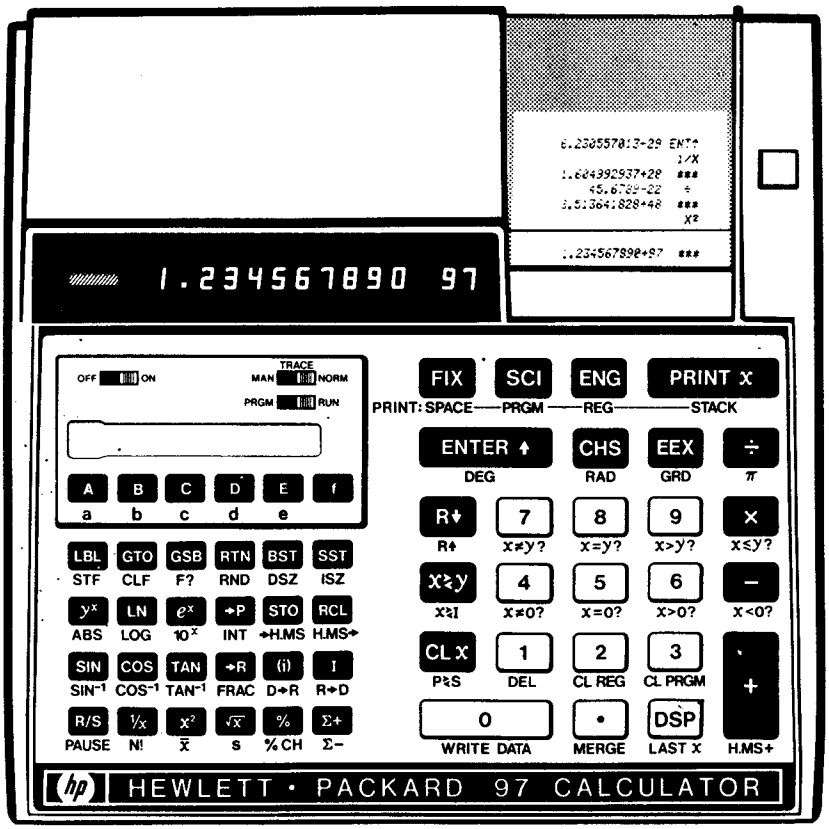
HP-97
Programmable Printing Calculator

SERVICE MANUAL



HEWLETT PACKARD

HEWLETT hp PACKARD

HP-97
Programmable Printing Calculator

SERVICE MANUAL

00097-90130

HEWLETT-PACKARD COMPANY
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T 0.00
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Y 0.00

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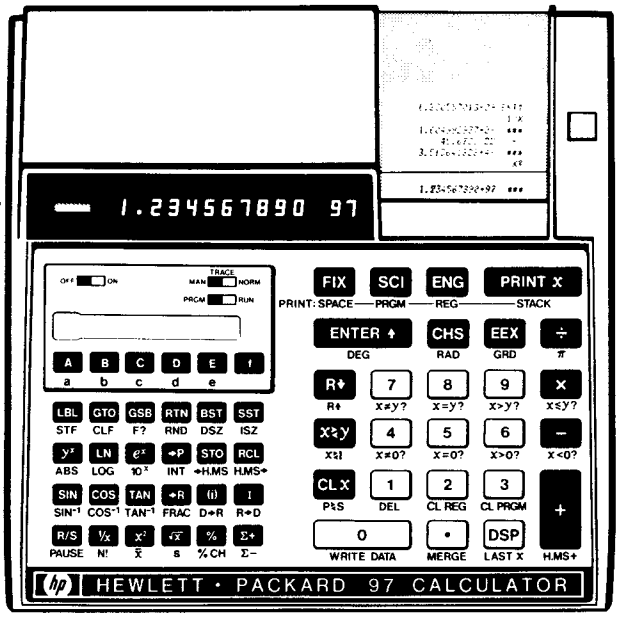


LAST X

Addressable Storage Registers

Primary Registers

	(i) Address
I	25
R_E	24
R_D	23
R_C	22
R_B	21
R_A	20
R_9	9
R_8	8
R_7	7
R_6	6
R_5	5
R_4	4
R_3	3
R_2	2
R_1	1
R_0	0

Protected Secondary Registers

	(i) Address	
R_{S9}	19	n
R_{S8}	18	Σxy
R_{S7}	17	Σy^2
R_{S6}	16	Σy
R_{S5}	15	Σx^2
R_{S4}	14	Σx
R_{S3}	13	
R_{S2}	12	
R_{S1}	11	
R_{S0}	10	

Program Memory

000	
001	51
002	51
003	51
004	51
005	51
220	51
221	51
222	51
223	51
224	51

Figure 1-1. HP-97 Keyboard and Memory

SECTION I

General Information

1-1. INTRODUCTION

1-2. This manual contains the information needed to troubleshoot, disassemble, 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 operating information along with the specifications for the HP-97. Tables 1-1 and 1-2 list the various HP-97 keys and their functions. Improper operations leading to an error display are listed in appendix A.

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

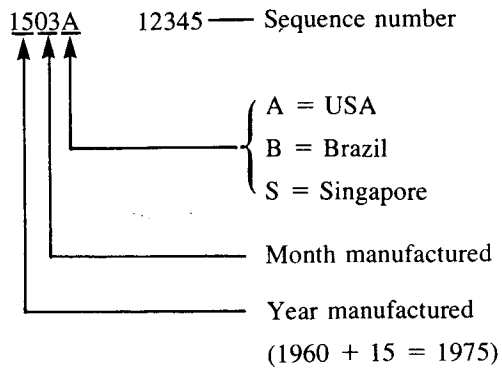
1-8. The HP-97 is compatible with the HP-67: programs recorded on a magnetic card from an HP-67 can be loaded into and executed on an HP-97, and vice versa.

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.

1-10. IDENTIFICATION

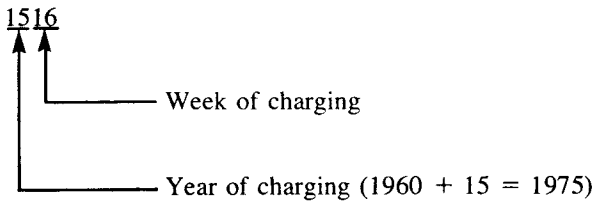
1-11. The serial number of the calculator is used for identification and warranty determination. It is located just above the battery door as the bottom of the calculator faces you. The format is described below:

Calculator Identification

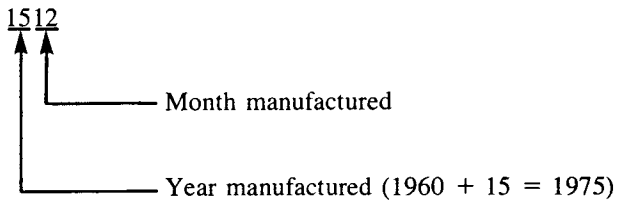


1-12. The serial numbers located on the battery and on the ac adapter/recharger are used to determine the week the unit was fully charged and the date of manufacture, respectively. The format for each is described below:

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. HP-97 Function Key Index

Manual RUN Mode. PRGM-RUN switch PRGM ▮ RUN set to RUN. Function keys pressed from the keyboard execute individual functions as they are pressed. Input numbers and answers are displayed. All function *keys* listed below operate either from the keyboard or as recorded instructions in a program.

□ Paper advance push-button. Press to advance paper without printing.

OFF ▮ ON Power switch.

TRACE
MAN ▮ NORM Print mode switch. Selects printing option.

PRGM ▮ RUN Program mode switch.

Selects PRGM mode for manual loading of program into calculator or recording upon magnetic card. Selects RUN mode for manual operation of calculator, loading of program into calculator from magnetic card, or recording or loading of data on or from magnetic card.

Printing Functions

PRINT: [SPACE] advances paper one space without printing.

PRINT: [REG] Prints contents of all primary storage registers.

PRINT: [STACK] Prints contents of automatic memory stack.

[PRINT X] Prints contents of displayed X-register.

Digit Entry

[ENTER↑] Enters a copy of number displayed in X-register into Y-register. Used to separate numbers.

[CHS] Changes sign of mantissa or exponent of 10 in displayed X-register.

[EEX] Enter exponent. After pressing, next numbers keyed in are exponents of 10.

[0] through [9] Digit keys.

[•] Decimal point.

Number Alteration

[ABS] Gives absolute value of number in displayed X-register.

[INT] Leaves only integer portion of number in displayed X-register by truncating fractional portion.

[FRAC] Leaves only fractional portion of number in displayed X-register by truncating integer portion.

[RND] Rounds mantissa of 10-digit number in X-register to actual value seen in the display.

Number Manipulation

[R↓] Rolls up contents of stack for viewing in displayed X-register.

[R↑] Rolls down contents of stack for viewing in displayed X-register.

[x≷y] Exchanges contents of X- and Y-registers of stack.

[CLx] Clears contents of displayed X-register to zero.

Display Control

[FIX] Selects fixed point display.

[SCI] Selects scientific notation display.

[ENG] Selects engineering notation display.

[DSP] Followed by number key, selects number of displayed digits.

Mathematics

[N!] Computes factorial of number in displayed X-register.

[1/x] Computes reciprocal of number in displayed X-register.

[x^2] Computes square of number in displayed X-register.

[$\sqrt{x}$] Computes square root of number in displayed X-register.

[π] Places value of pi (3.141592654) into displayed X-register.

[+] [−] [×] [÷] Arithmetic operators.

Percentage

[%] Computes x% of y.

[%CH] Computes percent of change from number in Y-register to number in displayed X-register.

Logarithmic and Exponential

[y^x] Raises number in Y-register to power of number in displayed X-register.

[10^x] Common antilogarithm. Raises 10 to power of number in displayed X-reigster.

[e^x] Natural antilogarithm. Raises e (2.718281828) to power of number in displayed X-register.

[LOG] Computes common logarithm (base 10) of number in displayed X-register.

[LN] Computes natural logarithm (base e, 2.718...) of number in displayed X-register.

Magnetic Card Control

[W/DATA] If a magnetic card is passed through the card reader immediately after this operation, the contents of the storage registers are recorded on the card.

[MERGE] Merges, rather than overwrites, data or program from magnetic card with data or program in calculator.

Polar/Rectangular Conversion

[→P] Converts x, y rectangular coordinates placed in X- and Y-registers to polar magnitude *r* and angle *θ*.

[→R] Converts polar magnitude *r* and angle *θ* in X- and Y-registers to rectangular x and y coordinates.

Statistics

[Σ+] Accumulates numbers from X- and Y-registers into secondary storage registers R_{S4} through R_{S9}.

[Σ−] Subtracts x and y values from storage registers R_{S4} through R_{S9} for correcting or subtracting [Σ+] accumulation entries.

[$\bar{x}$] Computes mean (average) of x and y values accumulated by [Σ+].

[s] Computes sample standard deviations of x and y values accumulated by [Σ+].

Flags

[STF] Set flag. Followed by flag designator (0, 1, 2, or 3), sets flag true.

[CLF] Clear flag. Followed by flag designator (0, 1, 2, or 3), clears flag.

Table 1-1. HP-97 Function Key Index (Continued)

Trigonometry

[→H.MS] Converts decimal hours or degrees in displayed X-register to *hours, minutes seconds* or *degrees, minutes, seconds.*

[H.MS→] Converts *hours, minutes, seconds* or *degrees, minutes, seconds* in displayed X-register to decimal degrees.

[H.MS+] Adds *hours, minutes, seconds* or *degrees, minutes, seconds* in Y-register to those in X-register.

[SIN⁻¹] [COS⁻¹] [TAN⁻¹] Computes arc sine, arc cosine, or arc tangent of number in displayed X-register.

[SIN] [COS] [TAN] Computes sine, cosine, or tangent of value in displayed X-register.

[D→R] Converts degrees to radians.

[R→D] Converts radians to degrees.

[DEG] Sets decimal degrees mode for trigonometric functions.

[RAD] Sets radians mode for trigonometric functions.

[GRD] Sets grads mode for trigonometric functions.

Indirect Control

[I] Recalls number from I-register into displayed X-register. (To store number in I, use [STO] [I].)

[f] When preceded by [DSP], [GTO], [GSB], [STO], [RCL], [ISZ], or [DSZ], the address or control value for that function is specified by the current number in I.

[ISZ] Increment and skip if zero. Followed by [I], adds 1 to contents if I. Followed by [f], adds 1 to contents of storage register specified by value in I. Skips one step if contents are then zero.

[DSZ] Decrement and skip if zero. Followed by [I], subtracts 1 from contents of I. Followed by [f], subtracts 1 from contents of storage register specified by value in I. Skips one step if contents are then zero.

[X≷I] Exchanges contents of displayed X-register with those of I-register.

Storage

[STO] Store. Followed by address key, stores displayed number in specified primary storage register (R_0 through R_9, R_A through R_E, I). Also used to perform storage register arithmetic.

[RCL] Recall. Followed by address key, recalls number from specified primary storage register (R_0 through R_9, R_A through R_E, I) into the displayed X-register.

[CL REG] Clears contents of all primary storage registers (R_0 through R_9, R_A through R_E, I) to zero.

[LAST X] Recalls number displayed before the previous operation back into the displayed X-register.

[P≷S] Primary exchange secondary. Exchanges contents of primary storage registers R_0 through R_9 with contents of protected secondary storage registers R_{S0} through R_{S9}.

Table 1-2. HP-97 Programming Key Index

PROGRAM Mode

PRGM-RUN switch set to PRGM PRGM RUN

All function keys except the ones below are loaded into program memory when pressed. Program memory contents recorded upon magnetic card when card passed through card reader.

Active keys:

In PROGRAM mode only six operations are active. These operations are used to help record programs, and cannot themselves be recorded in program memory.

Automatic RUN Mode

PRGM-RUN switch PRGM RUN set to RUN.

Function keys may be executed as part of a recorded program or individually by pressing from the keyboard. Input numbers and answers are displayed by the calculator, except where indicated. Data or instructions loaded from magnetic card into calculator when card is passed through card reader.

Pressed from keyboard:

[A] [B] [C] [D] [E] [a] [b] [c] [d] [e]

User-definable keys. Cause calculator to search downward through program memory to first designated label and begin execution there.

Executed as a recorded program instruction:

[A] [B] [C] [D] [E] [a] [b] [c] [d] [e]
[0] [1] [2] [3] [4] [5] [6] [7] [8] [9]

Label designators. When preceded by [LBL], define beginning of routine. When preceded by [GTO] or [GSB], cause calculator to stop execution, search downward through program memory to first designated label, and resume execution there.

Table 1-2. HP-97 Programming Key Index (continued)

PROGRAM Mode	Automatic RUN Mode	
Active keys:	**Pressed from the keyboard:**	**Executed as a recorded program instruction:**
GTO Go to. Followed by • n n n, positions calculator to step nnn of program memory. No instructions are executed.	GTO Go to. Followed by • n n n, sets calculator to step nnn of program memory without executing instructions. Followed by label designator (A through E, f a through f e, 0 through 9 or (i)), causes calculator to search downward through program memory to first designated label and begin execution there.	GTO Go to. Followed by label designator (A through E, f a through f e, 0 through 9 or (i)), causes calculator to stop execution, search through program memory to first designated label, and resume execution there.
	GSB Go to subroutine. Followed by label designator, (A through E, f a through f e, 0 through 9, (i)), causes calculator to start executing instructions, beginning with designated label.	GSB Go to subroutine. Followed by label designator (A through E, f a through f e, 0 through 9 or (i)), causes calculator to search through program memory to first designated label and execute that section of program memory as a subroutine.
	RTN Return. Sets calculator to step 000 of program memory.	RTN Return. If executed as a result of pressing a label designator or execution of a GTO instruction, stops execution and returns control to keyboard. If executed as a result of a GSB instruction, returns control to next step after the GSB instruction.
PRINT: PRGM Print program. Prints contents of program memory, beginning with current step and continuing until two consecutive R/S instructions are encountered or step 224 is printed.	PRINT: PRGM Print program. Prints contents of program memory, beginning with current step and continuing until two consecutive R/S instructions are encountered or step 224 is printed.	PAUSE Stops program execution and transfers control to keyboard for 1 second, then resumes program execution.
CLPRGM Clear program. Clears program memory to all R/S instructions, sets calculator to step 000, clears all flags, and specifies FIX 2 and DEG modes.	CLPRGM After f prefix key, cancels that key. After other keys, does nothing. Does not disturb program memory or calculator status.	x≠y? x=y? x>y? x≤y? x≠0? x=0? x>0? x<0? Conditionals. Each tests value in X-register against 0 or value in Y-register as indicated. If true, calculator executes instruction in next step of program memory. If false, calculator skips one step before resuming execution.
BST Back step. Moves calculator back one step in program memory.	BST Back step. Sets calculator to and displays step number and keycode of previous program memory step when pressed; displays contents of X-register when released. No instructions are executed.	F? If flag true. Followed by flag designator (0, 1, 2, or 3), tests designated flag. If flag is set (true), the calculator executes the instruction in the next step of program memory. If flag is cleared (false), calculator skips one step before resuming execution. F? clears flags F2 and F3 after test.
SST Single step. Moves calculator forward one step in program memory.	SST Single step. Displays step number and keycode of current program memory step when pressed; executes instruction, displays result, and moves calculator to next step when released.	
DEL Delete. Deletes current instruction from program memory. All subsequent instructions moved up one step.	DEL After f prefix key, cancels that key. After other keys, does nothing. Does not disturb program memory or calculator status.	
	R/S Run/stop. Begins execution from current step of program memory. Stops execution if program is running.	R/S Run/stop. Stops program execution.
	Any key. Pressing any key on the keyboard stops execution of a running program.	

Table 1-3. 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: 5 ounces (155 grams).

Power

- Rechargers

	HP Part Number	
United States	82040A	90-127 Vac, 50-60 Hz, 7 watts
Australian	82039A	200-254 Vac, 50-60 Hz, 7 watts
European	82043A	90-127 Vac, 50-60 Hz, 7 watts
	82031A	200-254 Vac, 50-60 Hz, 7 watts
Desktop	82032A	200-254 Vac, 50-60 Hz, 7 watts

- 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.

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:
  $\pm 1 \times 10^{-99}$ to $\pm 9.999999999 \times 10^{99}$
- Formats:

Fixed Point:	Numbers are shown with "n" places to the right of the decimal point.
Scientific:	Numbers are shown in scientific notation with "n" places to the right of the decimal point.
Engineering:	Numbers are shown with "1 + n" digits and an exponent of 10 that is the nearest multiple of three.
Special:	"Error" written on display when improper operation is attempted (see appendix A). "Crd" written on display when card is expected.

- Special indications:

Overflow:	X-register overflow displays all nines ($\pm 9.999999999\ 99$).
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.

Environmental Specifications

- Operating: 0° to 45°C (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.

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 inverter.
c. Keyboard.
d. ACT (arithmetic, control, and timing).
e. PIK (printer interface 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.

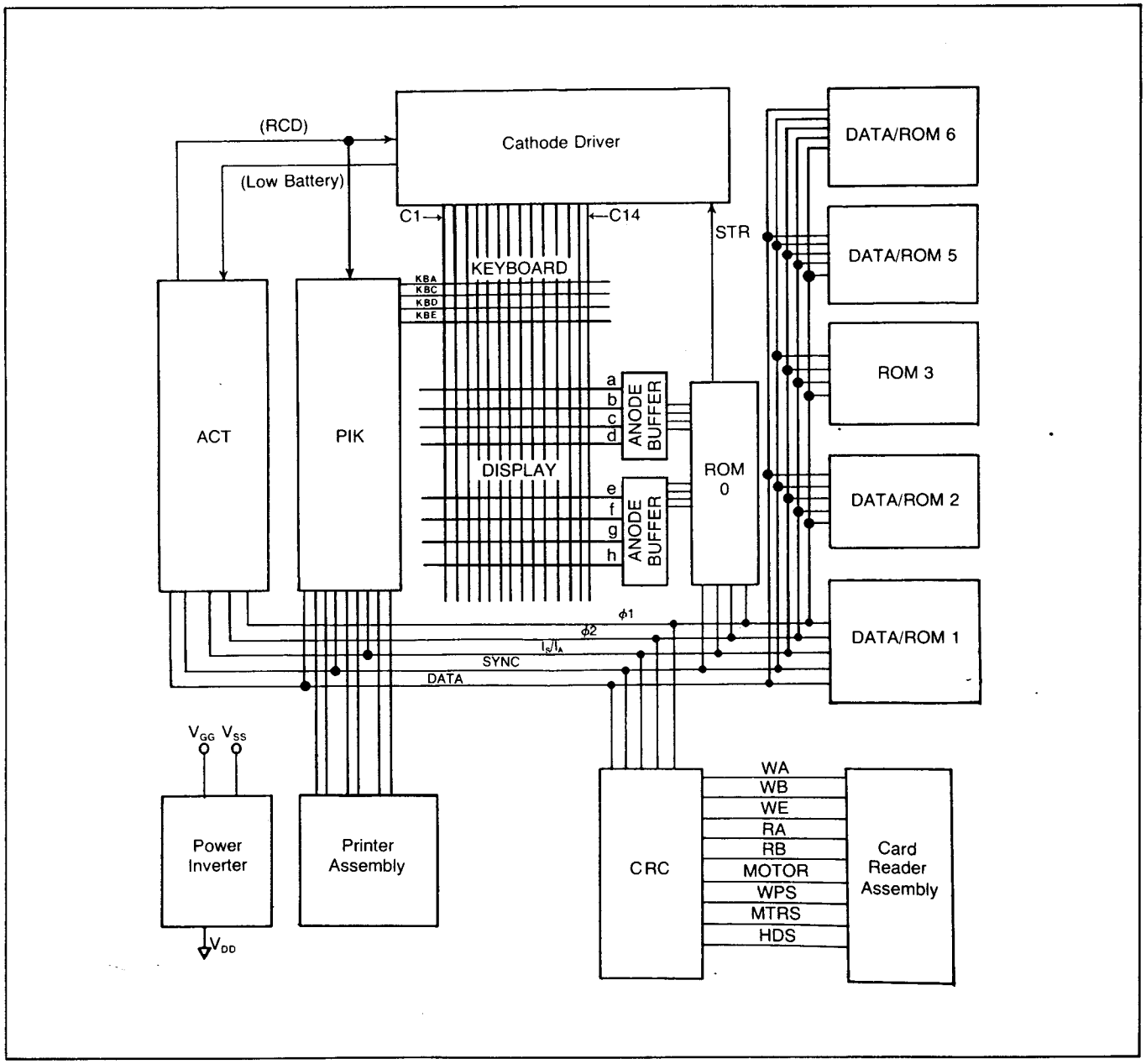


Figure 2-1. HP-97 Block Diagram

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.

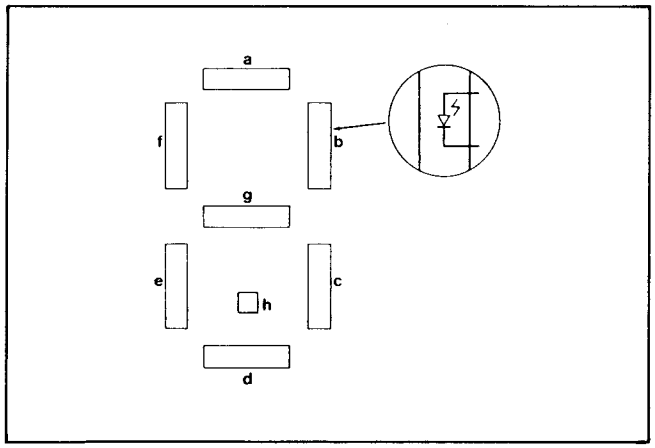


Figure 2-2. LED Digit

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.

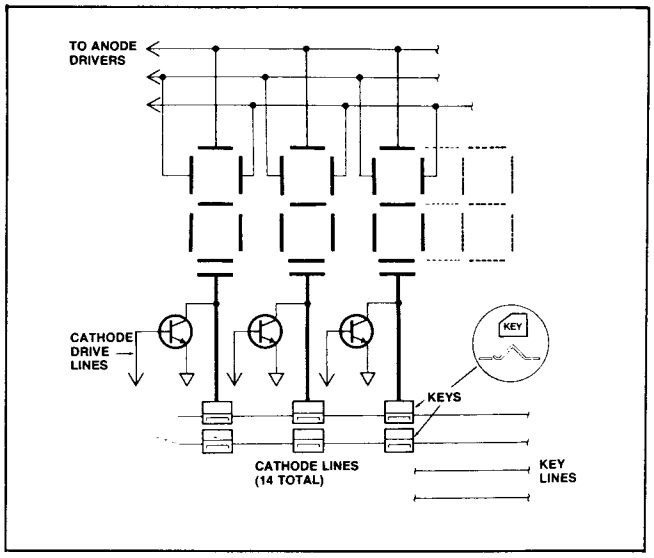


Figure 2-3. LED Display Format

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 and reset by reset cathode driver (RCD), which is provided by the ACT. (See figure 2-4.)

