



SERVICE MANUAL

MODEL 2647A GRAPHICS TERMINAL

Manual part no. 02647-90003

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OPTIONS COVERED

This manual covers the 2647A standard model terminal and lists part numbers for the following options:

2647A-007 Integrated Dual Cartridge Tape Units	2647A-031 Deletes Standard Asynchronous Communications without replacing it
2647A-013 5 Cartridges	2647A-900 BS1363/CEE Power Cord Set
2647A-015 220 Volts, 50 Hertz	2647A-901 ASC112/CEE Power Cord Set
2647A-016 110 Volts, 50 Hertz	2647A-902 GMBH/CEE Power Cord Set
2647A-030 Replaces Standard Asynchronous Communications (Accessory 13260A) with one of accessories 13260B, 13260C, or 13260D	2647A-906 SEV/CEE Power Cord Set

ACCESSORIES COVERED

This manual lists parts numbers for the following terminal accessories:

13231A Display Enhancements	13296A HP-IB Interface
13231A-201 Mathematic Set	13232A 103/202 Modem Cable Assembly
13231A-202 Line Drawing Set	13232B 12531/12880 Hood-to-Hood Cable Assembly
13231A-203 Large Character Set	13232C RS232C Cable Assembly
13238A Terminal Duplex Register	13232F Current Loop Connector Kit
13245A PROM Character Set Accessory	13232G RS232C Cable Assembly (Male)
13246A Printer Subsystem (9866 A/B)	13232H RS232C Cable Assembly (Female)
13250B Serial Printer/Extended Asynchronous Data Communications Interface	13232J 9871 Cable Assembly
13254A Video Output Interface	13232K Tektronix 4632 Interface Cable Assembly
13260A Standard Asynchronous Communications	13232L Conrac TV Monitor Interface Cable Assembly
13260B Extended Asynchronous Communications	13232N Modem Cable Assembly
13260C Asynchronous Multipoint Communications	13232P Modem/Multipoint Cable Assembly
13260C-001 Asynchronous Multipoint Communications	13232Q Multipoint Cable Assembly
13260D Synchronous Multipoint Communications — Bisync	13232R Multipoint Extension Cable Assembly
13260D-001 Synchronous Multipoint Communications — Bisync with Monitor Mode Capability	13232S HP 9866 Cable Assembly
	13232T Power Protect Multipoint Cable Assembly
	13232U Modem Bypass Cable Assembly

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PREFACE

This manual provides field service information for the Hewlett-Packard 2647A Graphics Terminal. The HP 2647A is a state-of-the-art product and, because of product design, a complete modular philosophy has been implemented to minimize on-site time for repair. There are two additional manuals associated with this terminal — a User's Manual and a Reference Manual. These manuals are listed below:

- *HP 2647A Graphics Terminal User's Manual*, part no. 02647-90001.
- *HP 2647A Graphics Terminal Reference Manual*, part no. 02647-90002.

The User's Manual contains operator instructions; the Reference Manual contains programming information, installation instructions for the terminal and accessories, self-test instructions, and a brief overview of the terminal's architecture.

The Service Manual is divided into three sections:

- Section I provides a functional level block diagram discussion of the terminal.
- Section II provides information relative to troubleshooting, alignment and adjustment, preventive maintenance, and the use of HP CTU Tester.
- Section III contains removal and replacement procedures for terminal assemblies, instructions for rethreading a tape cartridge, and a list of field replaceable parts.

The following accessory manuals are also available:

- *13246A/B Printer Subsystem (9866A/B) Operator's Manual*, part no. 13246-90901.
- *13250B Serial Printer/Extended Asynchronous Data Communications Interface Operating Manual*, part no. 13250-90004.
- *13254A Video Interface Accessory Operating and Service Manual*, part no. 13254-90001.
- *13349A Printer Subsystem Operator's Manual*, part no. 13349-90901.

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FUNCTIONAL OPERATION

SECTION

I

1-1. INTRODUCTION

This section contains a block diagram level theory of operation discussion for the terminal.

1-2. GENERAL DISCUSSION

As shown in figure 1-1, the terminal basically consists of a power supply section, display section, memory section, control section, and input/output section. The interaction of these sections to provide the terminal's capabilities is discussed briefly in the following paragraphs.

The power supply section consists of a Power Supply PCA and a Power Supply Control PCA that convert the primary power source into required operating voltages and basic clock pulses for the terminal. Except for the Sweep PCA, all interfacing between the power supply section and other terminal modules is provided by the Backplane Assembly.

The display section consists of a display controller subsection, graphics display subsection, Sweep PCA, CRT display, and, if installed, a Display Enhancement PCA. The display controller subsection generates all timing and control signals for the display section, provides drive signals for the Sweep PCA, initiates ASCII character (data) transfers from the memory section, and converts the ASCII characters into video drive signals. The graphics display subsection, which is part of the display section, consists of a Graphics Display Memory PCA, a Graphics Microcontroller PCA, a top plane connector assembly, and a rear connector assembly. The graphics display subsection provides storage capability for the terminal's graphics matrix and a converter system that converts memory data into serial data. This data is displayed on the CRT via the Display Control and Display Timing PCA's. When installed, the Display Enhancement PCA generates the required drive signals to add half bright, underline, and blinking display enhancements to the CRT and provides the capability for adding up to three additional 128 character sets to the terminal. The Sweep PCA is controlled by the Display Timing and Display Control PCA's (also the Display Enhancement PCA when installed) and generates all drive signals, including filament and high voltages required by the CRT display. Timing and control signal interfacing between the display controller subsection modules (including the Display Enhancement PCA when installed) is provided by the Top Plane Assembly. Data, associated transfer signals, and address interfacing between the subsection modules and other terminal modules is provided by the Backplane Assembly.

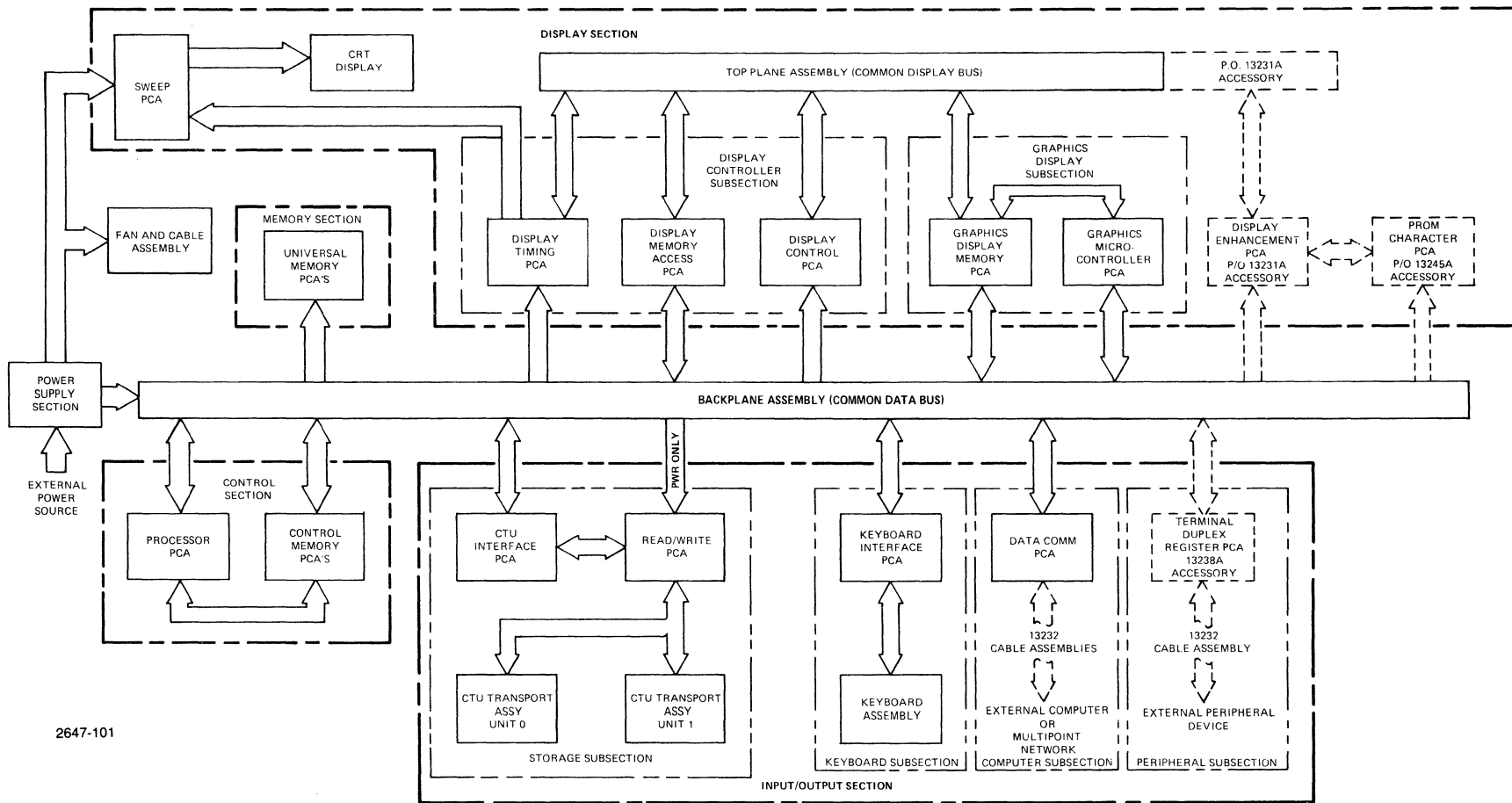
The control section is the central processing unit of the terminal and consists of the Processor and Control Memory PCA's. The Processor PCA fetches instructions from the operating system section of the Control Memory PCA and executes them; accessing the memory section, implementing input/output section modules or, if installed, implementing the Display Enhancement PCA. In addition, the control section also controls and directs received byte information to the display section for translation from ASCII code into video signals. All signals interfacing between the control section and the other terminal modules is provided by the Backplane Assembly.

The memory section provides the operator with the usable RAM storage capability of the terminal. This section consists of Memory PCA's which provide random access memory to the terminal. All read/write memory is accessed by the Processor PCA through the Backplane Assembly.

The input/output section is divided into a keyboard subsection, storage subsection, computer subsection, and peripheral subsection. All three subsections are implemented by the control section through the Backplane Assembly. The keyboard subsection consists of the Keyboard Assembly and Keyboard Interface PCA which provide direct data and instruction entry by the terminal operator. The storage subsection is a dual cartridge tape unit that provides data storage and retrieval capabilities for the terminal. The subsection consists of a Cartridge Tape Unit (CTU) Interface PCA, a Read/Write PCA, a CTU Top Plane Assembly, two CTU Transport Assemblies, and two or more tape cartridges. Each tape cartridge contains 140 feet of single-track 0.150 tape with a maximum formatted storage capacity of 128-K, eight-bit, data bytes. The dual cartridge tape unit provides full read and write capabilities in phase-encoded format. Data, associated transfer signals, and address interfacing between this subsection and other terminal modules is provided by the Backplane Assembly and CTU Interface PCA. The Read/Write PCA controls recording, reading, and tape motion of the two CTU Transport Assemblies. Interfacing between the two PCA's is provided by the CTU Top Plane Assembly and interfacing between the Read/Write PCA and the two CTU Transport Assemblies is provided by a Motor Cable Assembly and two CTU Cable Assemblies. The computer subsection consists of the Asynchronous Data Comm PCA and an interface cable assembly which provide a communication link between the terminal and an external computer. The peripheral subsection, if installed, consists of the Terminal Duplex Register PCA with an interface cable assembly and the HP-IB Interface with the HP-IB Interface Bus. The Terminal Duplex Register PCA

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and associated cable provide a communication link between the terminal and an external peripheral device such as a paper printer. The HP-IB Interface and the HP-IB Interface Bus provide a communication link between the terminal and a number of external peripheral devices which are connected to the HP-IB Interface Bus.



2647-101

Figure 1-1. Basic Block Diagram

2-1. INTRODUCTION

This section contains troubleshooting information for isolating terminal malfunctions to a replaceable assembly, alignment and adjustment procedures, preventive maintenance procedures, and instructions for using special test equipment.



WARNING



Hazardous voltages are present inside equipment. The procedures contained in this section shall be performed only by qualified service personnel.



VORSICHT



Innerhalb des Geräts bestehen gefährliche Spannungen. Die in diesem Abschnitt enthaltenen Arbeiten dürfen nur durch Betriebsfachpersonal durchgeführt werden.



ATTENTION



Des tensions dangereuses sont présentes à l'intérieur du matériel. Les opérations décrites dans cette section ne devront être effectuées que par un personnel qualifié.



AVVISO



Pericolo: Alta tensione presente in questa apparecchiatura. Le procedure contenute in questa sezione debbono essere effettuate soltanto da qualificato personale di servizio.



ADVERTENCIA



Hay voltaje peligroso en el interior de este equipo. Los procedimientos expuestos en esta sección sólo deberá llevarlos a cabo el personal de servicio calificado.



高圧危険



内部装置に危険な高電圧がきています。この章にある処置や手続に関しては、専門のサービスマンによってのみ行なって下さい。

2-2. TROUBLESHOOTING

2-3. GENERAL TROUBLE ISOLATION PROCEDURES

The majority of apparent terminal malfunctions are caused by incorrect operation. Therefore, before attempting any detailed trouble isolation procedures, verify that a terminal malfunction truly exists as follows:

- a. Ensure that terminal is properly installed (power cord connected and fuses properly installed) and is set to correct operating mode. (Refer to the *Reference Manual* for installation and configuration procedures.)
- b. Ensure that special function keys are being used correctly and in correct sequence (refer to the *User's Manual*).
- c. Determine whether or not any recent service routines (accessory installation, cables removed or installed, adjustments performed, etc.) have been performed on terminal. If so, check workmanship.
- d. Check all connections in accordance with paragraph 2-4.
- e. Check keyboard in accordance with paragraph 2-5.
- f. Perform terminal self test in accordance with paragraph 2-6.
- g. Perform data communications self test in accordance with the *Reference Manual*.
- h. Check storage subsection (cartridge tape option) in accordance with paragraph 2-8.

2-4. CONNECTION INSPECTION

Set mainframe rear panel ~LINE switch to OFF, disconnect power cord, and inspect cable connections as follows:

- a. Ensure that Keyboard Cable Assembly hood connector is firmly connected to Keyboard Interface PCA.
- b. Ensure that interface cable assembly hood connector is firmly connected to the data communications PCA.
- c. If installed, ensure that peripheral interface cable assembly hood connector is firmly connected to Terminal Duplex Register PCA.
- d. Open terminal mainframe to its full open position in accordance with the Installation Section in the *Reference Manual*, and check that all PCA's are firmly seated in Backplane Connector Assembly.
- e. Ensure that Power Supply Control PCA is firmly seated in Power Supply PCA connector J5 (refer to figure 2-3).
- f. Ensure that all internal cable assembly connectors are correctly and firmly connected.

2-5. KEYBOARD CHECKOUT

The major part of the terminal keyboard can be quickly checked for proper operation by setting the terminal for local operation (REMOTE key up), pressing each of the keys listed in table 2-1, and obtaining the listed results. If an incorrect result is observed, a malfunction exists in either the Keyboard Interface PCA or Keyboard PCA. (Removal and replacement procedures are contained in Section III.)

Table 2-1. Keyboard Checkout Keys

KEY	RESULTS
DISPLAY FUNCTIONS 1 Q or q Z or z L CNTL G	DISPLAY FUNCTIONS indicator lights 1 is displayed Q or q is displayed Z or z is displayed L is displayed is displayed
Release DISPLAY FUNCTIONS key and again press CNTL G keys.	Audible "beep" is generated

2-6. SELF TEST

The self test feature provides an overall check of the terminal making it possible to quickly analyze and isolate most terminal malfunctions. Section VII of the *Reference Manual* contains complete instructions for performing the three self tests (basic self test, cartridge tape self test, and data comm self test). A more comprehensive check of the storage subsection (cartridge tape units) is contained in paragraph 2-8. (Removal and replacement procedures are contained in Section III.) An overview of the basic self test and interpretations of indications are given below along with possible malfunctioning assemblies.

- a. Set mainframe rear panel ~LINE switch to ON and observe keyboard. Some keyboard indicators may flash on and then off. If any indicators with the exception of TRANSMIT indicator remain lighted, a malfunction exists in the Processor PCA. Also, Control Memory PCA ROM's are checked. In most cases, if a ROM malfunction is encountered, or if a ROM is missing, monitor will display either "PAGE 0 ROM ERROR" or "PAGE 1 ROM ERROR" followed by some numbers, indicating that either a ROM IC is in the wrong socket, or the checksum was incorrect. (The basic terminal self-test flowchart in the *Reference Manual* shows the error messages.) Figure 2-1 shows the ROM numbers assigned to each socket (0, 2, 4, etc.) and the ROM IC part numbers for each location (e.g., 1818-0590 for ROM number 0). It also identifies page 0 and page 1.
- b. Check that TERMINAL READY appears in upper left corner of display monitor approximately seven seconds after terminal is energized. This verifies that Sweep, Processor, Control Memory, Display Memory Access (DMA), Display Control, and Display Timing PCA's are operating correctly. If the alphanumeric cursor does not appear, a malfunction probably exists in the Sweep PCA.
- c. Press Keyboard TEST key and observe following sequence of events:
 - (1) Keyboard indicators light. If no indicators light, malfunction probably exists in Power Supply or Power Supply Control PCA.
 - (2) Entire display including cursor momentarily blanks which checks display portions of Processor, DMA, Display Control, and Display Timing PCA's. Also the ROM's on the Control Memory PCA's are checked as described in step a. If display does not clear (blank), malfunction probably exists in Display Control PCA.

