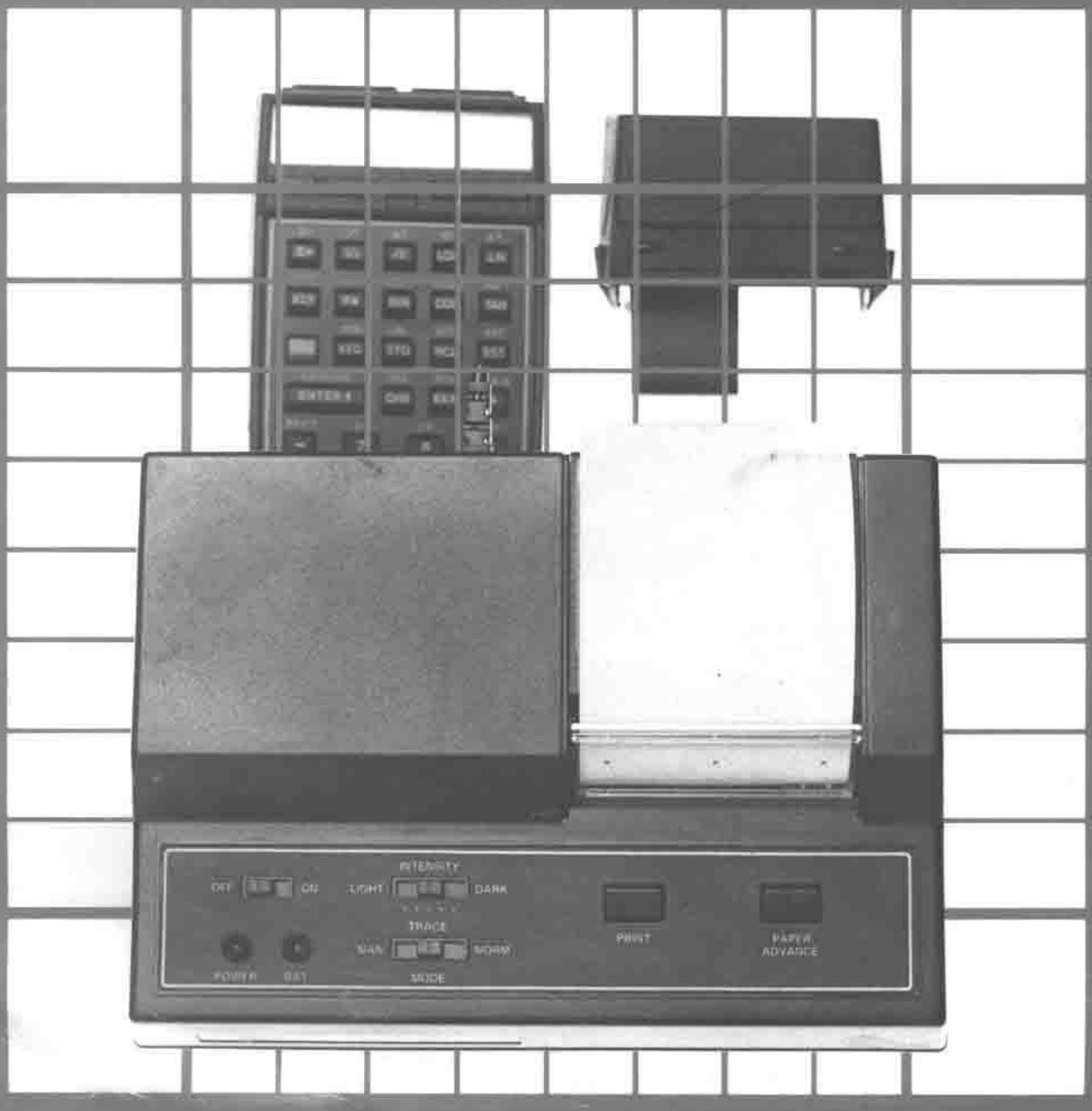
HEWLETT-PACKARD

82143A PRINTER

SERVICE MANUAL



HEWLETT hp PACKARD

HP 82143A
Printer

SERVICE MANUAL

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SECTION I

General Information

1-1. INTRODUCTION

1-2. This service manual contains information necessary to troubleshoot and repair the HP 82143A Printer.

1-3. The manual is divided into seven sections, which give:

a. A description of the printer (section I).

b. An explanation of how it works (section II).

c. Information for disassembly and reassembly (section III).

d. Steps for troubleshooting and testing the printer (section IV).

e. Information for testing electrical accessories (section V).

f. A description of the plug-in service module (section VI).

g. A list of replaceable parts (section VII).

1-4. DESCRIPTION

1-5. The HP 82143A Printer (figure 1-1) is a plug-in accessory for HP-41C style calculators. It adds printing, plotting, graphics, and special-character capabilities to the calculator system. The specifications of the HP 82143A Printer are summarized in table 1-1.

1-6. The printer mechanism in the HP 82143A is similar to that in the HP-97 calculator with the following differences:

a. A belt drive is used in place of the former gear drive.

b. An infrared detector is used to continually determine the position of the print head.

c. A soft platen is used in place of the former rigid platen.

d. A mechanical home switch is used instead of the magnetic reed switch.

Figure 1-1. HP 82143A Printer

1-7. Service procedures for the printer require a plug-in service module and an HP-41C test calculator. These units give a reliable check of certain printer components and produce a visual output of the diagnosis.

1-8. IDENTIFICATION

1-9. The serial number of the printer is used for identification and determination of warranty status. It is located on the bottom case. Its format is described opposite.

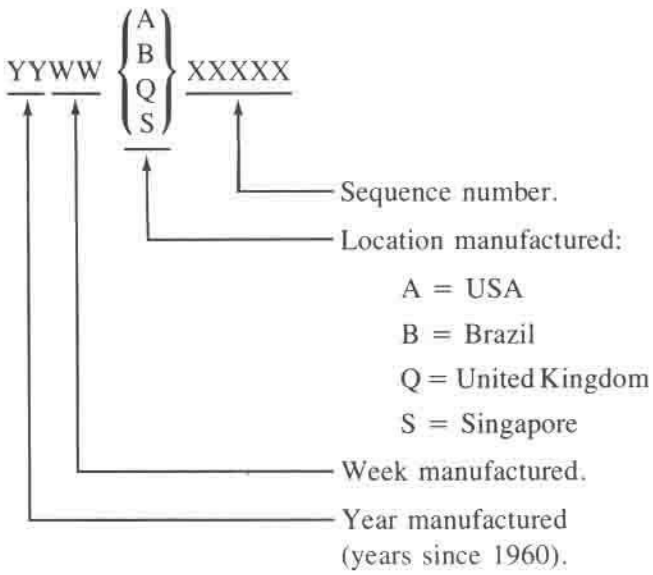


Table 1-1. Specifications

Physical Properties

- Width: 16.8 centimeters (6.61 inches).
- Depth: 13.2 centimeters (5.20 inches).
- Height: 6.2 centimeters (2.44 inches).
- Cable length: 86 centimeters (34 inches).
- Weight: 770 grams (1.5 pounds) with paper and battery.

Power

- Battery: Four-cell, 4.4- to 6.0-volt, quick-charge, nickel-cadmium battery pack.
- Battery current, worst case: 250 mA (idle). 5 A (printing).
- Recharging time: 14 to 16 hours (printer ON or OFF).

Compatibility

- Plugs into HP-41C style calculator.

Print Format

- 24 normal characters, 12 double-wide characters, 168 dot-columns per line.
- Uppercase and lowercase letters.
- Special-character generation.
- Plotting capabilities.

Temperature

- Operating: 0° to 45° C (32° to 113° F).
- Charging: 15° to 40° C (59° to 104° F).
- Storage: −40° to 55° C (−40° to 131° F).

Theory of Operation

2-1. FUNCTIONAL DESCRIPTION

2-2. The HP 82143A Printer design (see figure 2-1) consists of nine primary electrical circuits:

a. The interface circuit.
b. The processor.
c. The motor drive circuit.
d. The encoder circuit.
e. The print-head drive circuit.
f. The print-head power supply.
g. The primary power supply.
h. The power control circuit.
i. The battery circuit.

2-3. CMOS (complementary metal-oxide-semiconductor) circuitry is used in the interface hybrid circuit. The processor integrated circuit (IC) utilizes NMOS (N-channel metal-oxide-semiconductor) technology. Other circuits use conventional bipolar components. The interface circuit is located in the plug-in module on the I/O cable. The remaining circuits are on the logic PCA (printed-circuit assembly) inside the printer case.

2-4. Printed output is produced by a printer mechanism capable of printing 24 characters per line.

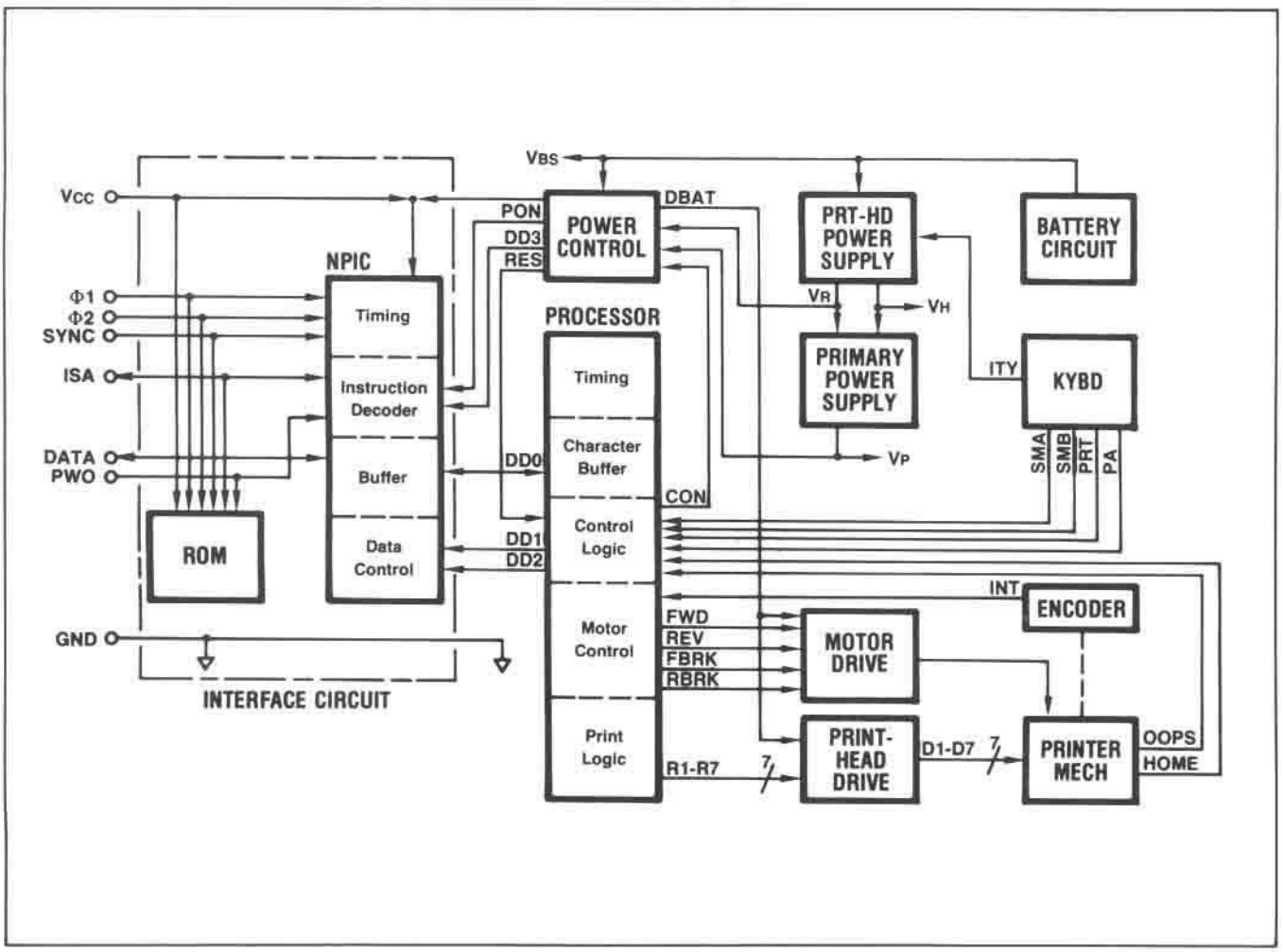


Figure 2-1. HP 82143A Printer Block Diagram

2-5. Interface Circuit

2-6. The interface hybrid circuit consists of two integrated circuits: the peripheral interface chip (NPIC) and the printer ROM (read-only memory).

2-7. Peripheral Interface Chip. The NPIC enables the CPU* in the calculator to interact with the printer's processor.* These circuits have different system clocks, signal lines, and operating speeds. (Signal names are listed in table 2-1.)

2-8. The timing generator portion of the NPIC synchronizes the NPIC with the CPU using the Φ1, Φ2, and SYNC signals.

2-9. The instruction decoder processes instructions arriving from the calculator on the ISA line. Also, in response to a PON signal from the processor in the printer, the instruction decoder puts the CPU into RUN mode by temporarily setting the ISA line high. The DD3 line indicates to the NPIC whether the printer circuits are turned on.

2-10. The data buffer consists of two 56-bit registers, one for transferring data from the CPU to the processor and one for transferring data from the processor to the CPU. The DATA line connects the CPU to the NPIC buffer; the DD0 line connects the processor to the NPIC buffer.

2-11. The data control logic directs the serial transfer of data between the buffer and the CPU or processor. Data is exchanged with the CPU in sync with the Φ1 and Φ2 signals. Data is exchanged with the processor one bit at a time in response to a series of strobe pulses on the DD1 line; the state of the DD2 line determines the direction of the data transfer (low indicates transfer to NPIC, high is to processor). Two flags indicate whether data is present in either register (that is, whether data is being transferred).

2-12. Printer ROM. The ROM contains 4096 10-bit microprogrammed instructions. These instructions are used by the CPU in the calculator to implement the 24 functions provided by the HP 82143A Printer.

2-13. Processor

2-14. The processor controls the operation of the printer in response to instructions from the calculator's CPU (transmitted via the NPIC) or from any of the printer's keys.

2-15. The timing generator uses an external inductor to determine its operating frequency. This frequency is between 3.7 and 4.0 MHz.

2-16. The character buffer consists of 44 eight-bit registers which are used to store an eight-bit code for each character to be printed. Character mode and end-of-line information are also stored in these registers.

2-17. The control logic directs the transfer of character data into the buffer via the DD0 line and the transfer of status information (such as print mode, print and

Table 2-1. Signal Names

SIGNAL	DESCRIPTION
CON	Calculator control line
D1 thru D7	Head driver lines
DATA *	Data line
DBAT	Disable/battery line
DD0 thru DD3	Interface lines
FWD	Forward motor control
FBRK	Forward motor brake
GND *	Ground
HOME	Home switch line
INT	Encoder interrupt line
ISA *	Instruction/address line
ITY	Intensity control line
LB	Low-battery line
OOPS	Out-of-paper switch line
PA	PAPER ADVANCE switch line
PON	Power control line
PRT	PRINT switch line
PWO *	Power on/off line
R1 thru R7	Head control lines
RBRK	Reverse motor brake
RES	Processor reset line
REV	Reverse motor control
SMA and SMB	MODE switch lines
SYNC *	Timing/information line
V_{BS}	Switched battery voltage
V_{CC} *	Calculator voltage
V_H	Print-head voltage
V_P	Primary voltage
V_R	Reference voltage
Φ1 *	Timing line
Φ2 *	Timing line

* Interfaces with calculator.

* Throughout this manual, "CPU" refers to the central processing unit in the *calculator* and "processor" refers to the control unit in the *printer*.

paper-advance key status, out-of-paper status, character mode) to the CPU via the DD0 line and the NPIC. The logic also ensures that the calculator is put into RUN mode when the PRINT or PAPER ADVANCE key is pressed.

2-18. The motor control section of the processor monitors the interval between pulses from the encoder via the INT line. During forward movement of the head carriage, the processor pulls the FWD line low each time the interval is longer than approximately 2400 microseconds. During reverse movement, the REV line is continuously pulled low. When the head carriage is to be stopped (as determined by counting encoder pulses during forward motion and by sensing HOME low during reverse motion), the FBRK and RBRK lines are both pulled low for approximately 32 milliseconds.

2-19. The print logic converts character strings contained in the buffer into a sequence of signals that activate the seven print-head resistors via lines R1 through R7. At the appropriate times, individual lines are brought low for approximately 1200 microseconds to produce a printed dot. Any dot that immediately follows a dot on the same line is generated by a signal that is interrupted for 300 microseconds; this compensates for residual heat from the previous dot. Special print modes (such as double-wide and lower case) are implemented by the print logic section.

2-20. Motor Drive Circuit

2-21. The motor drive circuit (see figure 2-2) drives the printer motor in both forward and reverse directions and brakes the motor in each direction. When the FWD line is brought low by the processor, the buffered signal turns on transistors Q8C, Q4, and Q6. This produces a forward voltage on the motor. Similarly, a low signal on the REV line turns on transistors Q8D, Q5, and Q7, producing a reverse voltage on the motor. When either of these signals is removed, inductive spikes generated by the motor are shunted to the battery by diode bridge CR8. The motor is braked by pulling FBRK and RBRK low, causing Q8B, Q6, Q8A, and Q7 to staturate, effectively shorting the motor terminals. The voltage generated by the rotating armature causes Q6 to go into reverse saturation for forward rotation (Q7 for reverse rotation), and the kinetic energy is rapidly dissipated.

2-22. Encoder Circuit

2-23. The encoder circuit (see figure 2-3) consists of an infrared encoder and comparator circuit. Infrared energy emitted by the LED (light-emitting diode) in the encoder is intermittently reflected by the toothed encoder wheel on the printer mechanism. Reflected energy causes the phototransistor in the encoder to turn on. When the phototransistor is on, the positive input to the comparator is higher than the negative, and the comparator output is high. When the phototransistor is off, the comparator output is low.

