4-48
97-102	ROM Update Policy	None
97-103	HP-97 Failure Symptoms and Causes	Sections III and IV
97-104	Further Explanation of Functional Test	page 3-8

February 1, 1982 Supersedes:

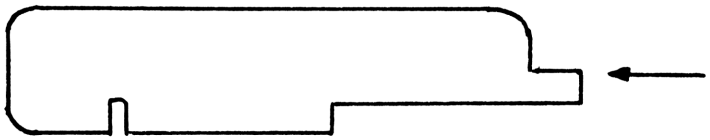
SUBJECT: Card Reader Repair Procedures

Repair of the HP-97 card reader consists of the following tests, checks and adjustments:

1. Mount the card reader on ET-9613-91M.
2. Power-up the wedge box and using an oscilloscope, adjust the card reader in the following manner:

   A. The fourth switch in the card reader is normally not used. It pressures the card against the magnetic head. The problem is a mechanical one. When the fourth switch is deflected, it bends the entire switch contact sheet and causes the head switch to make contact prematurely.

Flat side faces printer on the HP-97.



A tool cut from a plastic sheet has been developed to counter this problem. Insert the tool into the card reader exit slot before adjusting the other switches. The plastic finger on the end of the tool will activate the fourth switch (make sure it is inserted properly). This will better simulate actual operating conditions.

i. Insert the tool.

ii. Tighten the head switch screw until the head switch makes contact.

(continued...)

(...continued)

Supersedes:

iii. Back the screw out until it makes a second contact.

iv. If it requires more than ¼ turn to make a second contact, the switch is good and should then be adjusted for normal use (with plastic tool still in place). If the margin is less than ¼ turn, then the switch should be replaced.

B. Set the scope to trigger on the AC line at a 1 millisecond sweep rate, with 2v/div vertical sensitivity including the probe.

C. Put the scope probe on the head switch pick-up point. Turn the adjusting screw clockwise until the scope trace drops from 5v to 0v indicating the switch is closed. The switch should make and break clean. Any erratic action will show on the scope and indicates a dirty switch. The card reader PC board must be removed and the contact pads cleaned carefully with a soft, rubber pencil eraser; then pads and contacts are degreased with Freon TF or denatured alcohol and then cleaned with a Kimwipe. After re-assembly, if the switch makes and breaks with a clean signal, back the screw out 1/8 of a turn from the closed position.
(NOTE: the gold coating on the pads should not be removed any more than necessary for good cleaning).

A problem may arise if a switch is bent. If it is difficult to adjust the head switch, make sure it makes contact at only one position. If it makes multiple contacts when turning the adjusting screw, the switch should be replaced.

D. Using the same technique, adjust the file protect switch and back it out 1/8 turn also.

(continued...)

Supersedes:

(...continued)

E. Adjust the motor switch last and back it out approximately ½ turn from the contact position. (NOTE: the adjustment of the head switch can affect the location of the start bit. If the start bit on the card was made by a premature closing of the head switch due to the entire contact sheet bending, the location of the start bit will be on the extreme edge of the card or in front of the card. These situations should be detected by using Magna-See to observe the start bit location.

The switches are now adjusted.

F. Erase a blank card with a magnet. * Switch the calculator to Write Program Mode and record the blank card.

G. Dip the card in Magna-See.** Check that all four tracks are recorded. If any of the tracks are missing, check the head by trying to read a prerecorded card. Set the oscilloscope at 50 mV and 1 millisecond and check the head signals while reading a card. The same type of signal should be found on all wires except the center black ground wires. The problem can then be isolated between the head and the sense amp. Replace the defective part and continue the repair.

H. The card reader should now be electrically functional. Motor current must be adjusted and the noise of the assembly must also be adjusted to an acceptable minimum.

i. Noise is caused by:

a. Lack of lubrication.

(continued...)

Supersedes:

(...continued)

b. Bent worm gear/bad couplers.

c. Bad drive roller and gear.

d. Bad motor bearings.

Lubrication is done by removing the motor assembly from the card reader and applying moly-disulfide*** on the thrust bearing (the hole the tip of the worm gear fits into). The motor is reinstalled and a small amount of lubrication is applied to the worm gear. This should quiet the assembly, if not, check for bad components. Once the noise is at an acceptable level, the motor current must be adjusted. Hook the motor to a power supply set at 3.5V and measure the current drawn by the motor. By adjusting the eccentric cam on the drive roller and the motor mount screws, the current can be minimized. Using a card held in the unit, the eccentric cam can be set to give adequate card pull. This current should be around 180 $\pm$ 20 milliamperes.