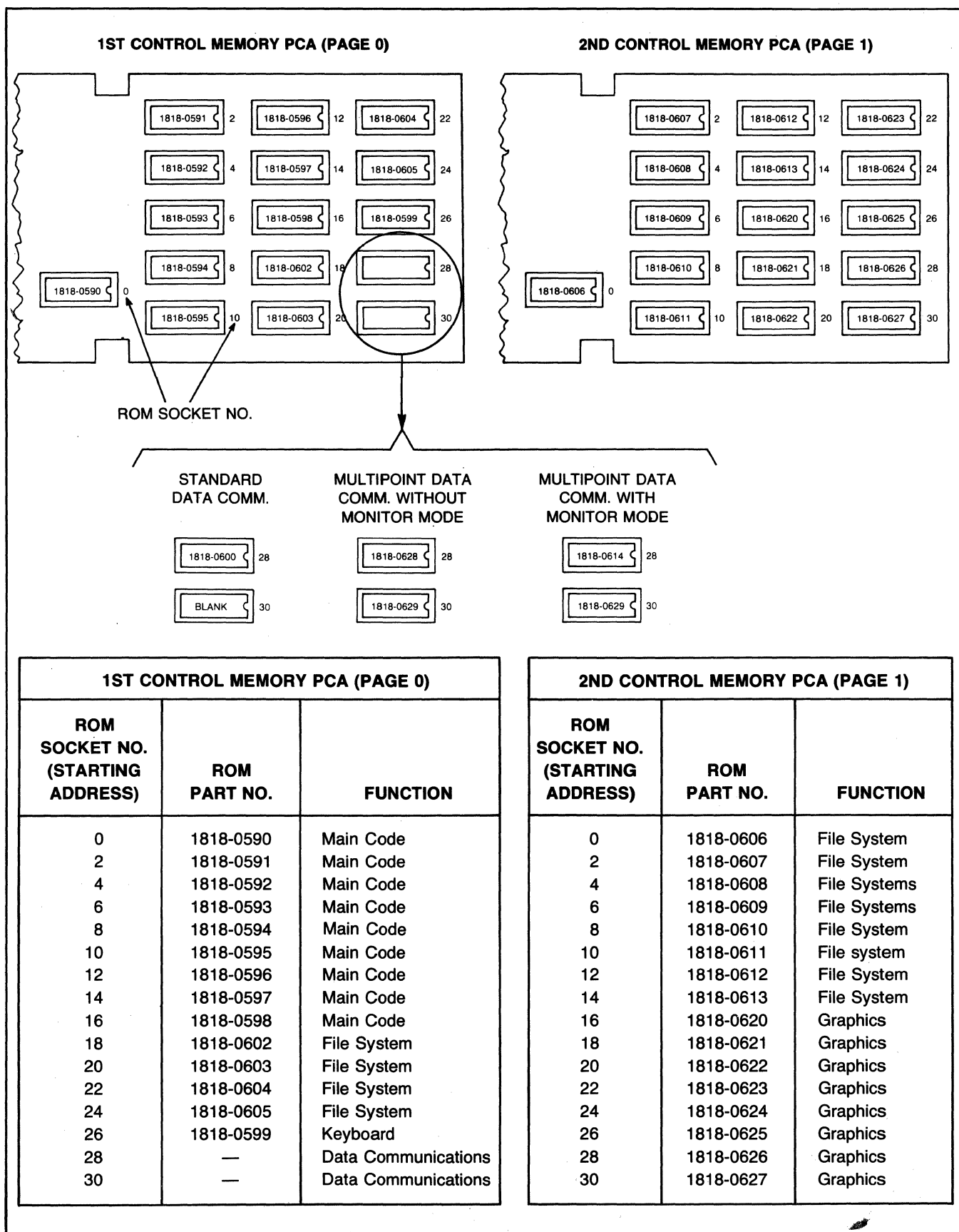


Figure 2-1. Control Memory PCA ROM Locations

- (3) While display is still blanked, the Memory PCA RAM's are checked. In most cases, if a RAM malfunction is encountered, or if the amount of RAM storage on the Universal Memory PCA's is less than 64K, the monitor will display "RAM ERROR" followed by some numbers indicating a defective Memory PCA. (The basic terminal self-test flowchart in the *Reference Manual* shows the error messages.)
- (4) Graphics Display Memory and Graphics Microcontroller PCA's are checked. A marching vector memory test is performed and a series of graphical characters is displayed. If a RAM or controller malfunction occurs, the monitor will display "GRAPHICS SELF TEST ERROR" "MEMORY CHIP Uxy", where Uxy is the failing RAM chip on the Graphics Display Memory PCA (02648-60126). For example, if "MEMORY CHIP U51" is displayed, then RAM chip U51 must be replaced. (To replace a RAM chip refer to paragraph 3-8.)

If multiple messages occur, i.e., message indicates every RAM chip has failed, or if replacing a RAM chip doesn't correct the problem, the Graphics Display Memory PCA or Graphics Microcontroller PCA should be replaced.

To check graphical characters, visually observe the drawing, zooming, erasing, and panning of the test patterns being displayed. Observe the graphics cursor (an enlarged plus sign) for correct operation. If the graphics cursor does not work, replace the Graphics Display Memory PCA or the Graphics Microcontroller PCA.

- (5) One audible "beep" is generated. If not, keyboard speaker may be defective or a malfunction probably exists in Processor PCA.
- (6) Entire character set is displayed and, after print-out, blinking cursor appears in first column of next lower line. The test pattern contains all available symbols and display enhancements. Last line of test pattern displays status of terminal. Refer to the *Reference Manual* for status byte definitions and correct test pattern displays. If test pattern is incorrect, refer to paragraph 2-9.

2-7. DATA COMMUNICATIONS SELF TEST

The procedures for performing this self test are contained in the *Reference Manual*. Following the procedures given, you should be able to isolate a malfunctioning assembly (i.e., Data Communications PCA, Cable, or modem.)

2-8. HP-IB SELF TEST

The HP-IB self test tests the PHI IC and the RAM buffer and exercises the burst transfer hardware. To initiate the test, type TEST HPIB #4 then press the RETURN key. If the HP-IB fails the test, the following message will be printed:

HPIB TEST FAIL, ERROR=X

where X is a number from 1 to 4 and is decoded as follows:

- 1 indicates no PCA installed.
- 2 indicates a PHI IC error.
- 3 indicates a RAM buffer error.
4. indicates a burst transfer hardware failure.

If the test is successful, the following message is displayed:

HPIB TEST OK, HPIB ADDR=XX, SYSCTL=YES or NO, CIC=YES or NO

This message shows the current strapping configuration of the HP-IB PCA. XX is an address, from 8 to 29, which uniquely identifies the HP-IB to differentiate it from all other HP-IB devices connected to the HP-IB. If YES is indicated for SYSCTL, the terminal has control of the HP-IB bus as soon as power is applied to the terminal. If NO is indicated, the terminal must wait for control. CIC means controller in charge. If YES is displayed for CIC, the terminal can transmit to another device connected to the HP-IB bus. If NO, transmission to another HP-IB bus device is not possible at this time.

2-9. STORAGE SUBSECTION CHECKOUT

The storage subsection checkout provides a check of the entire terminal, including the storage subsection, making it possible to quickly verify proper terminal operation and, when a malfunction exists, to isolate most malfunctions to a replaceable module. (Removal and replacement procedures are contained in Section III.) Perform the checkout in accordance with steps a through m. If a malfunction occurs, note the checkout step letter and refer to table 2-2. Table 2-2 is keyed to the checkout by step letter and contains a list of malfunctions that could occur for each step (SYMPTOM) and associated lists of PROBABLE CAUSE and CORRECTIVE ACTION procedures. If more than one probable cause is listed for a specific symptom, check the probable causes in the order listed. If more than one corrective action is listed for a specific probable cause, perform the corrective actions in the order listed. After any corrective action has been performed, *check if the malfunction has been corrected*. If the malfunction persists, check the next probable cause, perform the corrective action(s), and again check if the malfunction has been corrected. After any malfunction has been corrected, repeat this entire checkout procedure to ensure proper terminal operation.

- a. Open terminal to its half open position in accordance with the Installation Section in the *Reference Manual*.
- b. Using at least two tape cartridges, check that cartridges can be easily inserted and ejected for both UNIT 0 and UNIT 1.
- c. Perform terminal self test in accordance with paragraph 2-6.
- d. Press RESET TERMINAL key twice within 0.5 second and check that display clears and blinking cursor appears in upper-left corner of display.
- f. Press the COMMAND key to display the command functions along the bottom of the display; then press the following keys in the following sequence: NEXT(f1) three times, TEST (f4), TAPES (f4), and the RETURN key. The following sequence of events should occur:

Note: If a malfunction occurs while testing either CTU Transport Assembly, test will halt and the eject button on the CTU Transport Assembly under test when the malfunction occurred will be lighted.

CAUTION

Do not use tape cartridges containing data you wish to save when performing the following checkout procedures. Data previously stored on tape will be overwritten with test data.

Note: Many of the following test sequences can be individually duplicated using the HP CTU Tester discussed in paragraph 2-21. Whenever it is desired to perform such a test sequence more than once, it is recommended that the CTU Tester be used rather than to repeat the entire checkout procedure.

- e. Set cartridge protect tab on both tape cartridges to RECORD position, insert tape cartridges in UNIT 0 and UNIT 1, and observe the following sequence of events.
 - (1) The tape cartridges sequentially rewind to beginning-of-tape (BOT) and then search forward to load point (LP). (Tape motion; fast reverse then slow forward.)
 - (2) When both tapes are at LP, both eject buttons light.
- (1) UNIT 0 eject button light starts blinking indicating start of a complete test for UNIT 0. Test sequence is as follows:
 - (a) Worst case test pattern (one record of 128 "%Z" characters) is recorded on tape. (Tape motion; slow forward.)
 - (b) Tape is backspaced over recorded test pattern. (Tape motion; slow reverse.)
 - (c) Recorded test pattern is read and verified and an end-of-file mark recorded. (Tape motion; slow forward.)
- (2) UNIT 0 eject button light stops blinking and remains on indicating successful completion of UNIT 0 test.
- (3) Two self-test patterns appear on display indicating the successful completion of two basic terminal self-test sequences.
- (4) UNIT 1 eject button starts blinking indicating start of complete test for UNIT 1. Sequence of events for UNIT 1 test is identical to sequence of events for UNIT 0 test described in substeps (1)(a) through (1)(c) above.
- (5) Another self-test pattern appears and remains on display and both eject buttons remain lighted indicating the successful completion of UNIT 1 test.

Table 2-2. Storage Subsection Troubleshooting Guide

STEP	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Note: Some of the listed PROBABLE CAUSE malfunctions are preceded by an asterisk (*). The asterisk denotes that the malfunction can be further checked or verified by using the HP CTU Tester as discussed in paragraph 2-21. Whenever such a malfunction is encountered, it is recommended that the tester be used to verify the malfunction before performing any CORRECTIVE ACTION instructions.</p>			
a	Not applicable.		
b	Tape cartridge does not insert easily or does not seat properly.	1. Defective tape cartridge. 2. CTU Transport Assy and main-frame front bezel not properly aligned.	Replace tape cartridge. Align transport and bezel.

Table 2-2. Storage Subsection Troubleshooting Guide (Continued)

STEP	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
b (Cont)	Tape cartridge does not fully eject. Tape cartridge ejects from terminal.	3. Defective CTU Base Assy. Same as causes 1 through 3 above. Defective CTU Base Assy.	Replace CTU Transport Assy. Same as above. Replace CTU Transport Assy.
c	Not applicable.		
d	Display does not clear and/or cursor does not appear.	1. Operator error. 2. Basic terminal malfunction.	Press RESET TERMINAL key. Perform terminal self test (paragraph 2-6).
e(1)	No message appears and neither tape cartridge rewinds. NO TAPE message appears on display and only one tape cartridge rewinds. NO TAPE message appears on display and neither tape cartridge rewinds. RUNOFF message appears on display.	1. CTU Top Plane not properly connected. 2. CTU Interface and/or Read/Write PCA not properly connected. *3. Defective top plane or PCA top connectors. *4. Defective bus decoder and timing logic, command logic, or tape motion decoder. *5. Defective amplifier select logic or CTU drive circuits. 1. Tape cartridge not seated properly in CTU Transport Assy with lighted eject button. 2. Defective tape cartridge. *3. Defective Head Bridge Assy in CTU Transport Assy with lighted eject button. *4. Defective cartridge detect circuit, amplifier select circuit, or CTU drive circuits. *5. Defective command logic, hole detect logic, or status bus drivers. *1. Defective bus decoder and timing logic, command logic, hole detect logic, or tape motion decoder. *2. Defective amplifier select logic or CTU drive circuits. 1. Defective tape cartridge in CTU Transport Assy with lighted eject button. *2. Defective Head Bridge Assy in CTU Transport Assy with lighted eject button. *3. Defective hole detect logic or hole detect flip-flop.	Reinstall top plane on CTU Interface and Read/Write PCA top connectors. Reinstall PCA's in Backplane Assy. Use CTU Tester in its ON LINE mode. Verify malfunction and, if necessary, replace top plane and/or PCA's. Replace CTU Interface PCA. Replace Read/Write PCA. Eject and reinsert tape cartridge in Transport Assy. Replace tape cartridge. Replace CTU Transport Assy. Replace Read/Write PCA. Replace CTU Interface PCA. Replace CTU Interface PCA. Replace Read/Write PCA. If tape has run off either tape hub, either rethread (paragraph 3-11) or replace tape cartridge. If tape is attached to both hubs, rewind approximately 1/2 inch of tape by manually rotating cartridge belt drive puck. Replace CTU Transport Assy. Replace CTU Interface PCA.

Table 2-2. Storage Subsection Troubleshooting Guide (Continued)

STEP	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
e(1) (Cont)	<p>Both tape cartridges rewind, but neither searches forward to LP.</p> <p>One tape cartridge rewinds and stops at LP, but no tape motion on other tape cartridge.</p>	<p>*1. Defective command logic or tape motion decoder.</p> <p>*2. Defective CTU drive circuits or feedback circuits.</p> <p>*1. Defective Motor/Tachometer Assy on CTU Transport Assy with lighted eject button.</p> <p>*2. Defective amplifier select logic or CTU drive circuits.</p> <p>*3. Defective Head Bridge Assy on CTU Transport Assy with lighted eject button.</p>	<p>Replace CTU Interface PCA.</p> <p>Replace Read/Write PCA.</p> <p>Replace CTU Transport Assy.</p> <p>Replace Read/Write PCA.</p> <p>Replace CTU Transport Assy.</p>
e(2)	<p>Cursor appears on display, but neither eject button is lighted.</p> <p>Cursor appears on display, but only one eject button is lighted.</p>	<p>*Defective bus decoder and timing logic or command logic.</p> <p>1. Defective indicator lamp DS1 on unlighted eject button.</p> <p>2. Defective Head Bridge Assy on unlighted CTU Transport Assy.</p> <p>*3. Defective command logic.</p>	<p>Replace CTU Interface PCA.</p> <p>Replace DS1.</p> <p>Replace CTU Transport Assy.</p> <p>Replace CTU Interface PCA.</p>
f(1)	<p>PROTECTED TAPE message appears on display.</p> <p>RUNOFF message appears on display.</p> <p>READ FAIL message appears on display. (Also see END OF DATA message in paragraph 2-25.)</p>	<p>1. Operator error.</p> <p>*2. Defective Head Bridge Assy.</p> <p>*3. Defective unit/function decoder or write current circuit.</p> <p>*4. Defective command logic.</p> <p>Same as STEP e(1) RUNOFF message SYMPTOM.</p> <p>1. Defective tape cartridge.</p> <p>*2. Defective magnetic head.</p> <p>*3. Defective data I/O buffer, shift register, or encoder/decoder logic.</p> <p>*4. Defective unit/function decoder, write current circuit, read select switch, read amplifier circuit, or gap detect circuit.</p> <p>*5. Defective Motor/Tachometer Assy.</p>	<p>Eject tape cartridge, set cartridge protect tab to RECORD position, and reinsert tape cartridge in UNIT 0.</p> <p>Replace UNIT 0 CTU Transport Assy.</p> <p>Replace Read/Write PCA.</p> <p>Replace CTU Interface PCA.</p> <p>Condition UNIT 0 tape (paragraph 2-20) or, if malfunction persists, replace tape cartridge.</p> <p>Clean and degauss UNIT 0 magnetic head (paragraphs 2-18 and 2-19) or, if malfunction persists, replace UNIT 0 CTU Transport Assy.</p> <p>Replace CTU Interface PCA.</p> <p>Replace Read/Write PCA.</p> <p>Replace UNIT 0 CTU Transport Assy.</p>
f(2)	Not applicable.		
f(3)	ROM or RAM ERROR messages appear on display, test patterns do not appear, or incorrect test patterns appear.	Basic terminal malfunction.	Perform terminal self test (paragraph 2-6).

Table 2-2. Storage Subsection Troubleshooting Guide (Continued)

STEP	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
f(4) and f(5)	Same as f(1) except use UNIT 1 in lieu of UNIT 0.		
g	Tape cartridge does not rewind.	1. Operator error. *2. Defective command logic or tape motion decoder.	Repeat key stroke sequence. Replace CTU Interface PCA.
h	Same as step g.		
i	Not applicable.		
j	No characters appear on display. Blanks appear between displayed characters. READ FAIL message appears on display.	1. Operator error. *2. Defective bus decoder and timing logic, command logic, data I/O logic, shift register, or encoder/decoder logic. 1. Defective tape cartridges. *2. CTU Transport speeds not balanced. *1. CTU Transport speeds not balanced. *2. Defective magnetic head.	Repeat key stroke sequence. Replace CTU Interface PCA. Condition tapes or replace tape cartridges (paragraph 2-20). Perform speed adjustment (paragraph 2-16). Perform speed adjustment (paragraph 2-16). Clean and degauss UNIT 0 magnetic head (paragraphs 2-18 and 2-19) or, if malfunction persists, replace UNIT 0 CTU Transport Assy.
k	Same as step j except use UNIT 1 in lieu of UNIT 0.		
l and m	Not applicable.		

- g. Press the COMMAND key to display the command functions along the bottom of the display; then press the following keys in the following sequence: REWIND(f5), LTAPE(f5), and the RETURN key.
- h. Repeat step g for UNIT 1 except press the RTAPE(f6) key in place of the LTAPE(f5) key. UNIT 1 should perform the same as UNIT 0.
- i. Swap tape cartridges between UNIT 0 and UNIT 1.
- j. Press RESET TERMINAL key twice within 0.5 second and, after cartridges have rewound and both eject button lights are on, press READ key. Check that a line of "%Z" characters are read from UNIT 0 and appear on display. (Tape motion; slow forward.)
- k. Press the COMMAND key to display the command functions along the bottom of the display; then press the following keys in the following sequence: COPY(f2), LINE(f1), RTAPE(f2), DISPLAY(f3), then press the RETURN key.
- l. Rewind both tape cartridges (steps g and h above) and remove cartridges from terminal.
- m. Firmly grasp mainframe top cover in one hand and release safety latch by pressing it inboard with other hand. Then, using both hands, carefully lower top cover to its closed position.

2-10. DETAILED TROUBLE ISOLATION PROCEDURES

Any terminal malfunctions not isolated and corrected by the procedures contained in paragraphs 2-3 through 2-8 can be isolated to a replaceable assembly by performing in sequence the procedures presented in figure 2-2. Some corrective action procedures in figure 2-2 consist of more than one replacement instruction. When these are encountered, replace the first assembly listed and *check if the malfunction has been corrected*. (Removal and replacement procedures are contained in Section III.) If the malfunction persists, reinstall the first assembly listed, replace the second assembly listed, and again check if the malfunction has been corrected. After any malfunction has been corrected; use the terminal's self-test feature to ensure proper operation.

2-11. ALIGNMENT AND ADJUSTMENT

All alignment and adjustment procedures for the terminal and its add-on accessories are contained in the following paragraphs. Unless otherwise specified, these procedures can be performed individually or in any desired sequence.

Note: After performing any alignment or adjustment procedures, always use the terminals self-test feature (paragraph 2-6) to ensure proper terminal operation.