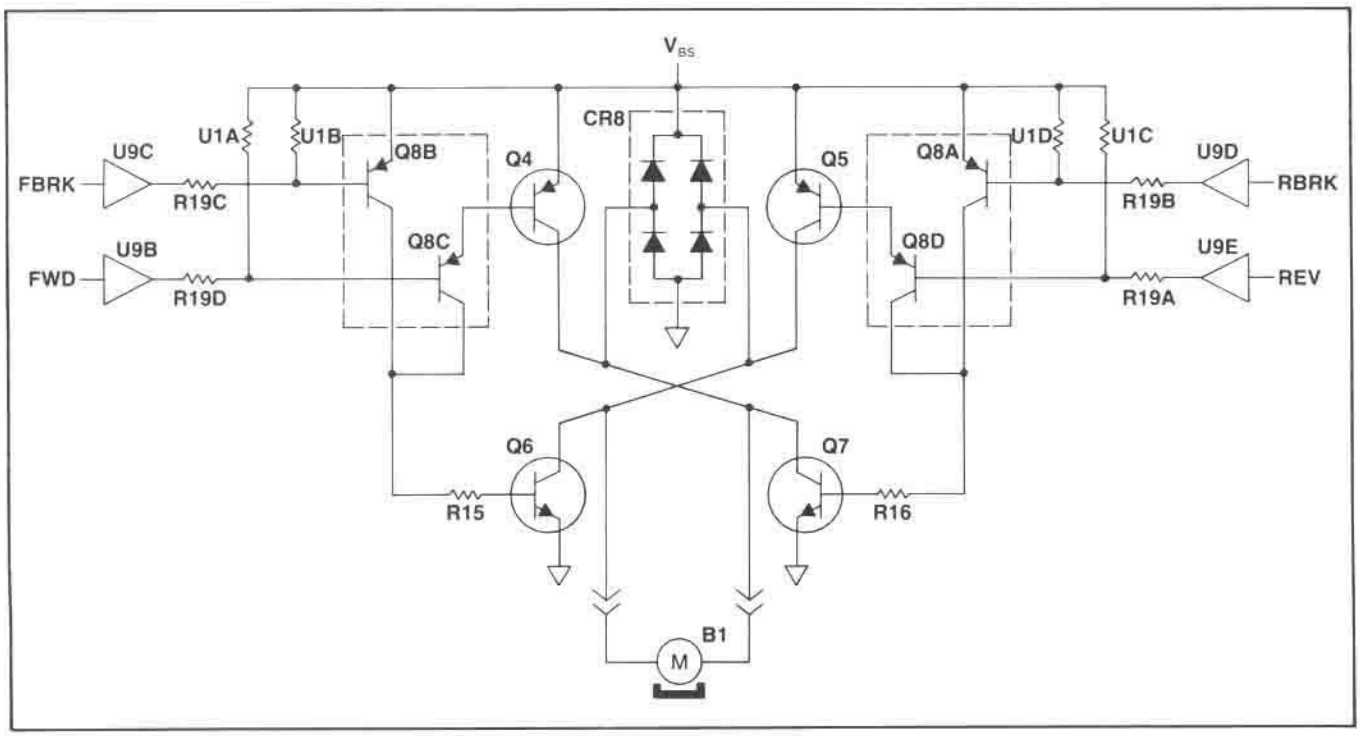


Figure 2-2. Motor Drive Circuit

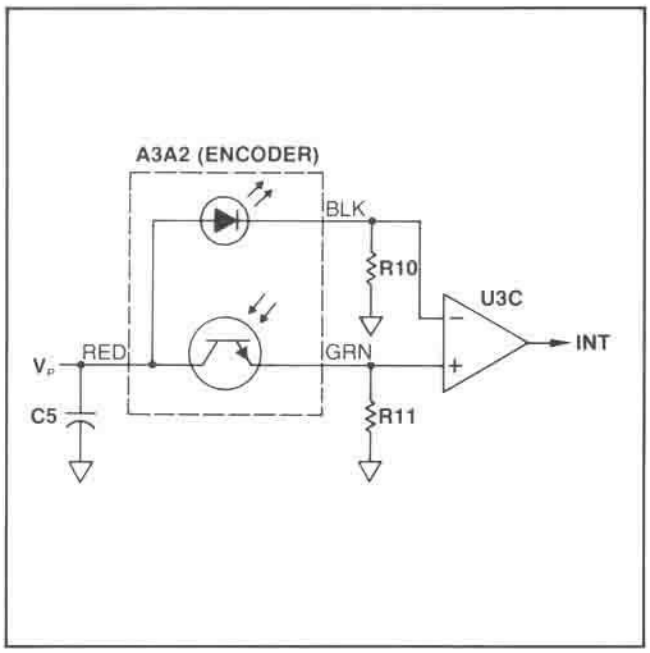


Figure 2-3. Encoder Circuit

2-24. Print-Head Drive Circuit

2-25. The print-head drive circuit drives the seven individual print-head resistors in response to signals from the processor. Each of the seven circuits (see figure 2-4) is activated by a low signal on the driver input line (R1, for example). If the buffered DBAT signal is also low, the driver output (D1) is pulled low, turning on the print-head resistor. If DBAT is high, the drive circuit is disabled.

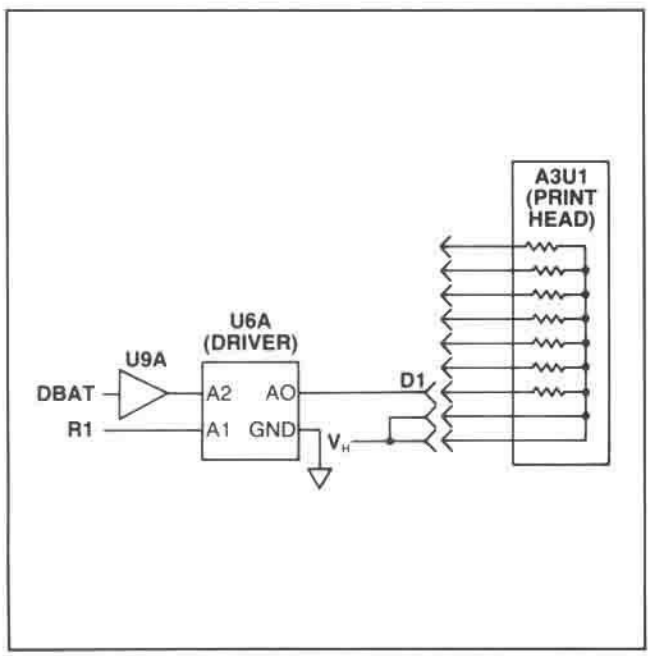


Figure 2-4. Print-Head Drive Circuit

2-26. Print-Head Power Supply

2-27. The print-head power supply (see figure 2-5) provides nominally 15 Vdc to the print-head drive circuit and the primary power supply. It also provides a 5 Vdc reference voltage to the primary power supply.

2-28. The switched battery line (V_{BS}) provides nominally 5V to the regulated power supply module (PS1). Its output powers the 5V reference IC (U2). The voltage divider network (R5 through R9) and the five-position print-intensity switch determine the reference control voltage (approximately 2.3 to 2.8 Vdc), which regulates the voltage V_H generated by PS1. The print intensity is determined by V_H. Capacitor C3 stores power for peak loads. Diodes CR4 and CR5 provide a control voltage during turn-on, but are normally reverse-biased.

2-29. Primary Power Supply

2-30. The primary power supply (see figure 2-6) provides 5 Vdc to the processor, encoder circuit, print-head drive circuits and power control circuit. It operates from the 15V print-head power supply and uses the 5V reference voltage for its regulation.

2-31. With transistor Q1 turned off and output voltage V_P lower than reference voltage V_R (causing the output from comparator U3D to be open), transistor Q2

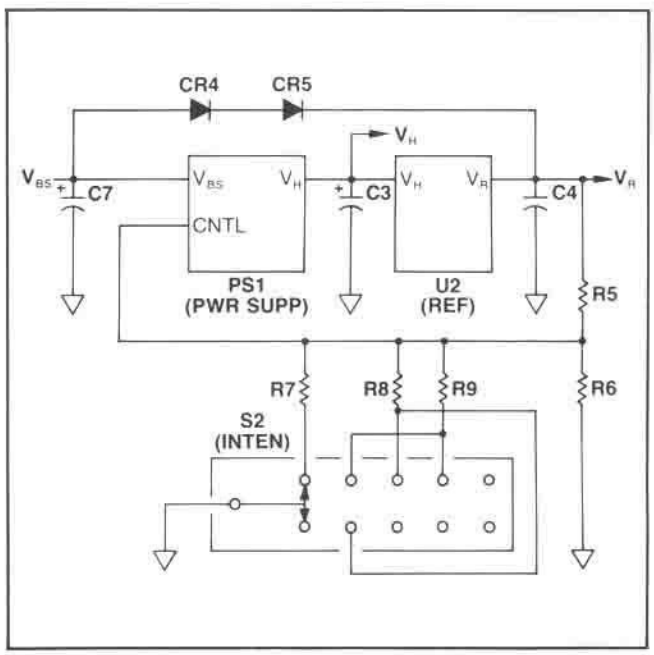


Figure 2-5. Print-Head Power Supply

is turned off and capacitor C1 charged through T1B and R3. When C1 becomes sufficiently charged, Q1 saturates, placing approximately 10V across T1A. This produces approximately 3.4V across T1B, causing current to flow through CR2 and R2 and causing C1 to charge in the reverse direction. At the same time, the current through T1A to C2 and the load increases linearly until V_P exceeds V_R, causing the output of U3D to go low, turning Q2 on and Q1 off. The energy stored in T1A causes a voltage reversal that maintains the current flow, drawing current through CR3 and supplying it to C2 and the load. A corresponding voltage reversal at T1B forces Q2 into temporary reverse saturation until C1 discharges sufficiently. It then continues charging through R3. When V_P eventually falls below V_R, the output of U3D goes high, turning Q2 off. When the energy stored in T1 is dissipated, the reverse voltages on T1A and T1B vanish, letting the voltage on C1 turn on Q1. This cycle repeats as required to keep V_P within 0.1V of V_R. Diode CR6 suppresses transient voltage spikes on V_P.

2-32. Transformer T1 and capacitor C2 are the primary energy-storing components in this circuit. Typically, Q1 is on and T1 stores energy during approximately 30 percent of the cycle.

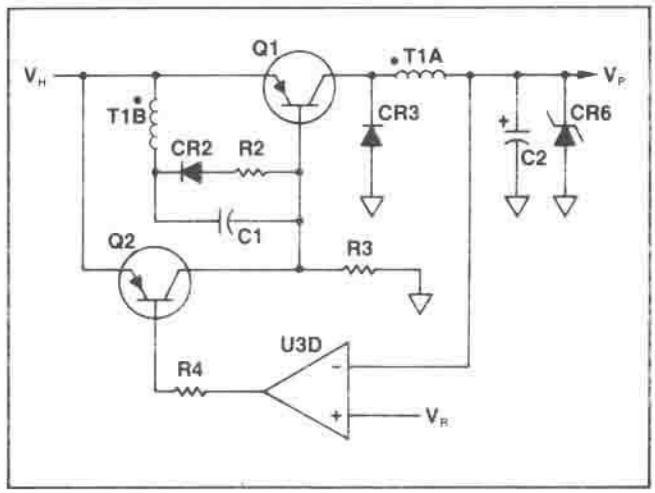


Figure 2-6. Primary Power Supply

2-33. Power Control Circuit

2-34. The power control circuit (see figure 2-7) senses and responds to various conditions of the battery voltage and the primary supply voltage. If the battery voltage (V_{BS}) falls below 4.34V, the BAT warning light is turned on, but the printer is still operable. If the primary voltage (V_P) falls below 4.75V, the POWER light is turned off and the printer is disabled.

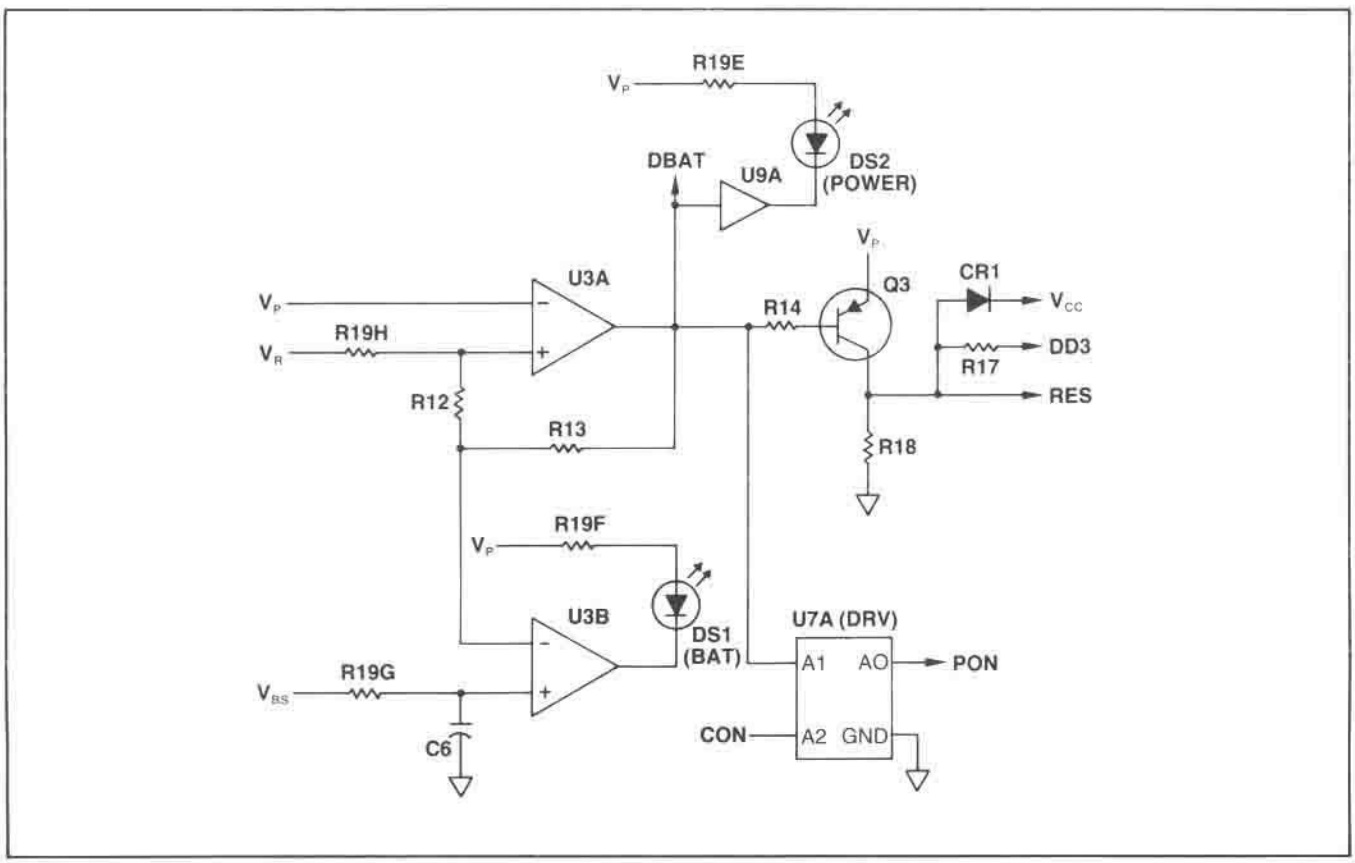


Figure 2-7. Power Control Circuit

2-35. When the printer is turned on, a reference voltage V_R is immediately established, causing the output DBAT from comparator U3A to be high. In this condition, the POWER light DS2 is off and transistor Q3 is off, setting RES low (resetting the processor), setting DD3 low (indicating to the NPIC that the printer circuits are turned off), and allowing V_{CC} to be controlled by the calculator. This high signal to driver U7A causes the output line to the NPIC to be open (disabled). When V_P reaches V_R, DBAT goes low, turning on DS2 and Q3. This sets RES high to the processor, DD3 high to the NPIC, and ensures that V_{CC} from the calculator will not fall significantly below V_P. (This latter condition prevents 5V signals from the processor from damaging the NPIC, which is powered by V_{CC}.) The low DBAT signal also enables U7A, so that a low CON signal from the processor is transmitted to the NPIC. The positive input to U3A is reduced to 4.75V, so that DBAT does not change unless V_P drops below this lower threshold (due to either a dead battery or power turn-off).

2-36. When V_P has been established, the negative input to comparator U3B is 4.34V. If the battery voltage V_{BS} falls below this level, the U3B output goes low, turning on the BAT light DS1.

2-37. Battery Circuit

2-38. The battery circuit (see figure 2-8) enables the nickel-cadmium battery pack in the printer to be charged using ac power. A transformer in the recharger drops the line voltage to 11.6 Vac at the input terminals of the printer. Diode bridge CR7 rectifies the alternating current, and resistor R1 limits the charging current to the battery pack when the printer is off. When the printer is turned on (by switch S1), R1 is shunted, providing sufficient current to operate the printer and charge the battery pack.

CAUTION

The printer may be damaged by operating it with the recharger connected and the battery pack removed.

2-39. Printer Mechanism

2-40. The printer mechanism consists of a thermal print head mounted in a carriage which moves it across the paper. The paper is backed up by a resilient platen that maintains close contact between the head and the paper.

2-41. The print head consists of a column of seven 85-ohm, thin-film resistors deposited on a ceramic substrate. The resistors rapidly heat and cool in response to electrical pulses. As the print head travels across the heat-sensitive paper, the selectively pulsed resistors leave a trail of dots. Each dot, approximately 0.3 mm on a side, is the result of a chemical reaction in the paper, which is coated with two types of pulverized thermoreaction compounds plus a binder. The chemical reaction changes the color of the paper at the point of heat application. The processor regulates the pulsing of resistors, so that the dots are normally arrayed in patterns seven high by five wide, each representing an alphanumeric character. A blank column normally precedes and follows each character, making the space between characters two dots wide.

2-42. The print-head carriage travels along a drive screw with a helical thread, driven by a fast-response, ironless-armature, dc motor. Characters are printed as the carriage moves from right to left; paper is advanced as the carriage returns to its "home" position (the right-hand wall of the printer assembly). A printed line contains up to 24 characters. The carriage always travels a minimum distance equivalent to 10 characters.

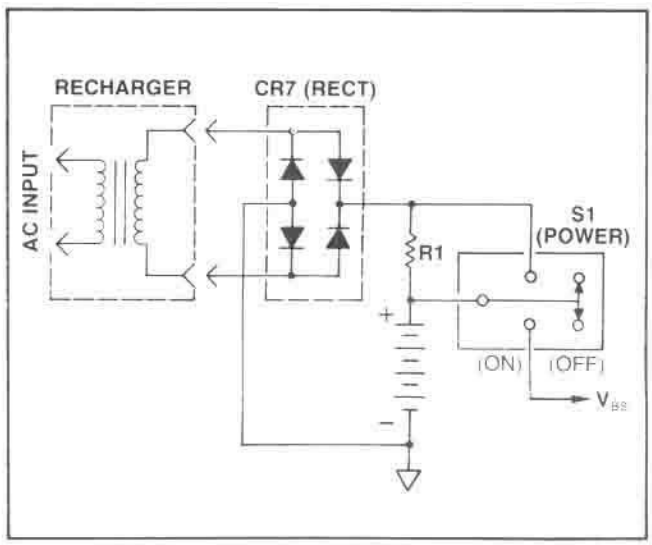


Figure 2-8. Battery Circuit

even when the 10th character (or each of the 10 characters, as in the case of a paper advance with no printing) is blank. Above 10 characters, the print head travels only the distance required to print all non-blank characters before the printer motor reverses, returning the print head to its home position. The minimum line of 10 characters is printed at the rate of approximately two lines per second; the maximum line of 24 characters is printed at approximately one line per second.