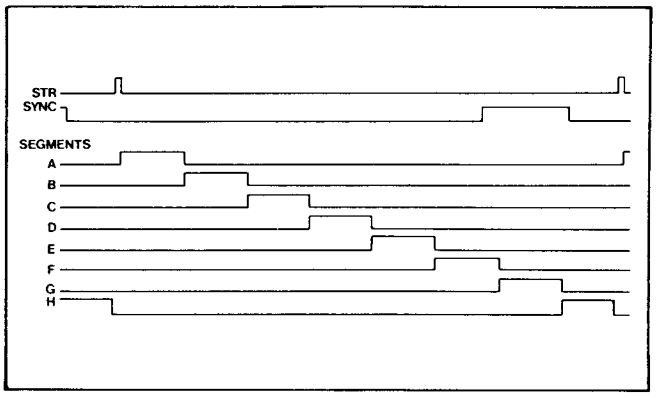


Figure 2-4. SYNC and Display Timing

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 I_S bus by the ACT to switch on the correct anodes, it alone is not capable of handling the large amount of current. Anode buffers 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 key codes. This allows the operator to press keys very quickly without waiting for the calculator or printer to catch up. The PIK will also hold each key code for approximately 4.5 milliseconds 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 (I_S) 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 I_S (instruction address) bus. The I_S 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 I_S pulses.

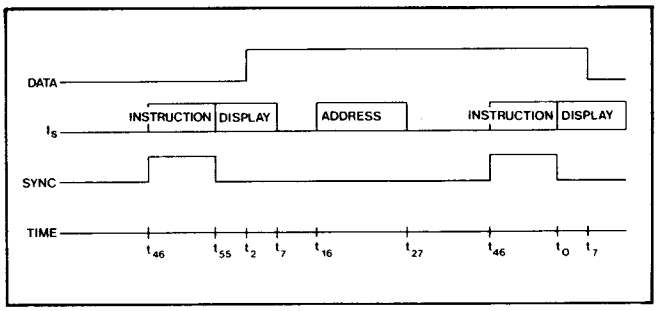


Figure 2-5. Timing Diagram

2-15. In addition to being used to synchronize the system, SYNC is also used to gate the 10-bit instruction that appears on I_S at bit times t_{46} through t_{55}. During this time, SYNC distinguishes instructions from addresses. Following an "IF" instruction on the I_S bus, the subsequent SYNC pulse is suppressed to allow a 10-bit address to be sent on the I_S bus.

2-16. At bit times t_{15} through t_{27}, the I_S line carries a 12-bit instruction address from the ACT to the ROM, while display information is carried from the ACT to the ROM during bit times t_0 through t_7. At bit times t_0 through t_3, 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 during bit times t_4 through t_7.

2-17. PRINTER

2-18. 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.

2-19. 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.

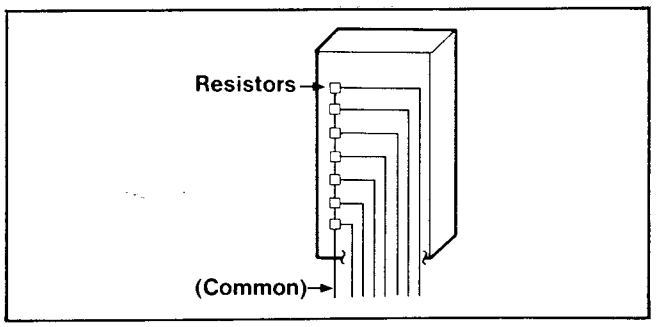


Figure 2-6. Print Head

2-20. 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.

2-21. Notice the slight slant of each character. This is done to decrease instantaneous 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.

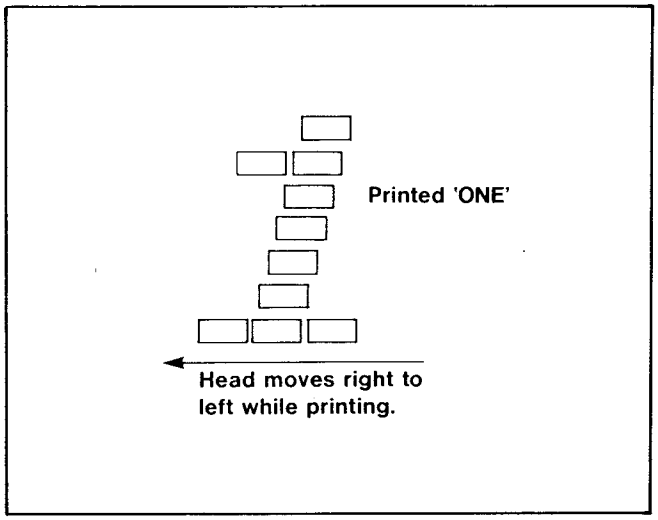


Figure 2-7. Printed Character

2-22. Print Head Drivers

2-23. Each head resistor requires approximately 0.5A of current to adequately print on the heat-sensitive paper. NPN transistors Q1 through Q7 act as current amplifiers to supply the head resistors with the required current and also lessen the drive requirements from the PIK

2-24. Printer Motor Control

2-25. 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.

2-26. When the PIK gives the comand to move forward, transistors Q11, Q14, and Q9 turn on. Transistors Q12, Q13, and Q10 turn on to reverse the direction of head travel.

2-27. 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.

2-28. 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 operaton 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.

2-29. Print Intensity Control

2-30. To maintain uniform print contrast, each head resistor must be energized to the same temperature, independent of battery voltage changes.

2-31. The remaining comparators in U4, alongwith the resistor network in U5, produce the variable duty-cycle signal STB, which is nominally 10 kHz. The STD 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 STD can be changed to adjust print intensity.

2-32. CARD READER

2-33. 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.

2-34. 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 passed 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.

2-35. 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.

2-36. 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.

2-37. POWER INVERTER

2-38. 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.

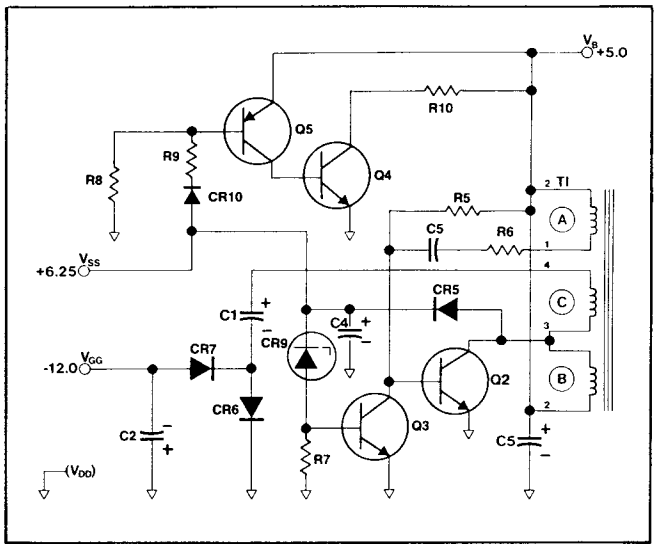


Figure 2-8. HP-97 Power Inverter Circuit

2-39. 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 tranformer primary from which V_{SS} 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 V_{GG}. Voltage regulation of V_{SS} is provided by controlling the frequency of oscillation of Q2 through the combined action of zener diode CR9 and transistor Q3.

2-40. An over-voltage circuit consisting of Q4, Q5, and R8 through R10, as shown in figure 2-9, prevents V_B (battery voltage) from rising above V_{SS}. When V_B approaches V_{SS}, CR10 conducts, turning on transistors Q4 and Q5. Current is drawn from the battery through R10 until V_B falls below V_{SS}.

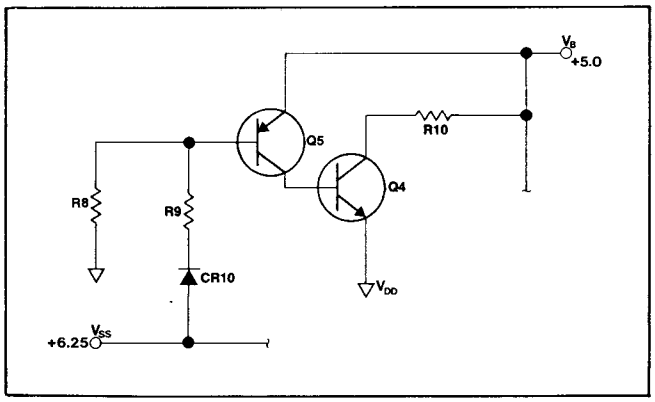


Figure 2-9. Over-Voltage Circuit

2-41. BATTERY CHARGING

2-42. 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 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: With batteries removed, the calculator will not be damaged by connecting the ac adapter/recharger to the input terminals; however, it will not operate correctly until the batteries have been reinstalled.

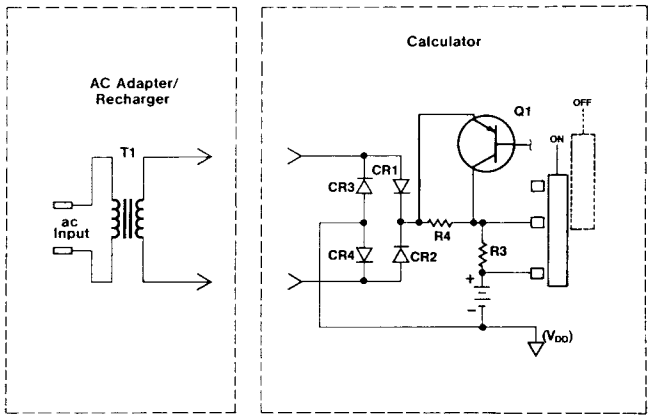


Figure 2-10. Battery Charging Circuit

2-43. POWER-ON PRESET

2-44. 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 preset circuit is included. Figure 2-11 shows the equivalent circuit.

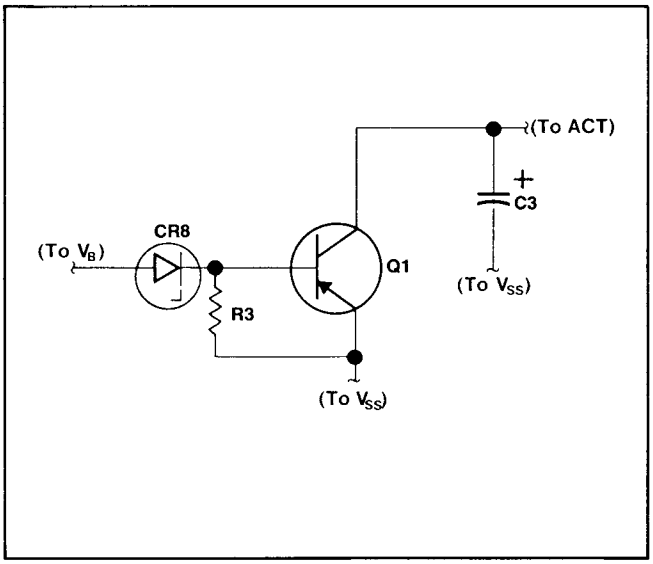


Figure 2-11. Power-On Preset Circuit

2-45. Basically, when power is applied, Q1 is turned off; V_{SS} rises and the voltage across C1 also rises, resetting the ACT. When V_{SS} rises to the correct level, Q1 turns on, discharging C1—now ready for the next power on sequence.

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 Flowchart (figure 3-1) shows 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 3-24) 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 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's 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 PCA 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 **P** on figure 3-1.

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.
CLx	5 CLx	0.00
$\sqrt{x}$	2 5 $\sqrt{x}$	5.00
x^2	5 x^2	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↑ CLx 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]	[2] [STO] [5]	*2.00*	
[RCL]	[CL x] [RCL] [5]	*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 Σ+ Σ− x̄ s	2 5 STO 4 f P≷S RCL 4 ENTER↑ Σ+ Σ+ Σ+ f Σ− f x̄ f s	0.00 2.00 12.50 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) (positive i)	PRGM RUN LBL 1 LBL 2 LBL 3 PRGM RUN 2 STO I GTO (i) PRGM RUN	002	21 02
GTO (i) (negative i)	5 CHS STO I GTO (i) PRGM RUN	220	51
LBL GTO	PRGM RUN LBL A LBL B LBL C PRGM RUN GTO B PRGM RUN	003 002	21 13 21 12
GSB RTN	PRGM RUN LBL A 1 2 3 GSB B + RTN LBL B 1 2 3 RTN PRGM RUN A	246.00	
x≠y? x=y? x=0? x>0? x<0? x≤y? x>y? x≠0?	f x≠0? 5 f x=0? f x<0? f x≤y? f x=y? ENTER↑ f x>y? CHS f x>0? f x>y? f x≠0? PRGM RUN	008	51
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
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) CLx 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 **Q** on figure 3-1.

Table 3-2. Initial Test

KEYSTROKE	DISPLAY	PRINTOUT
9	*9.*	
1/x	*0.11*	*9.00 1/X*
7	*7.*	
×	*0.78*	*7.00 x*
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*	*STO1*
f	*-7.777777777-77*	
ISZ	*-7.777777777-77*	
I	*-7.777777777-77*	*ISZI*
CLx	*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 **Q** on figure 3-1.

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 **Q** on figure 3-1.

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*

Table 3-4. Functional Test

STEP	PROCEDURE	DISPLAY	PRINTOUT
1	Set switches: OFF ON; TRACE MAN NORM; PRGM RUN		
2	Press CLx	*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*	
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

Table 3-4. Functional Test (Continued)

STEP	PROCEDURE	DISPLAY	PRINTOUT
			51. 0 -2.238303285+21 1 31. 2 -2.238303285+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.		
			211 FIX 212 PRST 213 PREG 214 SPC 215 RCLE 216 × 217 R/S 218 *LBL0 219 RCLi 220 X≠Y? 221 GTO0 222 DSZI 223 PSE 224 RTN
21	Insert side 2 of data card 2.	Error	ERROR
22	Switch to RUN mode.	Error	
23	Press CL X	-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

Table 3-5. Keyboard Test (Continued)

KEYSTROKES	PRINTOUT	
0	024	+
•	025	0
DSP 0	026	.
R/S	027	R/S
1/x	028	1/X
x²	029	X²
√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
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, and in addition checks for proper operation of the card reader.

3-23. To run this test, follow the procedures shown in table 3-6. If the indicated display or printout is not obtained, or if "Error" is displayed, return to **P** on figure 3-1. If the calculator passes the diagnostic test, return to **R** on figure 3-1.

Table 3-6. Diagnostic Test

STEP	PROCEDURE	DISPLAY	PRINTOUT
1	Set switches: OFF ON TRACE MAN NORM PRGM RUN	*0.00*	
2	Read side 1 of diagnostic test card.	*Crd*	
3	Read side 2 of diagnostic test card.	*0.00*	
4	Swtich to PRGM mode.	*000*	
5	Feed side 1 of data card 1.	*Crd*	
6	Feed side 2 of data card 1.	*000*	
7	Switch to RUN mode.	*0.00*	
8	Again feed side 1 of data card 1.	*Crd*	
9	Feed side 2 of data card 1.	*0.00*	
10	Press A.	*-7.777777770-77* *(pause)* *-8.888888888-88*	1.+07 10.000+06. *** 1.0000+07 ***

3-24. HP-97 ASSEMBLY REMOVAL AND REPLACEMENT PROCEDURES

3-25. 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.

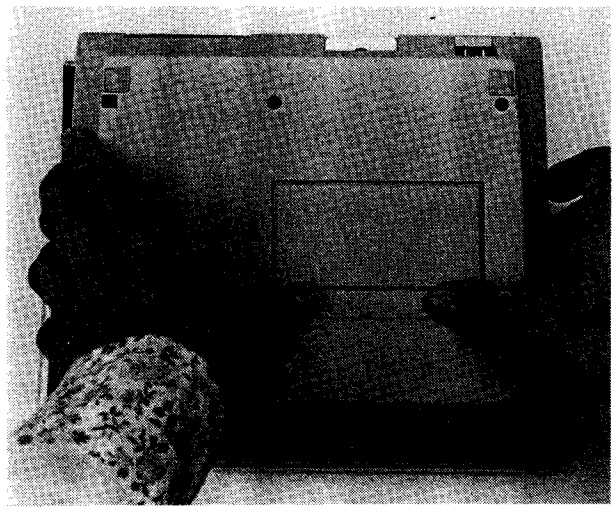
3-26. For a list of replaceable assemblies, refer to section VI. To reassemble the HP-97, follow the removal-replacement procedures in reverse order. The removal-replacement procedures are given in the following order:

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 replacment.

1

Battery Pack Removal

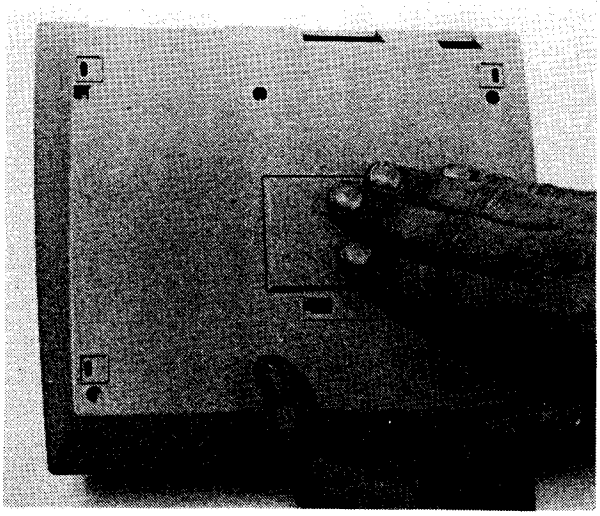
a. Lay the calculator upside down in a support fixture, part number T-155321.
b. While grasping the sides of the calculator, place each thumb firmly over the ridged door latches as shown.
c. Slide both latches inward with thumbs until they click.



1

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.



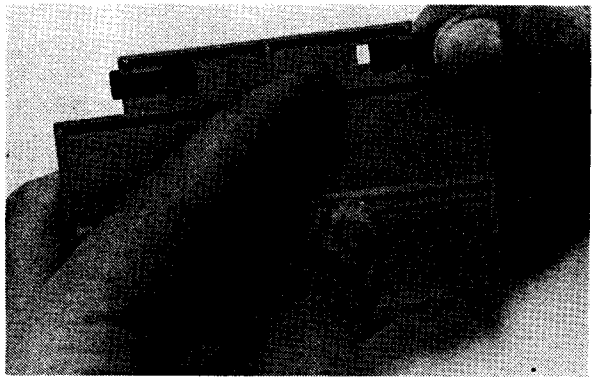
2

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.



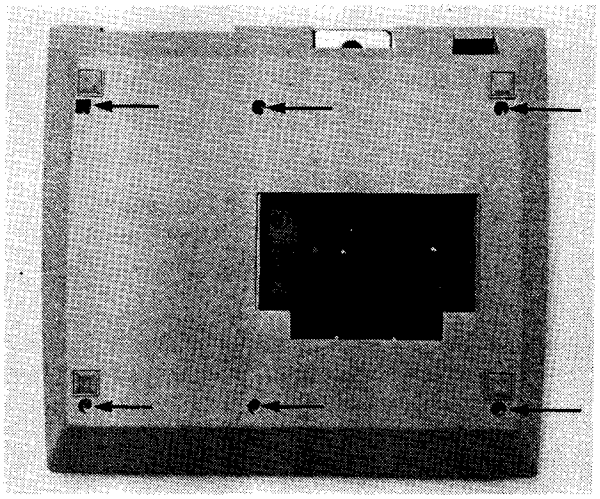
3

Bottom Case Assembly Removal

a. Perform removal/replacement procedure 1.

b. Remove the six Phillips screws as shown.

c. Lift off bottom case.



4

Rubber Feet Removal/Replacement

a. Grasp each rubber foot firmly with a needle-nose pliers.

b. Pull out firmly to remove.

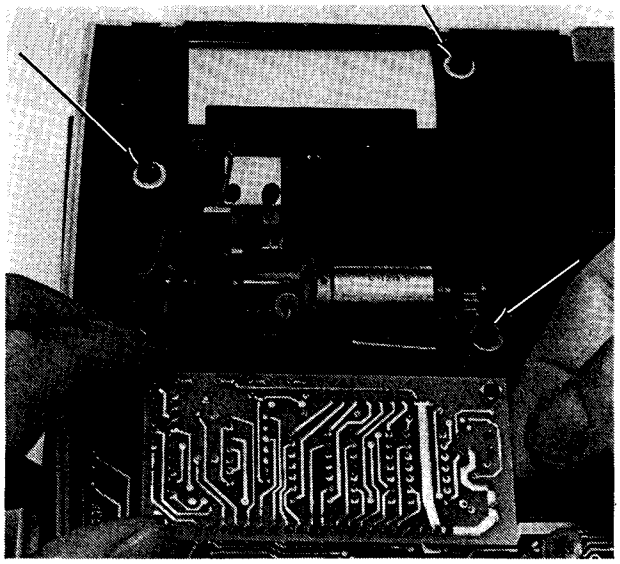
c. Firmly press in new feet while being careful not to damage bottom case.

d. Cut off excess rubber.

5

Printer Assembly Removal

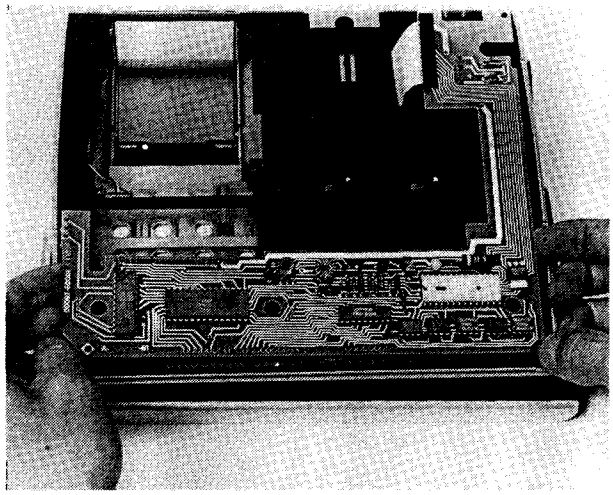
a. Perform removal/replacement procedures 1 and 3.
b. Remove the three printer supporting screws.
c. Carefully disconnect printer PCA from logic board.
d. Carefully lift out the printer assembly from calculator.



6

Logic Printed-Circuit Assembly Removal

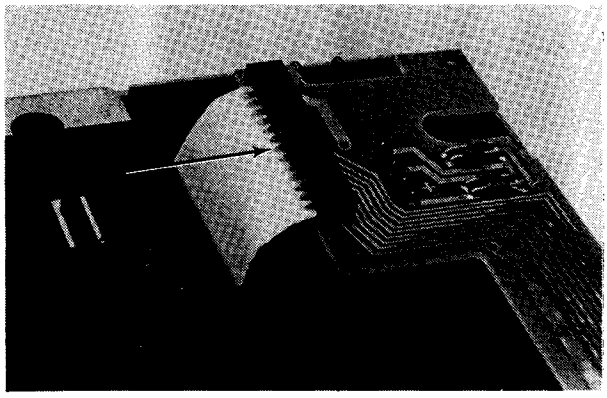
a. Pull up—alternating pressure between the left hand and right—on the logic PCA until it is free of the 18- and 9-pin connectors on the keyboard PCA.



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 connector; then remove the cable tool.

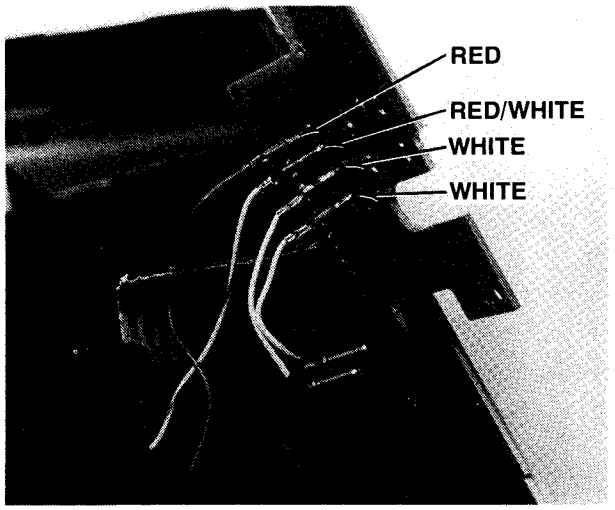
NOTE: The cable should be positioned with its contacts facing the top of the connector, and the connector tool should be positioned between these contacts and the connector.