2-12. POWER SUPPLY VOLTAGE ADJUSTMENT

After installing or removing accessories, you should adjust the +5 volt output of the terminal's power supply. Only this voltage need be adjusted because the +5 volts provides reference for the other supply voltages. The adjustment requires a 20,000 ohms/volt voltmeter.

- a. Open the terminal, and remove power supply cover.
- b. Turn on ac power to terminal, and ensure that neither cartridge tape transport motor is running (if installed).
- c. Check the voltages at the following points with the multimeter. (See figure 2-3.)

TEST POINT	VOLTAGE TOLERANCE
+5V diode	+4.85V to +5.25V
-42V diode	-40V to -46V
+12V diode	+11.8V to +12.6V
-12V diode	-11.8V to -12.6V

- d. Adjust +5V potentiometer until all voltages are within tolerance.
- e. When all voltages are within tolerance, turn off power, disconnect multimeter, and replace power supply cover.

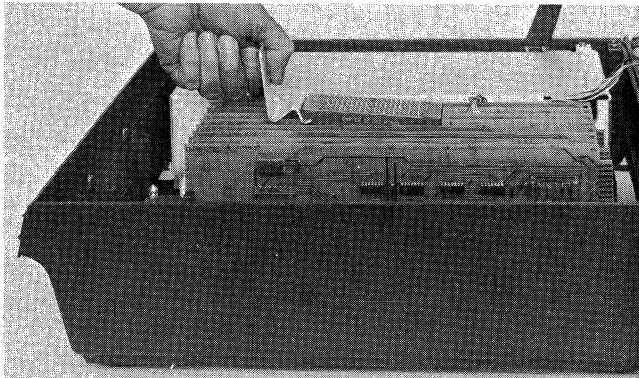
2-13. BRIGHTNESS, HALF BRIGHT, AND FOCUS ADJUSTMENTS

Due to product design, these adjustments seldom need be performed. However, minor adjustment can be made to each potentiometer (see figure 2-4) to suit individual preferences by opening the terminal mainframe to its half open position, energizing the terminal, and adjusting the applicable potentiometer for the desired display appearance. If extensive repair or replacement procedures have been performed on the terminal, it is suggested that the adjustment procedure below be performed in its entirety to ensure optimum terminal performance.

This procedure requires the use of the HP Display Test Module, part no. 02640-60063. The brightness, half bright, and focus adjustments are interactive and, therefore, must

be performed together. Perform the adjustments as follows:

- a. Open the terminal.
- b. Insert connector removal tool under Top Plane Connector Assembly as shown below and remove assembly by pressing down on removal tool handle.



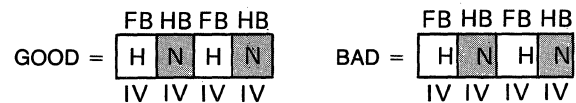
- c. Remove Display Memory Access (DMA) PCA from Backplane Assembly.
- d. If necessary, rearrange backplane PCA configuration to perform step e.
- e. Install Display Test Module on top connectors of Display Timing and Display Control PCA's so that test module cable is toward front of mainframe.
- f. Connect test module cable plug to Display Timing PCA +5V red test jack located on top front of PCA.
- g. Connect power cord between ac power source and mainframe rear panel LINE connector.
- h. Set rear panel ~LINE switch to ON position.
- i. Set test module HALF BRIGHT switch to off position, INVERSE VIDEO switch to off position, and DOTS/CROSSHATCH switch to DOTS.
- j. Adjust BRIGHTNESS R37 (see figure 2-4 for desired display brightness).
- k. Set test module HALF BRIGHT switch to on position, remove button covering CRT shield HALF BRIGHT adjustment access hole, and adjust HALF BRIGHT R5 for desired display half brightness.
- l. Repeat steps i, j, and k until desired display contrast is obtained between full bright and half bright.
- m. Set test module HALF BRIGHT switch to off position.
- n. Adjust FOCUS R33 (see figure 2-4 for best overall display sharpness).

- o. If desired focus cannot be obtained, adjust display brightness slightly lower and repeat steps i through n.
- p. Set rear panel ~LINE switch to OFF and reinstall button to cover HALF BRIGHT adjustment access hole.
- q. Secure CRT shield in place by pressing the two nylon snap fasteners into mounting holes.
- r. Disconnect test module cable plug from Display Timing PCA and disconnect test module from Display Timing and Display Control PCA's.
- s. Reinstall DMA PCA into vacated Backplane Assembly connector and reinstall Top Plane Connector Assembly on DMA, Display timing, and Display Control PCA's.

2-14. DISPLAY ENHANCEMENTS FIELD ADJUSTMENT

After initial installation of the HP 13231A Display Enhancements Accessory, check and, if necessary, adjust the Display Enhancement PCA as follows:

- a. Open the terminal.
- b. Connect power cord between ac power source and mainframe rear panel LINE connector.
- c. Set rear panel ~LINE switch to ON position.
- d. Using keyboard, set terminal for local operation (REMOTE key up) and press each of the following keys once: CAPS LOCK, f₁ and CNTL simultaneously, B, H, f₁ and CNTL simultaneously, J, N, f₁ and CNTL simultaneously, B, H, f₁ and CNTL simultaneously, J, N. Compare display against examples.



WHERE: FB = full bright enhancement
 HB = half bright enhancement
 IV = inverse video enhancement

- e. If necessary, adjust Display Enhancement PCA FIELD potentiometer R10 to center full bright and half bright enhancements over characters displayed on monitor.
- f. Set rear panel ~LINE switch to OFF and close terminal mainframe.

2-15. DISPLAY RASTER ALIGNMENT AND ADJUSTMENT

This procedure requires the use of the HP Display Test Module, part no. 02640-60063. Align and adjust the display raster as follows:

- a. Open the terminal and remove CRT shield as follows:
 - (1) Pull out on the two nylon snap fasteners on each side of the shield.
 - (2) Slide the shield toward the front of the mainframe to release it from the sheet metal lip on the monitor assembly. (The rear of the shield should be allowed to drop far enough to allow it to slide forward without binding.)
- b. Insert connector removal tool under Top Plane Connector Assembly as shown in paragraph 2-12 and remove assembly by pressing down on removal tool handle.
- c. Remove DMA PCA from Backplane Assembly.
- d. If necessary, rearrange backplane PCA configuration to perform step e.
- e. Install Display Test Module on top connectors of Display Timing and Display Control PCA's so that test module cable is toward front of mainframe.
- f. Connect test module cable plug to Display Timing PCA red test jack located on top front of PCA.
- g. Connect power cord between ac power source and mainframe rear panel LINE connector.
- h. Set rear panel ~LINE switch to ON position.
- i. Set test module HALF BRIGHT switch to off position, INVERSE VIDEO switch to on position, and DOTS/CROSSHATCH switch to center off position.
- j. The monitor should display an inverse video rectangular pattern. If no pattern is displayed, adjust BRIGHTNESS R37 (see figure 2-4 until pattern is displayed. If this step is required, perform brightness and focus adjustments in accordance with paragraph 2-12 after completing raster alignment and adjustment procedures.



WARNING



High voltage is present on exposed portions of Yoke Cable Assembly.



VORSICHT



An den offenen Stellen des Joch-Kabelsatzes (Yoke Cable Assembly) besteht Hochspannung!



ATTENTION



Du courant haute tension passe dans les parties exposées de l'ensemble de câbles de culasse (Yoke Cable Assembly).



AVVISO



Voltaggio ad alta tensione presente su parti scoperte della linea montaggio di cavo collegamento (Yoke Cable Assembly).



ADVERTENCIA



Hay voltaje peligroso en las partes al descubierto del conjunto de cable de horquilla (Yoke Cable Assembly).



高圧危険



ヨーク・ケーブルアセンブリの露出部には、高電圧がかかってます

- k. Loosen yoke retainer screw and rotate (see figure 2-4) until displayed rectangle is horizontal and parallel to monitor frame.

CAUTION

Do not tighten yoke retainer screw any more than necessary to keep yoke from sliding on the neck of the CRT (finger tight). Overtightening can damage CRT.

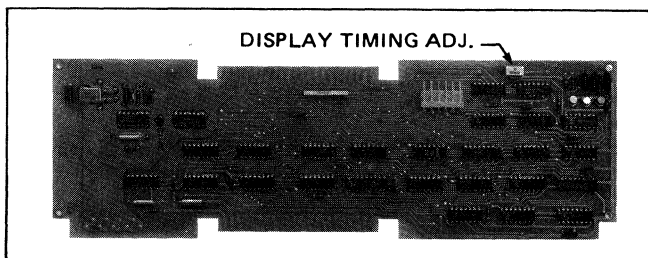
- l. Secure yoke in place by tightening yoke retainer screw.
- m. Rotate centering magnets (black tabs) until displayed rectangle is centered on monitor screen.
- n. Adjust WIDTH R28 until displayed rectangle is 9.50 in. (24.13 cm) wide.
- o. Adjust HEIGHT R10 until displayed rectangle is 4.75 in. (12.065 cm) high.
- p. Set rear ~LINE switch to OFF and secure CRT shield in place with fasteners.

- q. Disconnect test module cable plug from Display Timing PCA and disconnect test module from Display Timing and Display Control PCA's.
- r. Reinstall DMA PCA into vacated Backplane Assembly connector and reinstall Top Plane Connector Assembly on DMA, Display Timing, and Display Control PCA's.
- s. Close terminal mainframe and check for correct raster alignment.

2-16. DISPLAY TIMING ADJUSTMENT

After installation of the Display Timing PCA (part no. 02640-60088), check and, if necessary, adjust the CRT dot size for equal brightness of vertical and horizontal lines. Before and after performing the adjustment, check that BRIGHTNESS, HALF BRIGHT, and FOCUS are adjusted properly (refer to paragraph 2-12).

- a. With the terminal mainframe in its half open position and power applied to the terminal, locate the display timing adjustment (see figure below).



- b. Press and hold the "E" key to produce a row of uppercase E's on the display.
- c. Adjust display timing so that the vertical and horizontal lines of the E's are of equal brightness (see figure below).



2-17. CTU TRANSPORT ASSEMBLY SPEED ADJUSTMENT

This adjustment procedure requires the use of the HP CTU Tester, part no. 02640-60082 and the HP Checkout Cartridge, part no. 02640-60096. Perform the adjustment as follows:

- a. Open the terminal.

- b. Insert connector removal tool under CTU Top Plane Assembly and remove assembly by pressing down on the removal tool handle. Use of the removal tool is illustrated in paragraph 2-12.
- c. Install CTU Tester on top connectors of CTU Interface and Read/Write PCA's so that tester indicator lamps are closest to rear of terminals mainframe.
- d. Set CTU Tester's UNIT switch to 0, ON LINE/OFF LINE switch to OFF, RVS/FWD switch to FWD, and IPS switch to 10.
- e. Remove any tape cartridges inserted in terminal.
- f. Connect power cord between ac power source and mainframe rear panel LINE connector.
- g. Set rear panel ~LINE switch to ON position.
- h. Insert Checkout Cartridge in UNIT 0 CTU Transport Assembly.

Note: Maximum brilliance of tester 10 IPS ADJ indicator lamp indicates that CTU Transport Assembly motor is rotating at a speed as close as possible to drive tape at exactly 10 ips. Lesser brilliance indicates that tape motion will be faster or slower than 10 ips, but still within allowable tolerances.

- i. Set test ON LINE/OFF LINE switch to OFF LINE and check that tester 10 IPS ADJ indicator lamp is blinking. Indicator lamp should be on more than 50% of the time. If not proceed to step o.
- j. Set tester ON LINE/OFF LINE switch to OFF.
- k. Remove Checkout Cartridge from UNIT 0 CTU Transport Assembly and insert it in UNIT 1.
- l. Set tester UNIT switch to 1.
- m. Set tester ON LINE/OFF LINE switch to OFF LINE and check that tester 10 IPS ADJ indicator lamp is blinking. Indicator lamp should be on more than 50% of the time. If not proceed to step o.
- n. If 10 IPS ADJ indicator lamp indications are as stated in steps i and m, no further adjustment is required. Skip to step q.
- o. If tester 10 IPS ADJ indicator lamp indication is erroneous for either CTU Transport Assembly, insert Checkout Cartridge in defective CTU Transport Assembly, set tester UNIT switch to applicable unit number (0 or 1), and slowly adjust Read/Write PCA SPEED potentiometer R55 until tester 10 IPS ADJ indicator lamp is blinking on for more than 50% of the time.

- p. Reinsert Checkout Cartridge in remaining CTU Transport Assembly, set tester UNIT switch to applicable unit number, and check that tester 10 IPS ADJ indicator lamp is blinking on for more than 50% of the time. If not, repeat steps o and p until tester 10 IPS ADJ indicator lamp indications are correct. If 10 IPS ADJ indicator lamp indications are correct, no further adjustment is required.
- q. Set rear panel ~LINE switch to OFF and remove Checkout Cartridge from terminal.
- r. Remove CTU Tester from CTU Interface and Read/Write PCA's and reinstall CTU Top Plane Assembly on top connectors of CTU Interface and Read/Write PCA's.
- s. Close terminal mainframe.

2-18. PREVENTIVE MAINTENANCE

2-19. MAGNETIC HEAD CLEANING PROCEDURES

The CTU Transport Assembly magnetic heads should be cleaned after every 50 hours of operation or whenever dust or dirt is detected on the head surfaces. (Location of the magnetic head is illustrated in figure 3-5.) Clean the magnetic heads as follows:

- a. Open the terminal.

CAUTION

Do not attempt to clean magnetic heads with any cleaning materials other than those provided. Use of solvents other than Freon or alcohol may damage heads. Use of abrasive type cleaners may scratch head surfaces.

- b. Saturate cleaning swab with cleaning solvent.
- c. Using right-to-left and left-to-right motion, carefully wipe magnetic head surface clean with saturated swab. Do not clean head surface with an up and down motion.
- d. Using a clean, dry, cleaning swab, carefully wipe magnetic head surface dry. Do not dry head surface with an up and down motion.
- e. Firmly grasp mainframe top cover in one hand and release safety latch by pressing it inboard with other hand. Then, using both hands, carefully lower top cover to its closed position.

2-20. MAGNETIC HEAD DEGAUSSING PROCEDURES

The CTU Transport Assembly magnetic head should be degaussed whenever the magnetic head is suspected of being accidentally gaussed by exposure to a high magnetic field. The degaussing procedure requires the use of an HP Handheld Degausser, part no. 9160-0023 or equivalent. (Location of the magnetic head is illustrated in figure 3-5.) Degauss the magnetic head as follows:

- a. Open the terminal.

CAUTION

Remove all tape cartridges from vicinity of degausser.

CAUTION

The degausser should not be left energized for more than five minutes at a time to prevent permanent damage to degausser. Also, ensure that tip of degausser is clean and free of any small bits of metal that might scratch the magnetic head surface.

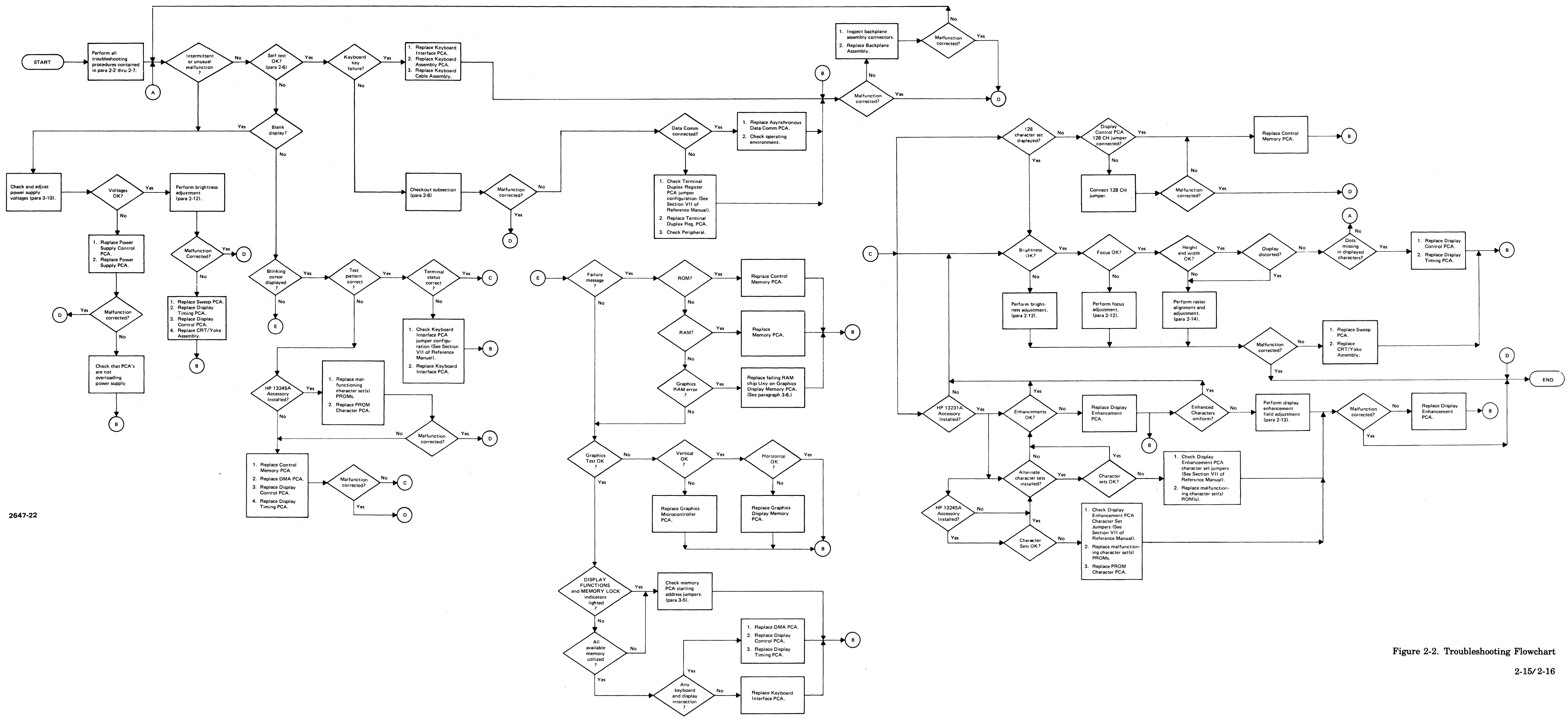
- b. Connect the degausser to an ac power source.
- c. Starting from at least three feet away, point tip of degausser toward magnetic head front center surface and slowly approach magnetic head until tip of degausser touches head front center surface.
- d. Slowly retract tip of degausser from magnetic head to a distance of at least three feet and disconnect degausser.
- e. Firmly grasp mainframe top cover in one hand and release safety latch by pressing it inboard with other hand. Then, using both hands, carefully lower top cover to its closed position.