2-43. SYSTEM OPERATION

2-44. The following paragraphs describe the interaction of the printer components and the calculator system.

2-45. The printer is designed so that when it is turned on, critical circuits are temporarily disabled to prevent them from responding to spurious signals. When the unit is switched on, but before V_P is established, the power control circuit keeps DBAT high, causing the six buffers in the buffer IC (U9) to be disabled (via its G1 and G2 inputs), which effectively prevents the print-head drivers and motor drive circuit from being activated. Also, the high DBAT keeps RES low (resetting the processor) and DD3 low (indicating to the NPIC that the printer is off). When V_P is established, DBAT goes low, enabling the circuits and setting DD3 high to the NPIC.

2-46. If the PAPER ADVANCE or PRINT key is pressed when the printer is on, the processor (via the PON line) instructs the NPIC to turn on the calculator (via the ISA line). However, the calculator cannot turn on the printer. If a print function is attempted when the printer is off, the CPU in the calculator causes ***PRINTER OFF*** to be displayed.

2-47. When the calculator is operating, the NPIC monitors the ISA and DATA lines. If the proper instruction is received on these lines, the NPIC is enabled and executes the instructions it receives, such as the transfer of data into and out of its buffer. The NPIC is disabled at the appropriate time by a subsequent instruction on the ISA and DATA lines.

2-48. *Control* of the printing process is exercised by the calculator's CPU based partially on information it receives from the processor (via the NPIC). *Execution* of the printing process is directed by the processor. The only operation that is performed entirely within the printer is paper advance when it is initiated by pressing the printer's PAPER ADVANCE key and the calculator is in SLEEP mode.

2-49. Information to be printed is sent by the calculator's CPU one character at a time. Each character is encoded into a 56-bit word and sent to the NPIC. The eight least-significant bits are then requested by the processor and stored in its character buffer. When a complete line of characters is accumulated in the processor, the processor determines the corresponding dot patterns and activates the motor drive and print-head drive circuits.

2-50. When the printer is turned off, the power control circuit sets DD3 low, indicating to the NPIC that the printer is off. This status is then available to the CPU.

2-51. When the calculator reverts to an inactive state, it sets PWO low. This signal disables the NPIC and ROM so that they do not respond to spurious signals.

Disassembly and Reassembly

The following procedures describe the steps necessary to disassemble and reassemble the HP 82143A Printer in order to replace components that are faulty:

1. Case Separation.
2. Drive Belt, Motor Replacement.
3. Print-Head Assembly Replacement.
4. Encoder Replacement.
5. Printer Assembly Removal.
6. Home Switch Replacement.
7. Platen, Pusher Assembly, Pinch Roller Replacement.
8. Paper-Advance Assembly Replacement.
9. Logic PCA, Switch, LED Replacement.
10. Printer Assembly Lubrication and Installation.
11. I/O Cable Replacement.
12. Recharger Connector Replacement.
13. Case Assembly.
14. Tear Bar Replacement.
15. Paper Roll Installation.

For additional aid, see the exploded views, figures 7-1 and 7-2.

1 CASE SEPARATION

a. **Remove the paper roll.**

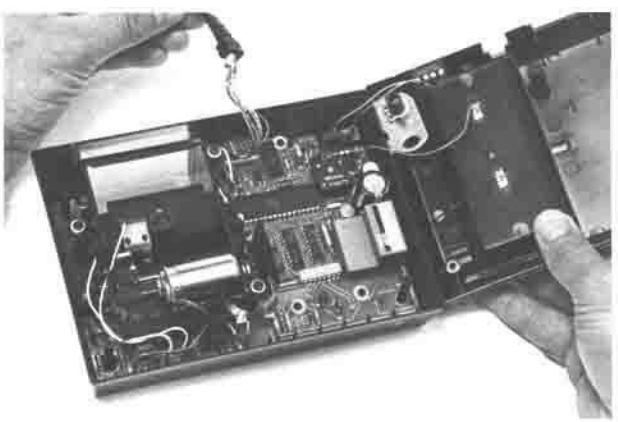
b. **Remove the battery door and battery pack** by sliding back the latches and then tipping the case.

c. **Remove and discard the four rubber feet** from the bottom case. Peel them off using a pointed knife.

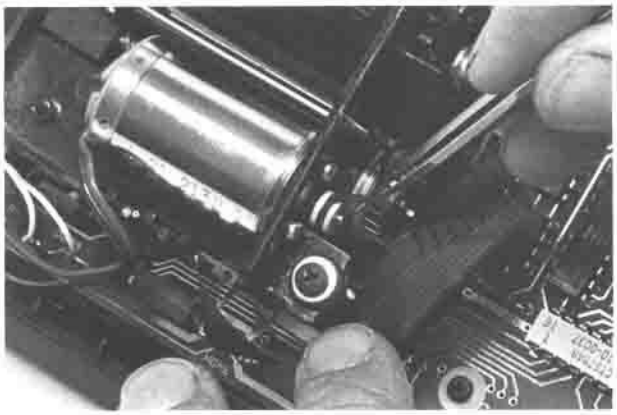
d. **Loosen the five screws** from the bottom case using a Phillips screwdriver.

e. **Lift off the bottom case,** slide out the I/O cable strain relief, and invert the bottom case to the right. If necessary, the bottom case may be completely removed by unplugging the four wires from the logic PCA (printed-circuit assembly).

f. **If necessary, remove the paper cover** by lifting the top case and swinging off the cover.



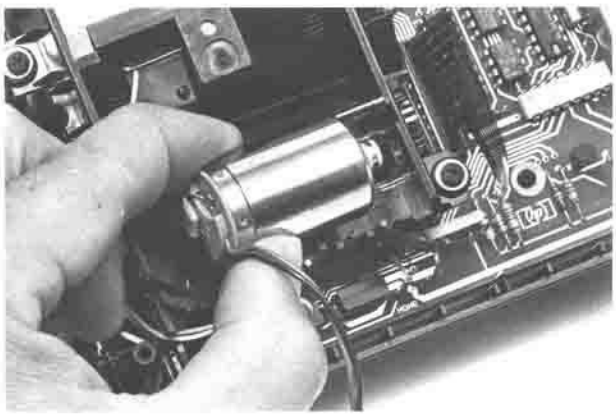
2 DRIVE BELT, MOTOR REPLACEMENT



After separating the case (procedure 1):

a. **Lift off the drive belt** first from the motor pulley, then from the encoder pulley.

b. **Unplug the motor wires** from the logic PCA.

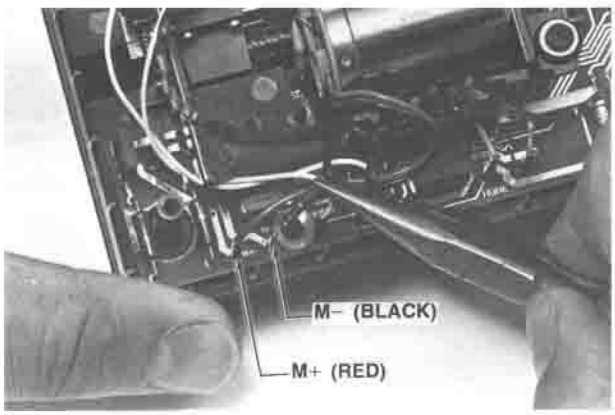


c. **Remove the motor assembly** by unscrewing its three mounting screws and withdrawing the pulley through the frame.

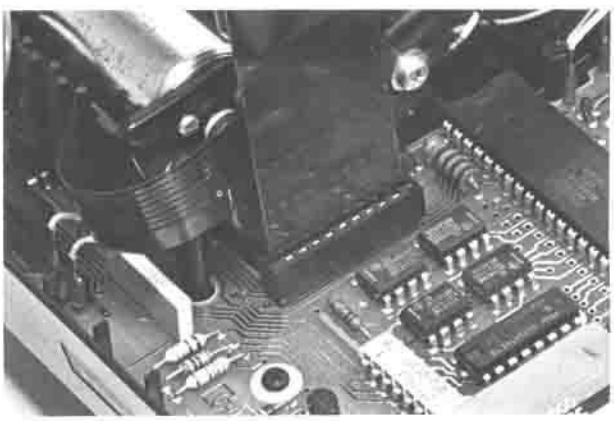
d. **Install the motor assembly** by inserting the pulley through the frame and installing the three mounting screws. Orient the motor so that its wires are adjacent to the flex-cable strain-relief posts.

e. **Install the drive belt** by first looping it around the encoder pulley and then stretching it over the motor pulley. Turn the encoder pulley by hand to seat the belt.

f. **Connect the motor wires** to the logic PCA. The red wire is positive (M+); the black wire is negative (M−).



3 PRINT-HEAD ASSEMBLY REPLACEMENT



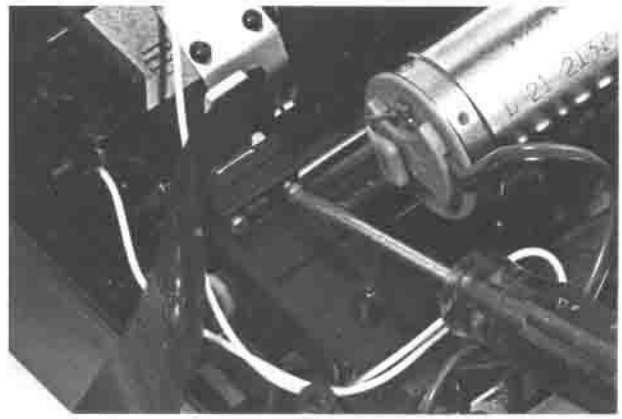
After separating the case (procedure 1):

a. **Release the flex-cable** from the connector and the strain-relief posts. Insert the cable-connector tool (T-190579) into the connector (positioned between the cable and the contacts); then withdraw the cable with the tool.

b. **Position the head carriage** at its "home" position by gently turning the encoder pulley.

c. **Remove the head clamp** by unscrewing the two head-clamp screws.

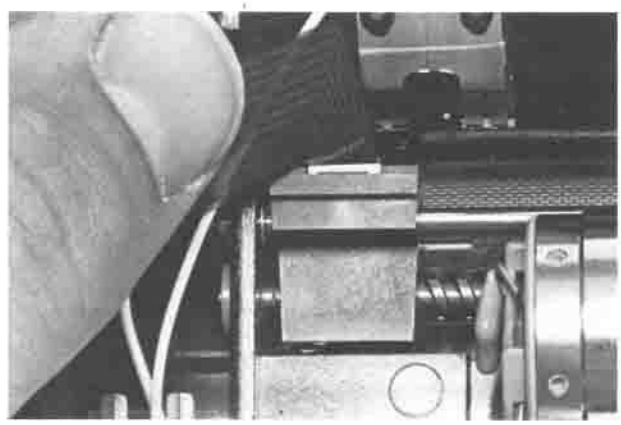
d. **Slide out the print head** by gently pulling on the flex-cable. The print head must clear the retaining flange at the base of the carriage. It may be helpful to slide out the tear bar and depress the platen from the front.



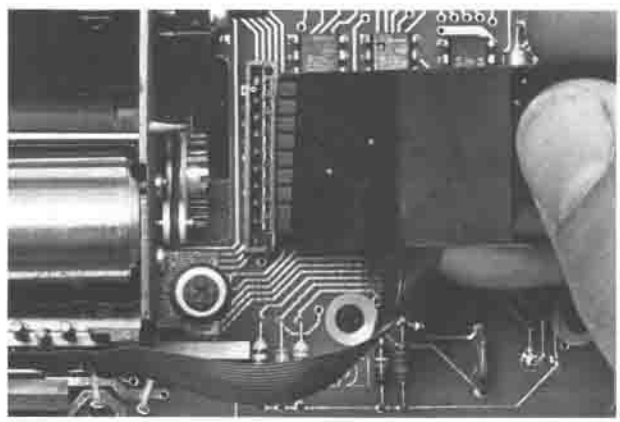
e. **Slide out the tear bar.**

f. **Insert the print head** while holding back the platen from the opposite side. Carefully adjust the position of the head so that it is squarely seated in the carriage and is retained at each end by the plastic flanges.

g. **Position and secure the head clamp.** The dimple on the face of the clamp should face the flex-cable. Tighten the screws as evenly as possible.

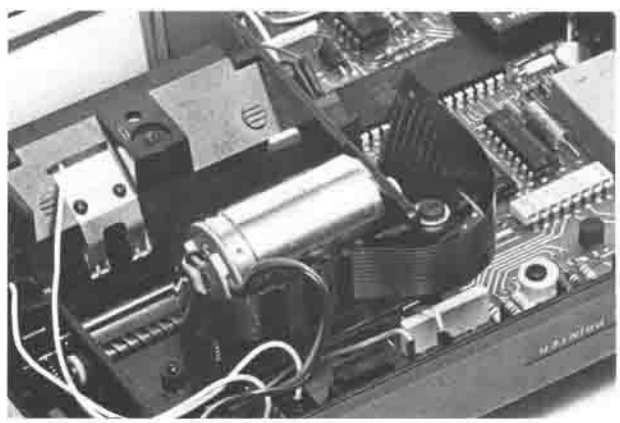


h. **Connect the flex-cable** to the connector on the logic PCA. Place the cable-connector tool into the fold in the flex-cable and insert them into the connector; then withdraw the tool. (If the end of the flex-cable is not folded, fold back approximately half of the exposed contact area.)



i. **Thread the flex-cable through the strain-relief posts.** The length of the loop should allow the flex-cable to barely clear the motor and capacitor when the carriage is at the far end of its travel (adjacent to the encoder pulley).

j. **Slide in the tear bar.** The lip faces outward.



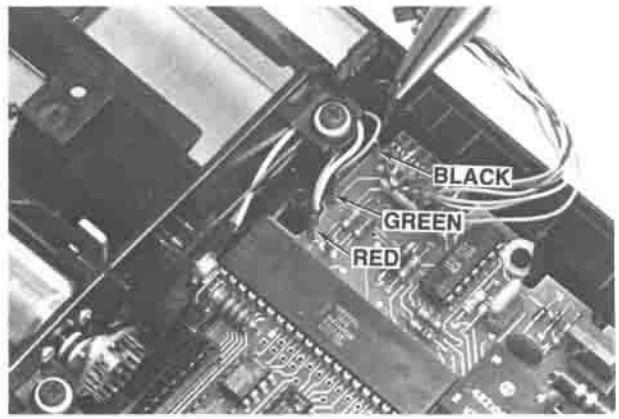
4 ENCODER REPLACEMENT

After separating the case (procedure 1):

a. **Unplug the encoder wires** from the logic PCA.

b. **Remove the encoder** by unscrewing its mounting screw.

c. **Install and connect the encoder** by reversing the previous steps. Be sure the wires pass between the printer frame and the mounting post, and that the indicated color coding is observed.



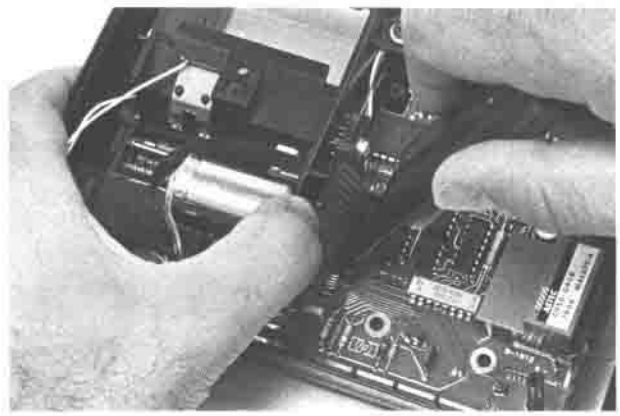
5 PRINTER ASSEMBLY REMOVAL

After separating the case (procedure 1):

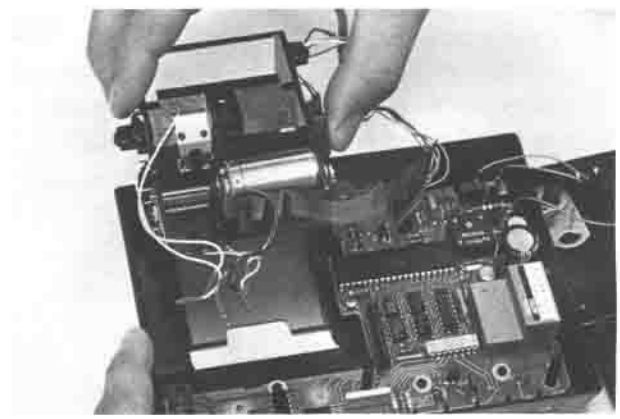
a. **Unplug the nine wires** from the logic PCA using a needlenose pliers. Do not pry against the edge of the top case; the retaining tabs could be damaged.

b. **Release the flex-cable from the connector** on the logic PCA. Insert the cable-connector tool (T-190579) into the connector (positioned between the cable and the contacts); then withdraw the cable with the tool.

c. **Remove the three screws** holding the printer assembly in position.



d. **Lift out the printer assembly.**

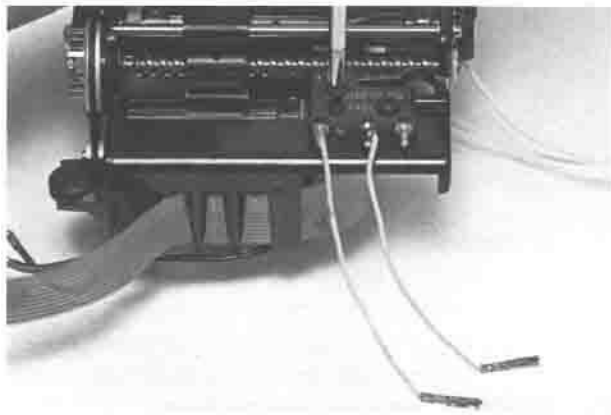


6 HOME SWITCH REPLACEMENT

After separating the case (procedure 1) and removing the printer assembly (procedure 5):

a. **Remove the two screws** that secure the home switch to the frame.

b. **Screw the switch to the frame** with the two screws. Be sure the looped end of the switch arm is adjacent to the side of the frame. The two wires should be attached to the common (C) and normally open (NO) terminals of the switch.



7 PLATEN, PUSHER ASSEMBLY, PINCH ROLLER REPLACEMENT

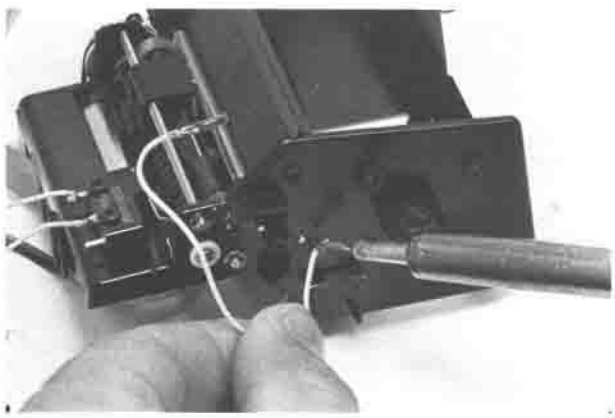
After separating the case (procedure 1) and removing the printer assembly (procedure 5):

a. **Slide out the tear bar.**

b. **Unsolder the out-of-paper wire** from the contact at the side of the frame.