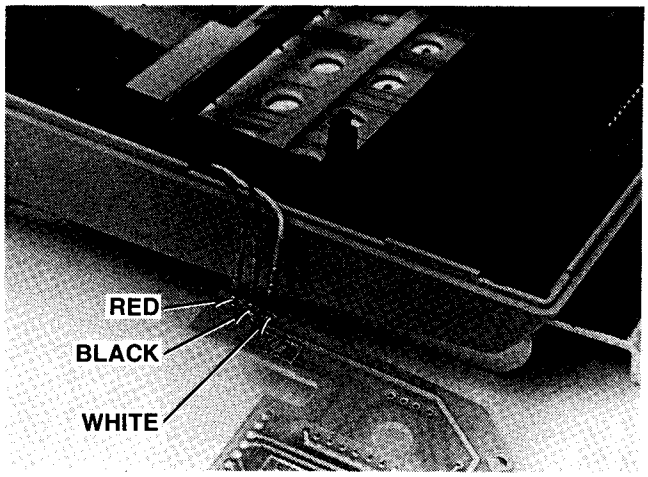


6

c. Carefully disconnect the ac adapter/recharger leads (two white) and 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

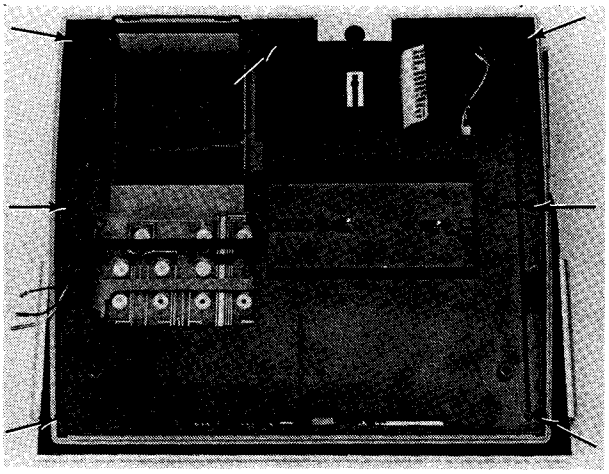
Support Plate Assembly Removal

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.

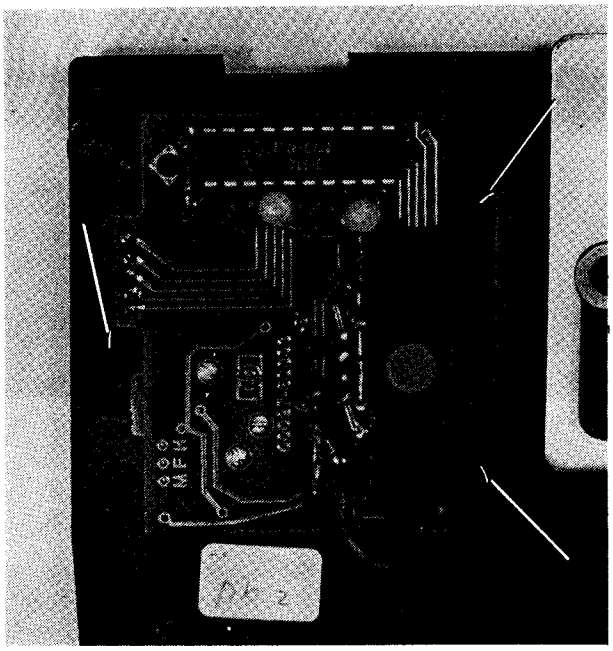


8

Card Reader Assembly Removal/Replacement

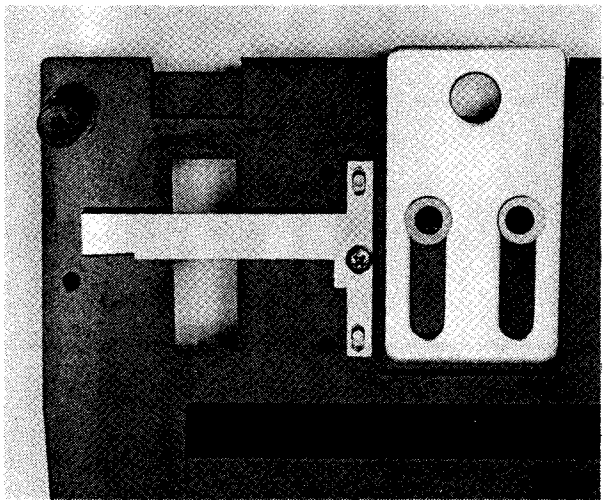
a. Perform removal/replacement procedures 1, 3, and 5 through 7.

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.

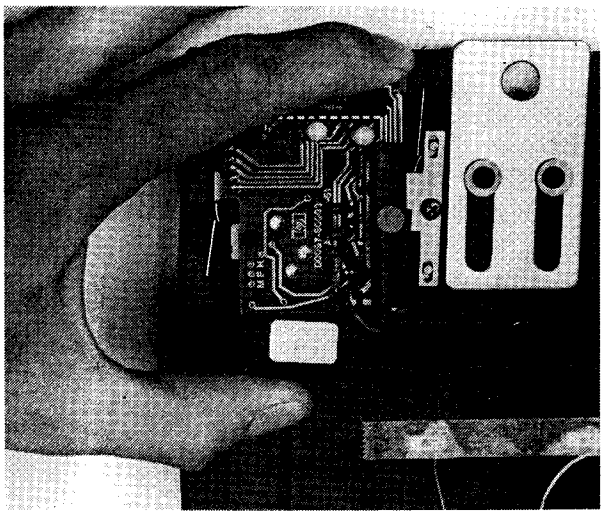


e. Place the card reader assembly onto the support plate straddling the tool as shown, and insert screws into the slots of the three feet of the card reader support.

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.

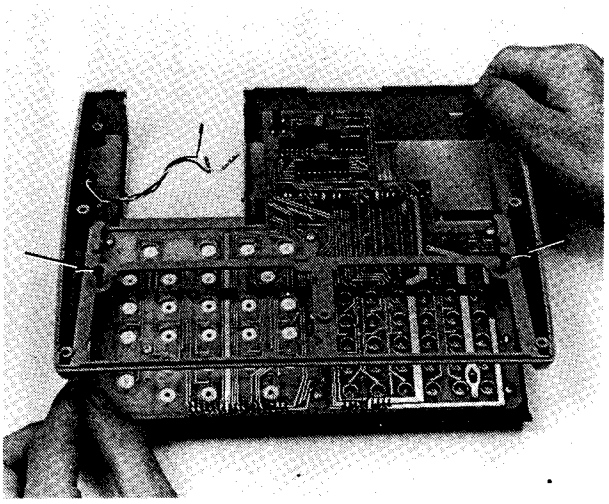
b. Apply light upward pressure to top case as shown.

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.

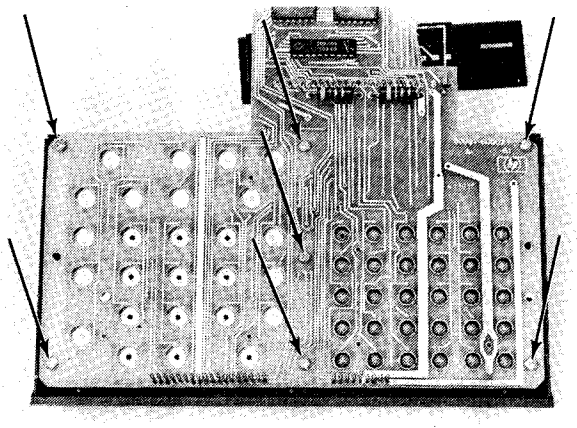
10

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.



10

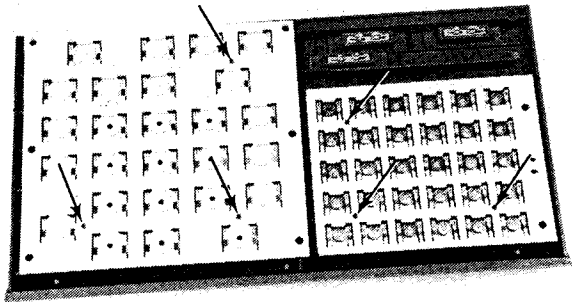
d. Note position of guide pins and holes for the next operation.

e. Lift off upper spacers.

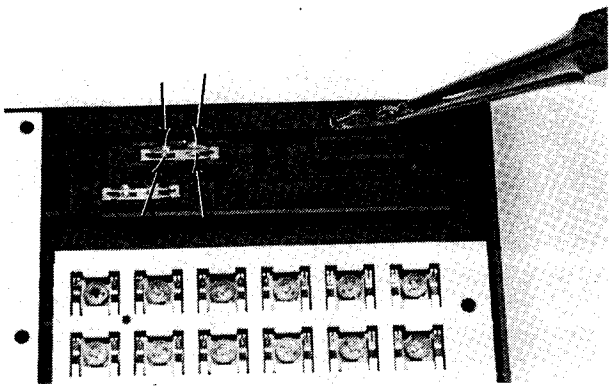
f. Lift off key spring strips.

g. Lift off lower spacers.

h. To replace key spring strips and spacers, carefully replace each in reverse order as 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 in the places indicated.



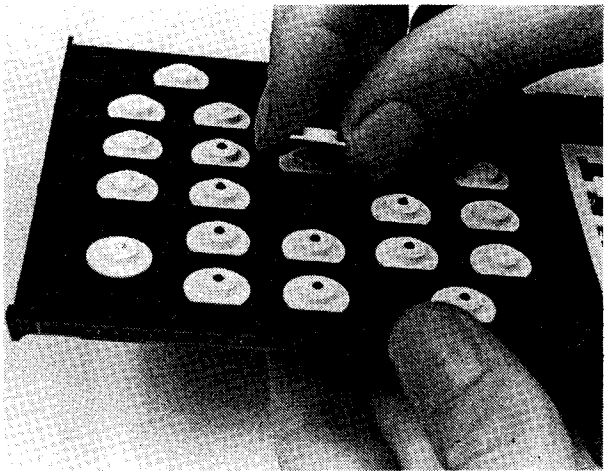
11

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 Replacment

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.

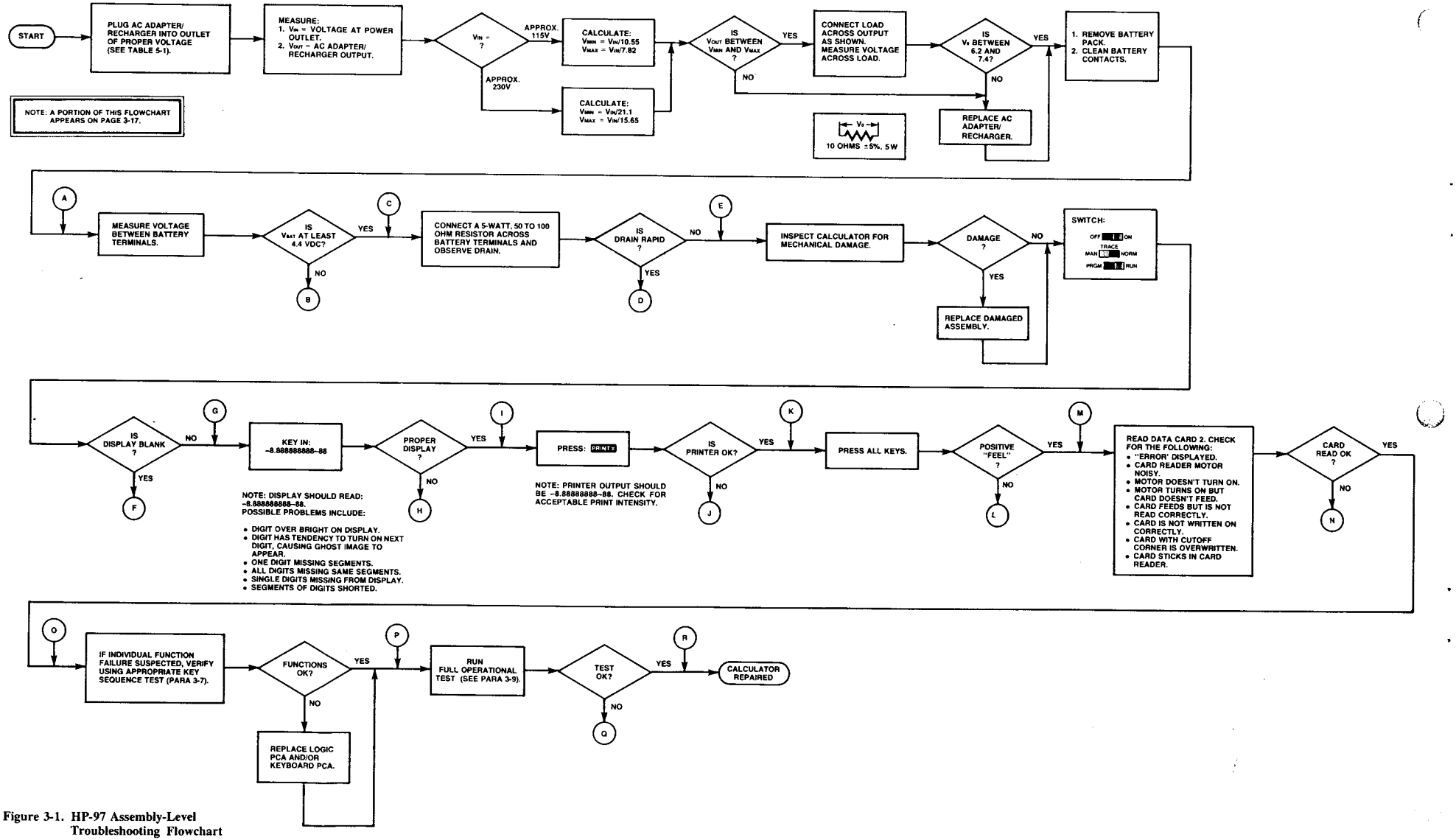


Figure 3-1. HP-97 Assembly-Level Troubleshooting Flowchart

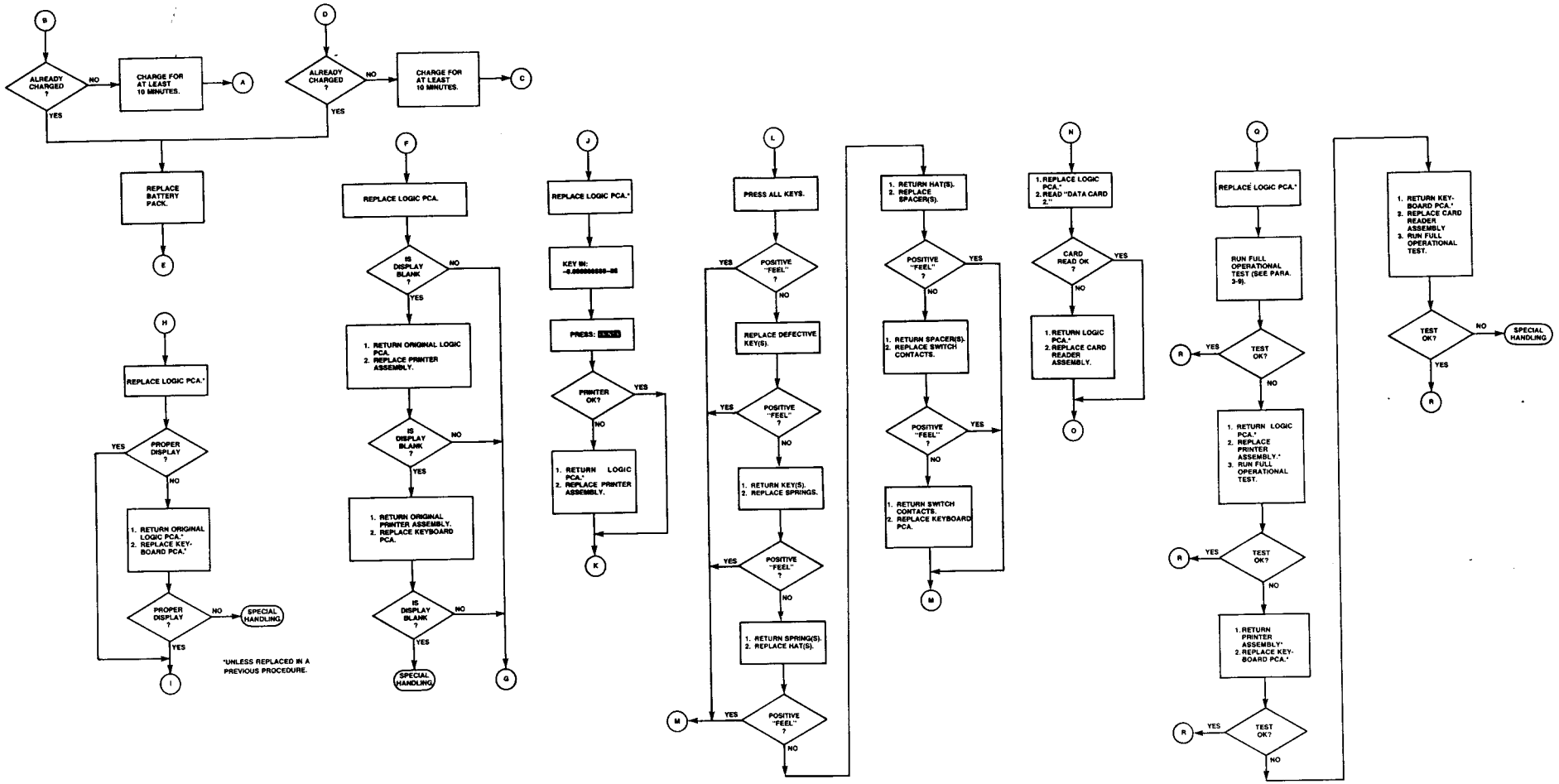


Figure 3-1. HP-97 Assembly-Level Troubleshooting Flowchart (Continued)

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 4-35.

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-155429	HP-67/97 Field Service Card Speed Gauge
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
HP 180C/1801A/1820C*	Oscilloscope. Measures pulse at 0.50μs. Maximum amplitude 13 Vdc.
HP 6213C*	Power Supply. Variable supply 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.
---	Ink 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 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 figure 4-8. 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 flowchart, figure 4-8.

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.

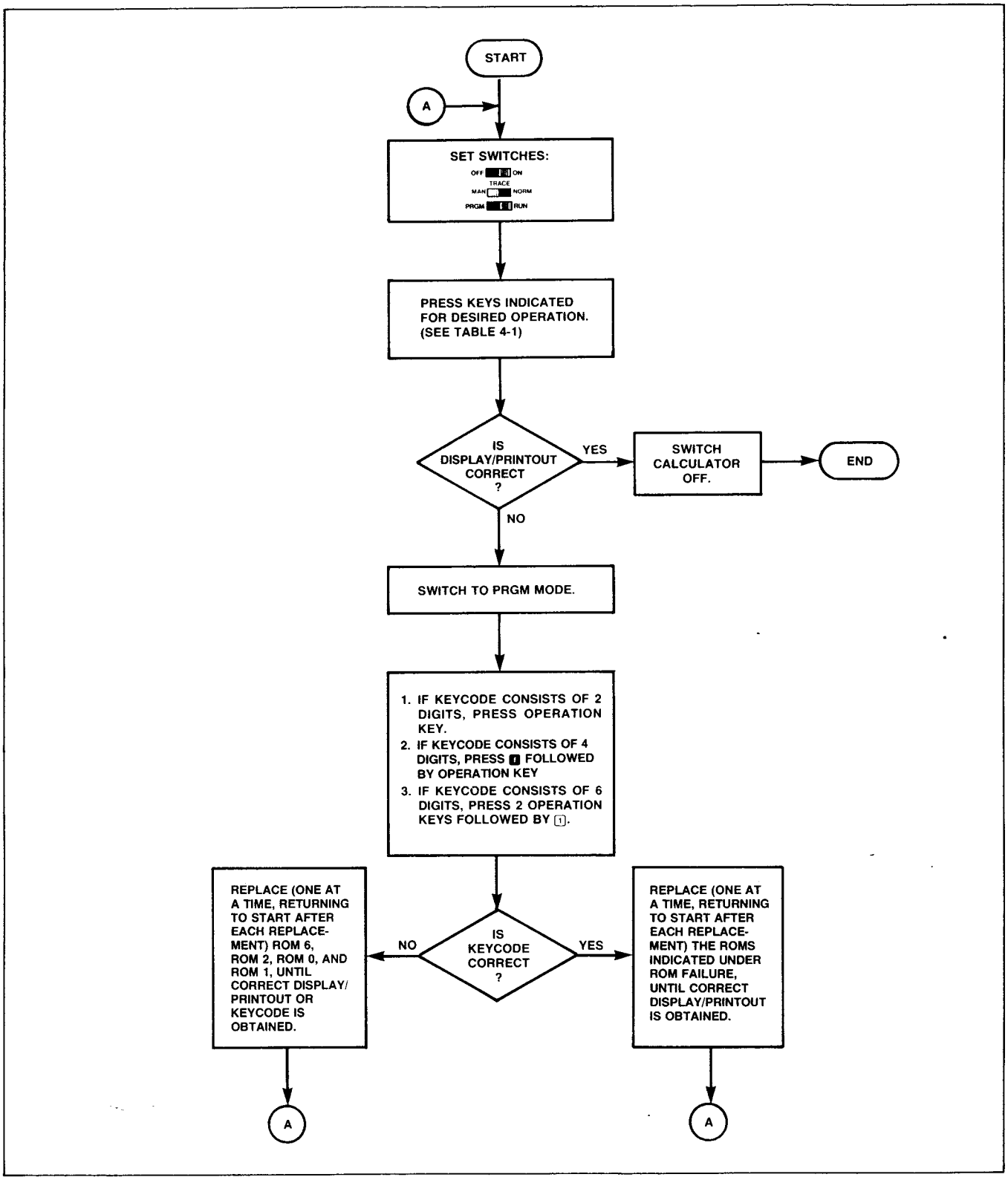


Figure 4-1. Faulty Function Verification and Repair

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
√x	2 5 √x	*5.00*		54	1, 3, 0
x²	5 x²	*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 →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	*10.23*			
→P	3 ENTER↑ 4 →P	*5.00*		34	2, 1, 3, 0
	x≷y	*36.87*			

Table 4-1. Faulty Function Repair (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT	KEYCODE	ROM FAILURE
→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			
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			

Table 4-1. Faulty Function Repair (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT	KEYCODE	ROM FAILURE
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
	f STF 1 f STF 3				
STF	f F? 3 f F? 3			21 01	3, 6, 0
CLF	f F? 1 f CLF 1			22 01	3, 6, 0
	f F? 1 5 f F?				
	3 PRGM RUN	*002* *51*			
PAUSE	PRGM RUN LBL A			16 51	0, 3, CRC
	f PAUSE GTO A				
	PRGM RUN 5 A	*5.00 (blinking)*			
•	• 5	*.5*		−62	3, 0, 6
x≥I	5 f x≥I I	*5.00*		16–41	3, 1, 0

Table 4-1. Faulty Function Repair (Continued)

OPERATION	KEYSTROKES	DISPLAY	PRINT	KEYCODE	ROM FAILURE
	5 STO 1 STO 2 f				
	W/DATA	Crd			
	(insert data card 1)	5.00			
	OFF ON				
W/DATA	OFF ON	0.00		16–61	6, CRC, 3, 0,
MERGE	1 STO I f MERGE			16-62	3, 0, CRC
	(insert card again)	1.00			
	RCL 1	5.00			
	RCL 2	0.00			
SPACE	f PRINT: SPACE		(paper moves)	16–11	0, PIK, 3
RCL Σ+	5 ENTER↑ Σ+ Σ+	2.00		36 56	3, 0
	RCL Σ+	6.00			
	x≷y	10.00			
STO (i)	5 STO (i) CLx RCL (i)	5.00		35 45	3, 0
RCL (i)	RCL 0	5.00		36 45	3, 0
DSZ I	1 STO I f DSZ I	1.00		16 25 46	3, 1, 0
	PRGM RUN	001 51			
ISZ I	1 CHS STO I f ISZ			16 26 46	3, 1, 0
	I I	0.00			
	PRGM RUN	001 51			

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.

4-12. INITIAL TEST

4-13. To run this test:

a. Set switches as follows:

OFF ON

TRACE

MAN NORM

PRGM RUN

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 additional 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.