2-21. TAPE CONDITIONING

Conditioning a tape restores proper tape tension by winding the tape forward to end-of-tape at 60 ips and then rewinding it back to beginning-of-tape at 60 ips. A tape should be conditioned whenever a tape cartridge has been rethreaded, been subjected to sudden environmental changes, or whenever improper tape tension is suspected. To condition a tape, insert the tape cartridge in either the left or right tape slot. Press the COMMAND key to display the command functions along the bottom of the display, press the NEXT(f1) key twice in succession, press the CONDITN(f6) key, press either the LTAPE(f5) or

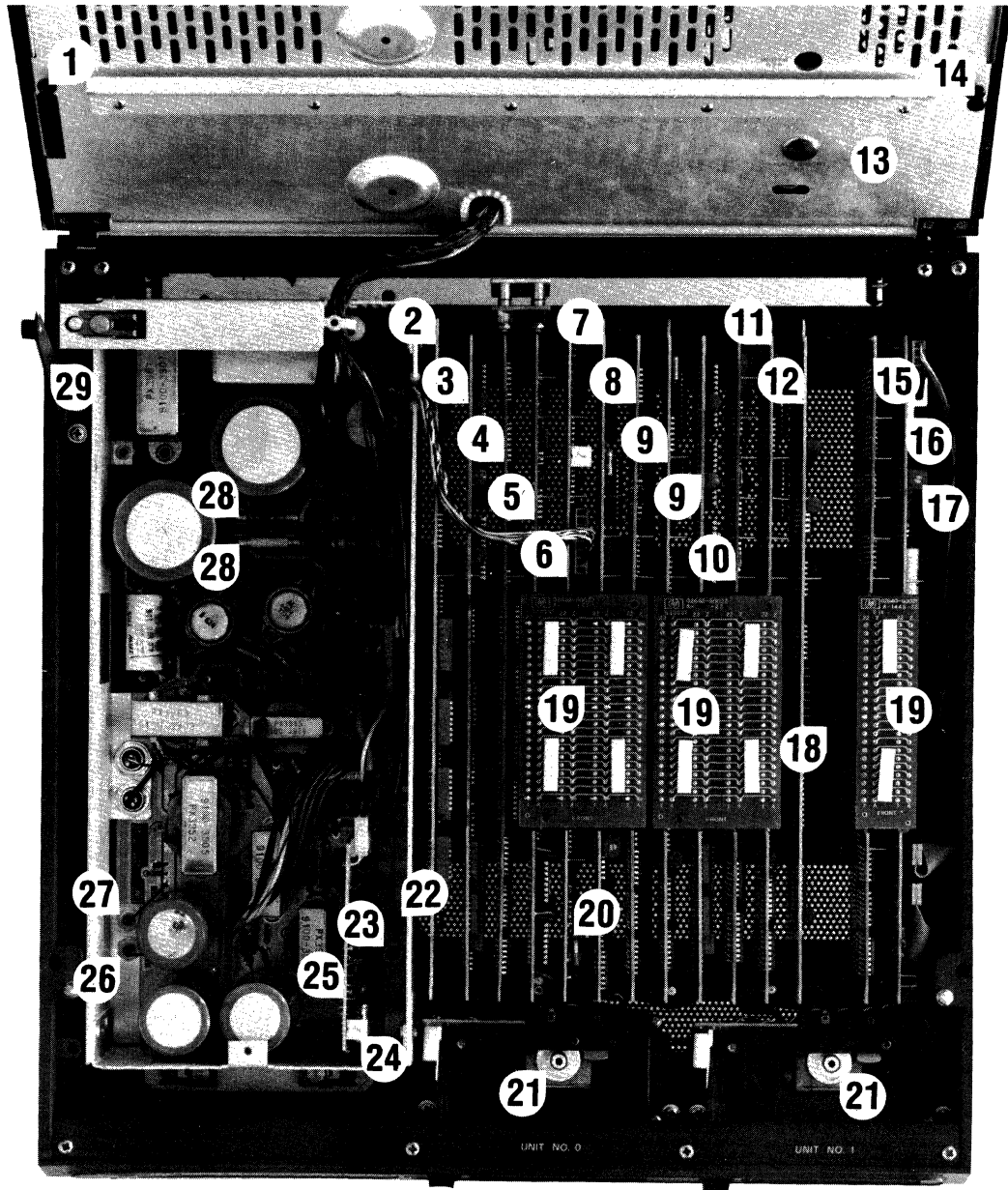
Service

RTAPE(f6) key, then press the RETURN key. (An alternate method is to type in either CON LTAPE or CON RTAPE while the command functions are displayed, then press the RETURN key.) The eject button will blink indicating that the tape is in motion and being conditioned. When the eject button light goes out, tape conditioning is complete. Usually, one tape conditioning sequence is sufficient to restore proper tape tension. The sequence can, however, be repeated as many times as desired. If three conditioning sequences fail to restore proper tape tension, replace tape cartridge.



2647-22

Figure 2-2. Troubleshooting Flowchart



- | | | |
|--|---|---|
| <ul style="list-style-type: none"> 1 SHIELD SNAP FASTENER 2 KEYBOARD INTERFACE PCA 3 16K (OPTIONALLY 32K) UNIVERSAL MEMORY PCA 4 GRAPHICS MICROCONTROLLER PCA 5 GRAPHICS DISPLAY MEMORY PCA 6 GP DISPLAY TIMING PCA 7 DISPLAY MEMORY ACCESS PCA 8 DISPLAY CONTROL PCA 9 CONTROL MEMORY PCAs 10 PROCESSOR PCA | <ul style="list-style-type: none"> 11 32K UNIVERSAL MEMORY PCA (CONNECTED TO TOP PLANE CONNECTOR) 12 ASYNCHRONOUS DATA COMM PCA 13 CRT SHIELD 14 SHIELD SNAP FASTENER 15 CTU INTERFACE PCA 16 READ/WRITE PCA 17 SPEED ADJUSTMENT 18 OPTION SLOT 19 TOP PLANE CONNECTORS 20 CRYSTAL Y1 | <ul style="list-style-type: none"> 21 CTU TRANSPORT ASSYS 22 -42V TEST POINT 23 +12V TEST POINT 24 +5V ADJUSTMENT 25 POWER SUPPLY CONTROL PCA 26 -12V TEST POINT 27 +5V TEST POINT 28 POWER SUPPLY FUSES 29 SAFETY LATCH |
|--|---|---|

Figure 2-3. Mainframe Bottom Test Point and Adjustment Locations

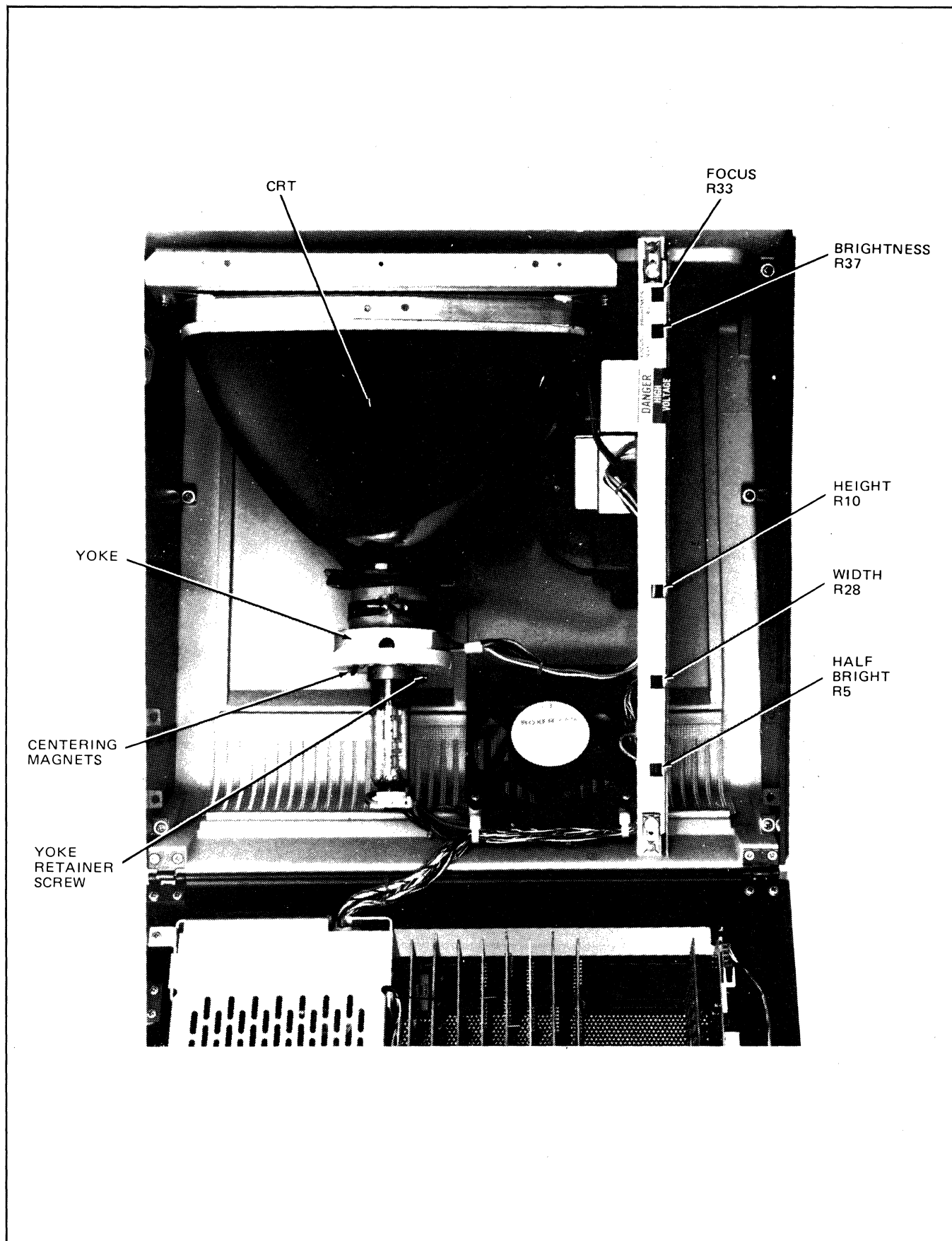


Figure 2-4. Mainframe Top Adjustment Locations

2-22. USING THE HP CTU TESTER

The HP CTU Tester, part no. 02640-60082 is used in place of the CTU Top Plane Assembly to provide visual displays for troubleshooting and adjusting the storage subsection and to provide optional local control of CTU tape motion.

2-23. CONTROLS AND INDICATORS

The CTU Tester controls and indicators are shown in figure 2-5 and described in table 2-3. Each control and indicator listed in table 2-3 is referenced by index number to figure 2-5 for ease of identification.

2-24. INSTALLING THE TESTER

Install the CTU Tester in place of the terminal CTU Top Plane Assembly as follows:

- a. Open the terminal.
- b. Insert connector removal tool under CTU Top Plane Assembly (figure 2-3) and remove assembly by pressing down on removal tool handle. (Use of the connector removal tool is shown in paragraph 2-13.)
- c. Install CTU Tester on CTU Interface and Read/Write PCA top connectors so that tester display indicator lamps are closest to rear of terminal mainframe.
- d. Set test ON LINE/OFF/OFF LINE switch to OFF.
- e. Reconnect power cord to mainframe rear panel LINE connector.
- f. Set rear panel ~LINE switch to ON position.

2-25. TROUBLESHOOTING WITH THE TESTER

2-26. TROUBLESHOOTING PHILOSOPHY. Before attempting to use the tester as a troubleshooting device, it is imperative to understand what each tester display indicator lamp signifies and which storage subsection circuits are associated with each indicator lamp. Use table 2-3 for reference.

Once familiar with the tester displays and storage subsection circuits, two other important facts must be understood: 1) when using the tester on line, the display indicator lamps are monitoring the signal paths between the CTU Interface PCA and Read/Write PCA just as though

the CTU Top Plane Assembly was installed, and; 2) when using the tester off line, the CTU Interface PCA is isolated from the rest of the subsection and the tester indicator lamps are monitoring the signal paths between the tester and Read/Write PCA. Therefore, if a specific malfunction is indicated during on line testing, but is not indicated during off line testing, it is most probable that the trouble exists in the CTU Interface PCA circuits, assuming that the basic terminal is operating properly. Conversely, if the same malfunction is indicated during both on line and off line testing, it is most probable that the trouble exists in either the Read/Write PCA or the CTU Transport Assemblies.

Once a trouble is isolated to either the Read/Write PCA or the CTU Transport Assemblies, it should be remembered that the CTU Transport Assemblies share common read, write, and tape motion circuits on the Read/Write PCA. Therefore, if a specific malfunction is indicated for UNIT 0, but is not indicated for UNIT 1, it is most probable that the trouble exists in the UNIT 0 CTU Transport Assembly. Conversely, if the same malfunction is indicated for both UNIT 0 and UNIT 1, it is most probable that the trouble exists in the Read/Write PCA circuits.

2-27. TROUBLESHOOTING PROCEDURE.

When a malfunction has occurred in the storage subsection that cannot be quickly isolated using the checkout procedures in paragraph 2-9, continue to troubleshoot with the tester as follows:

- a. Install the tester in accordance with paragraph 2-24.
- b. Set tester ON LINE/OFF/OFF LINE switch to ON LINE.
- c. Repeat checkout procedure in accordance with paragraph 2-9 while observing tester display indicator lamps.
- d. When the malfunction occurs, compare its symptoms against the tester display indicator lamps. In some cases, the malfunction can be isolated at this point. For example; if a NO TAPE message is displayed and the tester CRTG IN indicator lamp is lighted for the selected CTU Transport Assembly, it is most probable that the trouble exists in the CTU Interface PCA because the lighted CRTG IN indicator lamp verifies that the CTU Transport Assembly and Read/Write PCA cartridge detect circuits are operating properly.
- e. If the malfunction cannot be isolated by performing the previous step, set tester ON LINE/OFF/OFF LINE switch to OFF, determine how to duplicate the operation where the malfunction occurred with the tester, set tester control switches to required positions, set ON LINE/OFF/OFF LINE switch to OFF LINE, and again check the malfunction symptoms

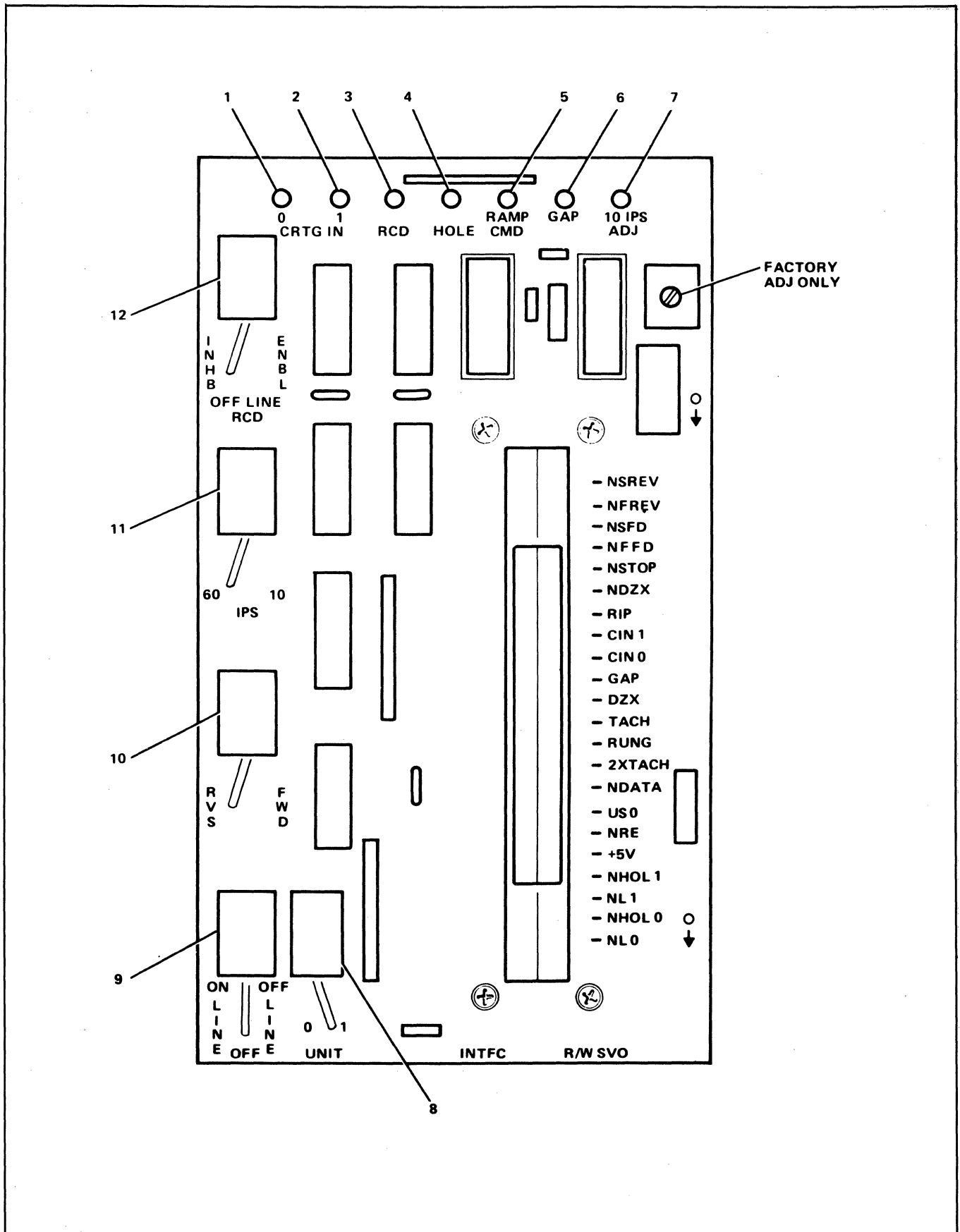


Figure 2-5. CTU Tester Controls and Indicators

Table 2-3. CTU Tester Controls and Indicators

INDEX NO.	NOMENCLATURE	DESCRIPTION
1	CRTG IN 0 indicator	When lighted, indicates that a tape cartridge is inserted in UNIT 0 CTU Transport Assy. Also verifies proper operation of UNIT 0 Head Bridge Assy switch circuit and Read/Write PCA cartridge detect circuit.
2	CRTG IN 1 indicator	When lighted, indicates that a tape cartridge is inserted in UNIT 1 CTU Transport Assy. Also verifies proper operation of UNIT 1 Head Bridge Assy switch circuit and Read/Write PCA cartridge detect circuit.
3	RCD indicator	When lighted, indicates that data is being recorded on selected CTU Transport Assy tape. Also verifies proper operation of Read/Write PCA write current circuit when tester is in ON LINE mode.
4	HOLE indicator	When lighted, indicates that a hole is being detected in selected CTU Transport Assy tape. Also verifies proper operation of Head Bridge Assy hole detection circuit.
5	RAMP CMD indicator	When lighted, indicates that a tape motion signal is being generated. Also verifies proper operation of Read/Write PCA CTU drive circuits. Also verifies CTU Interface PCA tape motion decoder and command logic when tester is used in ON LINE mode.
6	GAP indicator	When blinking, indicates that tape containing recorded data is moving past selected CTU Transport Assy magnetic head. Also verifies proper operation of Head Bridge Assy magnetic head and Read/Write PCA unit/function decoder, read select switch, read amplifier circuit, and gap detect circuit. Lamp on indicates presence of inter-record gap.
7	10 IPS ADJ indicator	When on, indicates that selected CTU Transport Assy is driving tape at 10 ips $\pm 1.0\%$. Also verifies proper operation of CTU Transport Assy Motor/Tachometer Assy; Read/Write PCA amplifier select logic, CTU drive circuits, tachometer feedback select and conditioning circuits, and feedback circuit; and CTU Interface PCA command logic and tape motion decoder.
8	UNIT switch	When operating OFF LINE, selects either UNIT 0 or UNIT 1 CTU Transport Assy and lights eject button of selected unit. Also verifies proper operation of Head Bridge Assy indicator lamp circuit and Read/Write PCA amplifier select logic and unit/function decoder.
9	ON LINE/OFF/OFF LINE switch	When set to ON LINE, CTU Tester performs as a CTU Top Plane Assy with visual displays. Storage subsection is controlled by terminal keyboard and CTU Interface PCA. When set to OFF LINE, storage subsection is controlled by CTU Tester, CTU Interface PCA is disabled, and tape motion is determined by RVS/FWD and IPS switches. Tape motion will stop when a hole is detected. When set to OFF, all tape motion and control is inhibited; CTU Tester and CTU Interface PCA are both disabled.
10	RVS/FWD switch	When operating OFF LINE, controls tape motion direction (reverse or forward) for CTU Transport Assy selected by UNIT switch. Verifies proper operation of Read/Write PCA CTU drive circuits, for both tape directions.
11	IPS switch	When operating OFF LINE, controls tape speed (60 or 10 ips) for CTU Transport Assy selected by UNIT switch. Also verifies proper operation of same circuits as RVS/FWD switch.
12	OFF LINE RCD switch	When operating OFF LINE and set to INHB, enables read mode circuits. When operating OFF LINE and set to ENBL, enables write mode circuits. Also verifies proper operation of Head Bridge Assy magnetic head and Read/Write PCA unit/function decoder, read select switch, read amplifier circuit, and gap detect circuit.