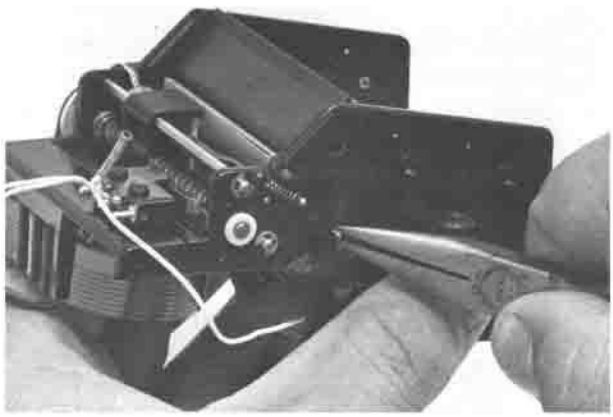
c. **Slide the contact back through the frame.**

d. **Remove the two screws** holding the top corners of the pusher assembly.



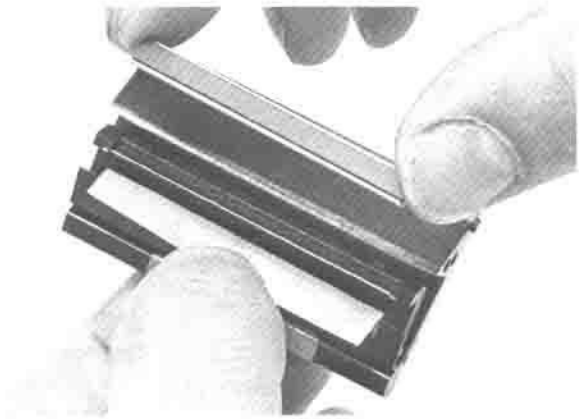
e. **Remove the two pins** holding the lower corners of the pusher assembly. From inside the frame, push the pins out part of the way with a flat-bladed screwdriver. Then pull the pins out using a pliers.

f. **Swing back the bottom of the pusher assembly, then lift it out** of the frame. The backward motion lets the cloth platen cover slip from behind the pinch-roller shaft.



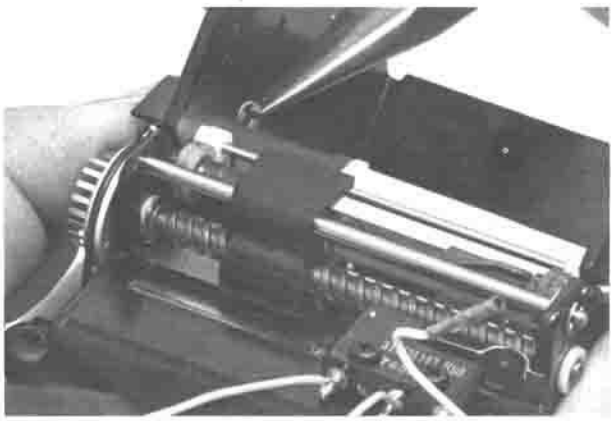
g. **If necessary, replace the platen assembly** on the pusher assembly. The platen assembly merely slips onto the flange on the pusher.

h. **If necessary, replace the out-of-paper contact** by sliding it along the grooves at the base of the pusher assembly.



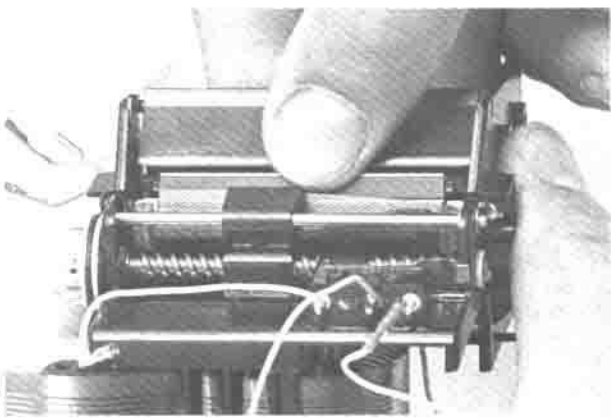
i. **If necessary, replace pinch roller parts** by disconnecting the two extension springs and one or both retainer rings from the pinch-roller shaft. Install the pinch rollers with the smaller diameter against the frame. Use a needlenose pliers or a $^{1}/_{16}$-inch ring tool to install the retainer rings.

j. **Center the head carriage** on the lead screw by gently turning the encoder pulley.



k. **Slip the cloth platen cover** between the head and pinch-roller shaft while positioning the pusher assembly. The two upper tabs should slide into place when the assembly is located in its final position.

l. **Slide the contact over** so that the solder terminal protrudes through the frame.

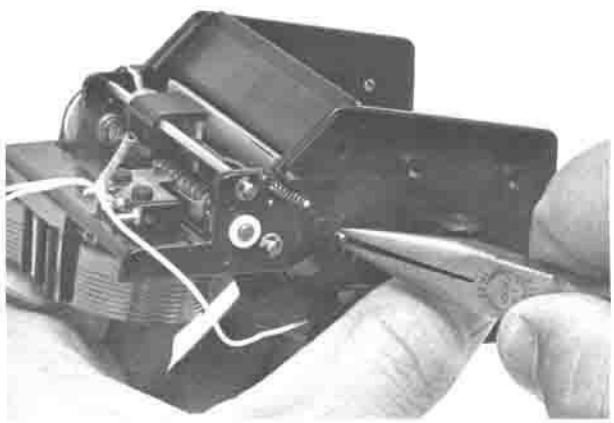


m. **Install the two pins** (pointed ends first) through the frame and into the lower corners of the pusher assembly. Be sure they are installed flush with the outer frame surface.

n. **Install the two screws** at the upper corners of the pusher assembly.

o. **Solder the out-of-paper wire** to the contact at the side of the frame.

p. **Slide in the tear bar.** The lip faces outward.



8 PAPER-ADVANCE ASSEMBLY REPLACEMENT

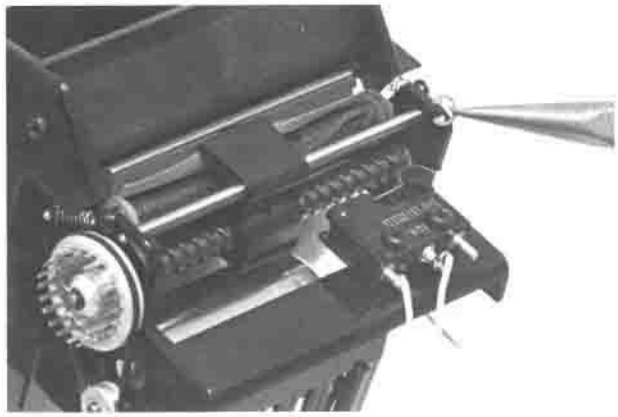
After separating the case (procedure 1), removing the printer assembly (procedure 5), and removing the print-head assembly (procedure 3, steps *a* through *e*):

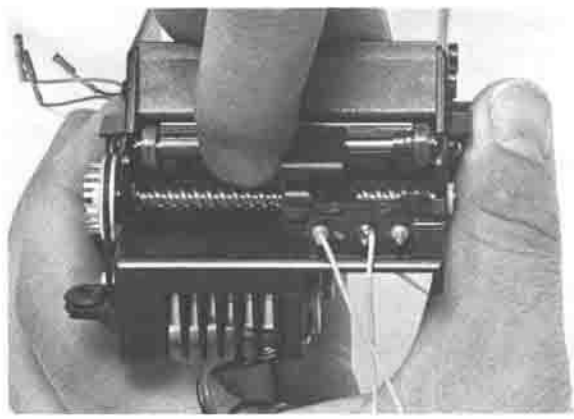
a. **Remove the inner retainer rings** from the two guide rods.

b. **Remove the two guide rods** by sliding them out of the frame.

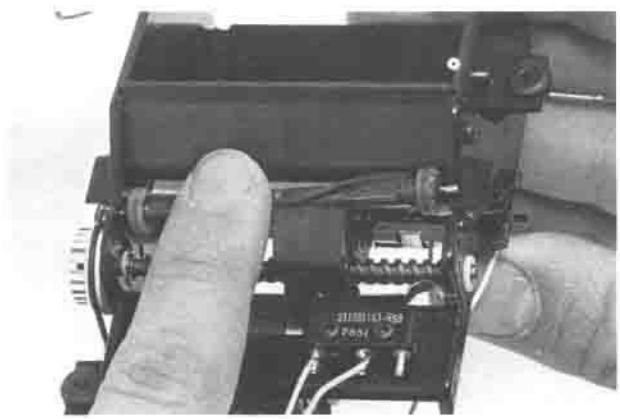
c. **Tilt the carriage** away from the platen. The carriage should be located away from the home switch.

d. **Firmly press both drive rollers back and up** until the paper-advance assembly snaps out of its slots.





e. **Insert the paper-advance assembly into the frame.** This is done by placing one end into the bottom of the slot in the frame, and then snapping the other end into the opposite slot. The ratchet end of the assembly should be adjacent to the home switch. Be careful not to fold back the cloth platen cover.



f. **Rotate the paper-advance assembly** so that the cam is aligned with the slot in the head carriage.

g. **Insert and secure the two guide rods** at the home-switch side of the frame. The inner retaining rings hold the rods in place; install them using a needlenose pliers or a $^{3}/_{32}$-inch ring tool.

h. **Install the print-head assembly.** (Refer to procedure 3.)

9 LOGIC PCA, SWITCH, LED REPLACEMENT

After separating the case (procedure 1) and removing the printer assembly (procedure 5):

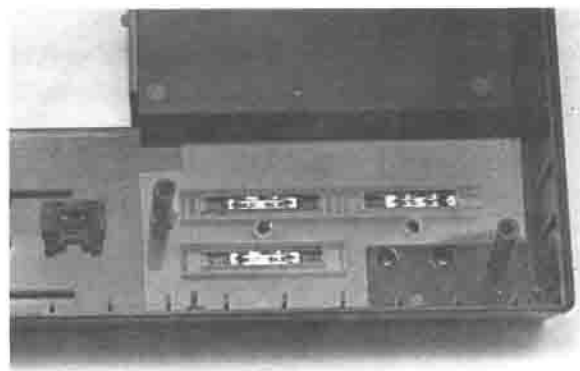
a. **If necessary, unplug the four wires** coming from the bottom case.

b. **If necessary, unplug the I/O cable assembly** from the connector on the logic PCA and place it in a plastic antistatic bag (like those containing new cable assemblies).

c. **Remove the five screws and washers** holding the logic PCA into the top case.

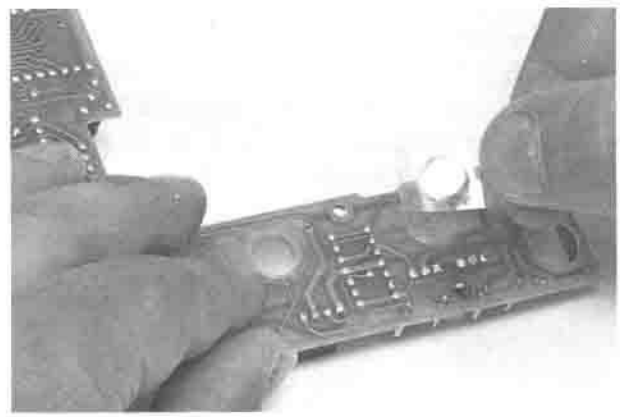
d. **Lift out the logic PCA.** The rubber spacer and slide-switch parts may stick to the PCA.

e. **If necessary, replace and lubricate slide-switch parts.** Install the flat side of the contact into the recess in the switch lever. Use a small amount of silicon lubricant on the printed-circuit pads. Be sure the slide-switch shield is properly installed around the posts and switches in the top case.



CAUTION

Maintain extreme cleanliness when replacing a snap-disc; otherwise, the switch may malfunction. Clean the printed-circuit pads with alcohol and handle the snap-disc with a clean tweezers, not your fingers.

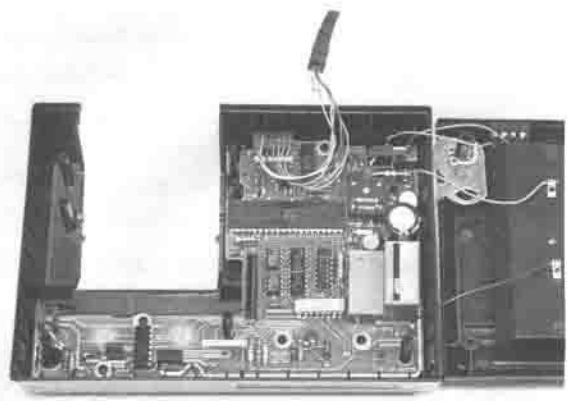


f. **If necessary, replace key-switch parts.** The snap-discs on the reverse side of the PCA should be centered on the printed-circuit rings and held in place with mylar tape.

g. **If necessary, replace an LED,** but do not solder it yet.

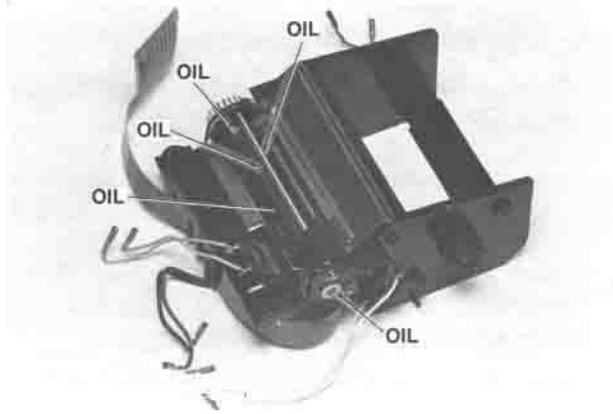
h. **Install and connect the logic PCA** by reversing steps *a* through *d*. Be sure that the rubber spacer is properly located by the two screws and that the black and red battery wires are connected correctly. *The I/O cable connector must be installed with the wires facing the front of the printer.*

i. **If necessary, position and solder a new LED.** Be sure it protrudes through the opening in the top case and is flush with the top surface.



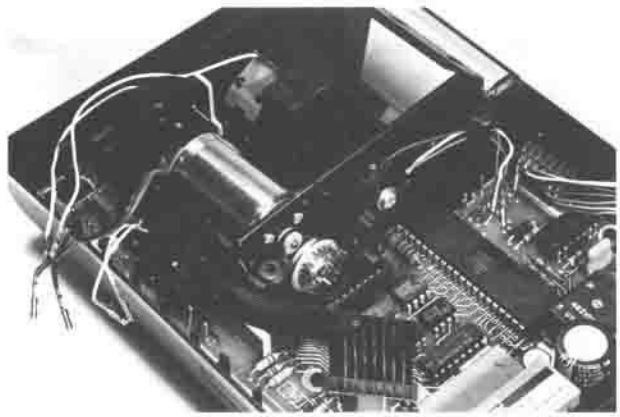
10 PRINTER ASSEMBLY LUBRICATION AND INSTALLATION

a. **Lubricate the lead screw and guide rods** with lightweight machine oil and a long-nosed applicator. Apply one drop at each bushing, and one or two drops along the screw itself and each guide rod. For new parts, double the amounts. Then turn the encoder pulley a number of times to distribute the lubricant. *Do not use an excessive amount of oil*. Do not get any oil on the drive belt or pulley.

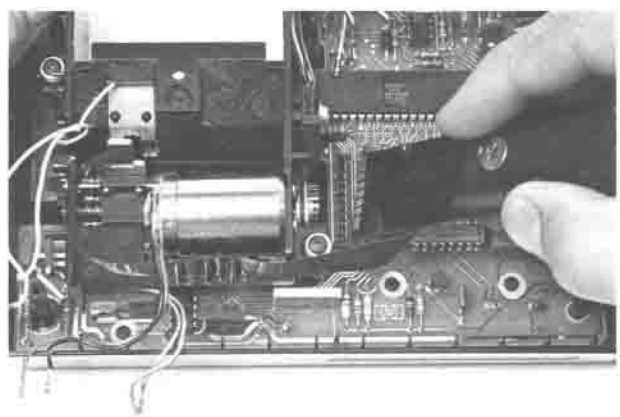


b. **Position the printer assembly,** with its three grommets, onto the three mounting posts. The encoder wires must pass between the printer frame and the mounting post.

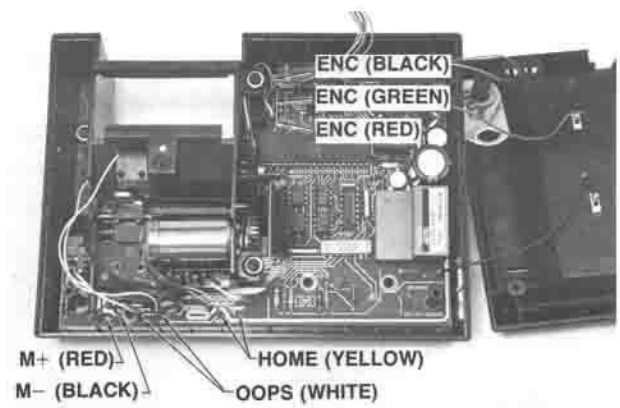
c. **Install the three mounting screws and washers.** Tighten them only until the grommets are slightly compressed (no more than one full turn past contact).



d. **Connect the flex-cable to the connector** on the logic PCA. Place the cable-connector tool into the fold in the flex-cable and insert them into the connector; then withdraw the tool. (If the end of the flex-cable is not folded, fold back approximately half of the exposed contact area.)



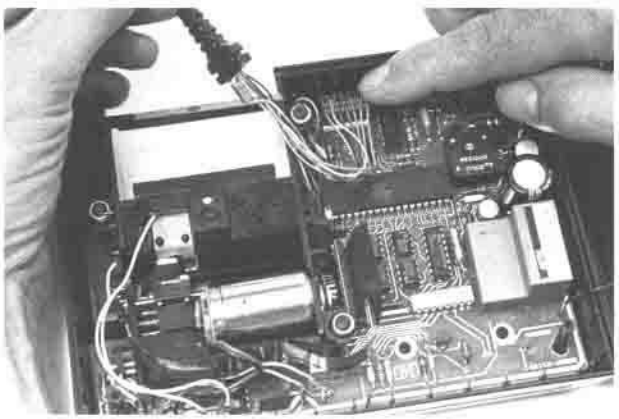
e. **Connect the nine wires** to the logic PCA using a needlenose pliers. Observe the indicated color coding of the encoder wires and the polarity of the motor wires—red is positive (M+), black is negative (M−).



11 I/O CABLE REPLACEMENT

After separating the case (procedure 1):

a. **Unplug the I/O cable assembly** from the logic PCA by pulling up on the connector.