4-14. PROGRAM MEMORY TEST

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

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

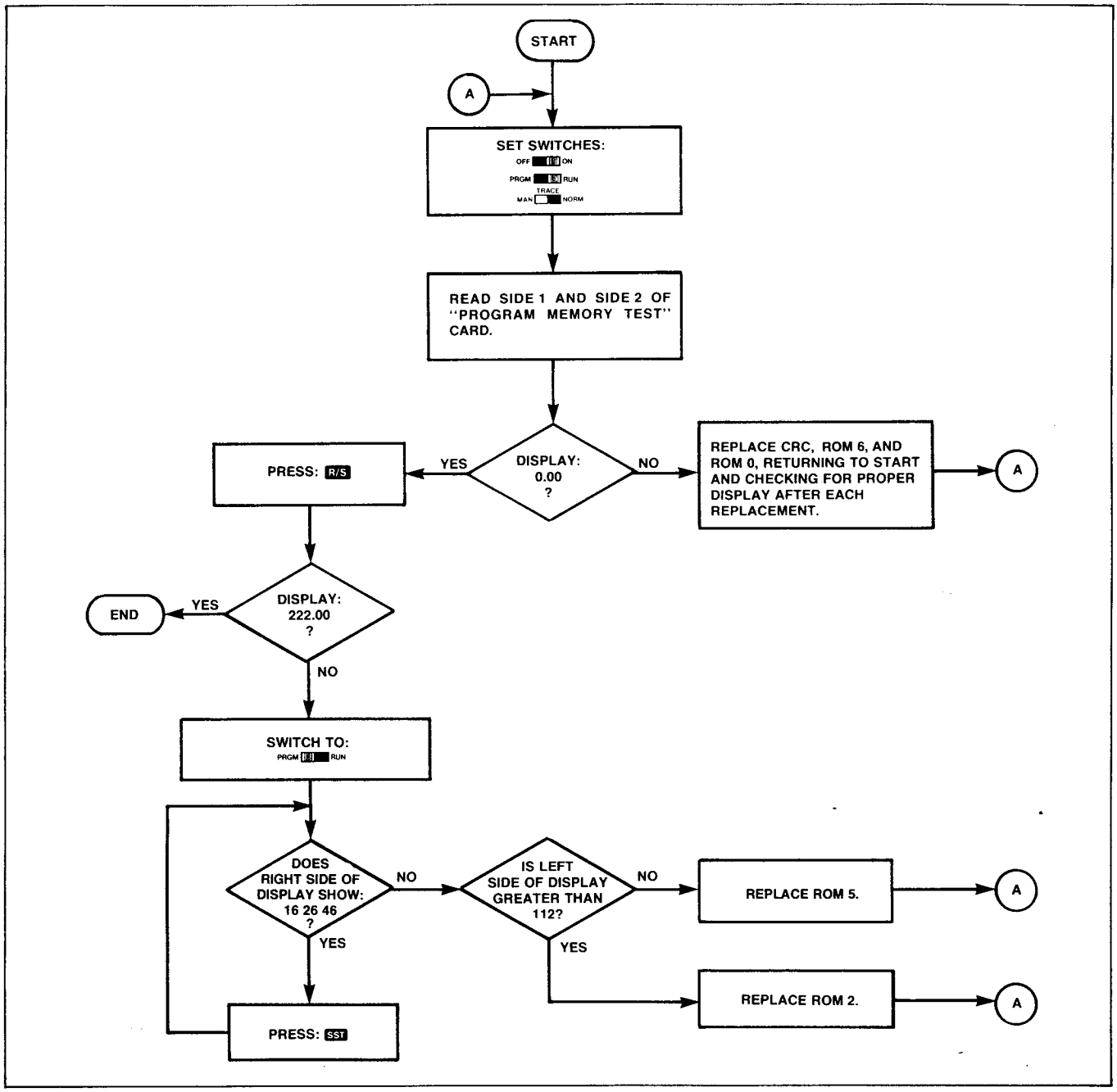


Figure 4-2. Program Memory Test

4-16. FUNCTIONAL TEST

4-17. To run the functional test, follow the step-by-step procedures shown in table 4-3.

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 4-4. 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 4-3. Functional Test

STEP	PROCEDURE	DISPLAY	PRINTOUT	IC REPLACEMENT
1	Set switches: OFF ON TRACE MAN NORM PRGM RUN			
2	Press CLX	*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)*		See Fig. 4-3
		Crd		See Fig. 4-3
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 7	
			-3.333333333-33 8	
			-2.222222222-22 9	
			-1.111111111-11 X	
			51. 0	
			-2.238303285+21 1	
			31. 2	
			-2.238303285+21 3	
			4.301773670+27 4	
			0. 5	
			0. 6	

Table 4-3. Functional Test (Continued)

STEP	PROCEDURE	DISPLAY	PRINTOUT	IC REPLACEMENT
			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	0, PIK, 3, 1
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 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	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	ERROR	0, 6, CRC 0, PIK
22	Switch to RUN mode.	Error		0, CRC
23	Press CLx	-8.888888888-88		3, 6, 0

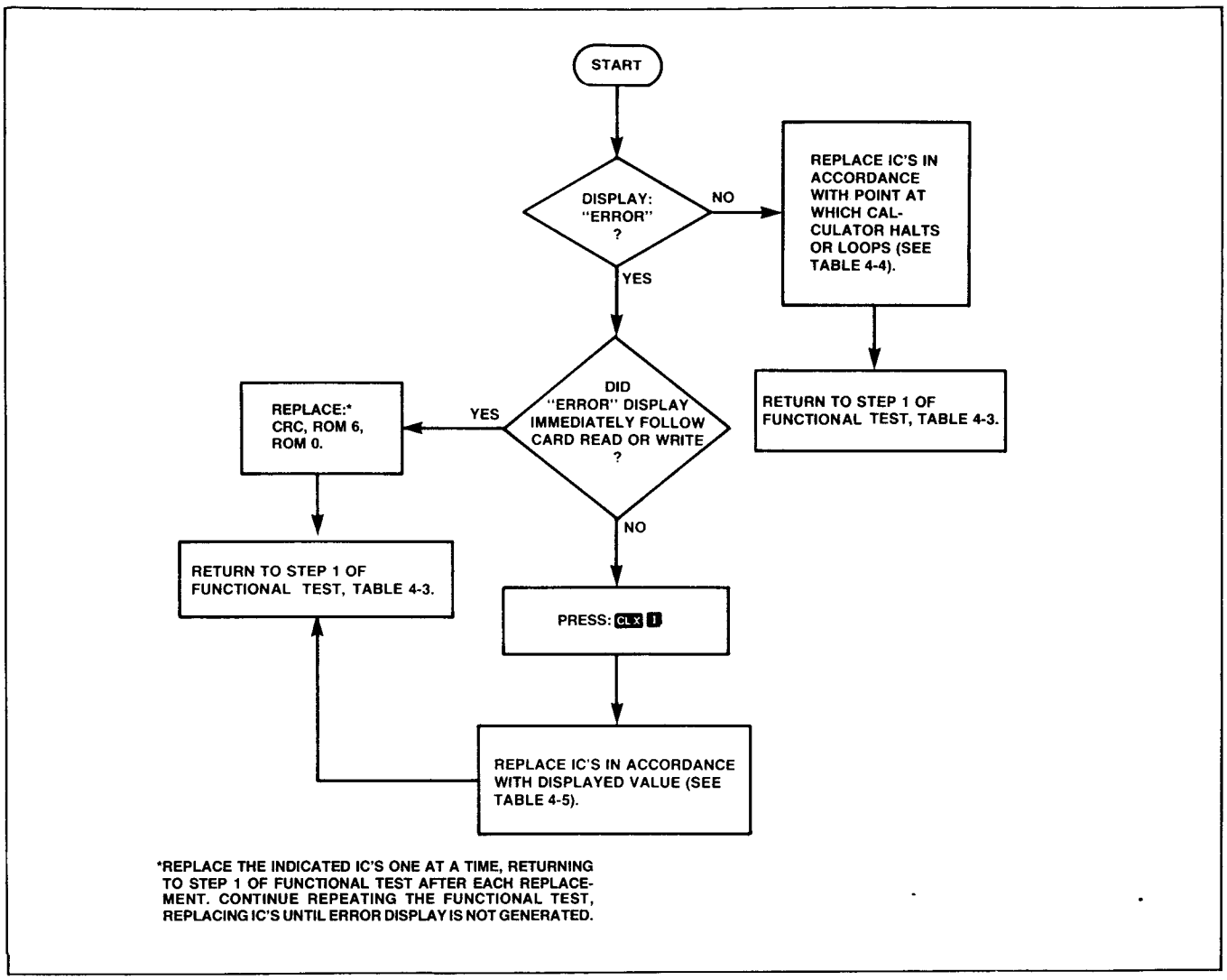


Figure 4-3. IC Replacement Flowchart, Functional Test

Table 4-4. 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

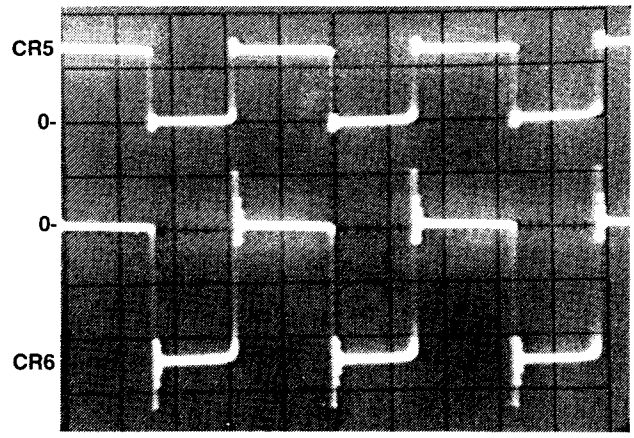
*Replace the indicated IC's (designated by ROM number) one at a time, returning to step 1 of functional test after each replacement. Continue repeating the functional test, replacing IC's until proper display is obtained.

Table 4-5. 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

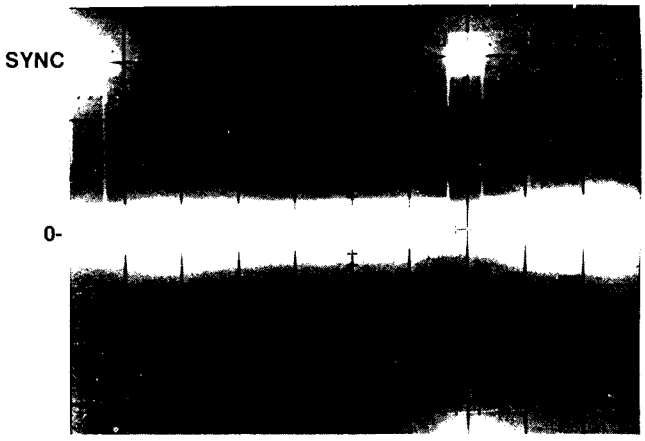
*Replace IC's (CRC, or ROM's designated by number) one at a time, returning to Step 1 of functional test after each replacement. Continue repeating the functional test, replacing the indicated IC's until "Error" display is not generated.

**Display format for value may vary.



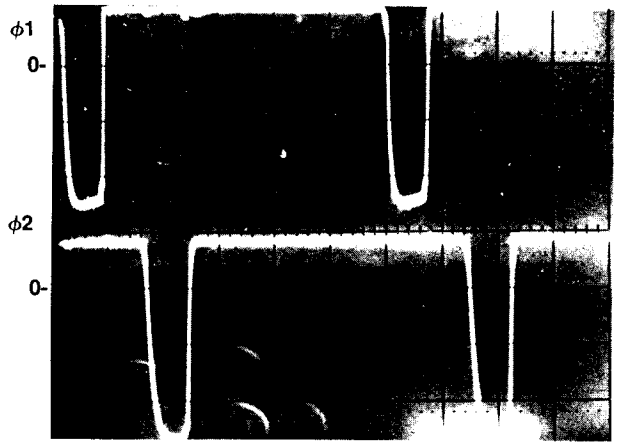
Test points: Anodes of CR5 and CR6
Oscilloscope time base: 2 μs/cm
Vertical gain: 5 V/cm

Figure 4-4. CR5 and CR6 Anode Waveforms*



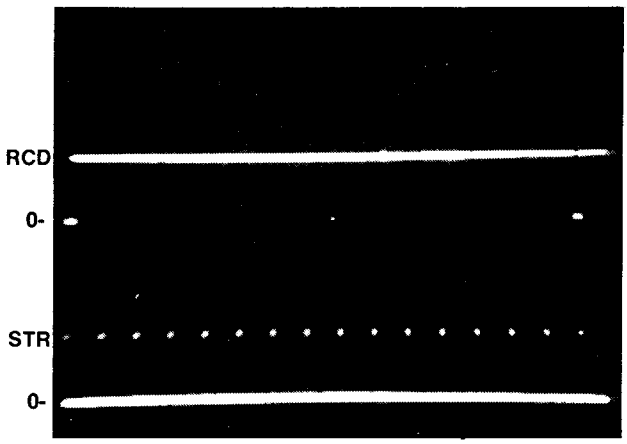
Test point: Pin 20 of ACT (U1)
Time base: 0.1 ms/cm
Vertical gain: 2 V/cm

Figure 4-6. SYNC Waveform*



Test point: Pins 16 and 17 of ACT (U1)
Oscilloscope time base: 1 μs/cm
Vertical gain: 5 V/cm

Figure 4-5. Φ1 and Φ2 Waveforms*



Test points: RCD: Pin 21 of ACT (U1)
STR: Pin 11 of ROM 0 (U2)
Time base: 5 ms/cm
Vertical gain: 2 V/cm

Figure 4-7. STR and RCD Waveforms*

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

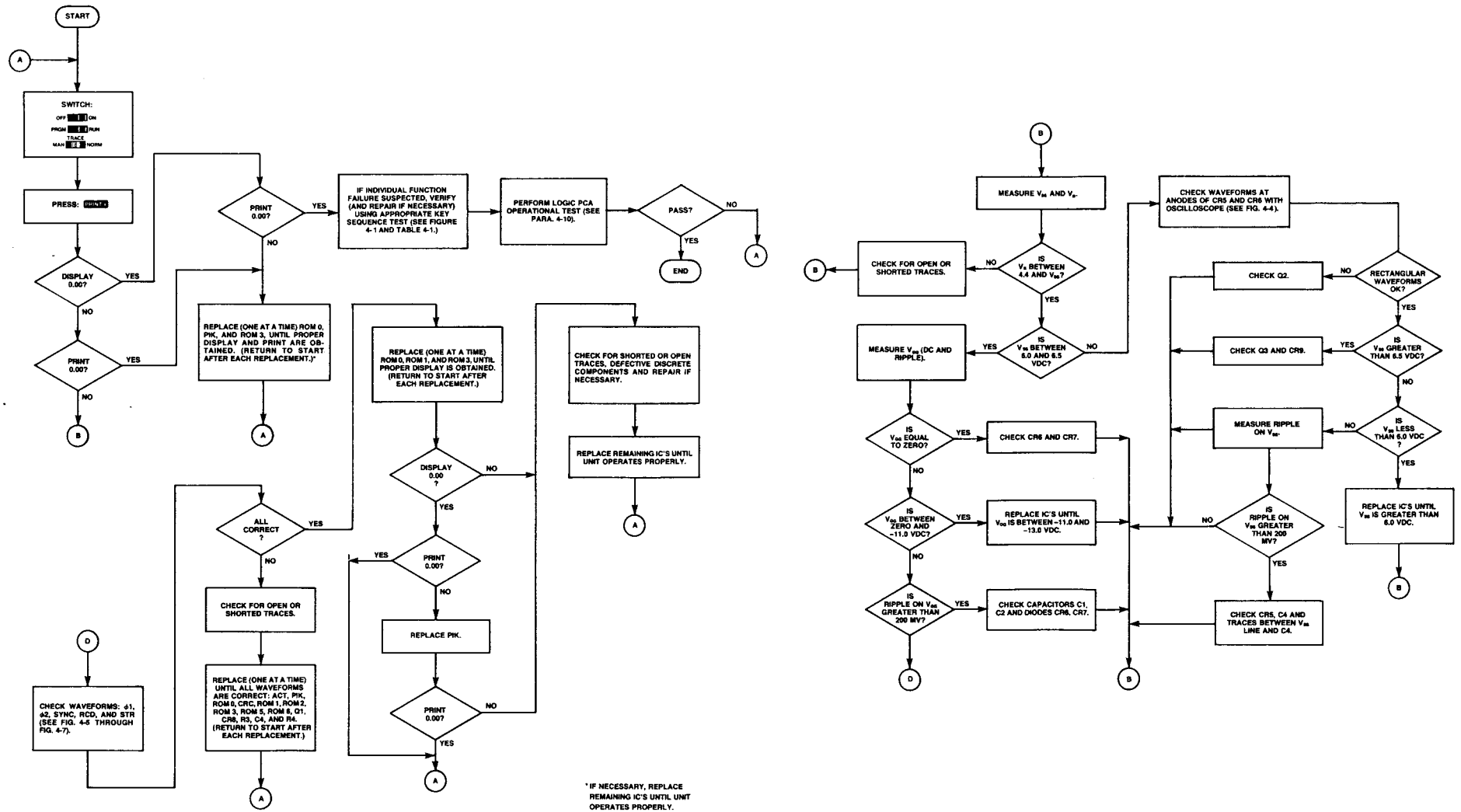


Figure 4-8. Logic PCA Troubleshooting Flowchart

Table 4-6. Logic Printed-Circuit Assembly A1 (00097-60001) Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION
C1, 2, 3	0180-0575	CAPACITOR, fxd, 2.2 μf
C4	0180-2615	CAPACITOR, fxd, 22 μf
C5	0160-3995	CAPACITOR, fxd, 3900 pf
C6	0180-2602	CAPACITOR, fxd, 47μf
CR1 thru CR4	1901-0704	DIODE, silicon
CR5 thru CR7, 10	1901-1098	DIODE, silicon
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	1900-3594	TRANSFORMER, toroidal
U1	1820-1812	INTEGRATED CIRCUIT, ACT
U2	1818-0225	INTEGRATED CIRCUIT, ROM 0
U3	1820-1751	INTEGRATED CIRCUIT, CRC
U4	1820-1723	INTEGRATED CIRCUIT, PIK
U5	1818-0228	INTEGRATED CIRCUIT, ROM 1
U6	1818-0226	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
J1-7	1251-0600	CONNECTOR, 1-pin
J8	1251-4426	CONNECTOR, 13-pin
P1	1251-4289	CONNECTOR, 21-pin
W1	8159-0005	WIRE, jumper
	00097-80001	BOARD, etched

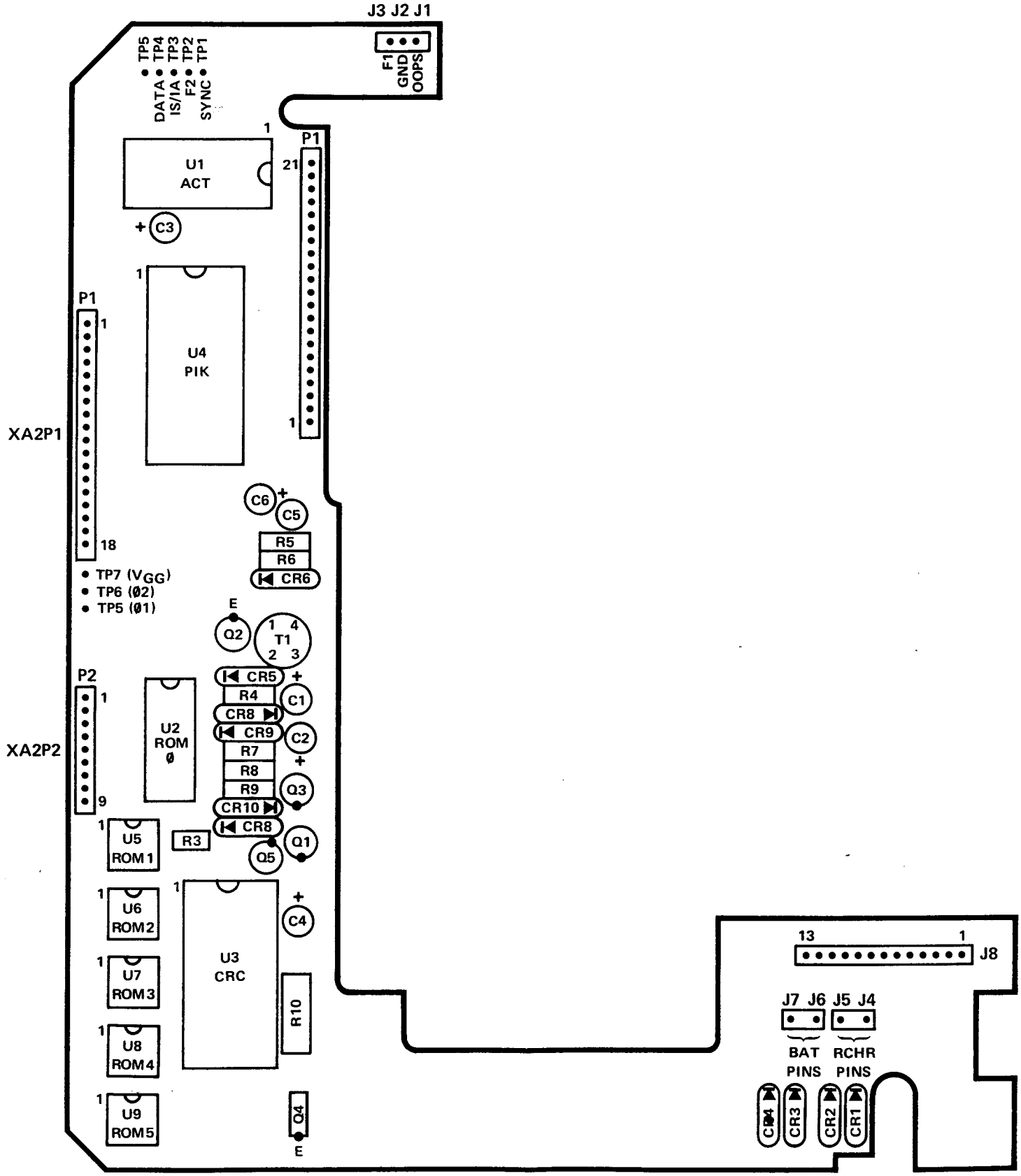


Figure 4-9. Logic PCA (A1) Component Location Diagram

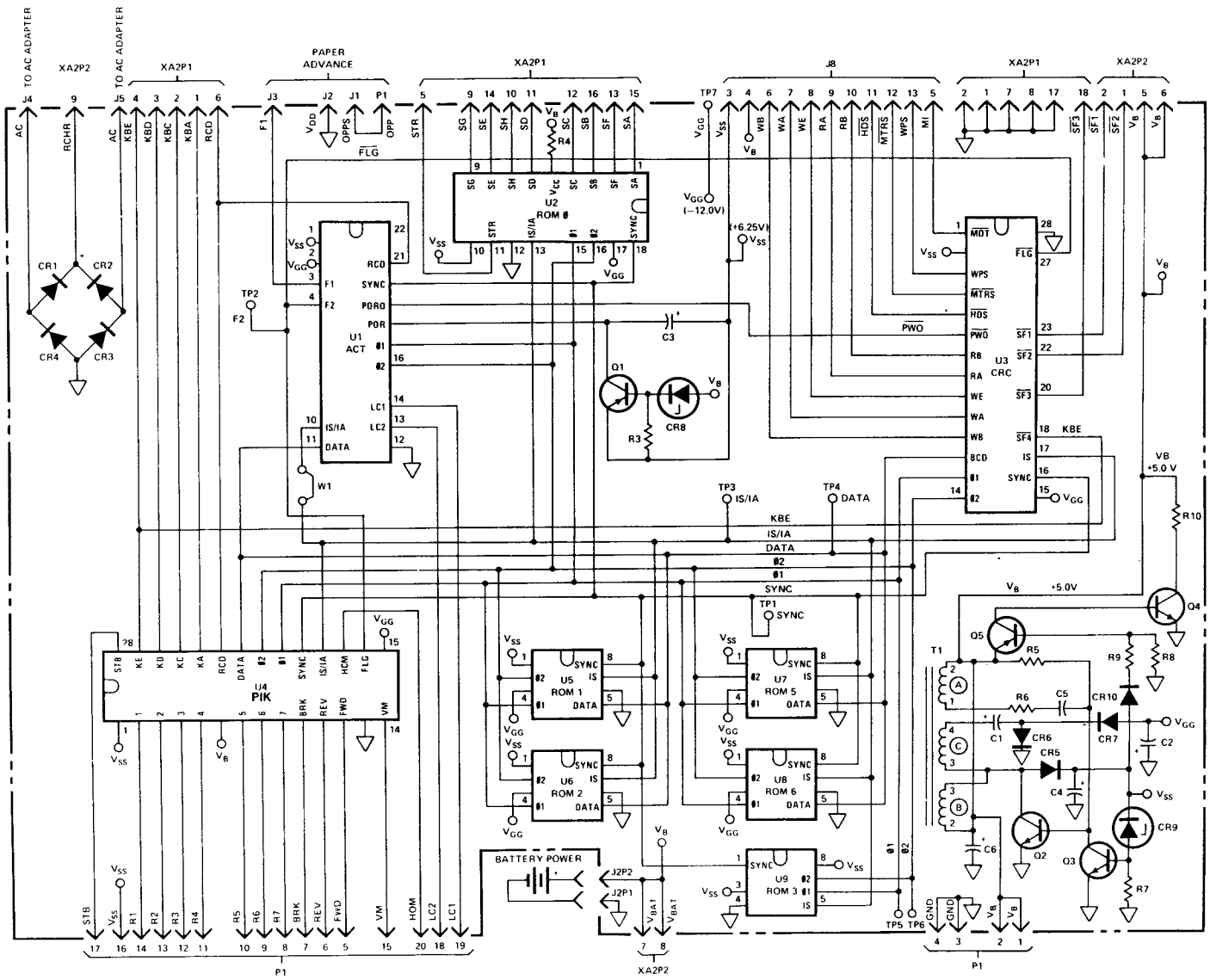


Figure 4-10. Logic PCA (A1) Schematic Diagram

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 figure 4-18.