against the tester display indicator lamps. If the malfunction no longer exists, it is most probable that the trouble exists in the CTU Interface PCA circuits. If the malfunction still exists, it is most probable that the trouble exists in either the Read/Write PCA or selected CTU Transport Assembly circuits. For example; if READ FAIL or END OF DATA message is repeatedly displayed and the malfunction cannot be isolated by performing step d, set tester ON LINE/OFF/OFF LINE switch to OFF and duplicate a read operation as follows:

- (1) Insert a prerecorded tape in CTU Transport Assembly that was being tested when the malfunction occurred.
- (2) Set tester UNIT switch to corresponding number of CTU Transport Assembly under test.
- (3) Set tester OFF LINE RCD switch to INHB, IPS switch to 10, and RVS/FWD switch to FWD.

CAUTION

The tester does contain "stop on hole detect" circuitry. However, to ensure prevention of tape run-off, it is recommended to discontinue tape motion commands once a "hole detect" has stopped the tape.

CAUTION

To restart tape motion, ON LINE/OFF/OFF LINE switch must first be set to OFF and then back to OFF LINE. However, care should be taken to change direction of tape motion to prevent tape run-off.

- (4) Set tester ON LINE/OFF/OFF LINE switch to OFF LINE and observe GAP indicator lamp. If GAP indicator lamp is blinking, it is most probable that the trouble exists in the CTU Interface PCA because the blinking GAP indicator lamp verifies that the CTU Transport Assembly and most of the Read/Write PCA read circuits are operating properly. If the GAP indicator lamp is not blinking, it is most probable that the trouble exists in either the CTU Transport Assembly or the Read/Write PCA. Set tester ON LINE/OFF/OFF LINE switch to OFF, insert prerecorded tape in other CTU Transport Assembly, set ON LINE/OFF/OFF LINE switch to OFF LINE, and again observe the GAP indicator lamp. If the GAP indicator lamp is blinking, it is most probable that the trouble exists in the CTU Transport Assembly originally under test. If the GAP indicator is not blinking, it is most probable that the

trouble exists in the Read/Write PCA read circuits commonly shared by both CTU Transport Assemblies.

- f. Once the malfunction has been isolated, perform the necessary repair procedures and repeat steps a, b, and c to ensure that the storage subsection is now operating properly.
- g. Remove tester from terminal and reinstall CTU Top Plane Assembly on CTU Interface PCA and Read/Write PCA top connectors.
- h. Firmly grasp mainframe top cover in one hand and release safety latch by pressing it inboard with other hand. Then, using both hands, carefully lower top cover to its closed position.

3-1. INTRODUCTION

This section contains instructions for removing and replacing terminal assemblies, instructions for rethreading a tape cartridge, and a listing of field-replaceable parts.



Hazardous voltages are present inside equipment. The procedures contained in this section shall be performed only by qualified service personnel.



Innerhalb des Geräts bestehen gefährliche Spannungen. Die in diesem Abschnitt enthaltenen Arbeiten dürfen nur durch Betriebsfachpersonal durchgeführt werden.



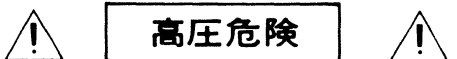
Des tensions dangereuses sont présentes à l'intérieur du matériel. Les opérations décrites dans cette section ne devront être effectuées que par un personnel qualifié.



Pericolo: Alta tensione presente in questa apparecchiatura. Le procedure contenute in questa sezione debbono essere effettuate soltanto da qualificato personale di servizio.



Hay voltaje peligroso en el interior de este equipo. Los procedimientos expuestos en esta sección sólo deberá llevarlos a cabo el personal de servicio calificado.



内部装置に危険な高電圧がきています。この章にある処置や手続に関しては、専門のサービスマンによるのみ行なって下さい。

3-2. REMOVAL AND REPLACEMENT



Always remove AC power from terminal before attempting any parts replacements. Use extreme caution when working near the CRT, Yoke Cable Assembly, and Sweep PCA high voltage sections.



Vor Auswechseln von Einzelteilen ist jeweils der Wechselstromanschluss von der Klemme zu trennen. Bei Arbeiten in der Nähe der Hochspannungsteile von Kathodenstrahlröhre (CRT), Joch-Kabelsatz (Yoke Cable Assembly) sowie der gedruckten Schaltung für den Kipposzillator (Sweep PCA) ist grösste Vorsicht zu beachten.



Toujours couper l'arrivée de courant alternatif des bornes avant d'entreprendre tout remplacement de pièces. Redoubler de prudence lorsqu'on travaille à proximité des sections haute tension du tube cathodique (CRT), de l'ensemble de câbles de culasse (Yoke Cable Assembly), et de l'ensemble de tableau de circuit oscillant (Sweep PCA).



Isolare sempre la tensione c.a. dal morsetto prima di procedere alla sostituzione di qualsiasi parte. Usare estrema cautela durante operazioni in prossimità delle sezioni ad alta tensione del tubo a raggi catodici (CRT), della linea montaggio cavo collegamento (Yoke Cable Assembly), e della linea del circuito stampato per l'oscillatore di base di tempi (Sweep PCA).



Desconéctese siempre la corriente alterna del terminal antes de intentar reemplazar cualquier pieza. Téngase sumo cuidado al trabajar cerca de las secciones de alta tensión del tubo de rayos catódicos (CRT), del conjunto de cable de horquilla (Yoke Cable Assembly), y del circuito impreso del oscilador de base de tiempo (Sweep PCA).



高圧危険



どんな部品でも交換する場合は、その前に A C の電源コードを機器よりはずして下さい。CRT、ヨーク・ケーブルアセンブリ、スイープ P C A などの高電圧がかかっている部分の近くでは、危険ですから特に注意を払って下さい。

Due to the modular design of the terminal, no special instructions are required for removing and replacing parts except for those discussed in paragraphs 3-3 through 3-12. To remove most replaceable parts, first refer to figure 3-7 and the replaceable parts list to determine how the part is attached and the number of attaching parts involved. Once this is accomplished, removal procedures for the part will be obvious. Always disconnect any attached cable assemblies before attempting to remove a part. Replacing a part is simply a matter of reversing the removal procedure.

3-3. DISPLAY CONTROL PCA

The Display Control PCA is manufactured with a jumper installed for use with a 128 character set terminal. When replacing the Display Control PCA, ensure that the 128 CH jumper (located approximately in the center of the PCA) is installed before installing it in the terminal.

3-4 FAN AND CABLE ASSEMBLY

When removing the Fan and Cable Assembly (82, figure 3-10, first open the terminal mainframe to its full open position. Then, disconnect the assembly's connector from the Power Supply PCA and remove the two cable clamps and wire harness attached to the fan. After removing the assembly's cable from the existing wire harness and cable clamps, remove the four screws and washers (83 and 84) securing the assembly to the mainframe top and remove the assembly from the terminal. Installing the Fan and Cable Assembly is basically accomplished by performing the removal procedures in reverse order. However, care should be taken to ensure that the assembly's cable is secured within the existing wire harness and cable clamps. Also, the assembly must be mounted so that its cable is closest to the back of the mainframe top and CRT, and the fan AIRFLOW arrow must point toward the back of the mainframe top.

3-5. CONTROL MEMORY PCA

No special instructions are required to remove the Control

Memory PCA. However, when replacing it, ensure that the replacement PCA jumpers are configured as shown in figure 3-1. Replacing the Control Memory PCA also requires that the ROM IC's be removed from the old PCA and installed on the new PCA. Care must be used when handling ROM IC's.

CAUTION

MOS integrated circuits can be damaged by electrostatic discharge. Use the following precautions:

DO NOT wear clothing subject to static charge buildup, such as wool or synthetic materials.

DO NOT handle MOS circuits in carpeted areas.

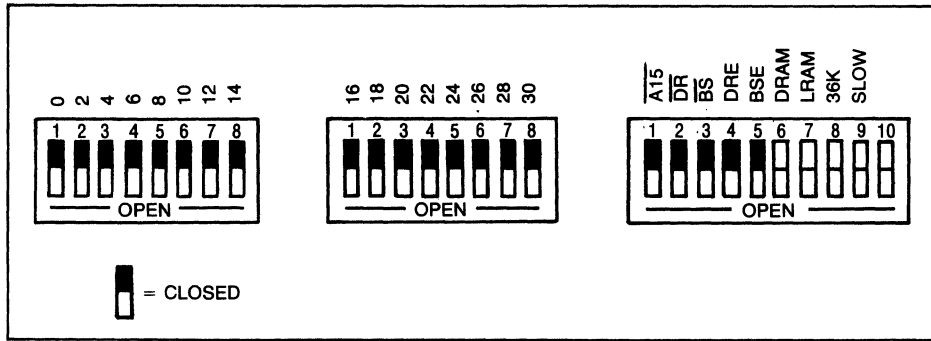
DO NOT remove the circuit from its conductive foam pad until you are ready to install it.

AVOID touching the circuit leads. Handle by the plastic package only.

ENSURE that the circuit, work surface (table, desk, etc.) and PCA are all at the same ground potential. This can be done by touching the foam pad to the PCA and then touch the foam pad, circuit, and PCA to the work surface.

Figure 2-1. shows proper positioning of the ROM IC's on the Control Memory PCA's.

1st Control Memory PCA



2nd Control Memory PCA

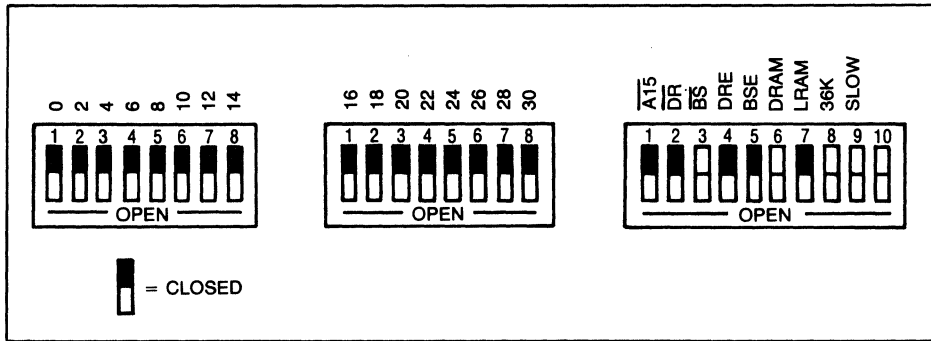
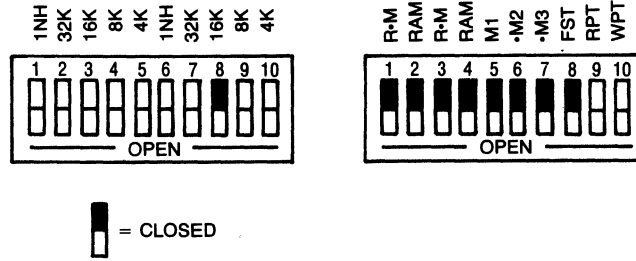


Figure 3-1. Control Memory PCA's Jumper Configurations

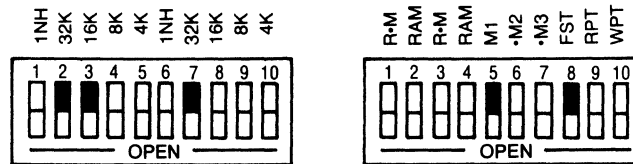
3-6. UNIVERSAL RAM MEMORY PCA

The HP 2647A in its standard configuration includes two 32K Universal (RAM Memory PCA's, one (used for BASIC program storage) is accessed through the top plane connector and the other (used for display memory) through the bottom plane (backplane connector). Figure 3-2 illustrates how these two PCA's should be strapped. If the terminal under repair includes additional Universal RAM Memory PCA's (Accessory 13297A) consult the 13297A Universal RAM Memory PCA Accessory Manual, part number 13297-90001 for configuration information.

Top Plane RAM PCA:



Bottom Plane RAM PCA:



Bank Selection Disabled on Both PCAs:

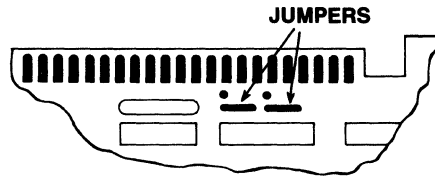


Figure 3-2. Universal RAM Memory PCA Jumper Configurations

3-7. HP-IB PCA

When replacing the HP-IB PCA, set the configuration switches (figure 3-3) to the same positions as the switches on the PCA being replaced or, if the PCA is to be reconfigured, refer to table 3-2 for switch settings.

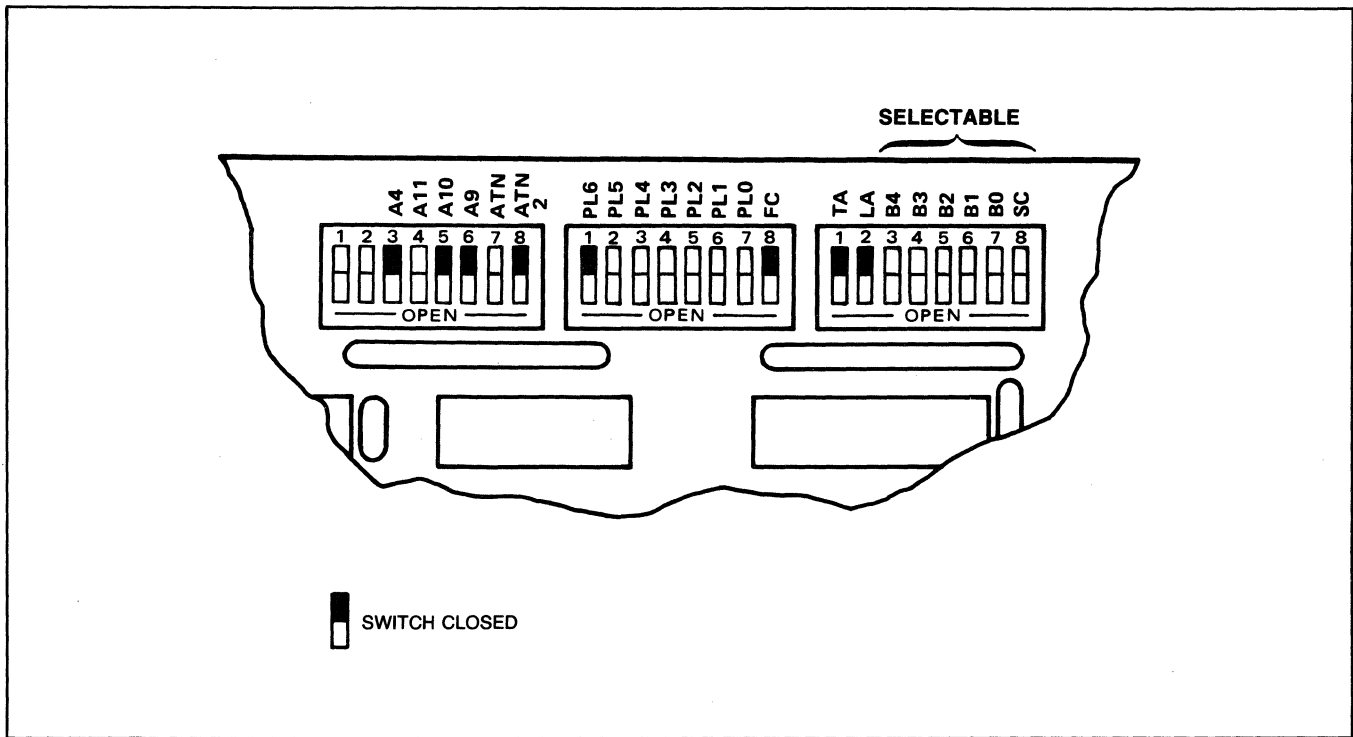


Figure 3-3. HP-IB PCA Configuration Switches

Table 3-1. HP-IB Interface Switch Functions

SWITCH(ES)	SETTING(S)																																																																																																																																										
A4, A11, A10, A9	<p>These four switches specify the PCA module address and must be set as follows:</p> <table border="0" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">A4</td> <td style="text-align: center;">A11</td> <td style="text-align: center;">A10</td> <td style="text-align: center;">A9</td> </tr> <tr> <td style="text-align: center;">Closed</td> <td style="text-align: center;">Open</td> <td style="text-align: center;">Closed</td> <td style="text-align: center;">Closed</td> </tr> </table>	A4	A11	A10	A9	Closed	Open	Closed	Closed																																																																																																																																		
A4	A11	A10	A9																																																																																																																																								
Closed	Open	Closed	Closed																																																																																																																																								
PL6 through PL0	<p>These seven switches are reserved for future use. PL6 should be closed and PL5 through PL0 should be open.</p>																																																																																																																																										
ATN	<p>This switch should be set to the open position.</p>																																																																																																																																										
ATN2, FC, and TA	<p>These three switches are reserved for future use and should all be set to the closed position.</p>																																																																																																																																										
LA	<p>This switch should be set to the open position.</p>																																																																																																																																										
B4 through B0	<p>These five switches specify the HP-IB address of your terminal. The terminal which is assigned as the System Controller of the HP-IB (see switch SC, below) must be assigned address 8 (decimal) and any other terminals in the configuration must be assigned consecutively higher addresses. The switch settings for the various terminal HP-IB addresses are as follows:</p> <table border="0" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Decimal Address</th> <th style="text-align: center;">B4</th> <th style="text-align: center;">B3</th> <th style="text-align: center;">B2</th> <th style="text-align: center;">B1</th> <th style="text-align: center;">B0</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">8</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">C</td><td style="text-align: center;">C</td></tr> <tr><td style="text-align: center;">9</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td></tr> <tr><td style="text-align: center;">10</td><td style="text-align: center;">C</td><td 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style="text-align: center;">C</td></tr> <tr><td style="text-align: center;">23</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td></tr> <tr><td style="text-align: center;">24</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">C</td><td style="text-align: center;">C</td></tr> <tr><td style="text-align: center;">25</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td></tr> <tr><td style="text-align: center;">26</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td></tr> <tr><td style="text-align: center;">27</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td></tr> <tr><td style="text-align: center;">28</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">C</td></tr> <tr><td style="text-align: center;">29</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">O</td><td style="text-align: center;">C</td><td style="text-align: center;">O</td></tr> </tbody> </table> <p>where O = switch open C = switch closed</p>	Decimal Address	B4	B3	B2	B1	B0	8	C	O	C	C	C	9	C	O	C	C	O	10	C	O	C	O	C	11	C	O	C	O	O	12	C	O	O	C	C	13	C	O	O	C	O	14	C	O	O	O	C	15	C	O	O	O	O	16	O	C	C	C	C	17	O	C	C	C	O	18	O	C	C	O	C	19	O	C	C	O	O	20	O	C	O	C	C	21	O	C	O	C	O	22	O	C	O	O	C	23	O	C	O	O	O	24	O	O	C	C	C	25	O	O	C	C	O	26	O	O	C	O	C	27	O	O	C	O	O	28	O	O	O	C	C	29	O	O	O	C	O
Decimal Address	B4	B3	B2	B1	B0																																																																																																																																						
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SC	<p>This switch determines whether or not your terminal will be the System Controller of the HP-IB (remember that the System Controller must have the lowest terminal address as its HP-IB address).</p> <p>Open = System Controller Closed = NOT System Controller</p>																																																																																																																																										