CAUTION

Install the I/O cable connector so that the wires face toward the front of the printer; otherwise, circuits may be damaged.

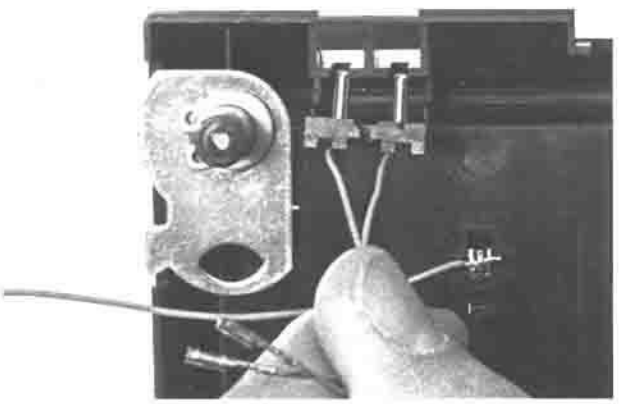
b. **Connect the I/O cable assembly** to the connector on the logic PCA, being sure that the wires face the front of the printer.

12 RECHARGER CONNECTOR REPLACEMENT

After separating the case (procedure 1):

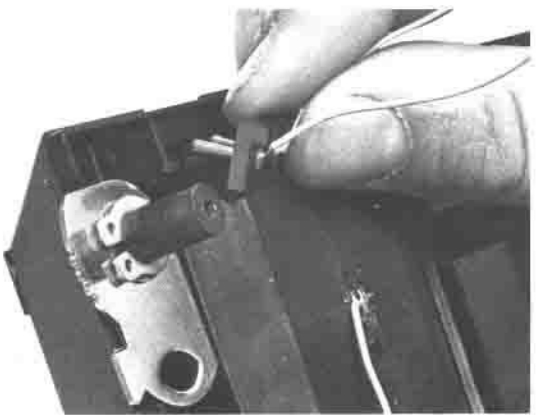
a. **Disconnect the two recharger leads** from the logic PCA.

b. **Remove the recharger connector** from the bottom case by firmly pulling up on the two leads.



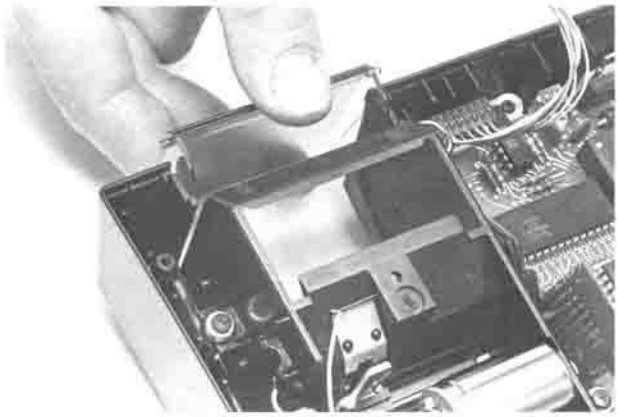
c. **Install the recharger connector** into the bottom case. Do this by inserting the two pins into the slots, being sure that the flanged edge of the holder is up and that the wires are located in their grooves; then press the holder into place until its lower edge is in the slot in the bottom case.

d. **Connect the two recharger leads** to the logic PCA. There is no polarity to observe.

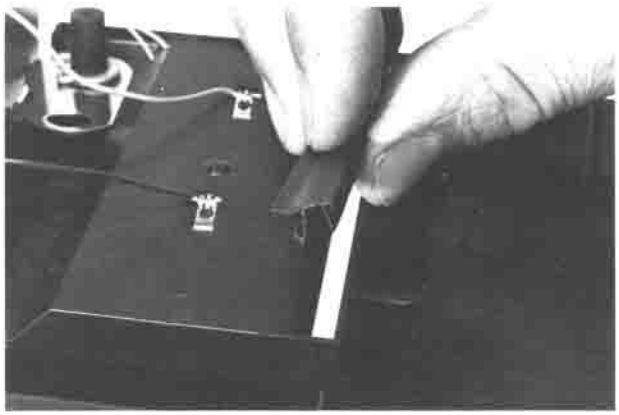


13 CASE ASSEMBLY

a. **Position the paper cover** so that the hinge tabs are located in the slots in the top case.



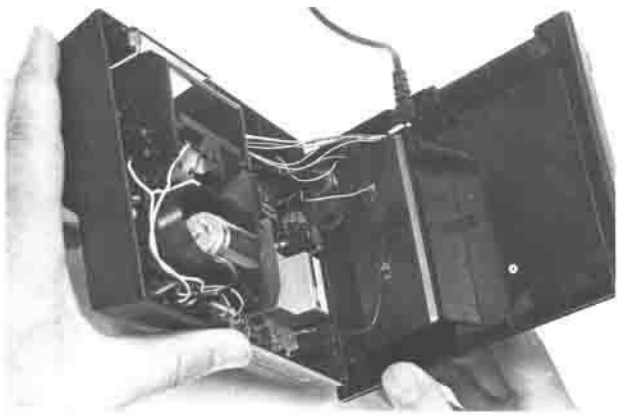
b. **Check the bottom case filler strip** to be sure that it is securely held in the gap along the edge of the battery compartment. The strip is installed so that the hooked flange engages the beveled edge of the battery compartment.



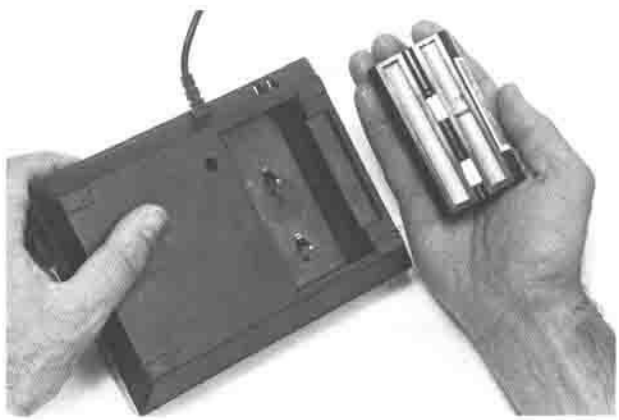
c. **Place the bottom case** onto the top case. Hold the flex-cable against the printer assembly so that the battery well does not pinch it against the logic PCA. Be sure that the strain relief on the I/O cable is properly located in the slot in the bottom case.

d. **Install the five screws** through the bottom case.

e. **Attach four new rubber feet** in the recesses in the bottom case. Press firmly to assure complete bonding.



f. **Install the battery pack and battery door.** The contacts on the battery pack should face and line up with the contact springs. Secure the door by sliding the latches outward.



14 TEAR BAR REPLACEMENT

a. **Slide out the tear bar** by gently lifting on the ridge across the top of its face.

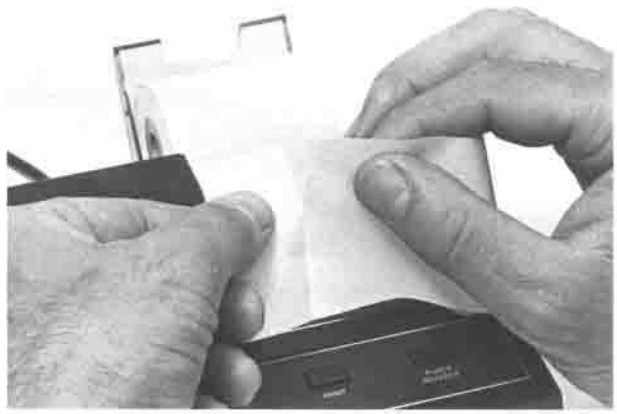
b. **Insert the tear bar** by sliding it into the grooves in the printer frame. The ridge along the top edge should face forward.

15 PAPER ROLL INSTALLATION

Be sure the battery pack is installed before loading paper.

a. **Prepare the roll of paper** by discarding the first full turn of a new roll and making a straight, square leading edge on the paper.

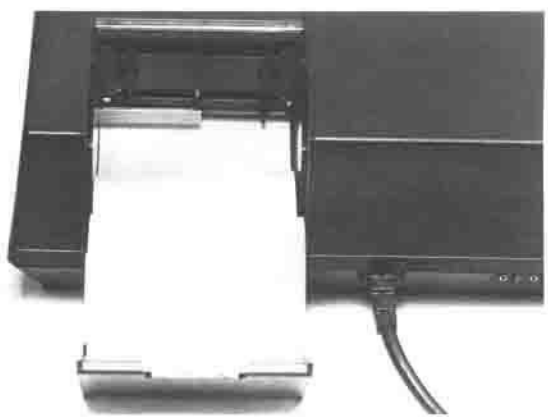
b. **Turn on the printer.**



c. **Push the leading edge fully into the slot** just below the metal contact. Temporarily place the roll in the paper cover with the paper feeding from the bottom of the roll.

d. **Press and hold the PAPER ADVANCE key** until the paper appears above the tear bar. It may be necessary to push the paper into the slot slightly to get it started.

e. **Drop the roll into the paper well and close the cover.**



SECTION IV

Troubleshooting and Testing

4-1. INTRODUCTION

4-2. This section contains the procedures required to troubleshoot and test the HP 82143A Printer. Tools that facilitate service are presented in table 4-1.

4-3. The troubleshooting and test procedures use a test calculator and plug-in service module. The service module tests a large portion of the printer circuitry. However, its diagnosis is often limited by the fact that the interface circuit prevents direct access to the main printer circuits. Key reassignments made by the service module are shown in figure 4-1.

4-4. Mechanical problems that are observed during the testing of the printer should be evaluated using table 4-2.

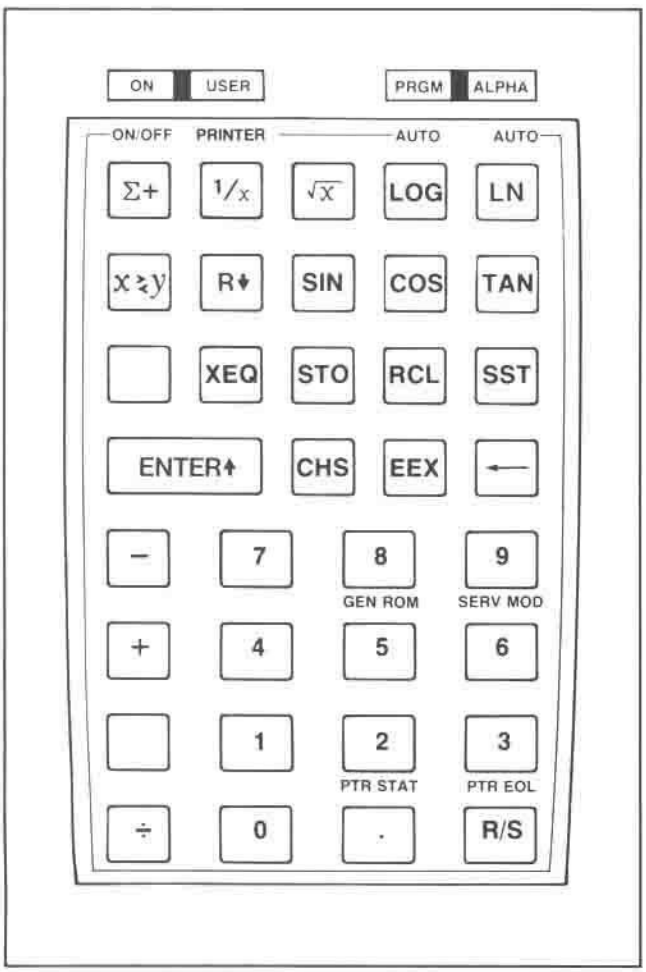


Figure 4-1. Key Assignments for Service Module

4-5. INITIAL PREPARATION

4-6. Perform the following steps before attempting to troubleshoot the printer:

a. **Visually inspect the printer** for physical damage. Replace any components that are visibly damaged.

b. **Determine the customer's concern, if possible.** Frequently the customer includes with the printer a message describing the problem.

- If the problem relates to the rechargeable battery pack or recharger, test them according to the procedures in section V.
- For other problems with the printer, perform the test and repair procedure (paragraph 4-7).

Table 4-1. Recommended Tools

HP PART/ MODEL NUMBER	DESCRIPTION
HP-41C	Test Calculator
ET-11968	Service Module
8690-0227	Desoldering Tool, antistatic
8690-0253	Desoldering Tool Tip, antistatic
8690-0129	Soldering Tool
8690-0132	Soldering Tool Stand
8700-0003	X-acto Knife
8700-0006	X-acto Knife Blade
8730-0008	Small Flat-Bladed Screwdriver
8730-0020	Phillips Screwdriver
8710-0549	Needlenose Pliers
T-190579	Cable Tool
8710-0026	Tweezers
HP 180C/1801A/ 1820C*	Oscilloscope. Measures pulse at 0.50 μs, maximum amplitude 13Vdc.
0960-0062	Continuity Tester
HP 6213C*	Power Supply. Variable supply rated at 10 Vdc at 5A. (Add 0.1 μF ceramic capacitor across output terminals.)
HP 3469B*	Multimeter. Accurate to 0.01 Vdc.
HP 10004*	Oscilloscope Probe

* Or equivalent.

Table 4-2. Mechanical Troubleshooting Guide

SYMPTOM	POSSIBLE CAUSE	REMEDY
Paper will not advance.	Rollers dirty or worn.	Clean or replace.
	Paper-advance assembly worn or damaged.	Replace.
	Paper jammed.	Reinsert or use proper type.
	Pinch-roller springs damaged.	Replace.
	Head-carriage inoperative.	(See symptom below.)
Paper will not advance fully (less than 90 percent).	Rollers dirty or worn.	Clean or replace.
	Paper-advance assembly worn.	Replace.
	Paper binding.	Reinsert or use proper type.
	Pinch-roller springs damaged.	Replace.
	Head carriage worn.	Replace.
	Encoder inoperative.	Check leads or replace.
	Encoder wheel dirty.	Clean.
Head carriage inoperative.	Lead screw or carriage worn or damaged.	Replace.
	Belt drive damaged.	Replace.
	Motor inoperative.	Check leads or replace.
	Instruction not received.	Check I/O connection.
	Pulley loose.	Replace.
Motor runs slowly.	Motor bad.	Replace.
	Belt drive dirty.	Clean or replace.
	Wrong lubricant used.	Clean and lubricate.
	Wrong paper used.	Install proper paper.
	Encoder malfunctioning.	Check leads or replace.
	Guide rods dirty or damaged.	Clean or replace.
	Paper-advance assembly worn or damaged.	Replace.
Motor runs fast (no speed control).	Encoder inoperative.	Check leads or replace.
	Encoder wheel dirty.	Clean.
Excessive noise.	Belt or pulleys worn or damaged.	Replace.
	Motor damaged.	Replace.
	Lead screw or carriage worn or damaged.	Replace.
	Lead-screw bushing worn.	Replace.
	Guide rods worn or damaged.	Replace.
Head carriage contacts left side.	Encoder bad.	Replace.
	Home switch sticking.	Replace.
	Encoder wheel dirty.	Clean.

Table 4-2. Mechanical Troubleshooting Guide (Continued)

SYMPTOM	POSSIBLE CAUSE	REMEDY
Head carriage contacts right side.	Home switch open.	Check leads or replace.
Printed lines not aligned.	Encoder bad. Home switch faulty. Encoder wheel dirty.	Replace. Replace. Clean.
Poor print control or quality.	Platen misaligned, worn, or damaged. Head dirty or bad. Excessive resistance at flex-cable connector.	Reinstall or replace. Clean or replace. Clean or replace.
Head carriage moves, does not print.	Print head bad. Poor platen contact. PAPER ADVANCE switch shorted. Out-of-paper switch shorted.	Replace. Replace pusher assembly. Replace. Repair or replace.
Prints without paper.	Out-of-paper switch bad.	Check leads or replace.

CAUTION

Ensure that the bench setup for troubleshooting and repair has adequate electrostatic protection; otherwise, IC's may be damaged.

4-7. TEST AND REPAIR

4-8. Perform the following steps to determine the causes of improper printer operation and to make the necessary repairs. For reference information concerning component locations and part numbers, use figures 4-5, 4-6, 7-1, and 7-2 and tables 4-10, 7-1, and 7-2.

CAUTION

Be sure that both the calculator and printer are turned off before connecting or disconnecting them. If this is not done, either or both of them could be damaged.

a. **Turn on the printer** while it is disconnected from the test calculator. Be sure that it has an adequate paper supply so that the test procedures will not be interrupted.

- If the POWER light turns on and the print head is correctly positioned adjacent to the right wall of the printer assembly (home position), go on to step *b*.
- If the BAT light turns on or there is no response, check the battery pack to be sure that it is good. Then repeat this step.
- If any other response occurs, determine and repair the cause using the procedure in table 4-3. Then repeat this step.

b. **Press the PAPER ADVANCE key.** Listen for excessive noise.

- If the paper advances normally, go on to step *c*.
- If the paper does not advance smoothly, determine and repair the cause using the procedure in table 4-4. Then repeat this test sequence.

c. **Turn off the printer.**

Table 4-3. Improper Turn-On Troubleshooting Procedures

Use this procedure to determine the cause of an improper response when the printer is turned on. Try the listed possibilities one at a time until the printer turns on properly. Be sure that the battery is good before starting.

SYMPTOM	CHECK	ACTION
POWER light does not turn on.	Measure V_P (U3 pin 6).	If not 4.9 to 5.1 Vdc, check power supply (table 4-5).
	Measure DBAT (U3 pin 1) and A+ (U3 pin 7).	If DBAT above 1 Vdc and A+ 4.9 to 5.1 Vdc, replace U3. If DBAT above 1 Vdc and A+ below 4.9 Vdc, check print-head supply (table 4-6). If A+ below 4.7 Vdc, check print-head supply (table 4-6), R12, R13, R19(H).
	Measure AO (U9 pin 3).	If above 1 Vdc, replace U9. If below 1 Vdc, check DS2, R19(E).
Head does not move to home position.	Check motor connections, mechanism condition.	Repair defects.
	Measure RES (U8 pin 39).	If less than 4.5 Vdc and pilot light is on, replace Q3.
	Measure HOME (U8 pin 25) with home switch open and closed.	If not low when closed, high when open, try (1) checking leads, (2) replacing switch.
	Ground REV line (U8 pin 36), remove, then ground FWD line (U8 pin 37).	If head moves, try (1) checking traces, (2) replacing U8. If head does not move, remove motor leads and check motor with a 6V supply.
	Trace low REV signal through motor control circuit.	Replace defective component.
Head moves right, bangs into right wall.	Measure HOME (U8 pin 25) with home switch open and closed.	If not low when closed and high when open, try (1) repairing connections, (2) replacing switch.
Head moves left, bangs into left wall.	Check polarity of motor leads.	Try (1) repairing connections, (2) replacing U8.
Motor does not turn off.	Measure FWD and REV (U8 pins 37 and 36).	If either is low, try (1) checking traces, (2) replacing U9, (3) replacing U8. If both high, trace high signals through motor control circuit.