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 3-24) 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 3-24.

(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 4-11.)

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.

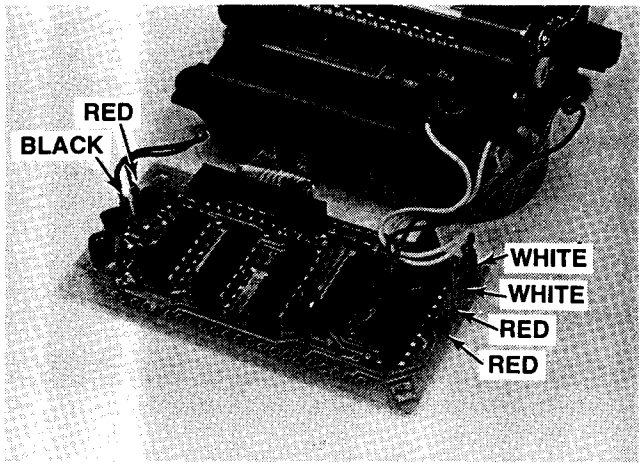


Figure 4-11. Printer PCA Lead Location

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 on the cable. (See figure 4-12.) 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 4-13). Ensure that the cable con-

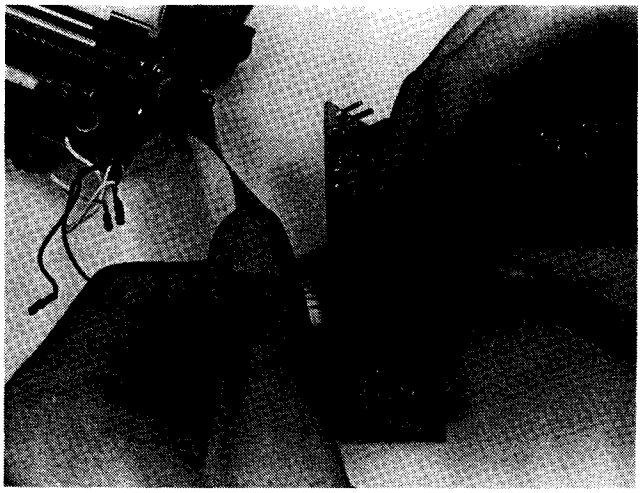


Figure 4-12. Print Head Cable Removal

tacts are properly aligned with the connector contacts as shown in figure 4-14. Remove the connector tool.

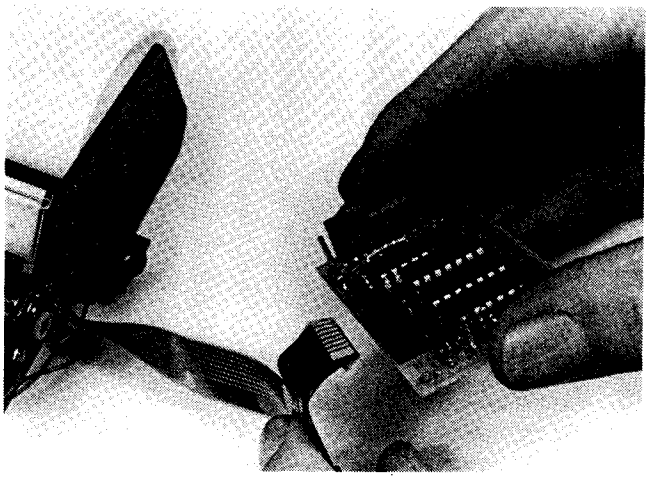


Figure 4-13. Print Head Cable Insertion

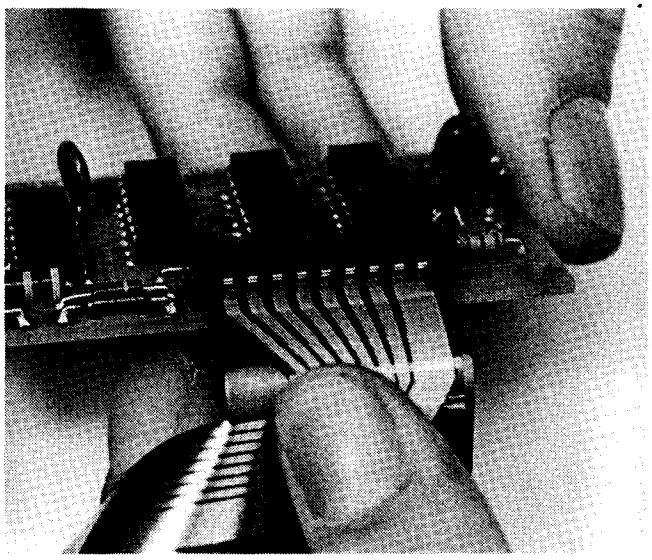


Figure 4-14. Print Head Cable Contacts

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.

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 than 9.0 ohms, carefully disconnect one lead of C2 and measure again. Replace the defective capacitor/dc motor assembly if necessary.

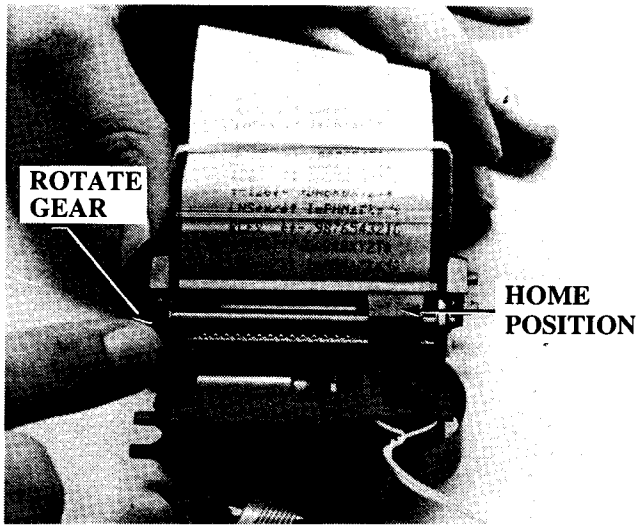
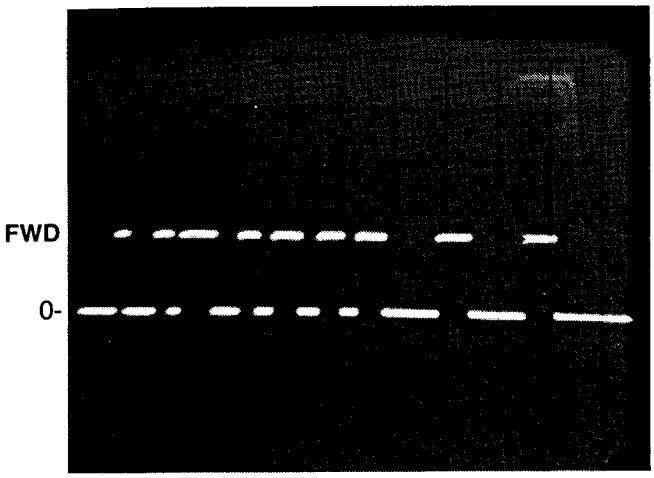


Figure 4-15. Head Carriage Home Position

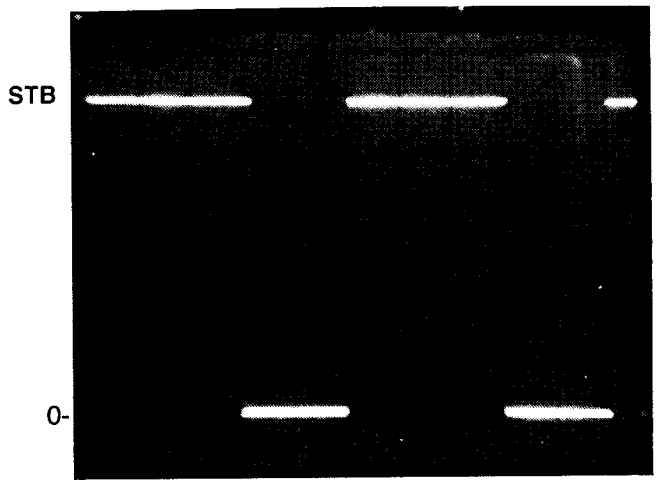
4-26. Printer Electrical Maintenance

4-27. To test the electrical portion of the printer assembly, follow the procedures as outlined in figure 4-18.



Test point: FWD (Pin 5 of XA1P1)
Time base: 2 ms/cm
Vertical gain: 1 V/cm

Figure 4-16. FWD Waveform



Test point: STB (Pin 17 of XA1P1)
Time base: 20 μs/cm
Vertical gain: 1 V/cm

Figure 4-17. STB Waveform

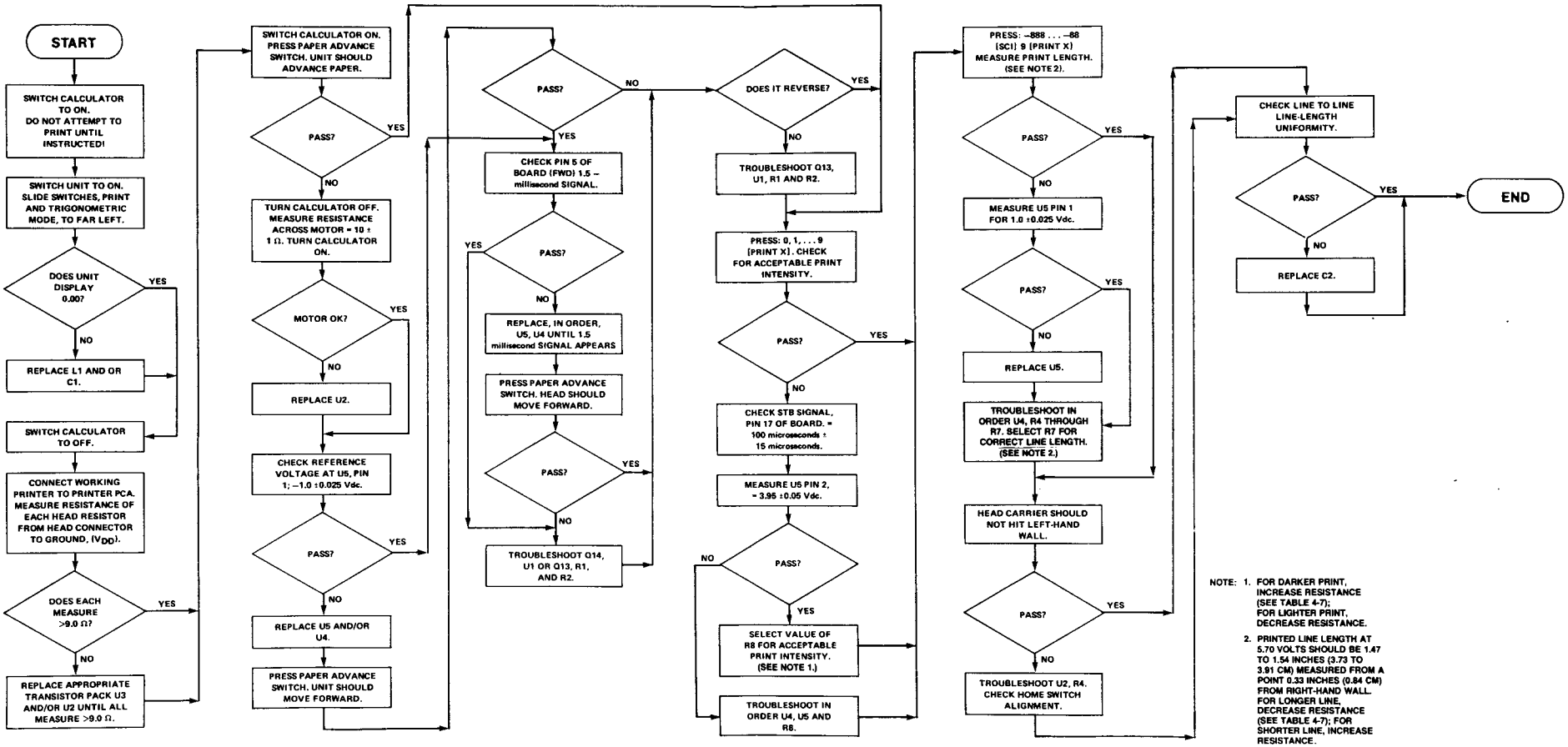


Figure 4-18. Printer PCA Troubleshooting Flowchart

Table 4-7. Printer Printed-Circuit Assembly (A4A1) Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION
C1	0160-4292	CAPACITOR, fxd, 330 pF, 5%
C3	0180-2602	CAPACITOR, fxd, 47 μF, 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%, ⅛W
R7*	0757-0751	RESISTOR, fxd, 7.50K, 1%, ⅛W
R7*	0698-3226	RESISTOR, fxd, 6.49K, 1%, ⅛W
R7*	0757-0200	RESISTOR, fxd, 5.62K, 1%, ⅛W
R7*	0698-4444	RESISTOR, fxd, 4.87K, 1%, ⅛W
R7*	0698-3154	RESISTOR, fxd, 4.22K, 1%, ⅛W
R7*	0698-3496	RESISTOR, fxd, 3.57K, 1%, ⅛W
R7*	0757-0273	RESISTOR, fxd, 3.01K, 1%, ⅛W
R7*	0757-0431	RESISTOR, fxd, 2.43K, 1%, ⅛W
R7*	0698-4430	RESISTOR, fxd, 1.91K, 1%, ⅛W
R7*	0698-4424	RESISTOR, fxd, 1.4K, 1%, ⅛W
R7*	0757-0422	RESISTOR, fxd, 909 ohms, 1%, ⅛W
R8*	0698-3453	RESISTOR, fxd, 196K, 1%, ⅛W
R8*	0757-0466	RESISTOR, fxd, 110K, 1%, ⅛W
R8*	0757-0464	RESISTOR, fxd, 90.9K, 1%, ⅛W
R8*	0757-0462	RESISTOR, fxd, 75.3K, 1%., ⅛W
R8*	0757-0459	RESISTOR, fxd, 56.2K, 1%, ⅛W
R8*	0698-3450	RESISTOR, fxd, 42.2K, 1%, ⅛W
R8*	0757-0123	RESISTOR, fxd, 34.8K, 1%, ⅛W
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 μH
J1 thru J6	1251-0600	CONNECTOR, pin, male
J7	1251-4143	CONNECTOR, 9-pin
	00091-80001	BOARD, etched

*Values of R7 and R8 are selected.

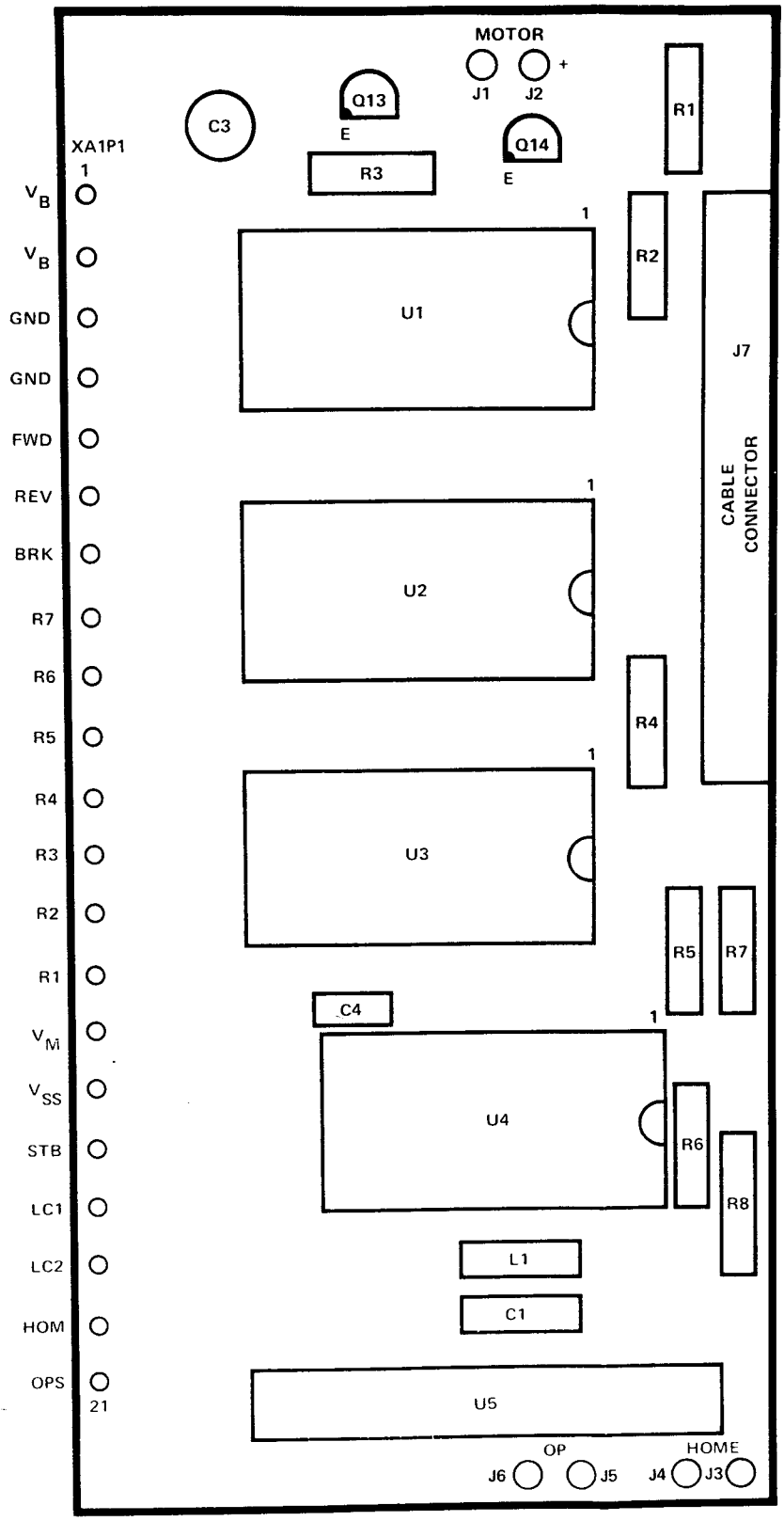


Figure 4-19. Printer PCA (A4A1) Component Location Diagram

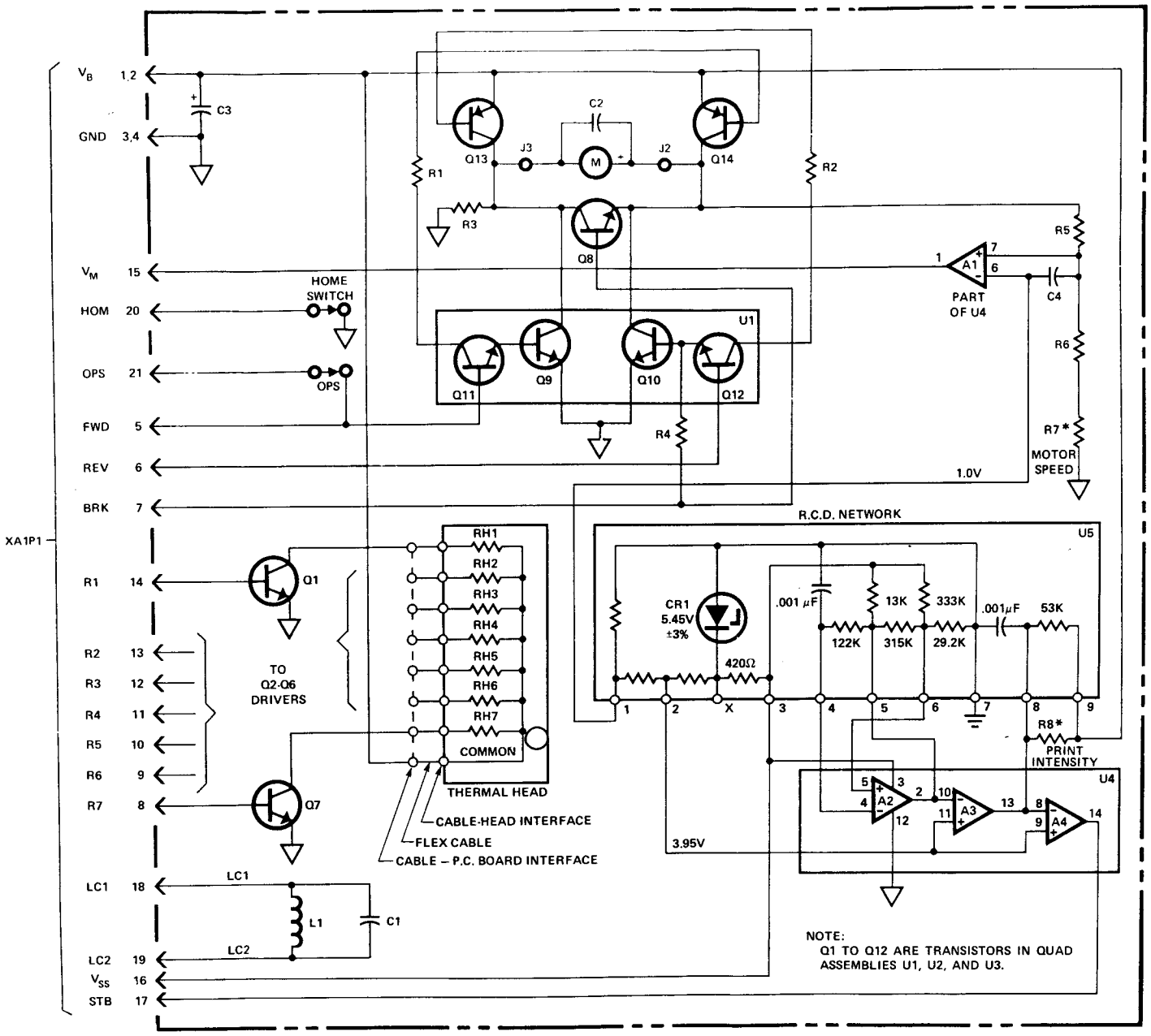


Figure 4-20. Printer PCA (A4A1) Schematic Diagram

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.

4-30. DISPLAY TROUBLESHOOTING

4-31. Figure 4-11 shows the LED digit structure. To test, key in -8.888888888-88. Display should correspond to the numbers keyed in. Possible problems are:

a. Digit over bright on display.

b. Digit has tendency to turn on next digit, causing ghost image to appear.

c. One digit missing segments.

d. All digits missing same segments.

e. Single digits missing from display.

f. Segments of digits shorted.

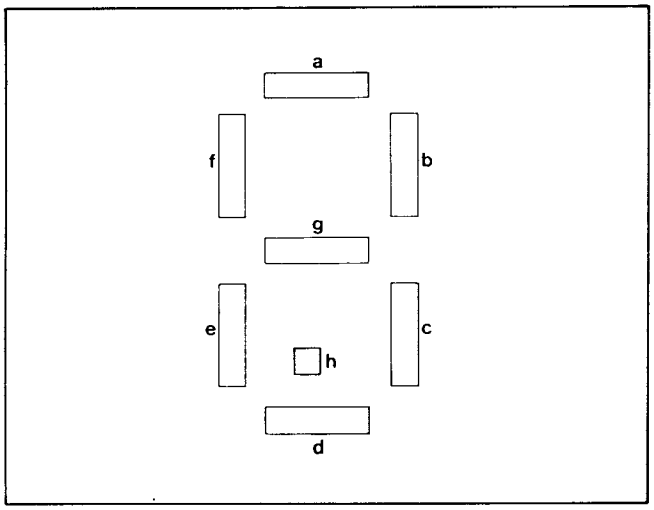


Figure 4-11. LED Digit

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

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

4-33. CATHODE DRIVER IC REPLACEMENT

4-34. After replacing cathode driver integrated circuit U1, a new value for resistor R2 may have to be selected. Refer to table 4-8.