3-8. GRAPHICS DISPLAY MEMORY AND GRAPHICS MICROCONTROLLER PCA'S

Removing and replacing the Graphics Display Memory PCA or Graphics Microcontroller PCA requires no special instructions. Defective RAM IC's on the Graphics Display Memory PCA (part no. 02640-60126) are isolated to the chip level by the self test sequence as described in paragraph 2-6, step c, substep (4).

RAM IC REMOVAL. Using the Keycap Disassembly Tool, part no. 5040-7433, remove defective RAM IC as follows:

a. At one end of the RAM IC, carefully place the hooked

end of the Keycap Disassembly Tool between the RAM IC and the IC socket and pry up the IC slightly.

b. At the other end of the RAM IC, repeat the procedure as described in step a.

c. Repeat steps a and b until the RAM IC is free for removal.

RAM IC REPLACEMENT. When replacing a RAM IC, ensure that the new RAM IC is installed correctly as shown in figure 3-4.

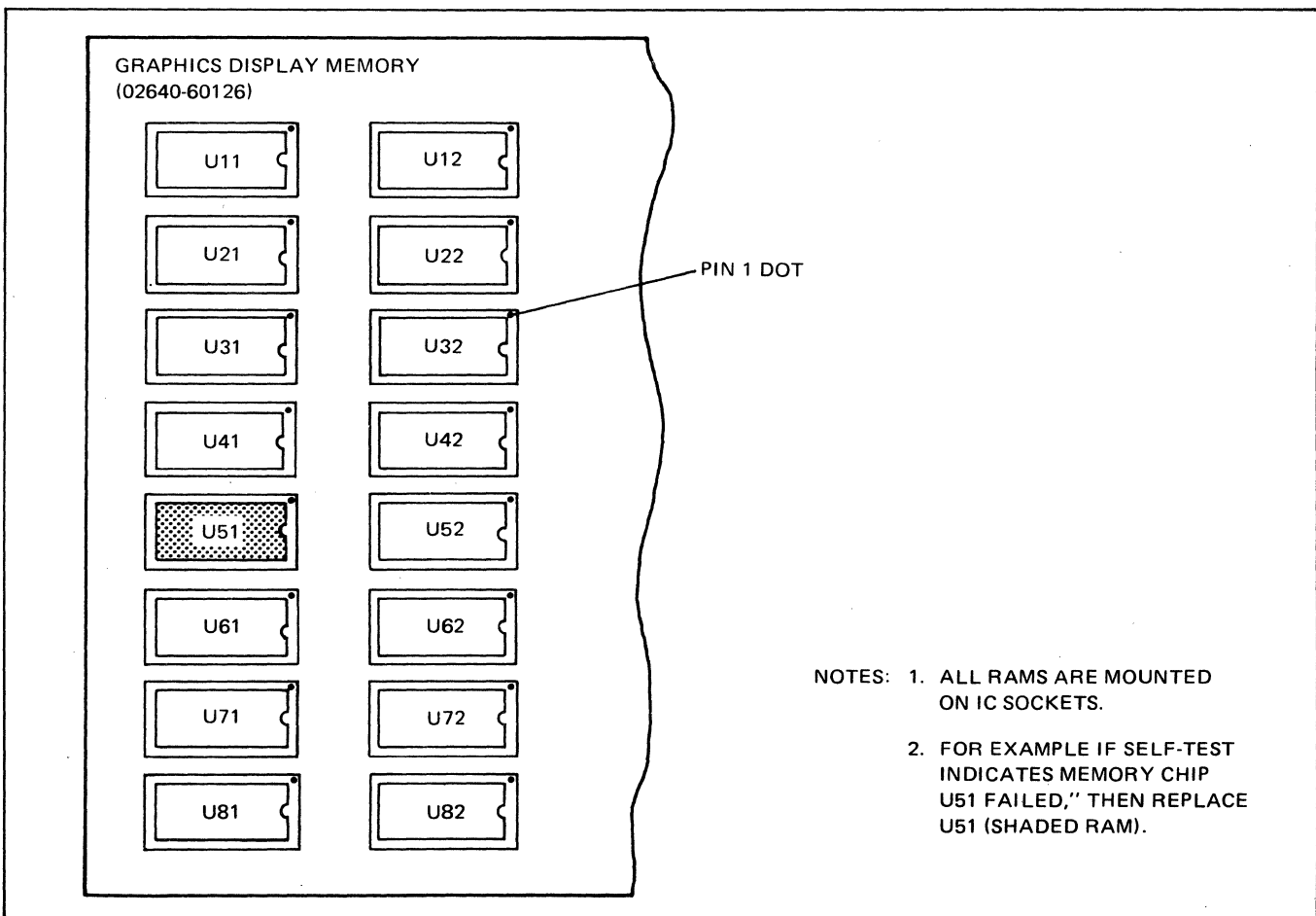


Figure 3-4. Graphics Display Memory PCA RAM Locations

3-9. CARTRIDGE TAPE MODULES

The cartridge tape modules consist of the CTU Interface PCA, Read/Write PCA, and two CTU Transport Assemblies. No special instructions are required to remove these modules except to exercise caution when handling the CTU Transport Assemblies to ensure that the magnetic heads are not damaged. It should be noted that when removing the front bezel (43, figure 3-7 to replace a defective CTU Transport Assembly, that the four screws (44) securing the bezel in place should be loosened only to the extent necessary to remove the bezel and should not be completely removed from the bezel. Completely removing the screws (44) may result in damage or loss of the associated o-rings (45). If a malfunction develops in a CTU Transport Assembly, it is recommended that the entire CTU Transport Assembly, be replaced rather than replacing a defective transport subassembly. However, if it becomes necessary to disassemble a CTU Transport Assembly, first refer to figure 3-5 and then disassemble the transport in reverse order of the assembly instructions contained in the following paragraph.

Note: The CTU Base Assembly pawl is held in place by spring tension only and is captured when the Head Bridge Assembly is attached to the CTU Base Assembly. Use caution when removing the Head Bridge Assembly to ensure that the pawl is not lost.

If a CTU Transport Assembly has been removed and disassembled, reassemble the three subassemblies as follows:

- a. Attach two Capstan Loading Springs to Motor/Tachometer Assembly casting as shown in figure 3-5.
- b. Set Motor/Tachometer Assembly into CTU Base Assembly Ball Sockets and, using a pair of long-nose pliers or equivalent, attach loose ends of Capstan Loading Springs to CTU Base Assembly.
- c. Set Pawl in CTU Base Assembly Pawl Pocket and carefully secure Pawl in Pawl Pocket by placing end of Torsion Spring behind Pawl.
- d. Using two alignment pins and sockets, carefully place Head Bridge Assembly on top of CTU Base Assembly and capture Pawl.
- e. Partially secure Head Bridge Assembly to CTU Base Assembly with one screw and washer at left, rear of Head Bridge Assembly behind captured Pawl.
- f. Install Compression Spring on CTU Base Assembly and capture Compression Spring in place with Head Bridge Assembly.
- g. Secure Head Bridge Assembly in place with remaining two screws and washers.
- h. Loosen and retighten screw securing left, rear of Head Bridge Assembly.
- i. Connect Tachometer Cable connector to Head Bridge Assembly Connector P1.
- j. Install reassembled CTU Transport Assembly.

3-10. POWER SUPPLY CONTROL, POWER SUPPLY, AND SWEEP PCA'S

In addition to its mating connector, the Power Supply Control PCA (6, figure 3-7 is attached to the Power Supply PCA with two slotted PCA mounting guide posts that contain detents to lock the PCA in place. To remove the Power Supply Control PCA, first pull one of the mounting guide posts slightly away from the PCA's edge to free the detent and then, carefully rock the PCA up and out of its mating connector on the Power Supply PCA. To replace the PCA, align the PCA's edges with the mounting guide post slots and press down firmly on the PCA until it is seated in its mating connector and locked in place by the mounting guide post slot detents.

To remove the Power Supply (8, figure 3-7), first remove the power supply cover (2). Then, after disconnecting three wire harness connectors from the PCA and the ground wire to the Keyboard I/F PCA, unlatch the two snap locks at the front of the Power Supply and one at the rear. Lift the entire Power Supply up and out of the mainframe shell. Installing the Power Supply is basically accomplished by performing the removal procedures in reverse order. However, care should be taken not to damage the Backplane Assembly (51) connector pins that mate with the Power Supply PCA bottom connector J2.

To remove the Sweep PCA (76, figure 3-7), first open the terminal mainframe to its full open position. Then, unlatch the snap locks at each end of the Sweep PCA and move the PCA up and to the right far enough to gain easy access to all cable connectors. Disconnect the High Voltage Cable Assembly from the CRT by pressing the cable assembly connector sides together and pulling it out of the CRT. Disconnect the remaining four cable connectors from the Sweep PCA and completely remove the PCA from the terminal. It is recommended that the cable connectors be disconnected in the order of P1, P2, P4, and P3.

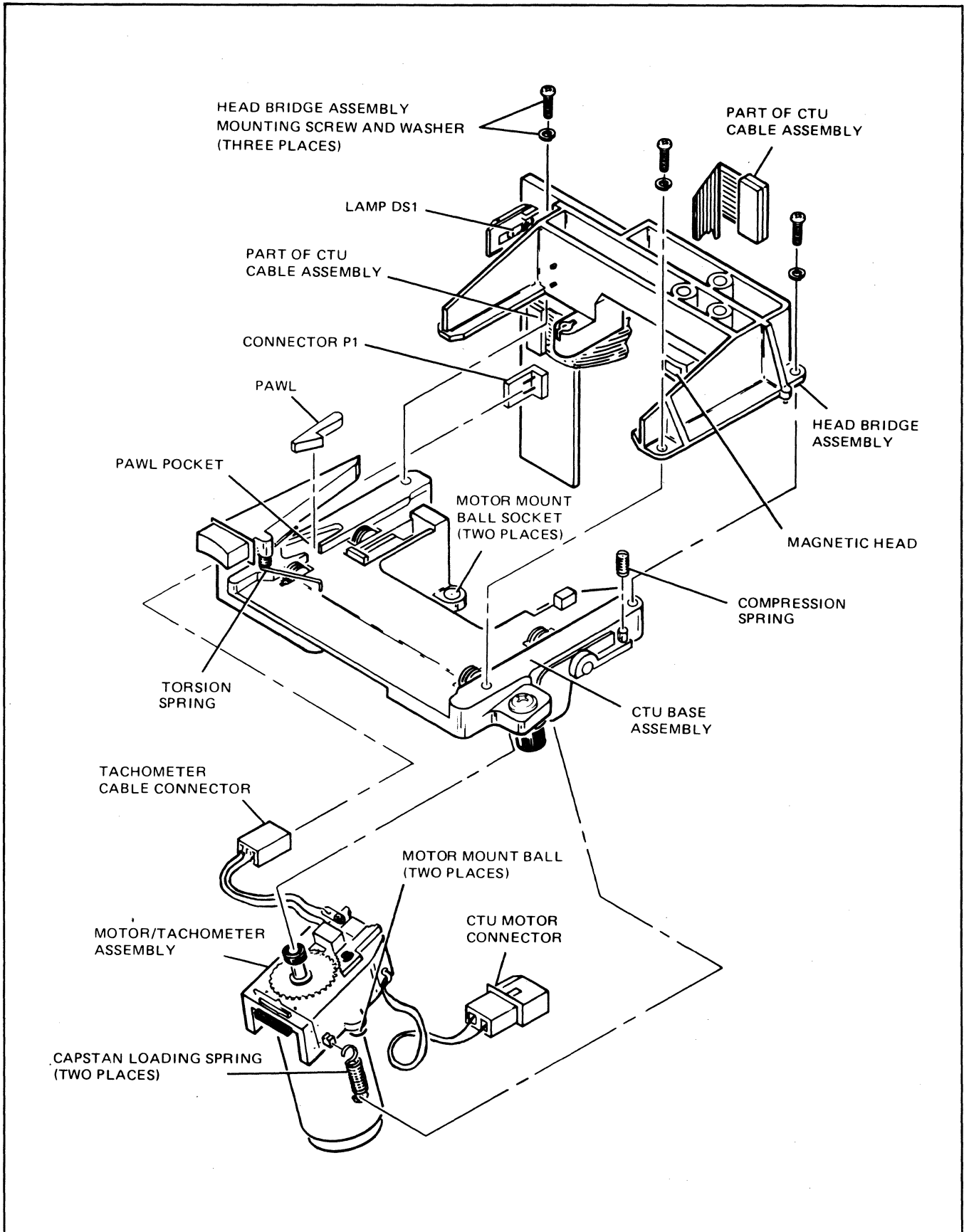


Figure 3-5. CTU Transport Assembly, Exploded View

3-11. ACCESSORIES

No special instructions are required to remove any terminal accessories. However, before attempting to replace an accessory, refer to the detailed installation instructions for the applicable accessory in Section VII of the Reference Manual.

3-12. KEYBOARD OVERLAY AND KEYBOARD

The keyboard overlay (99, 100, figure 3-7), is tension mounted on the keyboard top (102) by means of the overlay's hooked left end and a tension spring attached under its right end. To remove and replace the overlay, proceed as follows:

- a. Locate keyway on right side of keyboard top and insert access key supplied with terminal.
- b. Push access key into keyway (no key rotation is required) until overlay tension spring is released.
- c. When the tension spring is released, the right end of the overlay should raise up high enough to grasp. If not, the right end of the overlay can be pried up with a small screwdriver or similar tool.
- d. Unhook the left end of the overlay from the keyboard top by sliding it up and to the left and remove overlay from keyboard top.
- e. When replacing the overlay, hook the left end of the overlay in place on the keyboard top, guide the overlay down over the switch keys, and press down on the right end of the overlay until the tension spring snaps into place.

The keyboard is disassembled by removing five screws (103, figure 3-7) and ten washers (104 and 105) from keyboard bottom (115), and lifting off keyboard top (102). After keyboard top is off, the Keyboard Assembly (106) can be removed by disconnecting it from the two Keyboard Cable Assembly (93) connectors and Loudspeaker Assembly (111), and lifting it out of the keyboard bottom.

3-13. TAPE CARTRIDGE RETHREADING

Tape rethreading is difficult and is not recommended unless the data recorded on the runoff tape must be recovered. Instead, when tape runoff occurs, it is recommended to replace the entire tape cartridge. The rethreading procedures contained in this paragraph are for rethreading tape onto the tape cartridge's left tape hub. If a tape run-off condition occurs from the right tape hub, use the left tape hub rethreading instructions except interchange all right-hand and left-hand instructions and change all counterclockwise directions to clockwise direc-

tions. This procedure requires the use of a small Phillips-head screwdriver. Rethread tape onto the left tape hub as follows:

CAUTION

Whenever the tape cartridge top cover is removed, the spring-loaded door and spring can easily slide off the door pivot post. To prevent loss of parts, ensure that door is always completely seated on its pivot post as long as the tape cartridge top cover and backplate are separated.

- a. Remove tape cartridge top cover by removing four screws from backplate with Phillips-head screwdriver.
- b. As shown in figure 3-6, view A, rethread loose end of tape around right tape guide, through tape cleaner, past belt drive puck, outside guide pin, and around left tape guide so that approximately 1-3/4 inches of tape is clear of guide.
- c. Hold tape cartridge as shown in figure 3-6, view B, so that right hand can be used to rotate belt drive puck and left hand can be used to maintain tape tension at left tape guide.
- d. Moisten inside surface of free end of tape and, while maintaining tape tension at left tape guide, rotate belt drive puck counterclockwise to wrap free end of tape around left tape hub until tape reaches point where drive belt touches tape hub.
- e. While maintaining tape tension, use any small round-tipped tool to trap free end of tape between drive belt and left tape hub as shown in figure 3-6, view C.
- f. Rotate belt drive puck counterclockwise until tape is wrapped several times around left tape hub past first set of tape holes (approximately two feet).
- g. Replace tape cartridge top cover on backplate and secure in place with four screws.
- h. Condition tape in accordance with the instructions contained in paragraph 2-21.