I. Next adjust the motor speed by recording a card and after dipping it in Magna-See, check the record length against a speed scale. Adjust the motor speed by selecting a different R1 resistor from the list on page 4-25 of the Service Manual. Each resistor's range is about 3 mm of record length on the card. The card reader should now be repaired and a final checkout should be done by:

i. Read a program.

ii. Write this program on a blank card.

iii. Read the card that was written on.

iv. Try to write on a protected card. ("ERROR" should result).

v. Magna-See the card that was written on and check the motor speed.

(continued...)

Supersedes:

(...continued)

* Magnets can be obtained by breaking apart a defective motor assembly. The card can be erased by passing it over the flat side of the magnet.

** Part Number "8500-0790".

*** We use Dow-Corning Molykote G Paste, Cat. No. 87500-16.

3. The last problem to be discussed concerns noisy card reader motors. The thrust bearing on the end of the worm gear is designed to carry the thrust force when the motor is running. If the worm gear is pressed onto the motor very hard, the two bearing surfaces will never touch. The force will be riding entirely on the motor bearings and this causes noise. Make sure the worm gear will contact the thrust bearing by pulling it away from the motor slightly before installing it in the card reader.

   If the thrust force is riding on the ball bearing at the tip of the worm gear, rather than motor thrust bearing, the current drawn by the motor will be at a minimum and the motor speed will be at a maximum. This is important when adjusting motor speed on a card reader, to insure that card thickness and condition have a minimum effect on motor speed variations. This adjustment will have a minor impact on the noise of the card reader and will enhance the long term performance.

   When installing the motor, if the worm gear and coupler are pulled out a bit before installation, the force will be on the thrust bearing and the opposite motor bearing. If the worm gear is pushed towards the motor a small distance after installation, the thrust force will be entirely on the thrust bearing as is desired. This adjustment will help toward maintaining proper operation of the card reader.

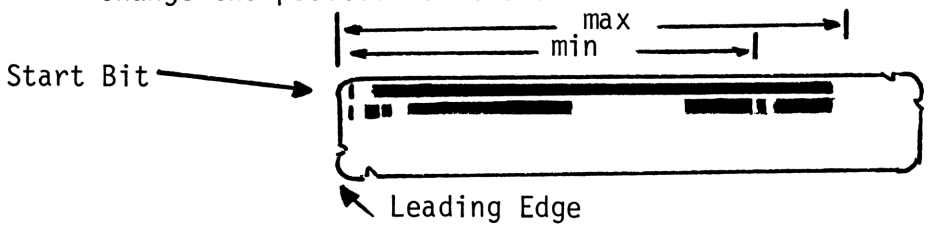
(continued...)

(...continued)

Supersedes:

4. Hints

A. Some of the problems that have been blamed on bad head frame assemblies are really caused by bad head switch adjustments. The head switch puts the first small mark on the card and is a big problem on card readers. Adjusting the head switch will change the position of the start bit.



B. Many card readers with slow motor speed will return to normal with proper lubrication and current adjustment.

C. Protected cards can be rerecorded by the following procedure:

i. Load the correct program into the calculator.
ii. Ground the write protect switch (Pin 15 on HP-67) (Pin 13 on HP-97).
iii. Record the program onto the protected card.

This can be done with cards that were improperly recorded and then protected. Make sure the card reader that is used is in good condition with proper motor speed and start bits. The ground connection to the write protect switch must be opened and reclosed each time that this procedure is used or it will cause error to be displayed and will not work.

(continued...)

Supersedes:

(...continued)

D. Often suspected misalignment of card reader head assemblies (00065-60230) has caused replacement of this part.

Production Engineering has investigated this problem and has found that the problem may be the sense amp (1826-0322). Some sense amps have been operating at marginal specifications and have caused read errors.

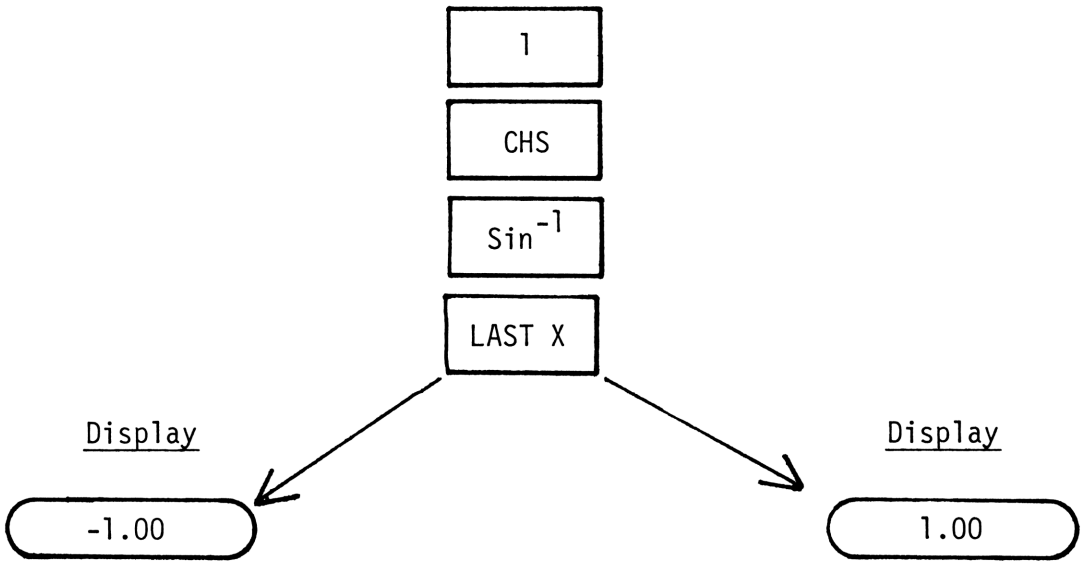
Please try replacing the sense amp before replacing the head assembly.