Table 4-8. Cathode Driver Resistor Selection Chart

U1 Category	I	J
Resistor Values (kilohms)	200	330

Table 4-9. Keyboard Printed-Circuit Assembly A2A1 (00097-60002) Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION
R1	0683-4715	RESISTOR, fxd, 470 ohm
R2*	0683-2045	RESISTOR, fxd, 200K
R2*	0684-3341	RESISTOR, fxd, 330K
R3	0812-0058	RESISTOR, fxd, 8.2 ohm, 2W
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%, ¼W
R7	0683-3915	RESISTOR, fxd, 390 ohm
CR1	1990-0450	LED, low battery indicator
Q1	1853-0393	TRANSISTOR, PNP
Q2	1853-0401	TRANSISTOR, PNP
Q3	1853-0374	TRANSISTOR, PNP
Q4	1854-0071	TRANSISTOR, NPN
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

*Value of R2 is selected.

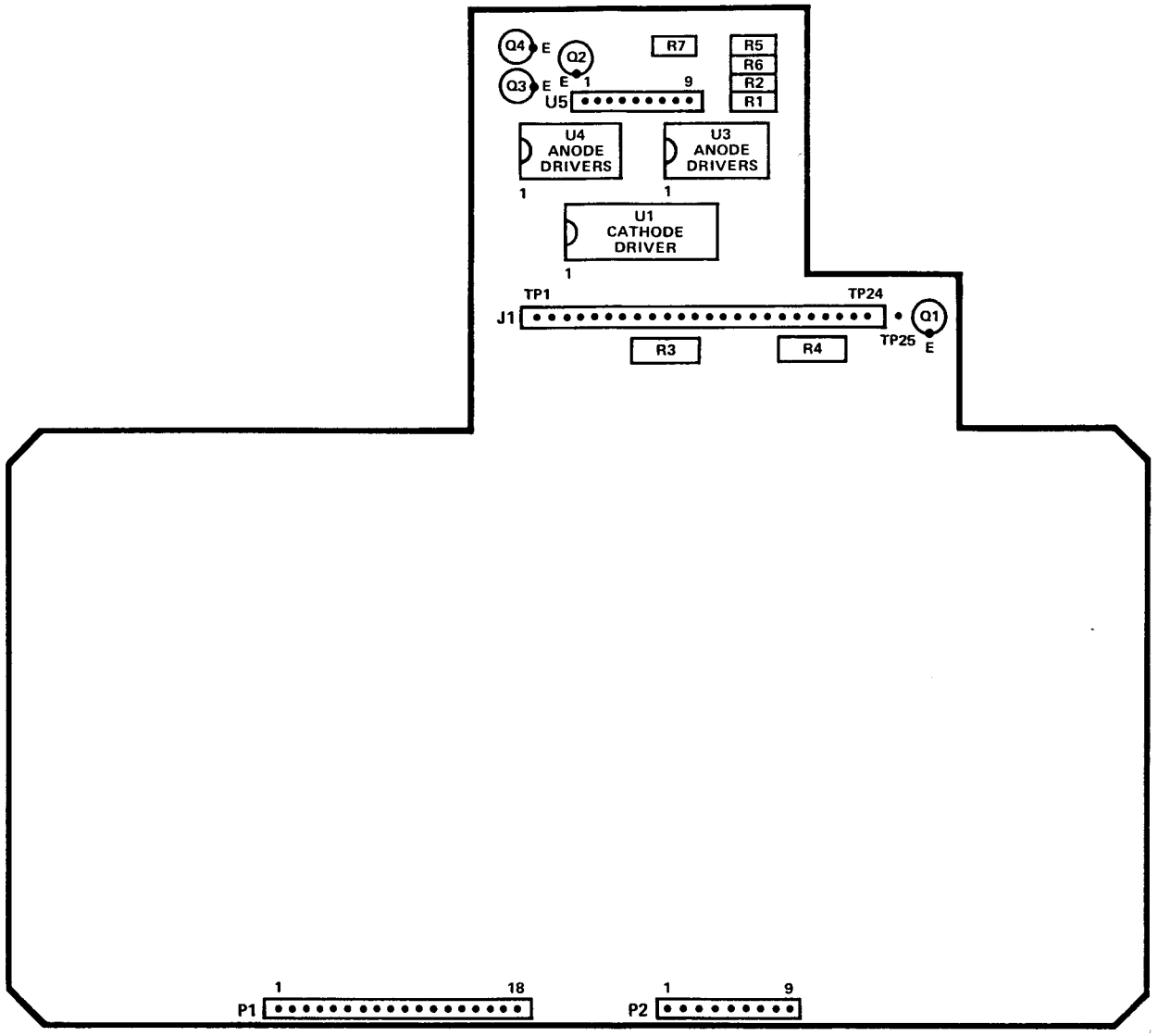


Figure 4-22. Keyboard PCA (A2A1) Component Location Diagram

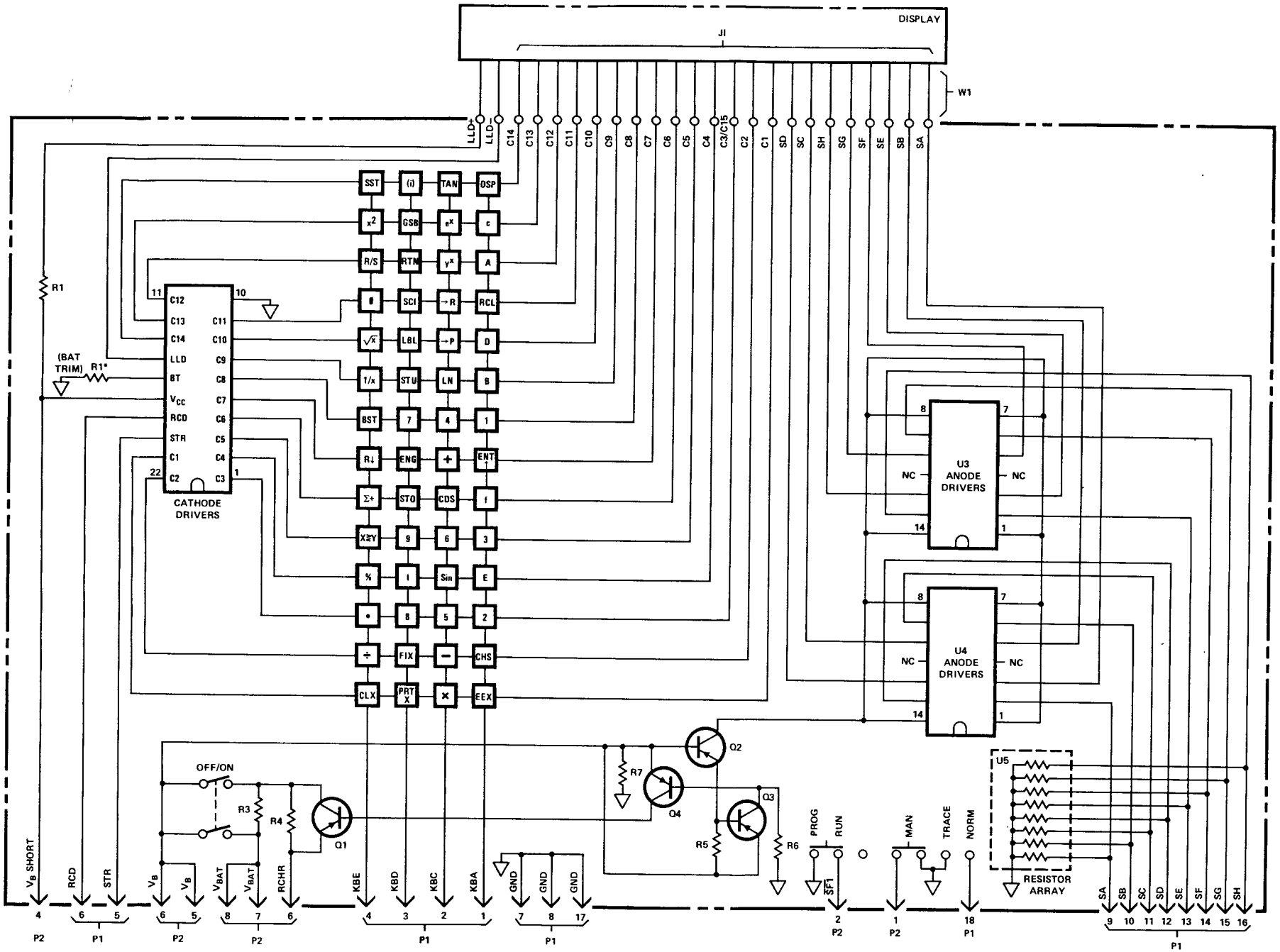


Figure 4-23. Keyboard PCA (A2A1) Schematic Diagram

4-35. CARD READER TROUBLESHOOTING

4-36. To repair a malfunctioning card reader, follow the troubleshooting flowchart given in figure 4-29. Refer to the card reader exploded view in figure 6-3 for aid in disassembly.

4-37. 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.

4-38. Note that the HP-97 card reader is a precision electrical/mechanical assembly containing 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.

4-39. 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 lightly rubbing the contacts with an ink eraser. Rub each only toward the end of the contact. If any of the switch contacts are bent, replace the leaf switch contacts rather than attempting to bend them into position.

4-40. When the card reader motor speed cannot be adjusted to within the proper limits, as described in the procedures of figure 4-29, the eccentric cam must be replaced and/or adjusted as follows:

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

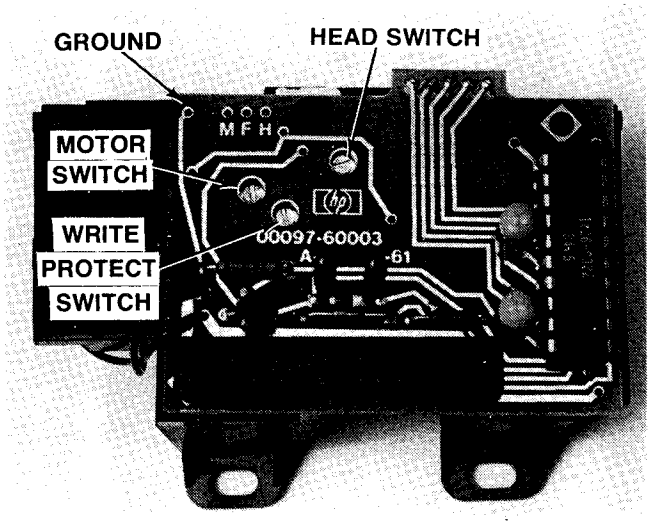
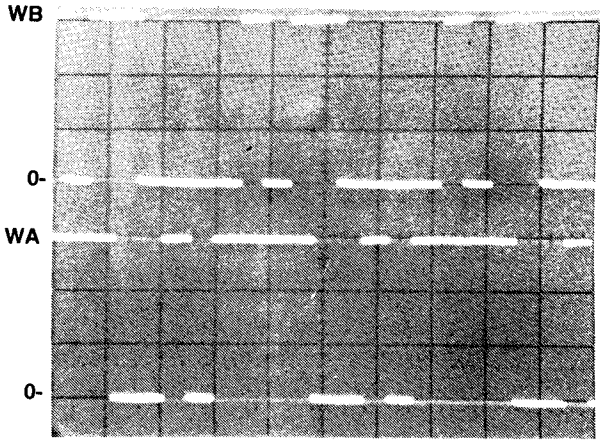


Figure 4-24. Card Reader Switch Adjustment Screws and Test Points

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.

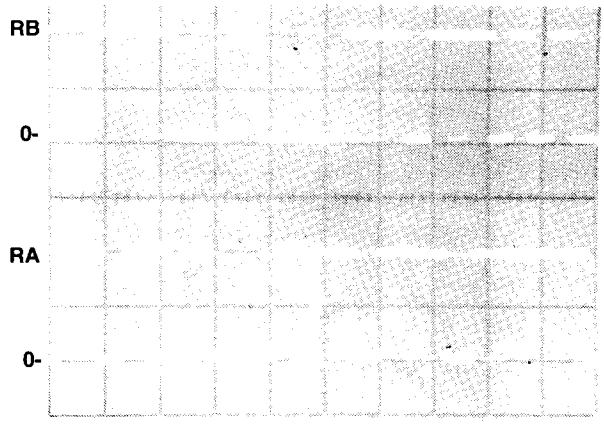
c. Adjust the eccentric cam (see figure 6-3) until the current meter reads 180±20 mA.

d. Perform the fine adjustment of motor speed using the procedures of figure 4-29.



Test points: Pins 11 (WB) and 10 (WA) of CRC (A1U3)
Oscilloscope time base: 2 msec/div
Vertical gain: 2 V/div

Figure 4-25. 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 4-26. RA and RB Waveforms

Table 4-10. Card Reader Printed-Circuit Assembly A3A1 Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION
R1*	0698-3151	RESISTOR, fxd, 2.87K
R1*	0757-0279	RESISTOR, fxd, 3.16K
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 μf
C3	0180-2664	CAPACITOR, fxd, 3.3μf
C4	0180-2663	CAPACITOR, fxd, 6.8 μf
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.

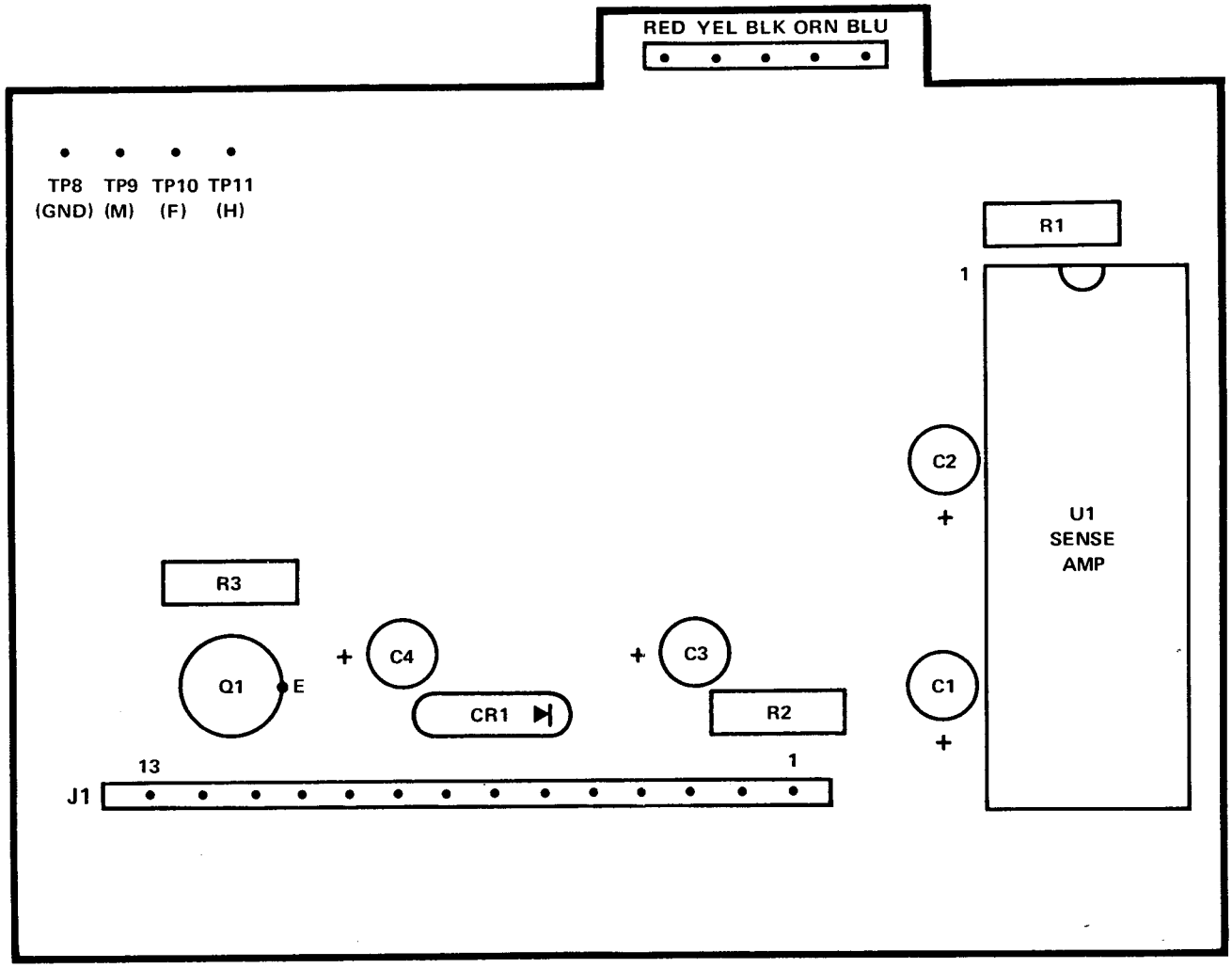


Figure 4-27. Card Reader PCA (A3A1) Component Location Diagram

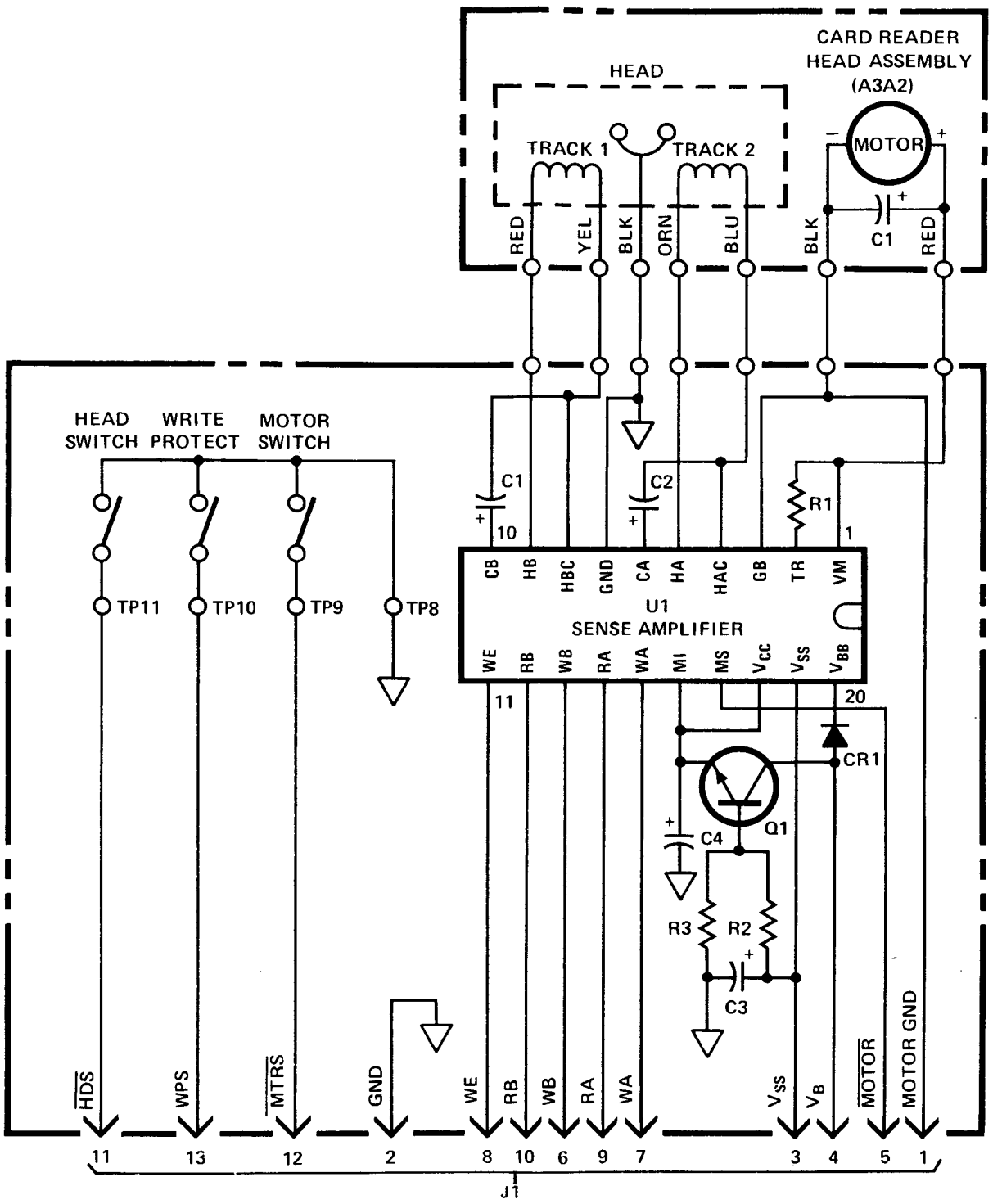
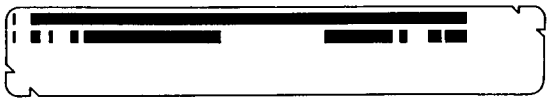
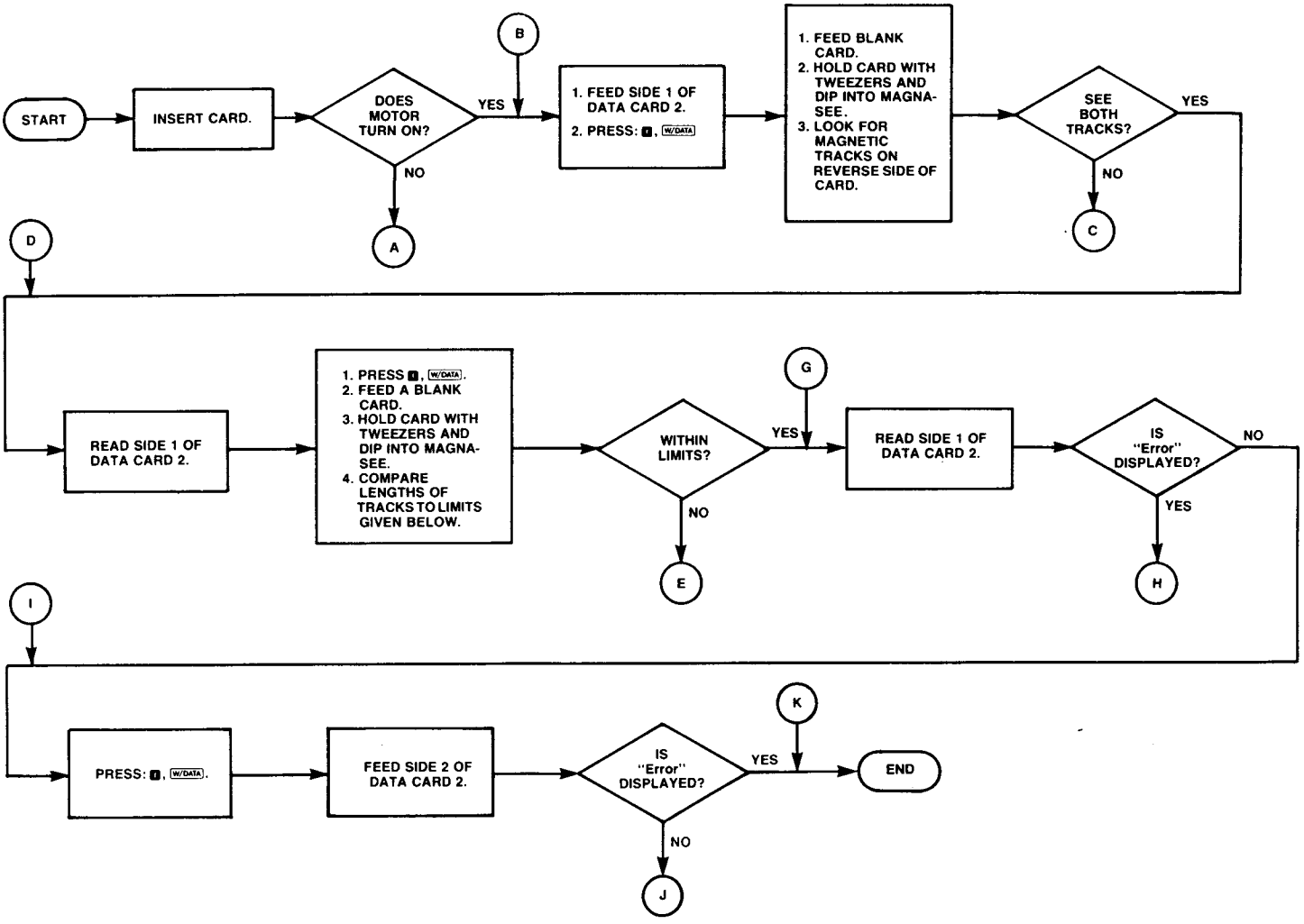
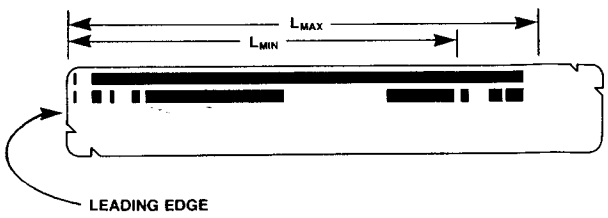


Figure 4-28. Card Reader PCA (A3A1) Schematic Diagram

NOTE: A PORTION OF THIS FLOWCHART APPEARS ON PAGE 4-27.