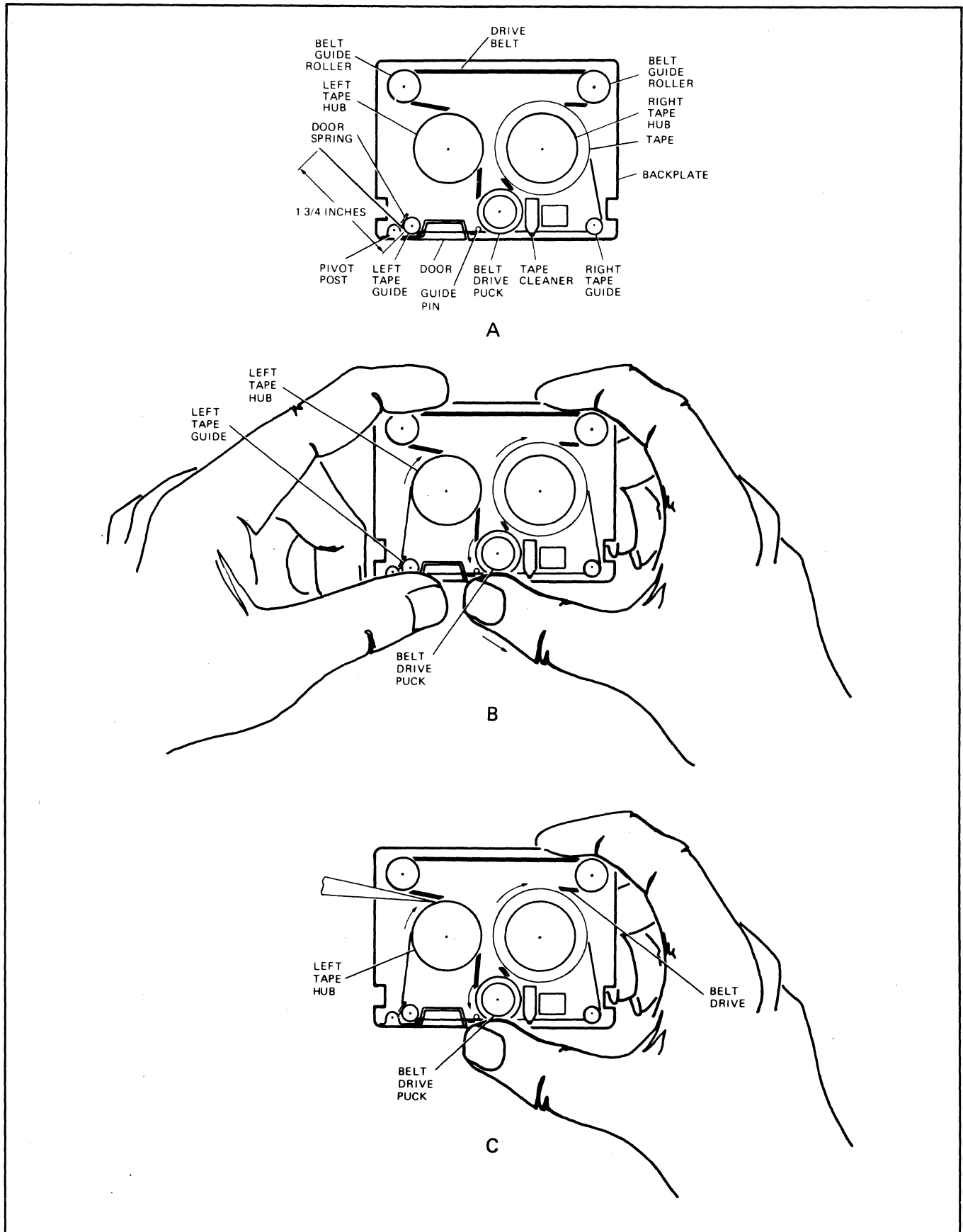


Figure 3-6. Tape Cartridge Rethreading

3-14. REPLACEABLE PARTS

Replaceable parts for the terminal are listed in table 3-3. The replaceable parts in table 3-3 are referenced to the exploded view (figure 3-7) of the terminal by index numbers which are in disassembly order, except attaching parts are listed immediately after the parts they attach. Items in the DESCRIPTION column of table 3-3 are indented to indicate item relationship. In addition, the symbol “— — — X — — —” follows the last of one or more attaching parts. Indention is as follows:

MAJOR ASSEMBLY

*Replaceable Assembly

*Attaching Parts for Replaceable Assembly

**Subassembly Parts

**Attaching Parts for Subassembly Parts

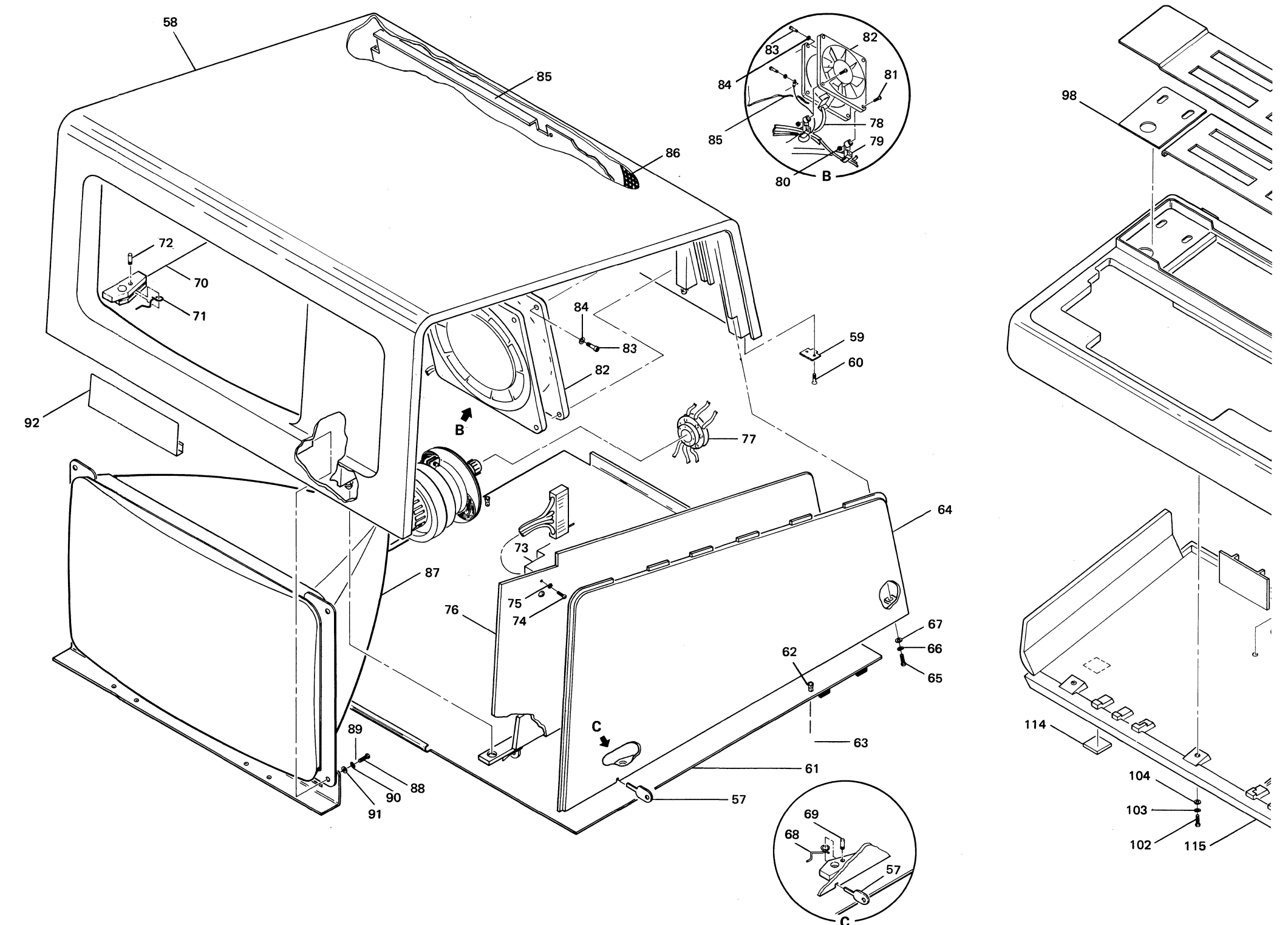
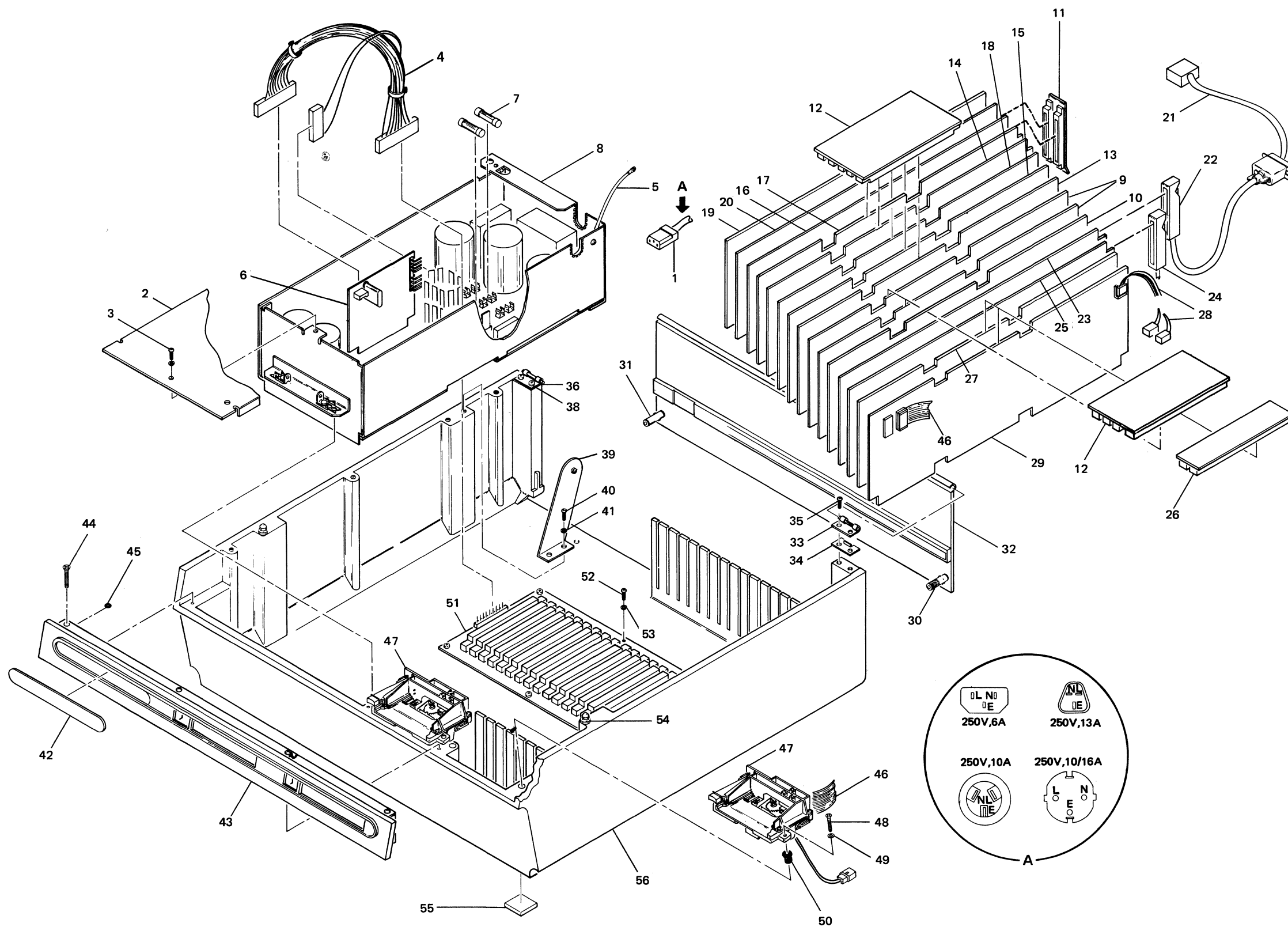
Table 3-3 provides the following information for each part:

- a. FIG & INDEX NO. The figure and index where the replaceable parts are shown in the exploded view.
- b. HP PART NO. The Hewlett-Packard part number for each replaceable part.
- c. DESCRIPTION. The description and any special applications (accessories and options) for each replaceable part.
- d. UNITS PER ASSY. The total quantity of each part used in the major assembly.

3-15. ORDERING INFORMATION

To order replaceable parts for the terminal or options and accessories, address the order to the local Hewlett-Packard Sales and Service Office listed at the end of this manual. The following information should be included in the order for each part.

- a. Complete terminal model number (including options and accessories) and serial number.
- b. Hewlett-Packard part number.
- c. Complete part description as provided in the replaceable parts list.



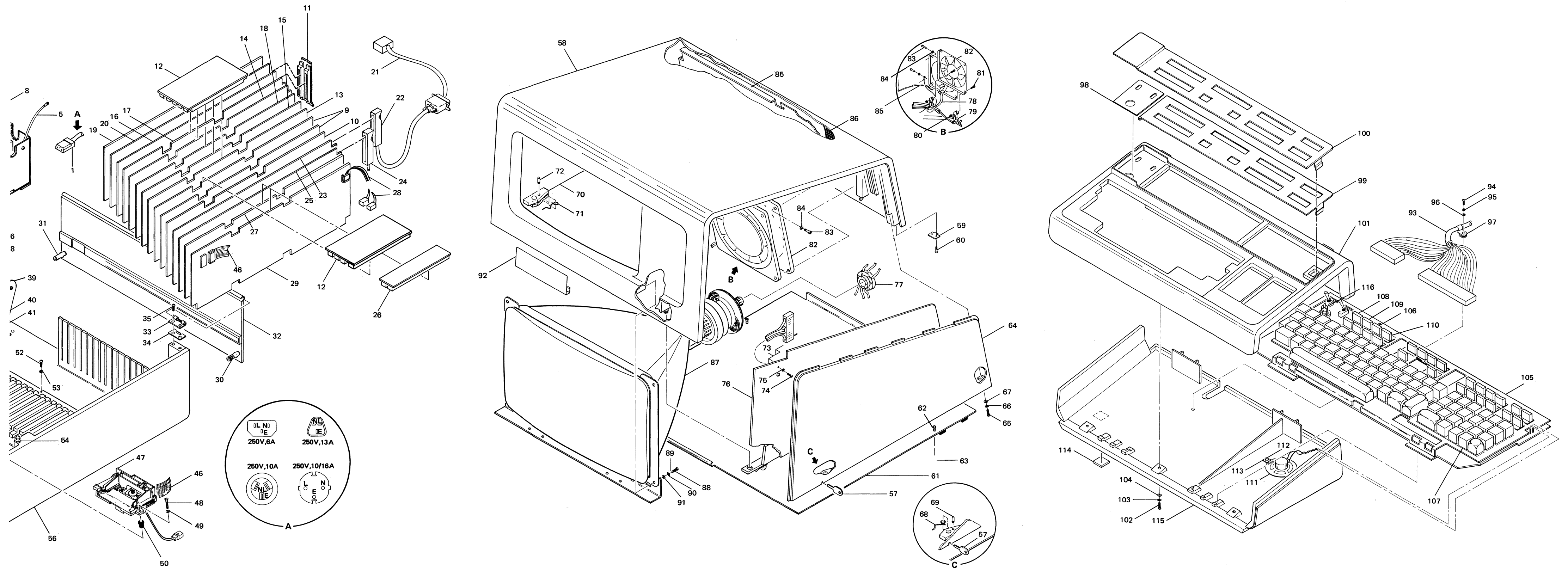


Figure 3-7. HP 2647A Terminal, Exploded View

Table 3-2. 2647A Terminal Replaceable Parts List

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY.
1	2647A	GRAPHICS TERMINAL	
	8120-1378	*Power Cord Set, 250V, 10A	1
	8120-2104	*Power Cord Set, 250V, 6A (used for Option 906)	1
	8120-1351	*Power Cord Set, 250V, 13A (used for Option 900)	1
	8120-1369	*Power Cord Set, 250V, 10A (used for Option 901)	1
2	8120-1689	*Power Cord Set, 250V, 10/16A (used for Option 902)	1
	02640-00064	*Cover, Power Supply (Attaching Parts)	
3	2360-0115	*Screw, machine, ph, no. 6-32, 0.312 in., with lockwasher — — — X — — —	1
4	02640-60148	*Cable Assembly	1
5	02640-60083	*Cable Assembly (used for Accessories 13260B, 13260C, and 13260D)	1
6	02640-60169	*Power Supply Control Assembly	1
7	2110-0202	*Fuse, 0.5A, 250V (not used on Option 015)	1
	2110-0588	*Fuse, 0.2A, 250V (used for Option 015)	1
	2110-0365	*Fuse, 4A, SB, 250V (not used on Option 015)	1
	2110-0583	*Fuse, 2A, SB, 250V (used for Option 015)	1
8	02640-60130	*Power Supply Assembly	1
9	02640-60221	*Control Memory	2
	1818-0590	**I.C., ROM, MOS	1
	1818-0591	**I.C., ROM, MOS	1
	1818-0592	**I.C., ROM, MOS	1
	1818-0593	**I.C., ROM, MOS	1
	1818-0594	**I.C., ROM, MOS	1
	1818-0595	**I.C., ROM, MOS	1
	1818-0596	**I.C., ROM, MOS	1
	1818-0597	**I.C., ROM, MOS	1
	1818-0598	**I.C., ROM, MOS	1
	1818-0599	**I.C., ROM, MOS	1
	1818-0600	**I.C., ROM, MOS (not used on Option 30. Used only on Accessory Options 13260A-006 and 13260B-006)	1
	1818-0602	**I.C., ROM, MOS	1
	1818-0603	**I.C., ROM, MOS	1
	1818-0604	**I.C., ROM, MOS	1
	1818-0605	**I.C., ROM, MOS	1
	1818-0606	**I.C., ROM, MOS	1
	1818-0607	**I.C., ROM, MOS	1
	1818-0608	**I.C., ROM, MOS	1
	1818-0609	**I.C., ROM, MOS	1
	1818-0610	**I.C., ROM, MOS	1
	1818-0611	**I.C., ROM, MOS	1
	1818-0612	**I.C., ROM, MOS	1
	1818-0613	**I.C., ROM, MOS	1
	1818-0614	**I.C., ROM, MOS (used for Accessories 13260C-001 and 13260D-001)	1
	1818-0620	**I.C., ROM, MOS	1
	1818-0621	**I.C., ROM, MOS	1
	1818-0622	**I.C., ROM, MOS	1
	1818-0623	**I.C., ROM, MOS	1
	1818-0624	**I.C., ROM, MOS	1
	1818-0625	**I.C., ROM, MOS	1
	1818-0626	**I.C., ROM, MOS	1
	1818-0627	**I.C., ROM, MOS	1
	1818-0628	**I.C., ROM, MOS (used for Accessories 13260C-006 and 13260D-006)	
1818-0629	**I.C., ROM, MOS (used for Accessories 13260C-006 and 13260D-006)		
10	02640-60209	*Processor Assembly	1
11	02640-60194	*Connector Assembly	1
12	02640-60022	*Top Plane Connector Assembly (four-connector)	2
	02640-60016	*Top Plane Connector Assembly (five-connector) (used for Accessory 13231A)	1