Table 4-4. Inoperative Paper Advance Troubleshooting Procedures

Use this procedure to determine the cause of an improper response when the PAPER ADVANCE key is pressed. Try the listed possibilities one at a time until the paper advances properly. To perform most of the checks below, it is necessary to turn the printer off and on.

SYMPTOM	CHECK	ACTION
Head does not move.	Check motor connections, mechanism condition.	Repair defects.
	Measure RES (U8 pin 39).	If less than 4.5 Vdc, replace Q3.
	Ground PA line (U8 pin 18).	If paper advances, repair switch circuit.
	Ground FWD line (U8 pin 37), remove, then ground REV line (U8 pin 36).	If motor runs, try (1) checking traces, (2) replacing U8. If motor does not run, remove motor leads and check motor with a 6V supply.
	Trace low FWD signal through motor control circuit.	Replace defective component.
Head immediately bangs into right wall.	Check polarity of motor leads.	Try (1) repairing connections, (2) replacing U8.
Head moves left, but stops half way.	Measure HOME (U8 pin 25) with home switch open and closed.	If not low when closed and high when open, try (1) repairing connections, (2) replacing switch, (3) replacing U8.
	Ground REV line (U8 pin 36).	If head moves to right, try (1) checking traces, (2) replacing U8.
	Trace low REV signal through motor control circuit.	Replace defective component.
Head moves left, bangs into left wall, stops.	Check encoder mechanism.	Replace defective component.
	Check encoder signal (green lead) with head moving.	If pulsed signal not observed, replace encoder.
	Check INT signal (U8 pin 38) with head moving.	If pulsed signal not observed, replace U3. If pulsed signal observed, replace U8.
Head moves left slightly, then stops or returns home.	Check encoder signal for spurious behavior (green encoder lead).	If spurious signals observed, try (1) replacing encoder, (2) cleaning or replacing encoder pulley, (3) checking C5. If no spurious signals observed, check HOME switch circuit.

Table 4-4. Inoperative Paper Advance Troubleshooting Procedures (Continued)

SYMPTOM	CHECK	ACTION
Head moves left, coasts past half way, moves home, coasts into right wall.	Ground FBRK and RBRK lines (U8 pins 35 and 34) and trace signals through motor control circuit.	Replace any defective component. If motor control circuit is good, replace U8.
Head moves slowly.	Check mechanism for friction, slippage.	Repair defects.
	Check encoder signal for spurious behavior (green encoder lead).	If spurious signals observed, try (1) replacing encoder, (2) cleaning or replacing encoder pulley, (3) checking C5.
	Measure the U8 signal period (U8 pin 13 or 14) with paper inserted.	If period is greater than 370 microseconds, try (1) replacing L1, (2) replacing U8. If period is less than 370 microseconds, replace Q8.

d. **Be sure the test calculator is off.**

e. **Insert the service module** (part number ET-11968) into the calculator's lower left (#3) I/O port (or any other port).

f. **Connect the printer** to the calculator, using the lower right (#4) I/O port (or any other port). See figure 4-2.

g. **Set the printer MODE switch** to MAN position. This setting is required by the service module printer test that follows.

h. **Turn on the calculator** by pressing its ON key.

- If two beeps are sounded and ***SELECT TEST*** is displayed, the calculator is ready to test the printer. Go on to step *i*.
- If any other response occurs, turn off the calculator, remove the printer, then repeat this step. If the calculator now operates correctly, replace the I/O cable assembly of the printer. Then repeat the test and repair sequence.

i. **Perform the printer test** that follows. For each step or condition that is described, the resulting LCD display on the test calculator is shown at the right. An LCD display of the form ***ERR M, 1100*** may occur after any step. If this occurs, record the error code and status code; then proceed as described in table 4-7.

Figure 4-2. Test Setup

1. **Press the [USER] key** to select the manual printer test. — ***PRESS R/S***
2. **Press [R/S]** (or any other key) on the calculator to proceed with the printer test. — ***PRINTER TEST***
   - This LCD display indicates that the printer power switch should be set to the ON position. — ***TURN ON PRTR***
   - An LCD error display indicates that a printer error was detected. Be sure that the printer was turned off before this test was begun; otherwise an error will occur. Proceed as described in table 4-7. — ***ERR A, 1100***
3. **Turn on the printer** using its power switch.
   - This LCD display indicates that the printer output should now be examined. — ***CHECK OUTPUT***
   - The continued display of this LCD message indicates that the printer did not turn on properly. Press [R/S] (or any other key) on the calculator to continue, then proceed as indicated in table 4-7. — ***TURN ON PRTR***
   - An LCD error display indicates that a printer error was detected. Be sure that the printer MODE switch was in MAN position before this test was begun; otherwise an error will occur. Proceed as described in table 4-7. — ***ERR I, 1100***
4. **Observe the printer output.** Check for correct formatting of the first line, for missing dots and uneven contrast in the bars in the next two lines, and for extra dots in the fourth, stepped line. Refer to the first four lines of figure 4-3 for the proper output. — ***CHECK OUTPUT***
   - Improper formatting of the characters or occasional missing dots indicate that the processor (U8) should be replaced at the end of this test.
   - The presence of extra dots indicates that two print lines may be shorted. Check this at the end of this test using table 4-9.
   - Poor print quality indicates that the printer mechanism or print-head circuit is faulty. Check the mechanism and circuit at the end of this test using table 4-9. (Paper quality also affects print quality.)
5. **Observe the LCD display.**
   - This LCD display indicates that the printer MODE switch should now be moved to the TRACE position. — ***TRACE***
6. **Switch to TRACE mode** by setting the printer MODE switch.
   - A beep and this LCD display indicates that the printer MODE switch should now be moved to the NORM position. — ***NORM***
   - The continued display of this LCD message indicates that the MODE switch change was not detected. Press [R/S] (or any other key) on the calculator to continue, then proceed as indicated in table 4-7. — ***TRACE***
7. **Switch to NORM mode** by setting the printer MODE switch.
   - A beep and this LCD display indicates that the PRINT key should now be pressed. — ***PRINT KEY***
   - The continued display of this LCD message indicates that the MODE switch change was not detected. Press [R/S] (or any other key) on the calculator to continue, then proceed as indicated in table 4-7. — ***NORM***

8. **Press the PRINT key.**

   - A beep and this LCD display indicates that the INTENSITY switch should now be moved to each of its five positions. ***INTENSITY SW***
   - The continued display of this LCD message indicates that the PRINT key was not detected. Press the PAPER ADVANCE key and note whether this keystroke is detected. If neither key causes a response, press [R/S] (or any other key) on the calculator to continue, then proceed as indicated in table 4-7. ***PRINT KEY***

9. **Move the INTENSITY switch** to each of its five positions and observe the print intensity.

   - A uniform change in print intensity as the switch is moved indicates proper operation of the head supply.
   - A nonuniform change in print intensity as the switch is moved indicates that the head supply control circuit is faulty. Test and repair this circuit after the printer test is finished. (Refer to paragraph 2-26.)

10. **Press** [R/S] (or any other key) on the calculator to end the intensity check. ***REMOVE PAPER***

11. **Examine the printer output** produced by the printer test. Check for missing dots and improper alignment. See figure 4-3 for the proper output. ***REMOVE PAPER***

    - A missing row of dots indicates that a print-head segment is not operating properly. Check this at the end of this test using table 4-9.
    - A blank dot column every 22 columns indicates that an encoder-pulley tooth is probably missing. Check this at the end of this test.
    - Irregular alignment of the lines in the intensity check indicates either a bad home switch or processor (U8). Test the operation of the switch at the end of this test, then replace the switch or U8 as indicated.

12. **Remove the paper** from the printer by tearing off the exposed portion and then pulling out the paper from inside the paper well.

    - A beep and this LCD display indicate that the paper should now be reinserted into the printer. ***INSERT PAPER***
    - The continued display of this LCD message indicates that the paper removal was not detected. Press [R/S] (or any other key) on the calculator to continue, then proceed as indicated in table 4-7. ***REMOVE PAPER***

13. **Reinsert the paper** into the slot in the paper well. Be sure to insert it fully.

    - A beep and this LCD display indicate that the PAPER ADVANCE key should be pressed and held down when the paper is fully inserted. ***HOLD ADV***
    - The continued display of this LCD message indicates that the paper insertion was not detected. Press [R/S] (or any other key) on the calculator to continue, then proceed as indicated in table 4-7. ***INSERT PAPER***

14. **Press and hold the PAPER ADVANCE key** on the printer. Watch for the proper sequence of paper advances.

    - A series of long (across the entire paper width) paper advances, then a 1-second pause when the paper reaches part way up the tear bar, and then a series of short (normal) paper advances indicate proper operation.

- Any other paper advance sequence (such as short initial advances, no pause, or all long advances) indicates improper operation. While still holding the PAPER ADVANCE key, press [R/S] (or any other key) on the calculator to continue, then proceed as indicated in table 4-7.
- A beep and this LCD display indicate that the PAPER ADVANCE key was not held down long enough. Repeat this step, being sure to hold down the key until after the short advances begin. ***HOLD ADV***

15. **Release the PAPER ADVANCE key** after the short advances have begun.
16. **Observe the final display.**
    - This LCD display indicates that no errors were detected by the printer test. ***ALL TESTS OK***
    - This type of LCD error display summarizes the errors that were detected during the printer test. ***ERROR @,M,***
17. **Press** [R/S] to prepare for the next test. ***SELECT TEST***

j. **If necessary, make any repairs** indicated by the printer test just completed and table 4-7. If more than one error code occurred, check table 4-7 to determine the most likely cause. Then repeat the test and repair sequence until no errors occur.

k. **Perform the end-of-line (EOL) test** that follows. The service module and printer should be connected to the test calculator, and the calculator and printer should be turned on. (If ***SELECT TEST*** is not displayed when the calculator is turned on, return to step *h*.) Be sure that at least 20 centimeters (8 inches) of paper is available for this test.

Figure 4-3. Printer Test Output

1. **Press the** [3] **key** to select the end-of-line test. This test checks the character buffer in the processor. ***EOL TEST***
2. **Observe the printer output.**
    - A **1** followed by 30 blank lines and **32** indicates proper operation. Refer to figure 4-4 for the proper output spacing. ***EOL TEST***
    - Improper spacing of the 32 lines indicates that the processor (U8) is bad. Replace it at the end of this test. ***EOL TEST***
    - An LCD error display indicates that a printer error was detected. Proceed as indicated in table 4-7. ***ERR Y, 1100*** ***ERR Z, 1100***
    - This LCD display indicates that the printer ran out of paper before the test was completed. Turn the printer off and on to clear the character buffer. Then load paper into the printer and repeat the EOL test. (If you do not turn off the printer, the remaining lines of the EOL test will be printed at the start of the next test.) ***OUT OF PAPER***

l. **If necessary, make any repairs** indicated by the EOL test.

m. **Test the printer** by performing the entire test and repair sequence. If additional repairs are required, be sure to perform the test and repair sequence again to verify proper operation.

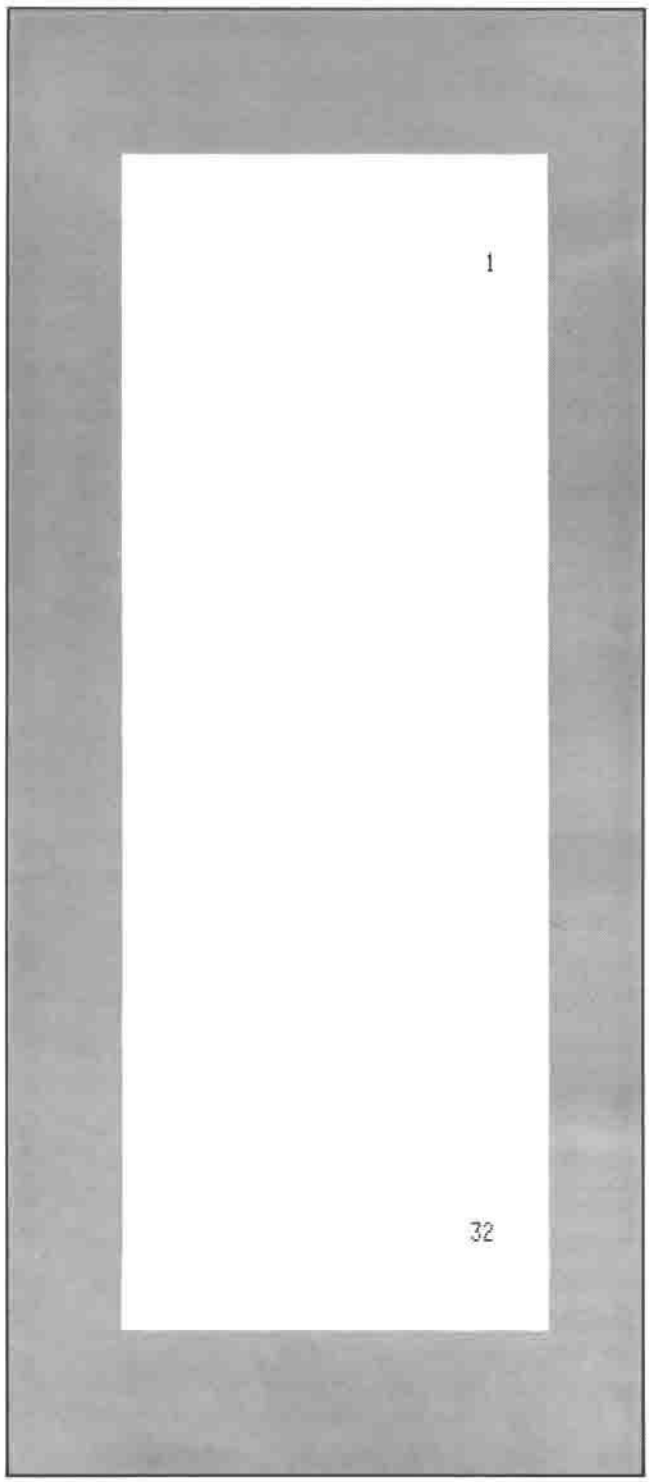


Figure 4-4. End-of-Line Test Output

Table 4-5. Power Supply Troubleshooting Procedure

Use this procedure to determine the cause of an improper supply voltage. Measure V_P after each component is replaced to determine if the defect has been corrected.

STEP	SPECIFICATION	ACTION
With the power switch turned on:		
1. Measure V_P (U3 pin 6).	4.9 to 5.1 Vdc	If within range, primary power supply is good.
2. Measure V_P (CR8 cathode —striped end).	4.9 to 5.1 Vdc	If out of range, replace jumper W1.
3. Temporarily remove jumper W1.		
4. Measure V_H (U3 pin 3).	13 to 18 Vdc	If out of range, repair print-head power supply (table 4-6).
5. Measure V_P (CR8 cathode —striped end).	4.9 to 5.1 Vdc	If within range, check for excessive current load.
6. Measure DO (U3 pin 14).		If V_P is high and DO is below 1V, check Q1, Q2, R4. If V_P is high and DO is above 13V, replace U3. If V_P is low and DO is below 1V, replace U3. If V_P is low and DO is above 13V, check Q1, Q2, C2, CR3, T1, CR2, R2, R3.
7. Reinstall jumper W1.		

Table 4-6. Print-Head Power Supply Troubleshooting Procedure

Use this procedure to check the print-head power supply. Measure V_H after each component is replaced to determine if the defect has been corrected.

STEP	SPECIFICATION	ACTION
With the power switch turned on:		
1. Measure V_H (U3 pin 3).	13 to 18 Vdc	If within range, the print-head power supply is good.
2. Measure V_R (U2 pin 1).	1.0 to 5.1 Vdc	If within range, replace PS1. If above range, replace U2.
3. Measure V_{BS} (C7+).	4.5 to 6.5 Vdc	If within range, check CR4 and CR5. If below range, check for low battery, C7 short, bad power switch.

Table 4-7. Service Module Error Procedures

Use this table to determine what to do when an LCD error display is generated by the service module. The procedures are based on the assumptions that the printer mechanism is functioning properly and that the printer is not out of paper.

Perform the following steps immediately after the error display is observed:

1. Record the error code and status code displayed by the calculator.
2. Press [R/S] (or any other key) on the calculator. This instructs the service module to continue testing.
   - For certain error conditions (indicated by * below), the service module continues the printer test according to the steps in paragraph 4-7. (***WORKING*** may be displayed.) At the end of the test, follow the instructions given below for the error codes that occurred during the test.
   - For all other error conditions, the printer test is terminated and an error summary (such as ***ERROR @, C,***) is displayed. Proceed according to the instructions given below for the indicated error codes.

When correcting a defect, try the listed possibilities one at a time until the error no longer occurs when the printer test is performed.

ERROR CODE	CHECK	ACTION
@* A B C D		Replace the I/O cable assembly.
E	With the printer turned on, measure DD3 (J2 pin 1).	If DD3 is above 4V, replace the I/O cable assembly. If DD3 is below 4V, try (1) checking the continuity from Q3 collector to J2 pin 1, (2) replacing the I/O cable assembly.
F G	Check continuity between: J2 pin 4 and U8 pin 13, J2 pin 5 and U8 pin 14, J2 pin 6 and U8 pin 15, J2 pin 7 and U8 pin 20. Check DD1 and DD2 signals (J2 pins 5 and 4).	Repair defects. If pulses are observed on both lines, replace the I/O cable assembly. If no pulses are observed on either line, replace U8.
H		Replace the I/O cable assembly.
I	Convert displayed status code into binary form (table 4-8) and check for proper status conditions.	If status code is 0000 or FFFC, replace I/O cable assembly. If one of first six bits is improper, try (1) checking the corresponding circuit, (2) replacing U8. If any of the remaining bits are improper, replace U8.

Table 4-7. Service Module Error Procedures (Continued)

ERROR CODE	CHECK	ACTION
J J,Z K K,Y L M* M,Y M,Z N N,Z O,Z P,Z Q,Y R,Z S* S,Z T* T,Z U,Y V,Y	For error codes with Y, check for out-of-paper condition. For error codes with Y or Z, measure the U8 signal period on the DD1 or DD2 line (U8 pin 14 or 13) with paper inserted.	If out of paper, install paper and repeat test. For Y or Z codes, if the U8 period is less than 310 microseconds, try (1) replacing L1, (2) replacing U8. For other conditions, try (1) replacing the I/O cable assembly, (2) replacing U8.
O*		Try (1) repairing MODE switch, (2) replacing U8.
P*		If the test continued when the PAPER ADVANCE key was pressed (paragraph 4-7, step 8), try (1) repairing the PRINT key circuit, (2) replacing U8. If the test did not continue when the PAPER ADVANCE key was pressed, try (1) checking the PON portion of the power control circuit, (2) replacing the I/O cable assembly.
R*		Try (1) repairing the out-of-paper circuit, (2) replacing U8.
X*	Convert displayed status code into binary form (table 4-8) and check for proper status conditions.	If status code is 0000 or FFFC, replace I/O cable assembly. If one of first six bits is improper, try (1) checking the corresponding circuits, (2) replacing U8. If any of the remaining bits are improper, replace U8.
Y Z	Measure the U8 signal period on the DD1 or DD2 line (U8 pin 14 or 13) with paper inserted.	If the U8 period is less than 310 microseconds, try (1) replacing L1, (2) replacing U8. If the U8 period is at least 310 microseconds, try (1) replacing the I/O cable assembly, (2) replacing U8.