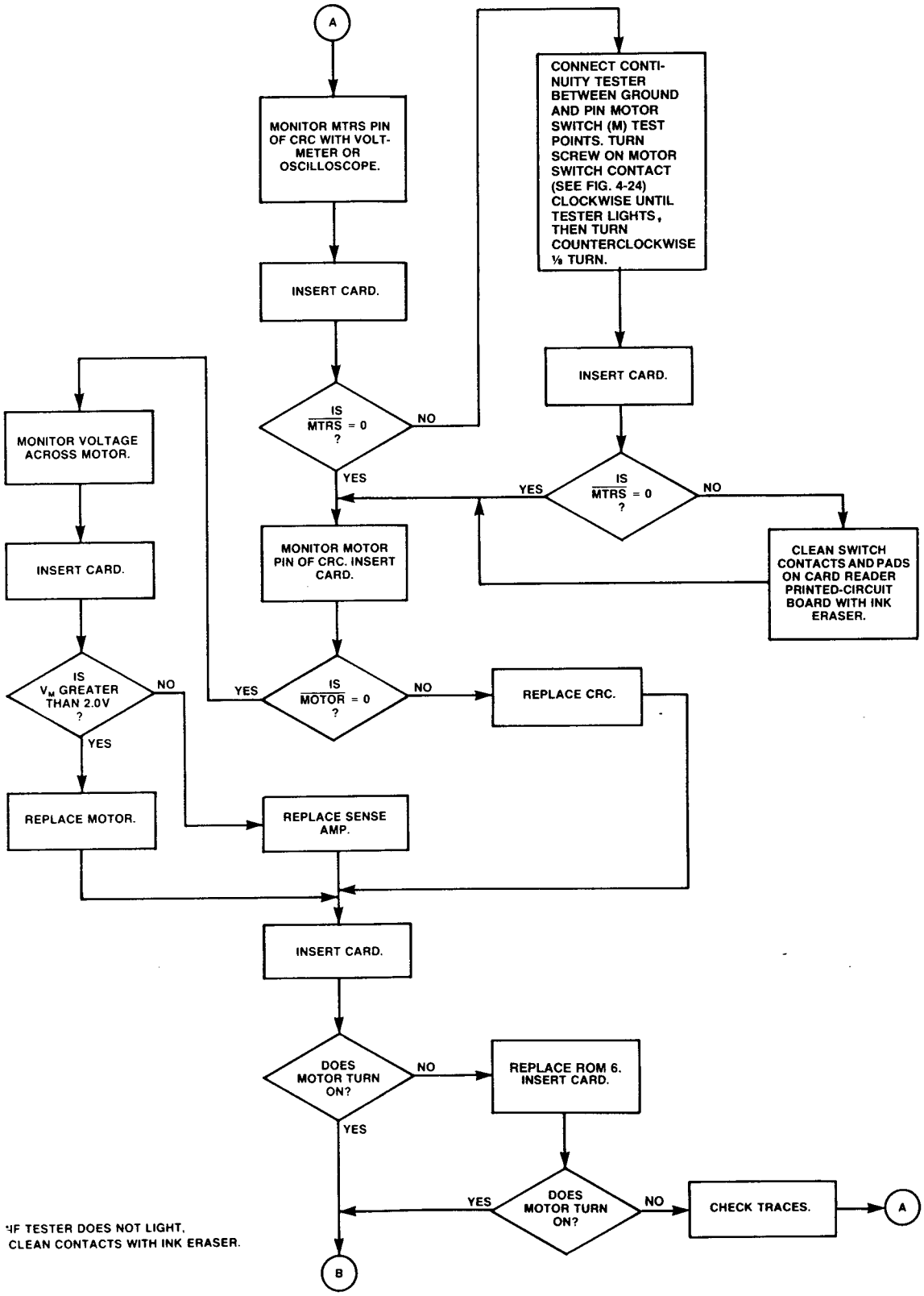


Figure 4-29. Card Reader Troubleshooting Flowchart

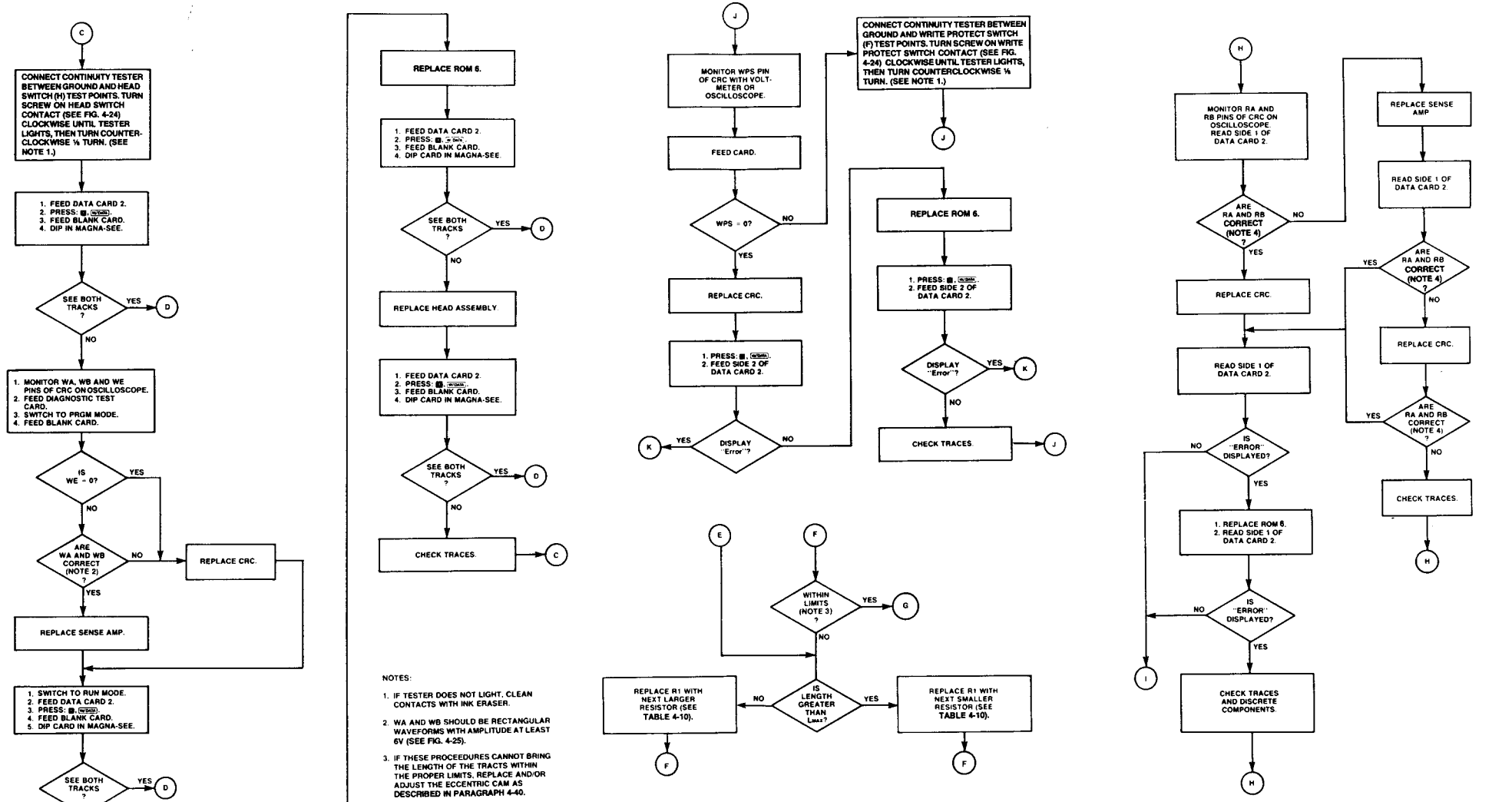


Figure 4-29. Card Reader Troubleshooting Flowchart (Continued)

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. BATTERY PACK

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

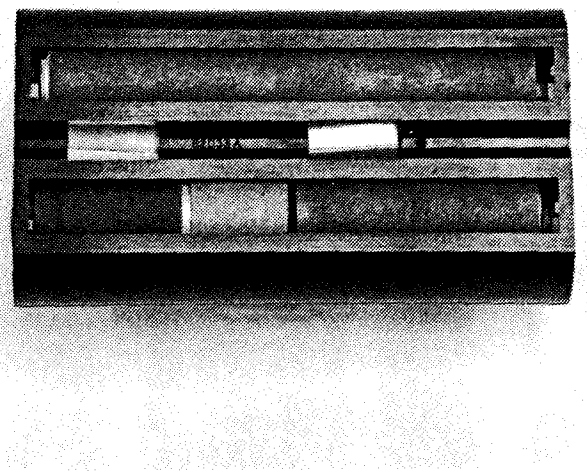


Figure 5-1. HP 82033A Battery Pack

5-5. AC ADAPTER/RECHARGER

5-6. Table 5-1 lists the various ac adapter/rechargers available for use with the HP-97. Figures 5-2 through 5-7 show 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
82031A	230	European
82032A	230	UK desktop
82032A Opt 001	230	UK with RSA plug
82039A	230	Australian
82040A	115	US
82043A	115	European

*Indicates nominal voltage; acceptable ranges are 200 to 254 Vac and 90 to 127 Vac.

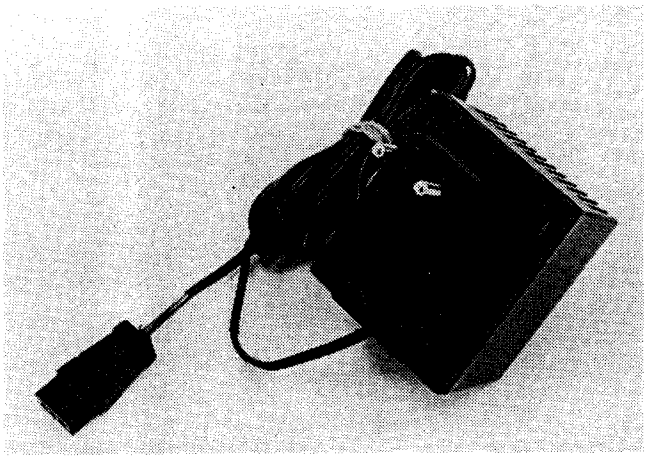


Figure 5-2. HP 82031A AC Adapter/Recharger

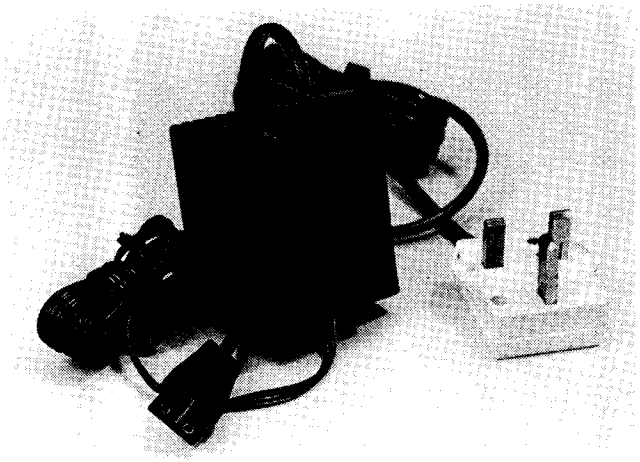


Figure 5-3. HP 82032A AC Adapter/Recharger

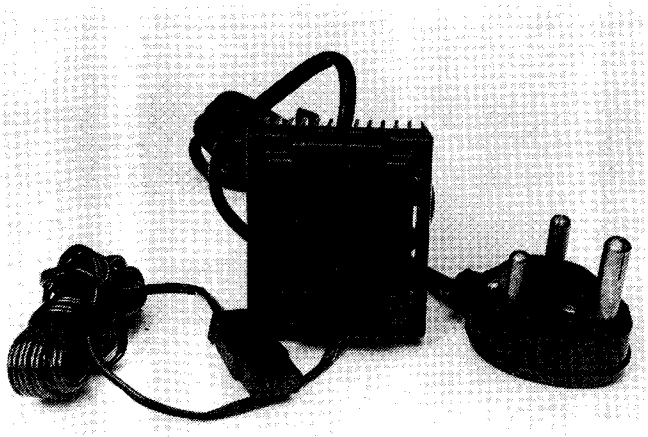


Figure 5-4. HP 82032A Opt 001 AC Adapter/Recharger

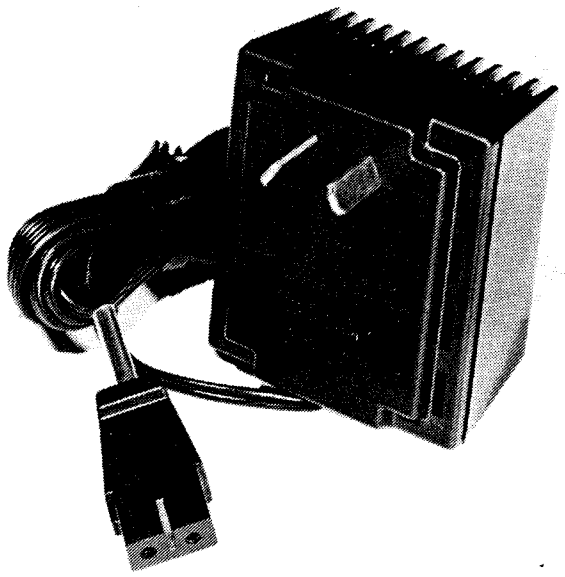


Figure 5-5. HP 82039A AC Adapter/Recharger

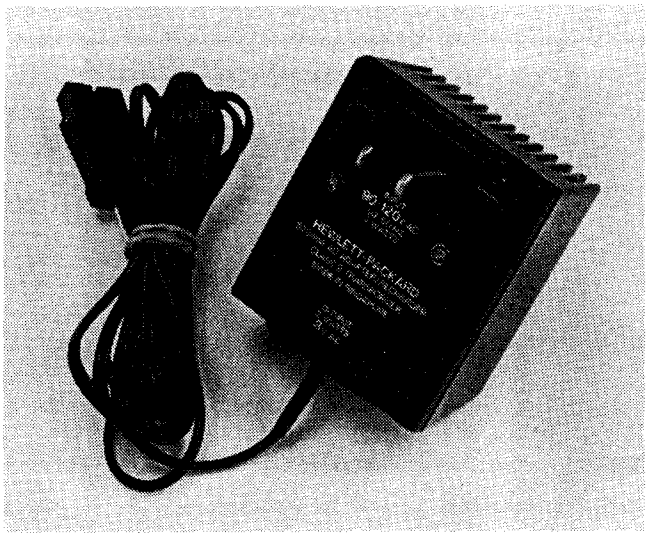


Figure 5-6. HP 82040A AC Adapter/Recharger

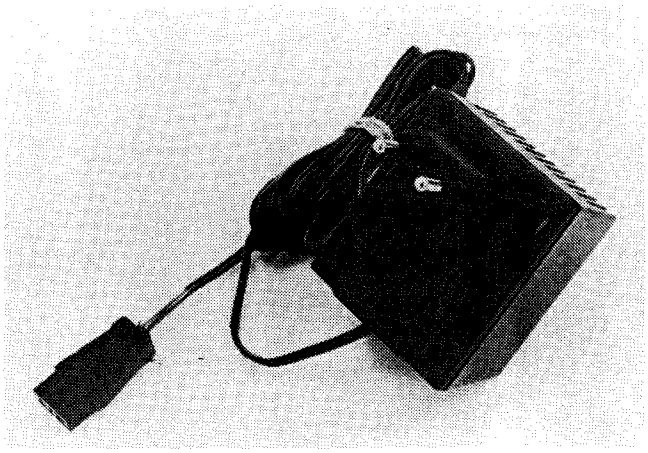


Figure 5-7. HP 82043A AC Adapter/Recharger

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 slide-out hasp. This hasp provides a convenient, strong point of attachment to the calculator. The use of the HP 82044A security cable and lock connected to the HP-97 hasp, securely ties down the calculator to prevent theft. (See figure 5-8.)

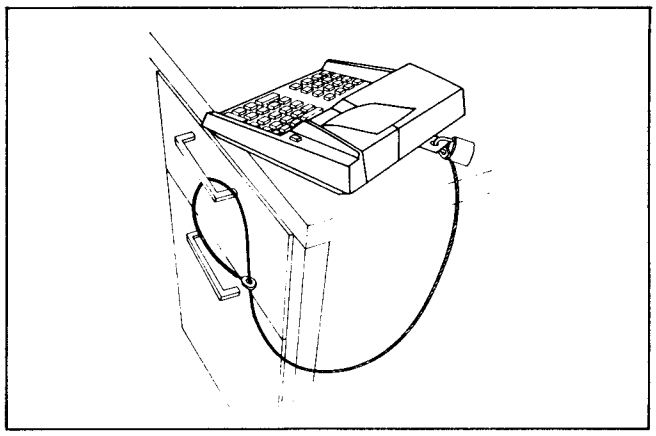


Figure 5-8. HP 82044 Security Cable and Lock

5-10. Conditions of Replacement

5-11. Replace when cable, lock or hasp 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 82037A Reserve Power Pack:

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

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

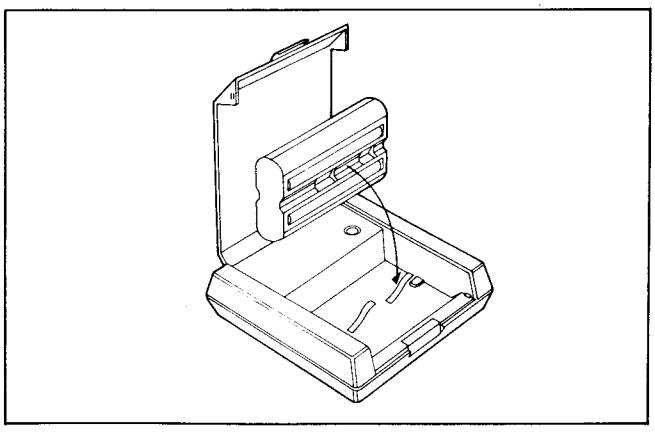


Figure 5-9. Reserve Power Pack

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 82037A Reserve Power Pack:

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

b. Weight: 3½ 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 connector from an ac adapter/recharger into the bottom of the reserve power pack. Then plug the ac adapter/recharger into a 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.

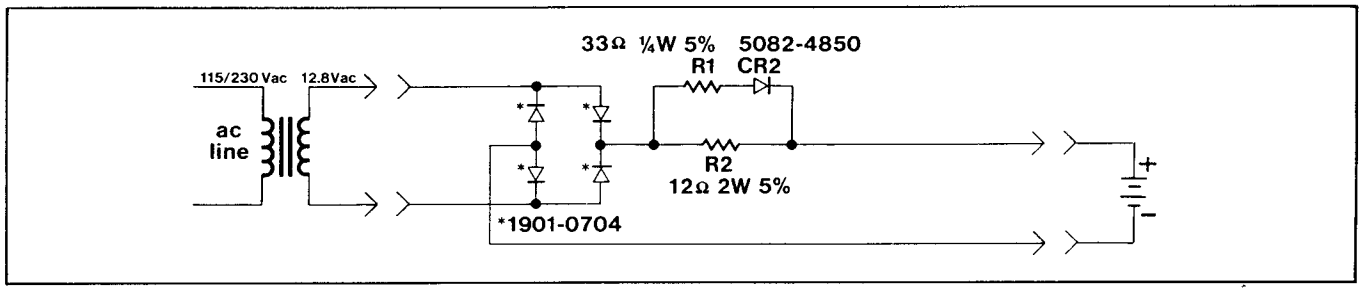


Figure 5-10. Reserve Power Pack Schematic Diagram

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	00097-60001	PCA A1, logic (refer to table 4-6)	1
2		ASSEMBLY A2, keyboard (refer to table 6-2)	1
3	00097-60004	ASSEMBLY A3, card reader (refer to table 6-4)	1
4	00097-60010	ASSEMBLY A4, printer (refer to table 6-3)	1
5		ASSEMBLY A5, bottom case	1
	00091-60013	• ASSEMBLY, power pack	1
	5040-9204	• DOOR, battery	1
	5040-9440	• LATCH, battery door	2
	0460-1218	• TAPE, battery door	1
	5040-9202	• CASE, bottom	1
	5040-9207	• FOOT	4
6		ASSEMBLY A6, support plate	1
	5040-9206	• PLATE, support	1
	0363-0067	• CONTACT, battery	2
	1600-0525	• HASP, security	1
	0624-0354	• SCREW, 4-20 × 0.5	2
	3050-0227	• WASHER, 0.149 ID	2
7		ASSEMBLY A7, top case	1
	5040-9709	• CASE, top	1
	00091-60016	• ASSEMBLY, paper advance switch	1
	1460-1465	• SPRING, compression	1
	5040-9213	• BUTTON, paper advance switch	1
	00097-60008	ASSEMBLY, recharger pin holder	1
	5040-9208	COVER, paper	1
	2190-0891	WASHER	3
	0400-0009	GROMMETT, vinyl	3
	0624-0354	SCREW, 4-20 × 0.5	20
	0624-0355	SCREW, 4-20 × 0.375	8

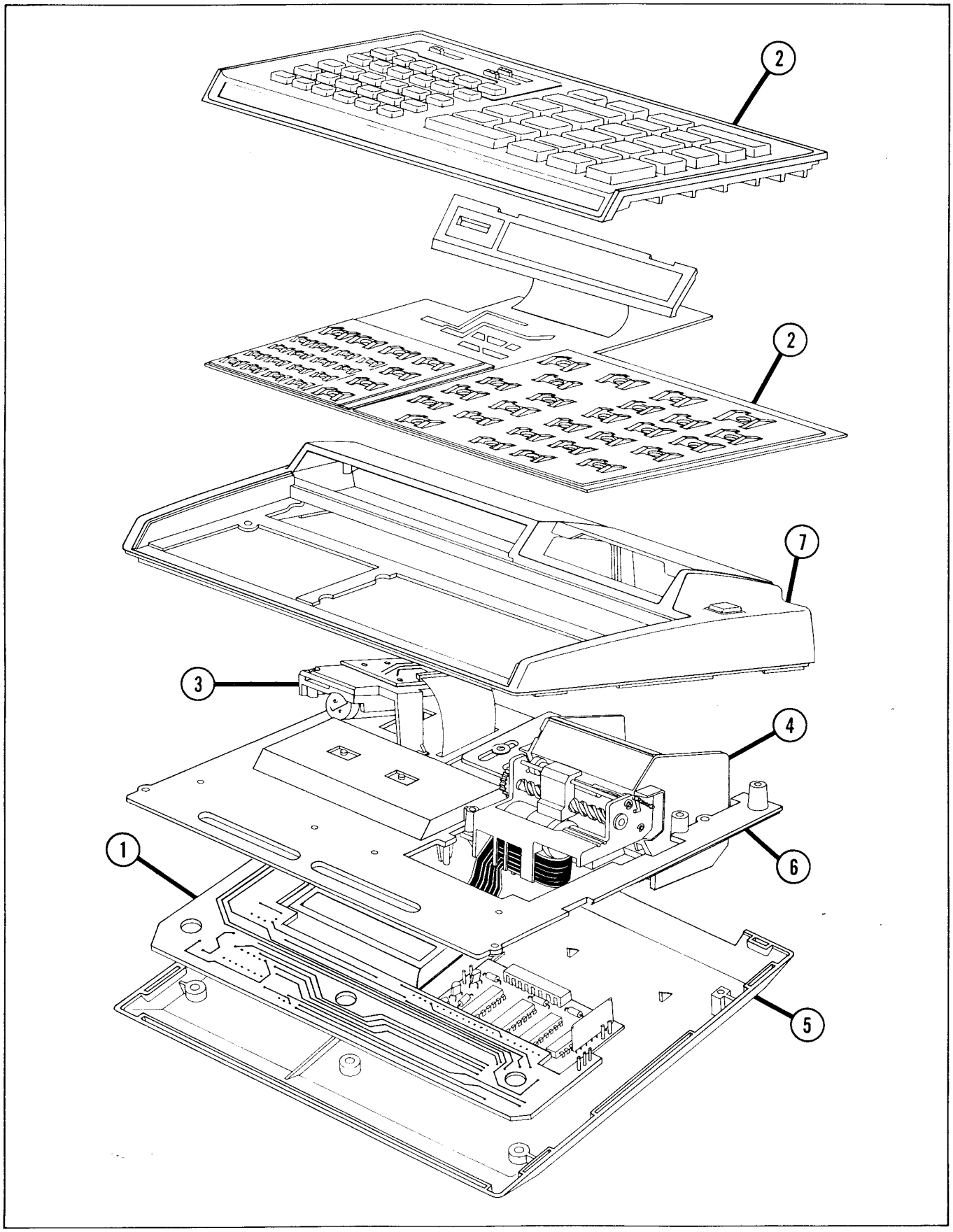


Figure 6-1. HP-97 Exploded View

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

HP PART NUMBER	DESCRIPTION	QTY
00097-60002	PCA A2A1, keyboard (refer to table 4-9)	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, CL x	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, ×	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
5040-9298	• KEY, f	1
5040-9299	• KEY, Σ+	1
5040-9401	• KEY, A	1
5040-9402	• KEY, B	1
5040-9403	• KEY, C	1
5040-9404	• KEY, D	1
5040-9405	• KEY, E	1
5040-9406	• KEY, LBL	1
5040-9407	• KEY, GTO	1
5040-9408	• KEY, GSB	1
5040-9409	• KEY, RTN	1
5040-9410	• KEY, BST	1
5040-9411	• KEY, SST	1
5040-9412	• KEY, y^x	1
5040-9413	• KEY, LN	1
5040-9414	• KEY, e^x	1
5040-9415	• KEY, →P	1
5040-9416	• KEY, STO	1
5040-9417	• KEY, RCL	1
5040-9418	• KEY, SIN	1