February 2, 1982 **Supersedes:**

SUBJECT: 97 ROM Update Policy

Some older HP-97's have old style ROM's which cause errors in the Sin^{-1}, Cos^{-1} and LAST X functions. (See Keynote January 1977.)

To identify which ROM's are contained in the calculator perform the following key strokes:



Calculator has updated ROM's

Calculator does not have updated ROM's

The policy for update of old ROM's is if any customer complains about these limitations on his HP-97, replace the older ROM's with the new revised ROM's. Charge the repair to warranty.

(continued...)

(...continued)

Supersedes:

The procedure to update a HP-97 is as follows:

1. Remove ROM's 1818-0226 and 1818-0228 from the logic board.
2. Replace 1818-0228 with 1818-0550. (ROM 1)
3. Replace 1818-1226 with 1818-0551. (ROM 2)
4. Reassembly the calculator and push the following keys to verify update:

	Display
1	1
CHS	-1
Sin^{-1}	-90.00
LAST X	- 1.00

Make sure that the customer is informed that this update has been done. (By a form letter or message on the Repair Order (See attached sample)).

HEWLETT PACKARD

CORVALLIS DIVISION • 1000 N.E. Circle Boulevard, Corvallis, Oregon 97330, Telephone 503 757-2000 TWX # 510-596-0683

Dear Customer,

The ROM in your HP-97 has been changed to eliminate the inaccuracies found in Sin^{-1}, Cos^{-1} of small magnitude arguments and the problems associated with inverse trig operations. This has been done at no cost to you but as part of our normal repair process.

If we can be of further assistance, please feel free to contact us.

Sincerely,

Service Representative

February 2, 1982 Supersedes:

SUBJECT: HP-97 Failure Symptoms

Our repairpersons in Corvallis have compiled a list of Common Failures and the corresponding part that caused the problem. This list is valuable as reference on difficult repairs.

	Symptoms	Problem Part
1.	Dim display	Q3 (keyboard PCA)
2.	Keys don't enter	PICK
3.	Paper advance doesn't work	PAS wired incorrectly
4.	Display blanks when printer used	Printer motor
5.	Freezes at end of program	ROM 6
6.	NTO	ROM Ø
7.	CLX acts like PRINT X	ACT
8.	NTO	Zener diode
9.	Keys do not have any relationship to keycodes or keys pushed	ROM 5
10.	Doesn't print	PICK
11.	Extra segments in display	ACT
12.	Will not merge data completely	ROM 6
13.	Keyboard entries "screwed up"	ROM 6
14.	Occasionally displays 2 zeros (one in center, one at right)	Q2 (display)
15.	Flickering "F" & "G" segments in left most digit when 1444... entered (occurs only when on charger with battery at full charge)	C1 (on cathode)
16.	Trig functions blank display	ROM 2
17.	Errors after 4th pass of blank card	ROM 6
18.	Keys won't enter. Prints erratic	PICK
19.	Extra decimal on turn-on. Changing to ghost number when machine used	Short on cathode
20.	After warm-up, center segment doesn't illuminate	ACT
21.	"NORM" print mode same as "MAN" mode	Solder splash on CRC
22.	Intermittent NTO	Battery contact (+) loose
23.	Paper advance too short	Reed switch
24.	Diagnostic show 9.999999999	ACT
25.	Print advance inoperative	ACT
26.	Printed 0.00*** or CLX when bumped or moved	Short on PICK
27.	ON/OFF switch will not turn off	Short on ON/OFF Switch
28.	Won't read cards	ROM 6
29.	Nothing enters from keyboard. Printer & card reader inoperative	ROM 6

(continued...)