Table 4-8. Status Code Information

Use this table to interpret the status code indicated during any service module test. After converting the status code to binary, the binary bits indicate the state of each function. A "1" indicates that the function is active; a "0" indicates that it is inactive.

Status Code Format

Display	0618															
Hex	0				6				1				8			
Binary	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0
Bit Name	SMA	SMB	PRT	ADV	OOP	LB	IDL	BE	LCA	SCO	DWM	TEO	EOL	HLD	XXX	XXX

Hex-Binary Conversions

Hex	Binary
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
4	0 1 0 0
5	0 1 0 1
6	0 1 1 0
7	0 1 1 1
8	1 0 0 0
9	1 0 0 1
A	1 0 1 0
B	1 0 1 1
C	1 1 0 0
D	1 1 0 1
E	1 1 1 0
F	1 1 1 1

Bit Names

Bit Name	Function
SMA	Mode Switch A (1 for TRACE only)
SMB	Mode Switch B (1 for NORM only)
PRT	Print Key
ADV	Paper Advance Key
OOP	Out-of-Paper
LB	Low Battery
IDL	Idle Condition
BE	Buffer Empty
LCA	Lower-Case Alpha
SCO	Special Column Output
DWM	Double-Wide Mode
TEO	Type of End-of-Line
EOL	Last End-of-Line
HLD	Hold for Paper

Table 4-9. Print Quality Troubleshooting Procedures

Use this procedure to determine the cause of improper printer output. Try the listed possibilities one at a time until the cause is found. Unless noted, the printer should be turned *off* for each check.

SYMPTOM	CHECK	ACTION
Extra dots are printed.	Disconnect print-head flex-cable.	
	Check for shorts between print-head segments.	If segments shorted, replace head assembly.
	Check for shorts between driver output lines (J1 pins 1 through 7).	If shorted, try (1) checking traces, (2) replacing driver (U4, U5, U6, or U7).
	Check for shorts between driver input lines (U8 pins 27 through 33).	If shorted, try (1) checking traces, (2) replacing driver (U4, U5, U6, or U7), (3) replacing U8.
Printing quality is poor.	Check printer mechanism for bad platen or bad head.	If bad, clean or replace.
	Measure V_H (U2 pin 1) with the printer turned on.	If outside 13 to 18 Vdc, repair print-head power supply (table 4-6).
	Disconnect print-head flex-cable and check resistance of each print-head segment.	If resistance of any segment is outside 70 to 90 ohms, replace head assembly.
A print-head segment is not operating.	Disconnect print-head flex-cable.	
	Check resistance of each print-head segment.	If resistance of any segment is outside 70 to 90 ohms, replace head assembly.
	Ground corresponding line at U8 (pin 27 to 33) and measure driver output (J1 pin 1 to 7) with the printer turned on (and flex-cable disconnected).	If driver output is not within 1 volt of V_H, replace driver (U4, U5, U6, or U7).

Table 4-10. Logic PCA Replaceable Parts

REFERENCE DESIGNATION	HP PART NUMBER	DESCRIPTION	QTY
	82143-80009	BOARD, printed-circuit	1
C3	0180-2958	CAPACITOR, 1000 μF	1
C2	0180-2962	CAPACITOR, 220 μF	1
C7	0180-2925	CAPACITOR, 82 μF, 10%, 10V	1
C5	0180-0575	CAPACITOR, 2.2 μF, 20%, 15V	1
C6	0160-3901	CAPACITOR, 2.2 μF, 20%	1
C4	0160-0127	CAPACITOR, 1 μF, 20%, 25V	1
C1	0160-3456	CAPACITOR, 1000 pF, 10%, 1 KV	1
J1	1251-5705	CONNECTOR, flex-cable	1
J2	1251-5940	CONNECTOR, seven-pin	1
J3-J15	1251-0600	CONNECTOR, single-pin, male	13
DS1, DS2	1990-0705	DIODE, light-emitting	2
CR1	1901-0868	DIODE, Schottky	1
CR2, CR4, CR5	1901-1098	DIODE, switching	3
CR3	1901-0693	DIODE, 1N4934	1
CR6	1902-3104	DIODE, zener	1
L1	9140-0402	INDUCTOR, 110 μH, 2%	1
	1200-0181	INSULATOR, transistor Q1	1
U9	1820-1641	INTEGRATED CIRCUIT, buffer	1
U3	1826-0287	INTEGRATED CIRCUIT, comparator, quad	1
U4-U7	1820-1016	INTEGRATED CIRCUIT, driver, dual	4
U8	1820-2280	INTEGRATED CIRCUIT, processor	1
CR7, CR8	1906-0232	INTEGRATED CIRCUIT, rectifier	2
U2	1826-0645	INTEGRATED CIRCUIT, voltage reference	1
PS1	0950-0408	POWER SUPPLY	1
R3	0683-1055	RESISTOR, 1M, 5%, $^1/_4$W	1
R11	0683-2735	RESISTOR, 27K, 5%, $^1/_4$W	1
R9, R13	0757-0447	RESISTOR, 16.2K, 1%	2
R14	0683-1035	RESISTOR, 10K, 5%, $^1/_4$W	1
R8	0757-0441	RESISTOR, 8.25K, 1%	1
R4, R17	0683-4725	RESISTOR, 4.7K, 5%, $^1/_4$W	2
R7	0698-3153	RESISTOR, 3.83K	1
R6	0698-0083	RESISTOR, 1.96K, 1%	1
R5	0757-0278	RESISTOR, 1.78K, 1%	1
R12	0757-0428	RESISTOR, 1.62K, 1%	1
R18	0683-1025	RESISTOR, 1K, 5%, $^1/_4$W	1
R10	0683-1215	RESISTOR, 120-ohm, 5%, $^1/_4$W	1
R2	0683-8205	RESISTOR, 82-ohm, 5%, $^1/_4$W	1
R15, R16	0698-4105	RESISTOR, 13.3-ohm, 1%, $^1/_4$W	2
R1	0689-0825	RESISTOR, 8.2-ohm	1
R19	1810-0037	RESISTOR PACK	1
U1	1810-0176	RESISTOR NETWORK, quad	1
S4, S5	3131-0405	SNAP DISC, switch	2
	0460-0970	TAPE, ½-inch mylar	
T1	9100-0425	TRANSFORMER, flyback	1
Q6, Q7	1854-0368	TRANSISTOR, 2N5191	2
Q2, Q3	1853-0036	TRANSISTOR, PNP	2
Q4, Q5	1853-0236	TRANSISTOR, 2N5193	2
Q1	1853-0320	TRANSISTOR, 2N4032 (requires INSULATOR)	1
Q8	1858-0056	TRANSISTOR, quad	1
W1	8159-0005	WIRE, jumper	1

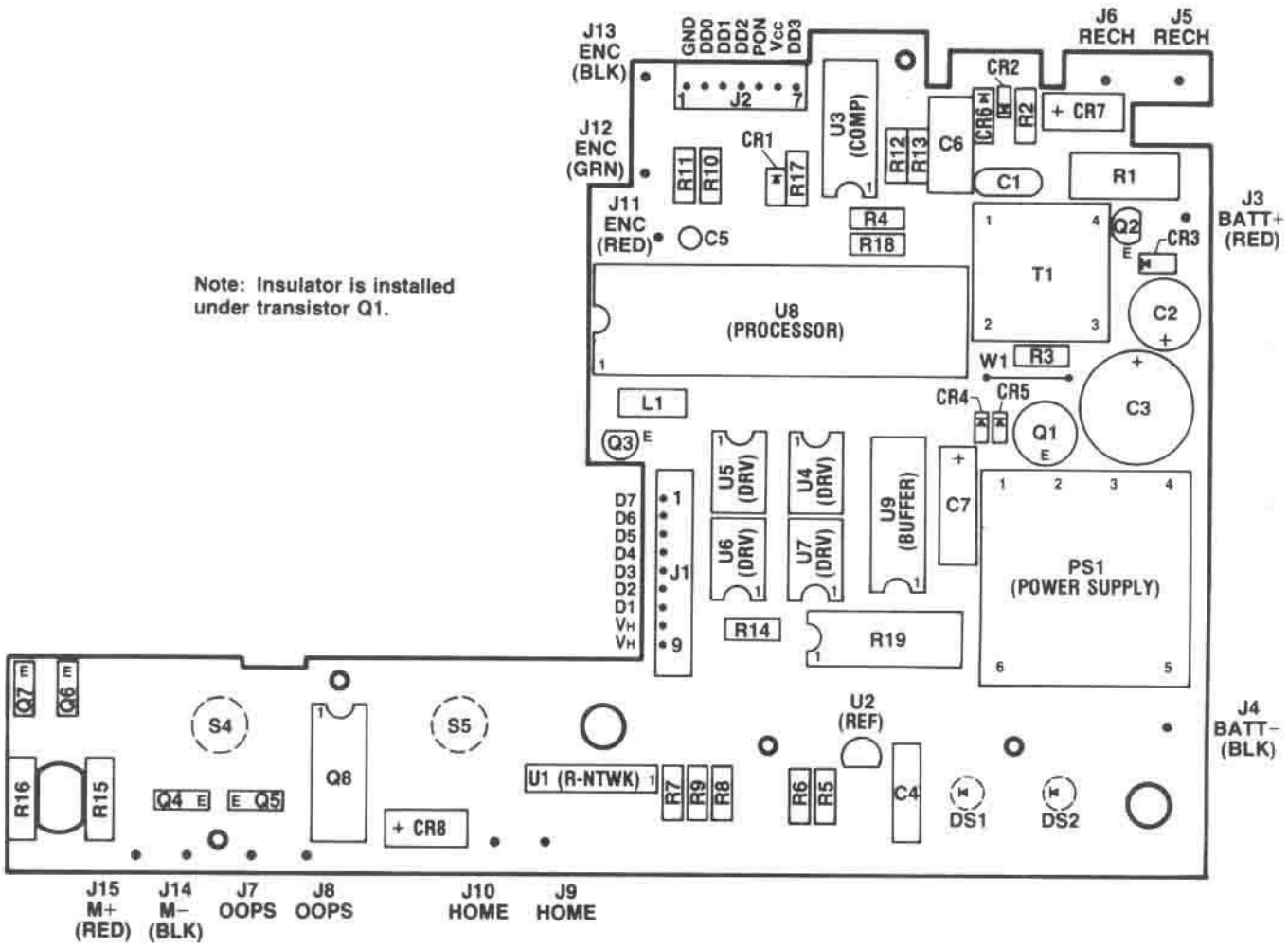


Figure 4-5. Logic PCA Component Location Diagram

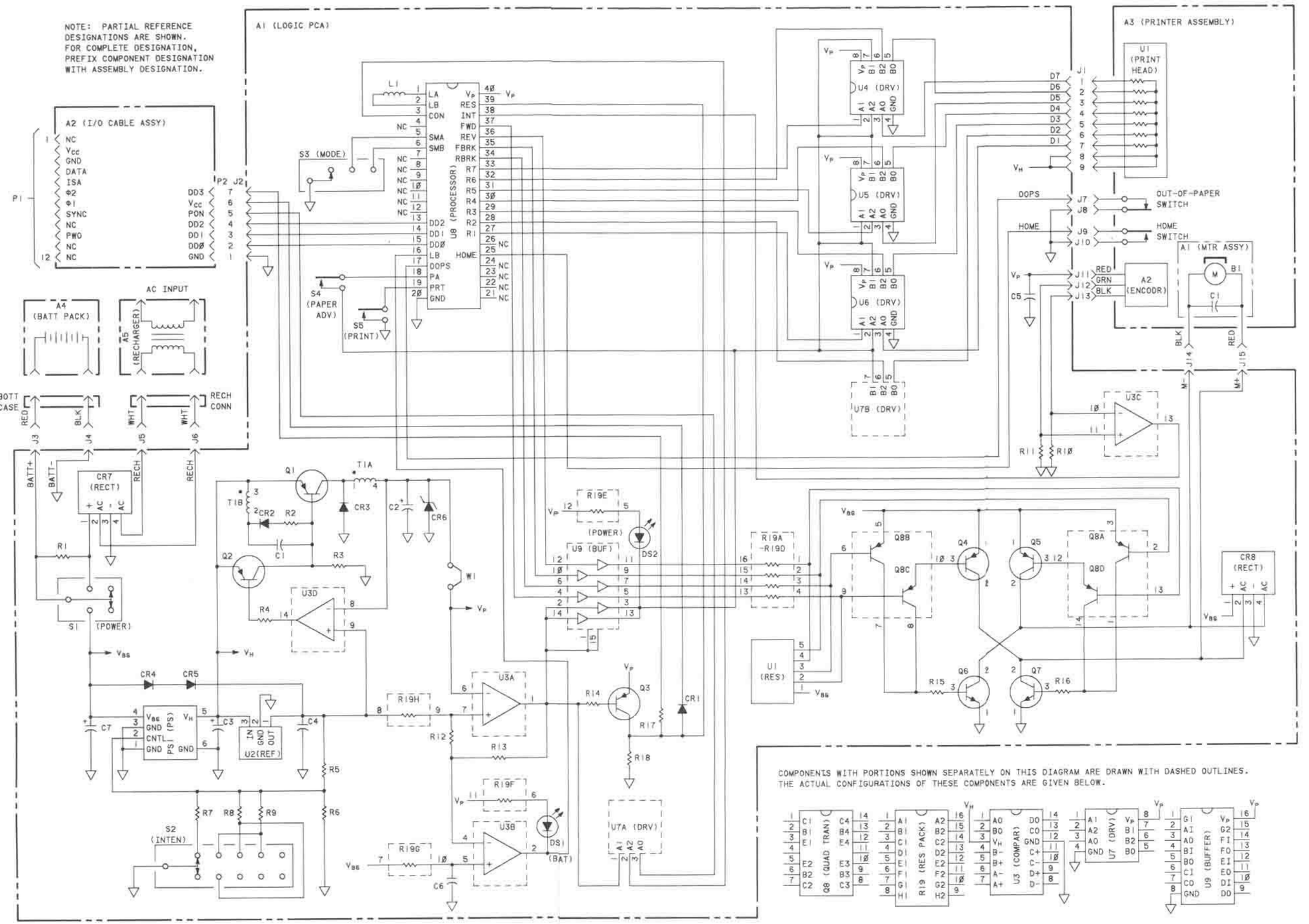


Figure 4-6. Printer Schematic Diagram

SECTION V

Accessories

5-1. INTRODUCTION

5-2. This section identifies electrical accessories that are available for the HP 82143A Printer. Defective accessories should be *replaced* rather than repaired since the cost of new unit is usually less than the cost of repair.

5-3. HP 82033A BATTERY PACK

5-4. The HP 82033A Battery Pack is shown in figure 5-1. This is the same pack that is used in the HP-97 calculator.

5-5. The serial number located on the battery pack indicates the week that the pack was charged. The format is described below:

YYWW

- WW — Week charged.
- YY — Year charged (years since 1960).

Figure 5-1. HP 82033A Battery Pack

5-6. To determine if the battery pack is bad or merely needs charging, perform the following procedure when time permits:

a. **Charge the battery pack** for at least 8 hours (in a reserve power pack, printer, or calculator that is good).

b. **Remove the battery pack.**

c. **Connect a 5-ohm, 10%, 10W resistor** across the battery contacts.

d. **After 45 minutes, remove the resistor.**

e. **Measure the dc voltage** between the battery contacts.

- If the voltage is less than 4 Vdc, the battery pack is bad.
- If the voltage is at least 4 Vdc, the battery pack is good. Charge it again for at least 5 hours, then store the pack for later use.

5-7. RECHARGERS

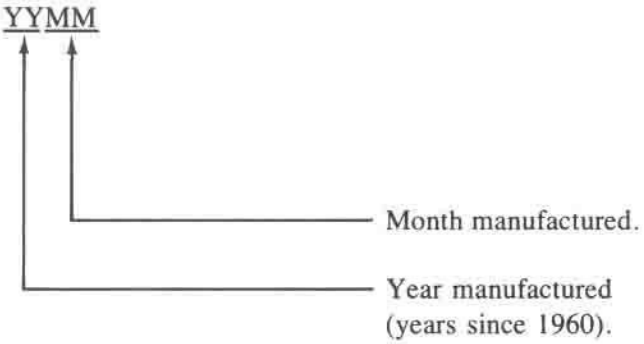
5-8. Various ac rechargers (table 5-1 and figure 5-2) are available for use with the HP 82143A Printer.

Table 5-1. Rechargers

HP MODEL NUMBER	VOLTAGE*	IDENTIFICATION
82059B	110	US
82066B	220	European
82067B	220	UK desktop
82067B Opt 001	220	UK with RSA plug
82068B	220	Australian
82069B	110	European

* Indicates nominal voltage; acceptable ranges are 210 to 250 Vac and 90 to 120 Vac.

5-9. The serial number located on the recharger indicates the month that the unit was manufactured. The format is described below:



5-10. To determine whether the recharger is functioning properly, perform this procedure:

a. **Plug the recharger into an outlet** of the proper voltage. (Refer to table 5-1.) Measure the power-outlet voltage (V_{IN}) using an ac voltmeter.

b. **Measure the recharger ac output voltage** (V_{OUT}) under no-load conditions using an ac voltmeter. V_{OUT} should be between 9.9 and 13.3 Vac at power voltages of 110 or 220 Vac. More generally, V_{OUT} should equal $(V_{IN}/110) \times 11.6$ Vac $\pm$ 1.7V or $(V_{IN}/220) \times 11.6$ Vac $\pm$ 1.7V. (V_{IN} is the ac voltage of the power outlet.)

- If V_{OUT} is outside the allowable range, the recharger is bad and should be discarded. *Stop testing here.*
- If V_{OUT} is inside the allowable range, continue with step *c*.

c. **Connect a 12-ohm, 5%, 5W resistor** across the recharger output contacts.

d. **Measure the ac voltage across the load** using an ac voltmeter.

- If the voltage is between 5.3 and 7.3 Vac, the recharger is good.
- If the voltage is outside 5.3 and 7.3 Vac, the recharger is bad and should be discarded.