Table 3-2. 2647A Terminal Replaceable Parts List (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY.
13	02640-60024	*Display Enhancement Assembly (used for Accessory 13231A)	1
	1816-0641	**I.C., ROM (Line Drawing Set) (used for Accessory 13231A-202)	1
	1816-0642	**I.C., ROM (Math Character Set) (used for Accessory 13231A-201)	1
	1816-0947	**I.C., ROM (Large Character Set) (used for Accessory 13231A-203)	1
14	02640-60124	*Display Memory Access Assembly	1
15	02640-60088	*General Purpose Display Timing Assembly	1
	0410-0646	**Crystal, 17.55 MHz (Y1) (for 50 Hz power) (used for Options 015 and 016)	1
	0410-0647	**Crystal, 21.06 MHz (Y1) (for 60 Hz power)	1
16	02640-60125	*Graphics Microcontroller Assembly	1
17	02640-60126	*Graphics Display Memory Assembly	1
18	02640-60112	*Display Control Assembly	1
	1816-0612	**I.C., ROM, (64-character upper case Roman)	1
	1816-0613	**I.C., ROM, (128-character lower case Roman)	1
19	02640-60123	*Keyboard Interface Assembly	1
20	02640-60171	*Universal Memory Assembly	1
	5090-0114	**I.C. RAM	16
21	02640-60134	*Multipoint Extension Cable Assembly (Accessory 13232R)	1
22	02640-60043	*103/202 Modem Cable Assembly (Accessory 13232A)	1
	02640-60058	*12531/12880 Hood-to-Hood Cable Assembly (Accessory 13232B)	1
	02640-60059	*RS232C Cable Assembly (Accessory 13232C)	1
	5061-2408	*Current Loop Cable Assembly (used for Accessory 13232F)	1
	02640-60098	*Male RS232C Printer Cable Assembly (Accessory 13232G)	1
	02640-60099	*Female RS232C Printer Cable Assembly (Accessory 13232H)	1
	02640-60116	*9871 Printer Cable Assembly (Accessory 13232J)	1
	02640-60120	*Tektronix 4632 Interface Cable Assembly (Accessory 13232K)	1
	02640-60121	*Conrac T.V. Monitor Interface Cable Assembly (Accessory 13232L)	1
	02640-60131	*Modem Cable Assembly (Accessory 13232N)	1
	02640-60132	*Modem/Multipoint Cable Assembly (used for Accessory 13232P)	1
	02640-60133	*Multipoint (Terminal-to-Terminal) Cable Assembly (Accessory 13232Q)	1
	02640-60151	*Power Protect Multipoint Cable Assembly (Accessory 13232T)	1
	5061-2403	*Modem Bypass Cable Assembly (Accessory 13232U)	1
23	02640-60171	*Universal Memory Assembly	1
	5090-0114	**I.C., RAM	16
24	02640-60135	*9866 Cable Assembly (Accessory 13232S; used for Accessory 13246A)	1
	02640-60122	*Sweep Extender Cable Assembly (used for Accessory 13254A)	1
25	02640-60086	*Asynchronous Data Comm Assembly (Also used for Accessory 13260A) (not used on terminal Options -030 and -031)	1
	02640-60143	*Serial Printer/Extended Asynchronous Data Comm Assembly (used for Accessories 13250B and 13260B)	1
	02640-60106	*Asynchronous Multipoint Interface Assembly (used for Accessory Option 13260C-006)	1
	02640-60107	*Synchronous Multipoint Interface Assembly (used for Accessory Option 13260D-006)	1
	02640-60031	*Terminal Duplex Register Assembly (used for Accessory 13238A)	1
	02640-60119	*Video Output Interface Assembly (used for Accessory 13254A)	1
	02640-60128	*HP-IB Interface (Accessory 13296A)	1
	02640-60215	**HP-IB Interface Assembly	1
	8120-1834	**HP-IB Load Box (not shown)	1
		**Cable Assembly (not shown)	1
26	02640-60021	*CTU Top Plane Assembly (two-connector)	1
27	02640-60137	*CTU Interface Assembly	1
28	02640-60085	*Motor Cable Assembly	1
29	02640-60032	*Read/Write Assembly	1
30	1390-0326	*Latch, door, right	1
31	1390-0327	*Latch, door, left	1
32	02640-20018	*Rear Door	1
33	3110-0100	*Right Hinge (Attaching Parts)	1
34	02640-00025	*Hinge Support	1
35	2360-0197	*Screw, Machine, ph. no. 6-32, 3/8 in. — X —	2

Table 3-2. 2647A Terminal Replaceable Parts List (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY.
36	3110-0101	*Left Hinge (Attaching Parts)	1
37	02640-00025	*Hinge Support	1
38	2360-0197	*Screw, Machine, ph, no. 6-32, 3/8 in. — — — X — — —	2
39	02640-00091	*Support (Attaching Parts)	1
40	2360-0197	*Screw, Machine, ph, no. 6-32, 3/8 in.	2
41	2190-0851	*Washer, Lock, split, no. 6 — — — X — — —	2
42	02647-00001	*Front Bezel Insert	1
43	02640-60177	*Front Bezel (Attaching Parts)	1
44	2360-0197	*Screw, Machine, ph, no. 6-32, 3/8 in.	4
45	2190-0918	*Washer, Lock, helical, no. 6 — — — X — — —	4
	9162-0061	Mini Cartridge (not shown)	1
	9162-0061	Mini Cartridge (used for Option 013)	6
46	02640-60066	Ribbon Cable, CTU	2
47	02640-60050	*CTU Transport Assembly (Attaching Parts)	2
48	2360-0205	*Screw, Machine, ph, no. 6-32, 3/4 in.	2
49	3050-0227	*Washer, Flat, no. 6	2
50	1520-0067	*Shock Mount — — — X — — —	2
	02640-40016	**Pawl	1
	1460-1440	**Spring, Compression	1
	02640-60056	**Head Bridge Assembly (Attaching Parts)	1
	0624-0314	**Screw, Tapping, no. 6-40	3
	2190-0003	**Washer, Lock, split, no. 4 — — — X — — —	3
	2140-0450	***Indicator Lamp DS1	1
	4040-1017	***Shield, Light	1
	02640-60055	**Motor/Tachometer Assembly (Attaching Parts)	1
	1460-1381	**Extension Spring — — — X — — —	2
	02640-60054	**CTU Base Assembly	1
51	02640-60158	*Backplane Assembly (Attaching Parts)	1
52	2360-0197	*Screw, Machine, ph, no. 6-32, 3/8 in.	6
53	2190-0851	*Washer, Lock, split no. 6 — — — X — — —	6
54	0570-0528	*Stud, retainer	2
55	0403-0324	*Bumper, rubber	4
56	02640-40035	*Mainframe Shell	1
	02640-40039	*Mainframe Shell (used only on Option 017)	1
57	02640-00021	*Access Key	2
58	02640-40031	*Display Top	1
	02640-40036	*Display Top (used only on Option 017)	1
59	3110-0099	*Hinge Top (Attaching Parts)	2
60	2360-0196	*Screw, Machine, flh, no. 6-32, 3/8 in. — — — X — — —	4
61	02640-00034	*CRT Shield (Attaching Parts)	1
62	1390-0365	*Plunger, Snap-in	2
63	1390-0366	*Grommet, Snap-in — — — X — — —	2

Table 3-2. 2647A Terminal Replaceable Parts List (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY.
64	02640-40033	*Right Side	1
	02640-40037	*Right Side (used only on Option 017) (Attaching Parts)	1
65	2360-0201	*Screw, Machine, ph, no. 6-32, 0.5 in. pozi	3
66	2190-0918	*Washer, Lock, helical, spring-type	3
67	3050-0066	*Washer, Flat, no. 6 — — — X — — —	3
68	1460-1580	Spring, wireform, right (Attaching Parts)	1
69	1480-0069	Pin, 0.125 in., 0.5 in. — — — X — — —	1
70	02640-40034	*Left Side	1
	02640-40038	*Left Side (used only on Option 017) (Attaching Parts)	
	2360-0201	*Screw, Machine, ph, no. 6-32, 0.5 in. pozi	3
	2190-9018	*Washer, Lock, helical, spring-type	3
	3050-0066	*Washer, Flat, no. 6 — — — X — — —	4
71	02640-60039	*Sweep Cable Assembly (not shown)	1
	1460-1579	Spring, wireform, left (Attaching Parts)	1
72	1480-0069	Pin, 0.125 in., 0.5 in. — — — X — — —	1
73	02640-00034	*Shield, Transformer (Attaching Parts)	1
74	2360-0197	*Screw, Machine, ph, no. 6-32, 3/8 in.	2
75	2190-0918	*Washer, Lock, Split, no. 6 — — — X — — —	2
76	02640-60095	*Sweep Assembly	1
77	02640-60042	*CRT Cable Assembly	1
78	02640-60138	*Fan Cable Assembly	1
79	1400-1440	*Cable Tie (Attaching Parts)	2
80	2420-0001	*Nut, hex, no. 6-32	2
81	2360-0205	*Screw, no. 6-32, 3/4 in. — — — X — — —	2
82	3160-0208	*Fan (Attaching Parts)	1
83	3030-0064	*Screw, Cap, no. 6-32, 5/8 in.	4
84	2190-0918	*Washer, Lock, spring, no. 6 — — — X — — —	4
85	02640-00066	*Fan, Shroud	1
86	02640-00046	*Screen, Display	1
87	02640-60084	*CRT/Yoke Assembly (Attaching Parts)	1
88	2510-0107	*Screw, Machine, ph, no. 8-32, 0.5 in.	4
89	2190-0017	*Washer, Spring, no. 8	4
90	2190-0010	*Washer, Lock, ext-tooth, no. 8	1
91	3050-0001	*Washer, Flat, no. 8 — — — X — — —	3
92	9320-3173	*Symbol Template (Mathematics) (used for Accessory 13231A-201)	1
	9320-3172	*Symbol Template (Line Drawing) (used for Accessory 13231A-202)	1
	02647-60003	*Keyboard and Cable Assembly (used only on Option 017)	1
93	02640-60160	**Keyboard Cable Assembly	1
	02640-00072	**Shield (Attaching Parts)	1
	2360-0193	**Screw, Machine, ph, no. 6-32, 0.25 in.	1
	2360-0201	**Screw, Machine, ph, no. 6-32, 0.5 in.	4
	2190-0918	**Washer, Lock, Spring, no. 6	4

Table 3-2. 2647A Terminal Replaceable Parts List (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY.
93	2190-0008	**Washer, Lock, ext-tooth, no. 6	2
	0362-0393	**Lug, Crimp, female, 0.250 in. tab, (for 16 to 14 AWG) — — — X — — —	1
	02648-60002	*Keyboard and Cable Assembly (not used on Option 017)	1
	02640-60081	**Keyboard Cable Assembly (Attaching Parts)	1
94	2360-0201	**Screw, Machine, ph, no. 6-32, 0.5 in.	1
95	2190-0918	**Washer, Lock, spring, no. 6	1
96	3050-0066	**Washer, Flat, 0.147 ID, 0.375 in. OD	1
97	1400-0440	**Cable Clamp — — — X — — —	1
98	7120-6388	**Baudrate Label (standard)	1
	7120-5486	**Baudrate Label (used for Accessories 13260A, 13260B, and 13260C, except Options 002 and 006)	1
	7120-6388	**Baudrate Label (used for Accessories 13260A and 13260B, Option 006 only)	1
	7120-5485	**Baudrate Label (used for Accessories 13260C and 13260D, except Options 002 and 006)	1
	7120-6386	**Baudrate Label (used for Accessories 13260C and 13260D, Option 006 only)	1
	7120-6388	**Baudrate Label (used for Accessories 13260C and 13260D, Option 006 only)	1
99	7120-7484	**Keyboard Overlay (standard)	1
100	02641-00003	**Keyboard Overlay (used for Accessories 13260C and 13260D, Option 3)	1
	02644-00002	**Keyboard Overlay (used for Accessories 13260A and 13260B, except Options 002, 004, and 006)	1
	02645-00003	**Keyboard Overlay (used for Accessories 13260C and 13260D, except Option 002, 004, and 006)	1
101	02640-40030	**Keyboard Top (Attaching Parts)	1
102	2360-0203	**Screw, Machine, ph, no. 6-32, 0.625 in.	5
103	2190-0918	**Washer, Lock, spring, no. 6	5
104	3050-0066	**Washer, Flat, 0.147 in. ID, 0.375 in. OD — — — X — — —	5
105	02640-60018	**Keyboard Printed Circuit Assembly	1
106	1990-0486	***Light-Emitting Diode, red	7
107	0370-2646	***ESC Key	1
	0370-2260	***1 ! Key	1
	0370-2261	***2 " Key	1
	0370-2262	***3 # Keycap	1
	0370-2263	***4 \$ Keycap	1
	0370-2264	***5 % Keycap	1
	0370-2265	***6 & Keycap	1
	0370-2266	***7 ' Keycap	1
	0370-2267	***8 (Keycap	1
	0370-2268	***9) Keycap	1
	0370-2641	***0 Keycap	1
	0370-2648	*** - = Keycap	1
	0370-2654	*** ~ Keycap	1
	0370-2651	*** \ Keycap	1
	0370-2637	***CNTL Keycap	1
	0370-2286	***Q Keycap	1
	0370-2292	***W Keycap	1
	0370-2274	***E Keycap	1
	0370-2287	***R Keycap	1
	0370-2289	***T Keycap	1
0370-2294	***Y Keycap	1	
0370-2290	***U Keycap	1	
0370-2278	***I Keycap	1	
0370-2284	***O Keycap	1	
0370-2285	***P Keycap	1	

Table 3-2. 2647A Terminal Replaceable Parts List (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY.
107 (Cont)	0370-2655	***@ Keycap	1
	0370-2652	***[{ Keycap	1
	0370-2650	*** — DEL Keycap	1
	0370-2270	***A Keycap	1
	0370-2288	***S Keycap	1
	0370-2273	***D Keycap	1
	0370-2275	***F Keycap	1
	0370-2276	***G Keycap	1
	0370-2277	***H Keycap	1
	0370-2279	***J Keycap	1
	0370-2280	***K Keycap	1
	0370-2281	***L Keycap	1
	0370-2324	***, + Keycap	1
	0370-2325	***, * Keycap	1
	0370-2653	***] } Keycap	1
	0370-2635	***RETURN Keycap	1
	0370-2636	***SHIFT Keycap	2
	0370-2295	***Z Keycap	1
	0370-2293	***X Keycap	1
	0370-2272	***C Keycap	1
	0370-2291	***V Keycap	1
	0370-2271	***B Keycap	1
	0370-2283	***N Keycap	1
	0370-2282	***M Keycap	1
	0370-2296	***, < Keycap	1
	0370-2297	***, > Keycap	1
	0370-2298	***/ ? Keycap	1
	0371-0213	***Space Bar Keycap	1
	0371-0644	***◀ Keycap	1
	0371-0645	***STOP Keycap	1
	0371-0646	***▶ Keycap	1
	0371-0647	***ZOOM IN Keycap	1
	0371-0648	*** Keycap	1
	0371-0649	***ZOOM OUT Keycap	1
	0371-0650	***ZOOM Keycap	1
	0371-0653	*** Keycap	1
	0371-0654	***G CURSOR Keycap	1
	0371-1069	***MULTIPLY Keycap	1
	0371-1070	***MULTIPLY MENU/CURSOR FAST Keycap	1
	0370-2656	***CLEAR TAB Keycap	1
	0370-2657	***SET TAB Keycap	1
	0370-2982	***CLEAR DSPLY Keycap	1
	0370-2658	***ROLL UP Keycap	1
	0370-2659	***ROLL DOWN Keycap	1
	0370-2638	***NEXT PAGE Keycap	1
	0370-2639	***PREV PAGE Keycap	1
	0370-2642	*** (Home) Keycap	1
0370-2640	***Arrow Keycap	4	
0370-2644	***Operating Function Keycap	17	
0370-2765	***f1 Keycap	1	
0370-2766	***f2 Keycap	1	
0370-2767	***f3 Keycap	1	
0370-2768	***f4 Keycap	1	
0370-2769	***f5 Keycap	1	
0370-2770	***f6 Keycap	1	
0370-2771	***f7 Keycap	1	
0370-2772	***f8 Keycap	1	
0370-2877	***BACKSPACE Keycap	1	
0370-2878	***TAB Keycap	1	
0370-2898	***Olive Black Keycap	1	

Table 3-2. 2647A Terminal Replaceable Parts List (Continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	UNITS PER ASSY.
108	3101-1745	***RESET TERMINAL Pushbutton Switch (under keycap)	1
109	3101-2137	***Pushbutton Switch, Momentary Contact (under keycap)	99
110	3101-2136	***Pushbutton Switch, Locking (under keycap)	4
111	9160-0233	**Loudspeaker Assembly (Attaching Parts)	1
112	2360-0193	**Screw, Machine, ph, no. 6-32, 0.25 in.	2
	2190-0918	**Washer, Lock, spring, no. 6	2
113	1400-0054	**Mounting Clamp ----- X -----	2
114	0403-0324	**Rubber Bumper	4
115	02640-40029	**Keyboard Bottom	1
116	0370-2991	**BAUD RATE Knob (Attaching Parts)	1
	3030-0609	**Set Screw, knurled tip, no. 4-40, 1/8 in. (not shown) ----- X -----	1
	9282-0690	Binder, three-ring	1
	02640-00072	Keyboard RFI Shield (not shown) (used on Option 017)	1
	8570-0585	**Keycap Removal Tool (not shown)	1
	9300-0468	Cleaning Swab (not shown)	25
	8500-1251	Tape Head Cleaning Solvent (not shown)	1
	5061-1340	Kit, 30-pin connector (used for Accessory 13250B)	1
	02648-90001	Manual, User's (not shown)	1
	02647-90002	Manual, Reference (not shown)	1
	02647-90003	Manual, Service (not shown)	1
	02645-13301	Instruction Tape, User's (not shown)	1
	02646-13301	Instruction Tape, User's (not shown)	1
	02648-13301	Instruction Tape, User's (not shown)	1
	02647-13301	Basic Interpreter and AGL tape (not shown)	1
	02647-13302	Instruction Tape, User's, No. 1 (not shown)	1
	02647-13303	Instruction Tape, User's, No. 2 (not shown)	1
	02647-13304	Basic Language Instruction Tape (not shown)	1
	1600-0676	I.C. Extractor (supplied only with Accessory 13231) (not shown)	1
	13349-90901	Manual, Operator's Printer Subsystem (supplied only with Accessory 13232J) (not shown)	1
		Manual, Operator's Printer Subsystem (supplied only with Accessory 13232S) (not shown)	1
	02645-60002	DC Self Test Assembly (not supplied with Option 031)	1
	02645-60004	Connector, Self Test (supplied only with Accessory 13232P)	1
	13255-91128	Manual, HPIB Technical Information Package (TIP) (supplied with Accessory 13296A)	1
	02647-90005	Basic Reference Manual	1
	02647-90006	Quick Reference Guide	1

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