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

HP PART NUMBER	DESCRIPTION	QTY
5040-9419	• KEY, COS	1
5040-9420	• KEY, TAN	1
5040-9421	• KEY, →R	1
5040-9422	• KEY, (i)	1
5040-9423	• KEY, I	1
5040-9424	• KEY, R/S	1
5040-9425	• KEY, 1/x	1
5040-9426	• KEY, x^2	1
5040-9427	• KEY, $\sqrt{x}$	1
5040-9428	• KEY, %	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-			
		PCA A4A1, printer (refer to table 4-7)	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	5040-8996	GEAR, idler	1
8	5040-8997	PUSHER, platen	1
9	5040-8998	HOLDER, platen pusher	1
10	5040-8999	BAR, tear	1
11	5040-9201	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 × 0.40, 5 mm	3
18	0570-0905	SCREW, 1-72 × 0.312 in.	2
19	0624-0303	SCREW, 2-28 × 0.312 in.	3
20	1460-1461	SPRING, extension	2
21	1460-1505	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	1600-0540	CONTACT, sensor	1
28	1600-0540	SENSOR	1
29	3050-0626	WASHER, flat	1
30	5020-9234	LEAD SCREW, microsealed	1
	9270-0513	PAPER, thermal	1/6

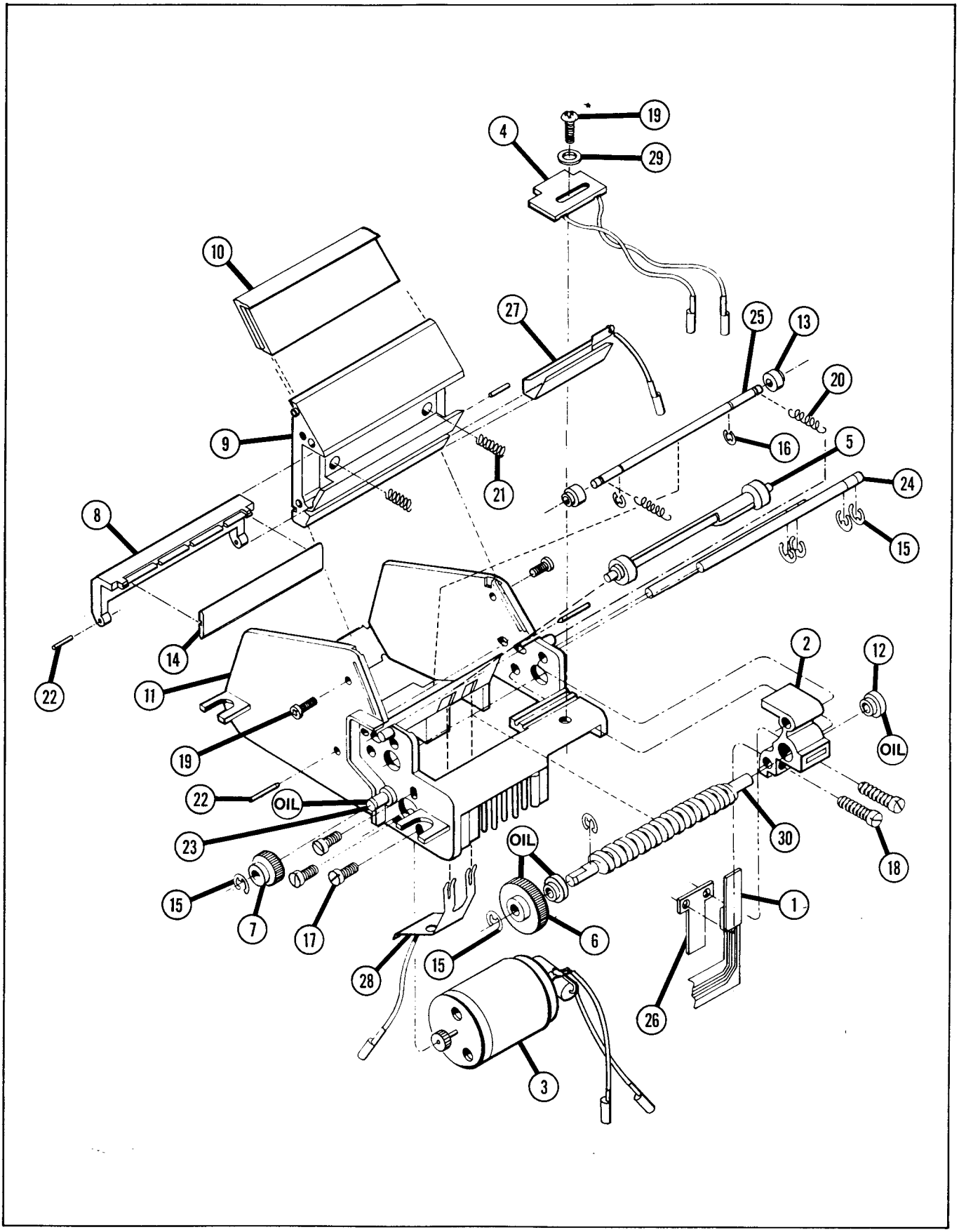


Figure 6-2. Printer Assembly Exploded View

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

FIGURE & INDEX NUMBER	HP PART NUMBER	DESCRIPTION	QTY
6-3-			
		PCA A3A1, card reader (refer to table 4-10)	1
	8120-2301	CABLE, interconnecting	1
1	00067-60904	ASSEMBLY, motor, service	1
2	00067-60905	ASSEMBLY A3A2, head, service	1
3	00067-60910	ASSEMBLY, drive roller, service	1
4	5040-9479	SUPPORT, card reader	1
5	00065-20201	ROLLER	1
6	0516-0031	SCREW, machine	2
7	00065-20202	CAM, eccentric	1
8	0624-0393	SCREW, 2-28 × 0.375	3
9	0624-0307	SCREW, 2-28 × 0.250	3
10	0624-0308	SCREW, 0-48 × 0.085	5
11	00097-00001	SWITCH, card reader	1
12	1410-0848	BEARING, ball	4
13	1460-0558	SPRING, side load	2

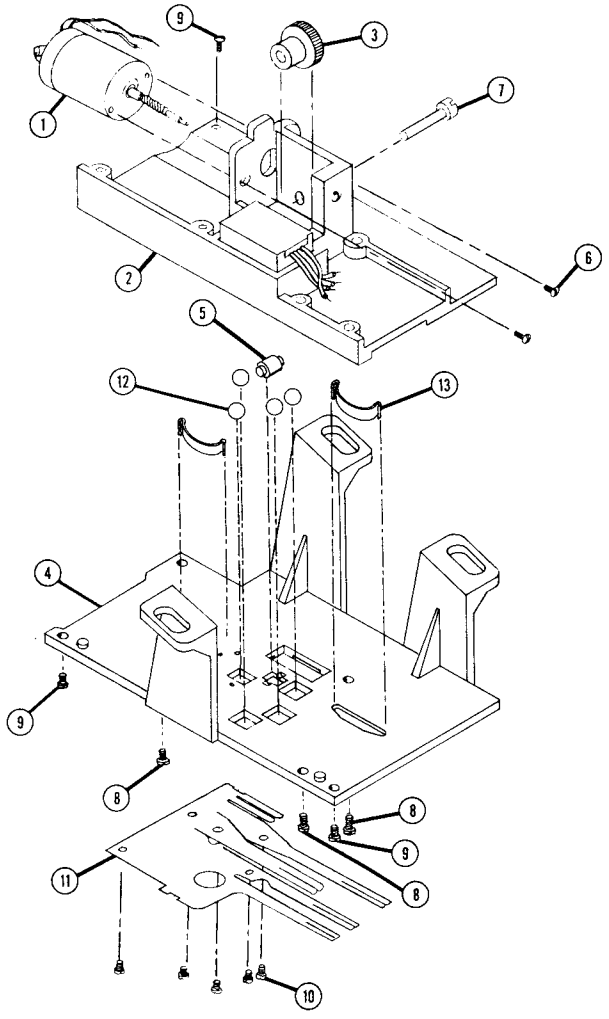


Figure 6-3. Card Reader Exploded View

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 MAN NORM is set to NORM or TRACE, the word Error will be printed (unless the calculator is out of paper). The following are improper operations:

x^{-1}	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 × ⊡, STO ÷ ⊡, where magnitude of number in storage register ⊡ would then be larger than $9.999999999 \times 10^{99}$.

STO + (i), STO − (i), STO × (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

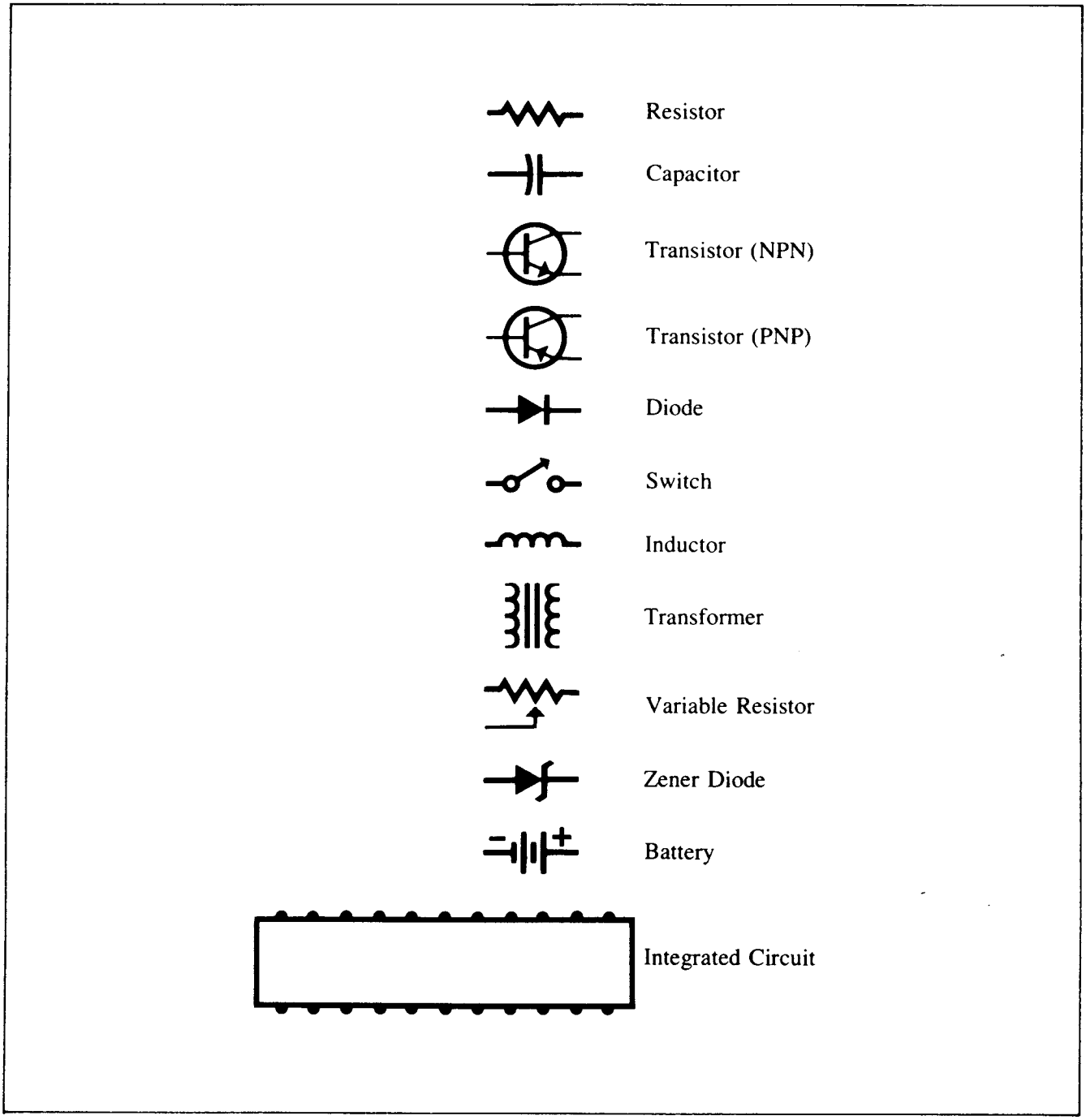


Figure B-1. Symbol Identification

Table B-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

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

ABBREVIATIONS

A	= amperes
ac	= alternating current
Ag	= silver
Al	= aluminum
ar	= as required
adj	= adjust
assy	= assembly
b	= base
bp	= bandpass
bpi	= bits per inch
blk	= black
blu	= blue
brn	= brown
brs	= brass
Btu	= British thermal unit
Be Cu	= beryllium copper
cpi	= characters per inch
coll	= collector
cw	= clockwise
ccw	= counterclockwise
cer	= ceramic
com	= common
crt	= cathode-ray tube
CTL	= complementary-transistor logic
cath	= cathode
Cd pl	= cadmium plate
comp	= composition
conn	= connector
compl	= complete
dc	= direct current
dr	= drive
DTL	= diode-transistor logic
depc	= deposited 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 (10^9)
Ge	= germanium
gl	= glass
gnd	= ground(ed)
gra	= gray
grn	= green
H	= henries
Hg	= mercury
hr	= hour(s)
Hz	= hertz
hdw	= hardware
hex	= hexagon, hexagonal
ID	= inside diameter
IF	= intermediate frequency
in.	= inch, inches
I/O	= input/output
int	= internal
incl	= include(s)
insul	= insulation, insulated
impgrg	= impregnated
incand	= incandescent
ips	= inches per second
k	= kilo (10^3), kilohm
lp	= low pass
m	= milli (10^{-3})
M	= mega (10^6), megohm
My	= Mylar
mfr	= manufacturer
mom	= momentary
mtg	= mounting
misc	= miscellaneous
met. ox.	= metal oxide
mintr	= miniature
n	= nano (10^{-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
p	= pico (10^{-12})
PC	= printed circuit
PCA	= printed-circuit assembly
PWB	= printed-wiring board
phh	= phillips head
pk	= peak
p-p	= peak-to-peak
pt	= point
prv	= peak inverse voltage
PNP	= positive-negative-positive
pwv	= peak working voltage
porc	= porcelain
posn	= position(s)
pozi	= pozidrive
rf	= radio frequency
rdh	= round head
rms	= root-mean-square
rwv	= reverse working voltage
rect	= rectifier
r/min	= revolutions per minute
RTL	= resistor-transistor 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
Ti	= titanium
tgl	= toggle
thd	= thread
tol	= tolerance
TTL	= transistor transistor logic
U(μ)	= micro (10^{-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 troubleshooting 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 thoroughly check out and troubleshoot the HP-97:

a. Program memory test program card.

b. Functional test program card.

c. Data card 1.

d. Data card 2.

e. Diagnostic test program card.

C-5. All five cards are required for assembly-level maintenance; all but the diagnostic test card are required for component-level maintenance of the logic PCA. The diagnostic test card and data card 1—which is the blank (erased) card—are required also for component-level maintenance of the card reader assembly.

C-6. 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-7. PROGRAM MEMORY TEST PROGRAM CARD

C-8. 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-9. The listing of this program is given in figure C-1 below. 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
013   ISZI
014   ISZI
015   ISZI
016   ISZI
017   ISZI
 •     •
 •     •
 •     •
220   ISZI
221   ISZI
222   ISZI
223   RCLI
224    R/S
```

Figure C-1. Program Memory Test Program

C-10. FUNCTIONAL TEST PROGRAM CARD

C-11. 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-12. The listing of this program is given in table C-1.

Table C-1. Functional Test Program

001	0	057	DF?	113	GTO1	169	SIN
002	CLRG	058	MRG	114	GTO2	170	LOG
003	9	059	PSE	115	R/S	171	×
004	1/X	060	FS?	116	*LBL1	172	X≠Y
005	7	061	RTN	117	GTO1	173	1/X
006	×	062	GTO6	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	8	066	GTO4	122	X^2	178	SIN
011	÷	067	X=0?	123	X≠Y	179	COS⁻¹
012	STO1	068	GTO4	124	CHS	180	√X
013	2	069	X>Y?	125	√X	181	Y^x
014	4	070	GTO4	126	÷	182	X≠Y
015	X≠I	071	F0?	127	÷	183	10^x
016	GSB4	072	GTO4	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	GSB1	076	GTO4	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	GTO4	136	RND	192	TAN⁻¹
025	GSB1	081	X<0?	137	X≠Y	193	×
026	GSB1	082	GTO4	138	÷	194	→P
027	GSB1	083	X=Y?	139	→HMS	195	Y^x
028	RTN	084	GTO4	140	-	196	LN
029	*LBL1	085	X≠0?	141	HMS→	197	→R
030	STO1	086	GTO1	142	X≠Y	198	CHS
031	RCL1	087	GTO4	143	DSP0	199	→P
032	X≠Y?	088	*LBL1	144	RND	200	X≠Y
033	GTO4	089	P≠S	145	N!	201	÷
034	DSZI	090	RCL3	146	×	202	SIN⁻¹
035	RTN	091	X≠0?	147	√X	203	e^x
036	RTN	092	GTO4	148	RCLI	204	GSB0
037	*LBL2	093	P≠S	149	LSTX	205	RCLA
038	PSE	094	CLX	150	×	206	RCLB
039	WDTA	095	RCL0	151	×	207	RCLC
040	E	096	INT	152	ST+1	208	RCLD
041	STO6	097	LSTX	153	ST×1	209	ENG
042	GSB6	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	GTO4	101	RAD	157	RCL1	213	PREG
046	RCL2	102	R↓	158	GSB0	214	SPC
047	RCL1	103	CLX	159	PI	215	RCLE
048	X≠Y?	104	R↑	160	COS	216	×
049	GTO4	105	ENT↑	161	R→D	217	R/S
050	EEX	106	X≠Y	162	TAN	218	*LBL0
051	2	107	GSB0	163	COS⁻¹	219	RCL1
052	X≠I	108	ENT↑	164	X≠Y	220	X≠Y?
053	GSB6	109	Σ+	165	CHS	221	GTO4
054	X≠I	110	+	166	LN	222	DSZI
055	GTO2	111	%	167	+	223	PSE
056	*LBL6	112	Σ+	168	DEG	224	RTN

C-13. DATA CARD 1

C-14. 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-15. A number of cards can be erased at one time for use in later repairs 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-16. DATA CARD 2

Table C-2. Data Card 2

REGISTER	NUMBER
0	5.861779945+01
1	0.000000000+00
2	3.088997258+01
3	-2.238303285+21
4	4.381773670+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	9.000000000-77
I	-3.000000000+00

C-17. Data card 2 is used in conjunction with the functional test. It can 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-18. DIAGNOSTIC TEST PROGRAM CARD

C-19. This diagnostic test program is used to ensure that the calculator will not fail when the user runs the diagnostic program supplied with the HP-97 Standard Pac (of which this program is a modification). A listing of the diagnostic test program for assembly-level maintenance is given in table C-3.

C-20. The diagnostic test program card can be generated from the diagnostic program card SD-15A supplied with the Standard Pac as follows:

a. Switch a working calculator ON.

b. Switch to RUN mode.

c. Insert side 1 of the Standard Pac card SD-15A.

d. Insert side 2 of the Standard Pac card SD-15A.

e. Switch to PRGM mode.

f. Press: GTO . 1 9 9

g. Press: 9 1/x 8 × CHS

h. Press: EEX 9 4 ÷ ×

i. Feed side 1 of a blank card.

j. Feed side 2 of the card.

k. Clip both notched corners of the card and label it appropriately.

Table C-3. Diagnostic Test Program

```
001  *LBLA
002   CLRG
003   P≠S
004   CLRG
005   053
006     7
007     7
008     7
009     7
010     7
011     7
012     7
013     7
014     7
015     7
016   CHS
017   EEX
018   CHS
019     7
020     7
021   X≠Y
022    R↑
023    R↑
024    R↑
025    R↑
026    R↓
027   PSE
028  *LBL0
029   STOI
030   RCLI
031   X≠Y?
032   GTOI
033   ISZI
034   RCLE
035   RCL0
036   X=Y?
037   GTO2
038   GTO8
039  *LBLI
040   RCLI
041    RTN
042  *LBL2
043     2
044     5
045   STOI
046    SIN
047   SIN⁻¹
048   GSB3
049    COS
050   COS⁻¹
051   GSB3
052    TAN
053   TAN⁻¹
054   GSB3
055     ÷P
056     ÷R
057   GSB3
058    SIN
059   →HMS
060   HMS→
061   SIN⁻¹
062   GSB3
063    LOG
064    10ˣ
065   GSB3
066     LN
067    eˣ
068   GSB3
069    X²
070    √X
071   GSB3
072   ENT↑
073    Yˣ
074   LSTX
075    1/X
076    Yˣ
077   GSB3
078   ENT↑
079     +
080   LSTX
081     -
082   GSB3
083   ENT↑
084     ×
085   LSTX
086     ÷
087   GSB3
088    1/X
089     1
090     +
091    FRC
092    1/X
093   LSTX
094     ÷
095    INT
096   GSB3
097   D→R
098   R→D
099   GSB2
100   EEX
101     2
102   X≠Y
103     %
104   GSB3
105   GTO4
106  *LBL3
107    RND
108   RCLI
109   X≠Y?
110    R/S
111   ISZI
112   RCLI
113    RTN
114  *LBL4
115     1
116     -
117   RCLI
118   X≠Y?
119    RTN
120   ISZI
121     2
122     +
123   RCLI
124   X>Y?
125    RTN
126   ISZI
127   RCLI
128   X=0?
129    RTN
130   ISZI
131   RCLI
132   X≠0?
133   GTO6
134    RTN
135  *LBL5
136   ISZI
137   RCLI
138   X<0?
139    RTN
140   ISZI
141   RCLI
142   X>0?
143   GTO5
144    RTN
145  *LBL5
146   ISZI
147   RCLI
148   F0?
149    RTN
150   ISZI
151   RCLI
152   F1?
153    RTN
154   ISZI
155   F2?
156    RTN
157   ISZI
158   RCLI
159   F3?
160    RTN
161   ISZI
162   SF0
163   SF1
164   SF2
165   SF3
166   F0?
167   GTO6
168    RTN
169  *LBL6
170   ISZI
171   RCLI
172   F1?
173   GTO6
174    RTN
175  *LBL6
176   ISZI
177   RCLI
178   F2?
179   GTO5
180    RTN
181  *LBL6
182   ISZI
183   RCLI
184   F3?
185   GTO6
186    RTN
187  *LBL6
188   EEX
189     7
190   PRTX
191   ENG
192   DSP4
193   PRTX
194    SCI
195   PRTX
196   CF0
197   CF1
198   FIX
199   DSP2
200     9
201    1/X
202     8
203     ×
204   CHS
205   EEX
206     9
207     4
208     ÷
209     ×
210    RTN
211    R/S
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