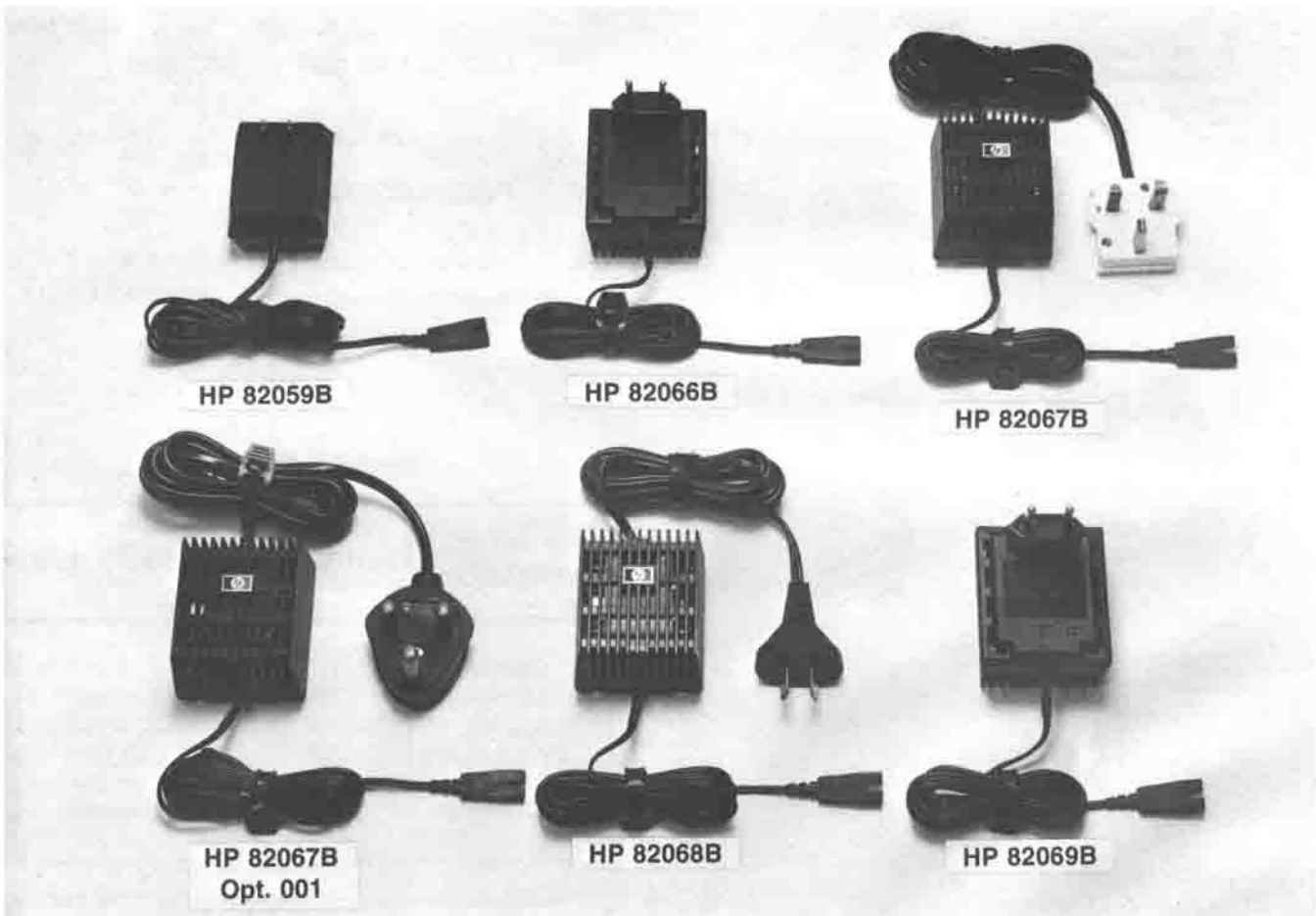


Figure 5-2. Rechargers

SECTION
VI

Service Module

6-1. This section gives a summary of the capabilities of the plug-in service module, part number ET-11968. It is intended as a reference only. *Do not* attempt to use it as a test procedure.

6-2. The plug-in service module is capable of testing a large portion of the printer circuitry. In addition, the module can test ROM in any plug-in accessory. It can also test itself. The calculator's display is used to give a visual output of the diagnosis.

6-3. Table 6-1 summarizes the capabilities of the service module. Options, possible LCD displays, comments, and actions are described for each test. See figure 4-1 to determine key assignments for specifying particular tests.

Table 6-1. Summary of ET-11968 Service Module Operation

TEST	LCD DISPLAY	COMMENT	NEXT STEP
Test Selection	***SELECT TEST (AUTO)***	Operating instruction. Selection of automatic operation.	Press any test key (manual operation), or press [PRGM] or [ALPHA] to select automatic operation. Press any test key (automatic operation), or press [R/S], [PRGM], or [ALPHA] to cancel.
Printer	***PRESS R/S*** ***PRINTER TEST*** ***TURN ON PRTR*** ***CHECK OUTPUT*** ***TRACE*** ***NORM*** ***PRINT KEY*** ***INTENSITY SW*** ***REMOVE PAPER*** ***INSERT PAPER*** ***HOLD ADV*** ***ALL TESTS OK*** ***ERR @, 1100*** ***ERROR @,M,***	Display at start of test. Display during first part of test. Operating instruction. Operating instruction. Operating instruction. Operating instruction. Operating instruction. Operating instruction. Operating instruction. Operating instruction. Operating instruction. All tests were passed. Error detected; status indicated. Summary of detected errors.	Press [R/S] to continue. Be sure printer is turned off and MODE is at MAN. * † Turn on the printer. * Examine printer output. † Set printer MODE switch to TRACE. † Set printer MODE switch to NORM. † Press printer PRINT key. Check printer INTENSITY switch, press [R/S] (or any other key) to continue. † Remove paper from printer. † Reinsert paper into printer. † Press and hold PAPER ADVANCE key on printer. Press [R/S] (or any other key) on calculator for test selection. Press [R/S] (or any other key) on calculator to continue. Press [R/S] (or any other key) on calculator for test selection.
End-of-Line Test	***EOL TEST*** ***ERR Y, 1100*** ***ERROR Y,*** ***OUT OF PAPER***	Display during test. Error detected; status indicated. Summary of detected errors. Printer ran out of paper.	* Press [R/S] (or any other key) on calculator to continue. Press [R/S] (or any other key) on calculator for test selection. Turn printer off and on, reload paper, then press [R/S] for test selection.
Status Check	***STS REC 1100***	Printer status indicated.	* Press [R/S] (or any other key) on calculator for test selection.
General ROM Test	***GEN ROM TEST*** ***MA-1B OK*** ***MA-1B BAD***	Display during test. Indicated ROM is good. Indicated ROM is bad.	* * Press [R/S] (or any other key) on calculator for test selection. Press [R/S] (or any other key) on calculator for test selection.
Service Module Test	***SRV MOD TEST*** ***SM-2B OK*** ***SM-2B BAD***	Display during test. Service module is good. Service module is bad.	* * Press [R/S] (or any other key) on calculator for test selection. Press [R/S] (or any other key) on calculator for test selection.

* Press [R/S] (or any other key) on calculator to stop automatic operation, if selected.

† Press [R/S] (or any other key) on calculator if test does not continue.

SECTION VII

Replaceable Parts

7-1. INTRODUCTION

7-2. This section contains information pertaining to the parts used in the HP 82143A Printer, illustrated in figure 7-1. Parts descriptions, HP part numbers, quantities, and reference designations (where applicable) are given in table 7-1.

7-3. Replaceable parts for the printer assembly (figure 7-2) are listed in table 7-2.

7-4. Replaceable parts for the logic PCA are listed in table 4-10, opposite the component location diagram.

7-5. ORDERING INFORMATION

7-6. To order replacement assemblies or parts, address order or inquiry to Corporate Parts Center or Parts Center Europe. Specify the following information for each part ordered:

a. Model and serial number.

b. HP part number.

c. Description.

d. Complete reference designation (if applicable).

Table 7-1. HP 82143A Printer Replaceable Parts

INDEX NUMBER, FIGURE 7-1	HP PART NUMBER	DESCRIPTION	QTY
1	00091-60013	ASSEMBLY, battery pack (A4)	1
2	82143-60017	ASSEMBLY, bottom case	1
3	1600-0816	• LATCH, security	1
4	0510-0064	• RING, retainer, security	1
5	2190-0184	• WASHER, spring	1
6	82143-60003	ASSEMBLY, I/O cable (A2)	1
7	82143-60009	ASSEMBLY, logic PC (A1)	1
8	82143-60004	ASSEMBLY, printer (A3) (refer to table 7-2)	1
9	82143-60016	ASSEMBLY, recharger connector	1
10	82143-40001	CASE, top	1
11	1460-1471	CONTACT, slide switch	3
12	82143-40011	COVER, paper	1
13	82143-40007	DOOR, battery	1
14	4040-1577	FILLER, bottom case	1
15	0403-0267	FOOT, rubber	4
16	0400-0009	GROMMET	3
17	82143-40009	KEY	2
18	7120-7924	LABEL, front	1
19	82143-40008	LATCH, battery door	2
20	82143-40010	LEVER, slide switch	3
21	7120-8169	OVERLAY, keyboard	1
22	0624-0307	SCREW, 0.25-inch	5
23	0624-0354	SCREW, 0.50-inch	8
24	4040-1587	SHIELD, slide switch	1
25	4320-0331	SPACER, rubber	1
26	2190-0400	WASHER, flat	3
27	3050-0438	WASHER, nylon insulating	5

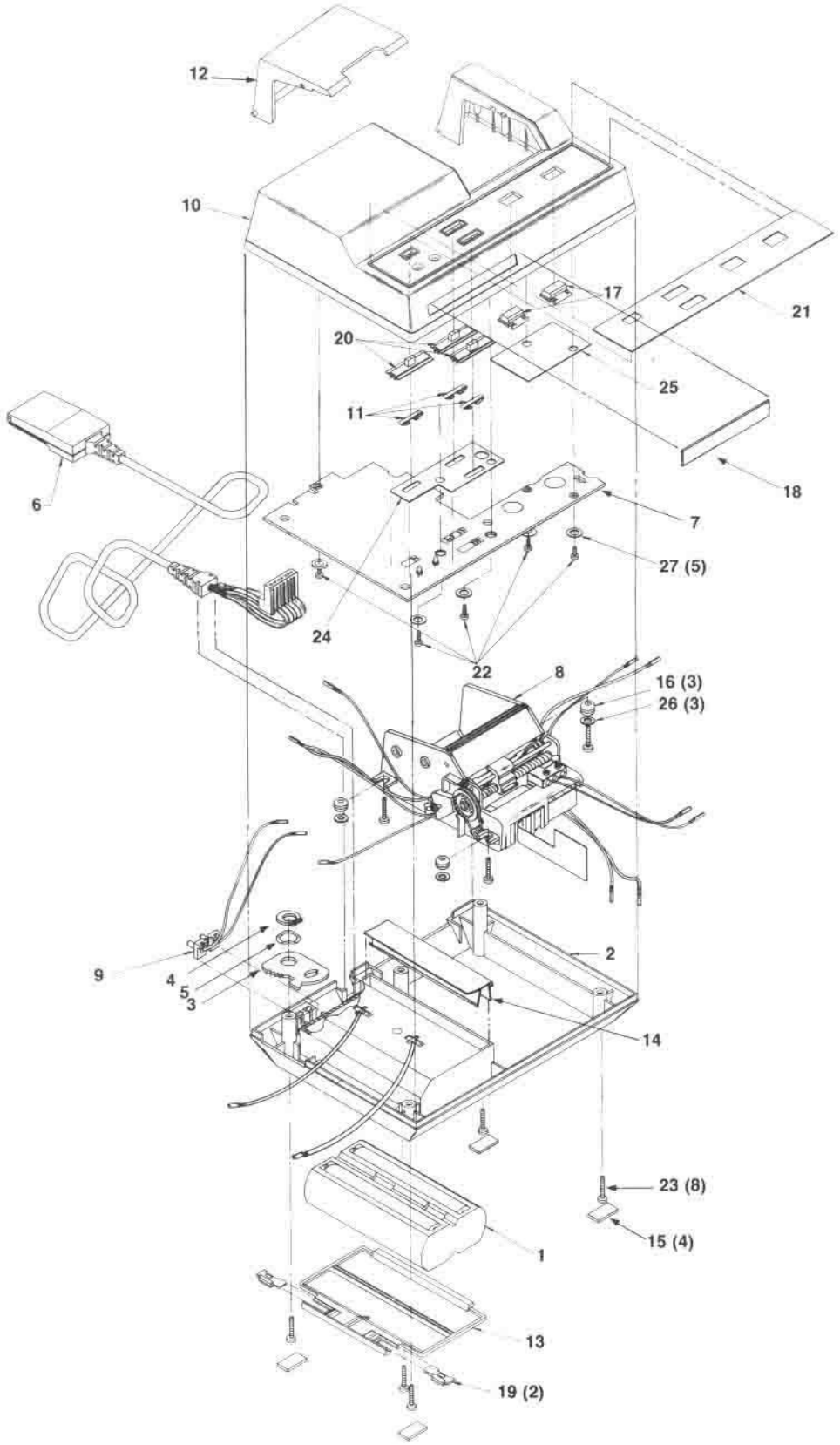


Figure 7-1. HP 82143A Exploded View

Table 7-2. Printer Assembly Replaceable Parts

INDEX NUMBER, FIGURE 7-2	HP PART NUMBER	DESCRIPTION	QTY
1	82143-60018	ASSEMBLY, encoder (A3A2)	1
2	82143-60912	ASSEMBLY, frame, service	1
3	82143-60913	• ASSEMBLY, encoder pulley, service	1
4	5040-9227	• BUSHING	2
5	82143-40017	• CARRIAGE, print-head	1
6	5020-9234	• LEAD SCREW	1
7	0510-0810	• RING, retainer, $^1/_{16}$-inch	2
8	0510-0261	• RING, retainer, $^3/_{32}$-inch	1
9	5040-9228	• ROLLER, pinch	2
10	1500-0468	• SHAFT, pinch-roller	1
11	1460-1461	• SPRING, pinch-roller	2
12	3050-0981	• WASHER, pulley	1
13	3050-0980	• WASHER, thrust	1
14	82143-60006	ASSEMBLY, home switch	1
15	3140-0624	ASSEMBLY, motor, service (A3A1)	1
16	82143-60015	ASSEMBLY, paper-advance	1
17	82143-60007	ASSEMBLY, platen	1
18	82143-60008	ASSEMBLY, print-head (A3U1)	1
19	82143-60011	ASSEMBLY, pusher	1
20	8120-2319	ASSEMBLY, wire/terminal	1
21	1500-0542	BELT, drive	1
22	1530-1872	CLAMP, head	1
23	1600-0539	CONTACT, out-of-paper	1
24	1480-0436	PIN, dowel	2
25	0510-0261	RING, retainer, $^3/_{32}$-inch	4
26	1500-0466	ROD, guide	2
27	0624-0355	SCREW, encoder, 0.375-inch	1
28	0517-0010	SCREW, head-clamp, 0.312-inch, machine	2
29	0624-0306	SCREW, home-switch, 0.50-inch	2
30	0515-0033	SCREW, motor, 5 mm, machine	3
31	0624-0307	SCREW, pusher, 0.25-inch	2
32	5040-8999	TEAR BAR	1
33	2190-0400	WASHER, encoder, flat	1

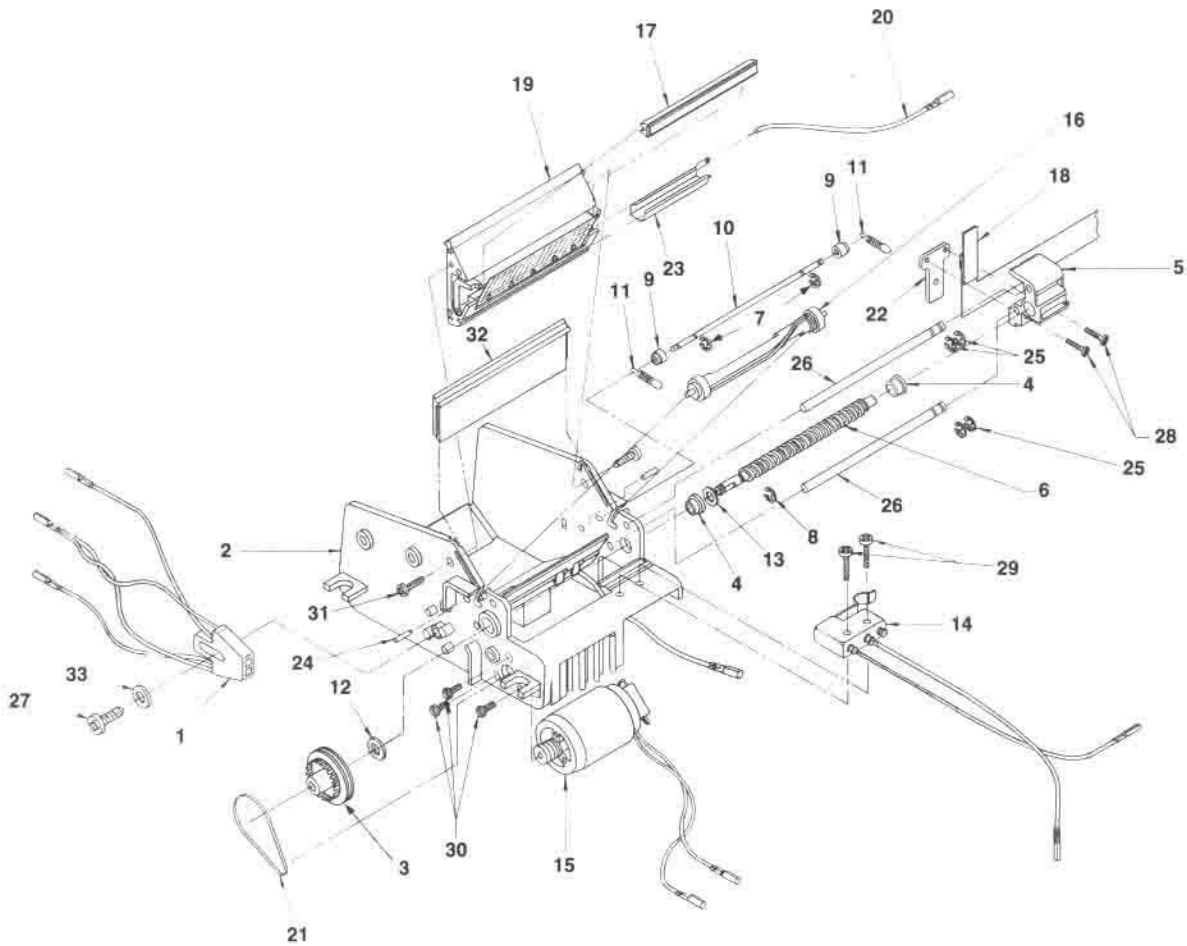


Figure 7-2. Printer Assembly Exploded View

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82143-90009

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