For more information, contact the Service Engineering Manager, Corvallis Division—1000 N.E. Circle Blvd., Corvallis, Oregon 97330
Telephone (503) 757-2000 • TWX # 510-596-0683

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(...continued)

Supersedes:

	Symptoms	Problem Part
30.	Lock up and display flickers	ROM 6
31.	Display flickers	ROM 5
32.	No keyboard entry	ROM 5
33.	P-R gives wrong answers in GRADS	ACT
34.	Turn-on gives 0000000000.	ACT
35.	Turn-on gives 0000000000.	ROM 1
36.	Printer drives to left on turn-on	PICK
37.	-0.66 --- on turn-on	ACT
38.	Turn-on gives ERROR	ACT
39.	Turn-on gives ERROR	ROM Ø
40.	All zeros on turn-on; printer prints one line and then stops	ROM 1
41.	Reads cards, but won't print out program; numbers entered result in 0.00 being printed	ROM 5
42.	After warm-up, printer fails to print and display blanks	PICK
43.	XXX ENTER ↑ : numbers appear in display, but won't print; PRINT X works	CRC
44.	Turn-ons - nothing enters from keyboard, just flashes 0.00	ROM 6
45.	Incorrect keycodes printed	ROM 5
46.	L-1 card runs, but ends at step 216; reads cards, but won't run program, read step 001, lists program beginning at step 007	ROM 6
47.	L-2 errors step 039 (16 61)	CRC
48.	L-2 errors step 039 (16 61)	ROM 6
49.	L-2 errors step 059 (16 51)	ACT
50.	L-2 errors step 059 (16 51)	CRC
51.	L-2 errors step 221 (22 16 11)	ACT
52.	After blank card inserted 4th time-ERROR step 045 (22 16 11)	ROM 6
53.	L-2 errors step 042 (23 16 12)	ROM 3
54.	L-2 errors step 202 (16 14)	ROM 3
55.	Diagnostic loop displays 25.00	ACT
56.	Diagnostic loop displays 35.00	ROM 5
57.	Diagnostic loop displays 26.00	ROM 2
58.	Diagnostic loop displays 15.00	ROM 6
59.	Diagnostic loop displays 45.00	ROM Ø
60.	Diagnostic loop displays 44.00	ROM Ø
61.	Diagnostic loop displays 44.00	ROM 2
62.	Incorrect keycodes	ROM 6
63.	Incorrect keycodes and operations	ROM Ø
64.	Prints & displays nonsense	ACT
65.	NTO	W1 (logic) missing
66.	Turn-on gives 0000000.0 (every other time	(continued...)

(...continued)

Supersedes:

	Symptoms	Problem Part
	and program step numbers inconsistent (007, 006, 018, 115)	ROM 5
67.	LBL D acts as LBL E	ACT
68.	NTO	ACT
69.	After 10 minutes calculator won't work	PICK

For more information, contact the Service Engineering Manager, Corvallis Division—1000 N.E. Circle Blvd., Corvallis, Oregon 97330
Telephone (503) 757-2000 • TWX # 510-596-0683

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February 2, 1982 Supersedes:

SUBJECT: Further Explanation of Functional Test
(page 3-8 of Service Manual)

The testing of a repaired calculator involves testing as many of the functions of the calculator as possible. This is accomplished with the three-card test that was included in the service manual. This service note is intended to further explain this test. The test consists of four cards:

Test Card 1 (T.C. 1)	Blank Card
Test Card 2 (T.C. 2)	Test Card 3 (T.C. 3)

The first card is a memory test. It checks all 224 locations of memory to make sure they can be programmed and executed. It also verifies the card reader can read cards. The display should read 222.00.

The second card starts a new sequence of tests. After reading T.C. 2, switch to Program mode and push: SST, BST, F, Delete, LBL, A. This tests the ability of the calculator to be programmed from the keyboard. After returning to Run mode, push A . The calculator will run, then flash -7.777777777-77, and then ask for a card. Feed in the blank card on both sides. The calculator is writing data onto the card. The calculator will then begin to flash 6.000000000.00. While the display is flashing, read the card that was just recorded. This tests the ability of the calculator to read a card that was written by the same calculator.

The display will now flash -1.000000000.00. While the display is flashing, read T.C. 3. This is a one-sided card that contains data. The flags are also being tested during these read loops. The test will now continue and the printer will print out. This tests the ability of the printer to print.

(continued...)

(...continued)

Supersedes:

The display will show -8.888888888-88 which allows inspection of all LED segments. Switch to Program mode and press: GTO .200

f Print Prgm

As the program is being printed, switch to Trace mode. This tests the interrogation of the switches. After the printer stops, try to record a protected card (any one will do). Switch to Run mode, clear the error and the display should show all segments again. This test is very quick and does a good job of a final test on the calculator. It does not replace the Data Store test or Heat Run-type tests.

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Corvallis Division
1000 N.E. Circle Blvd., Corvallis, OR 97330, U.S.A.

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