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Desktop Computer
Service Manual
for the HP 9845B/C

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Printing History

New editions of this manual will incorporate all material updated since the previous edition. Update packages may be issued between editions and contain replacement and additional pages to be merged into the manual by the user. Each updated page will be indicated by a revision date at the bottom of the page. A vertical bar in the margin indicates the changes on each page. Note that pages which are rearranged due to changes on a previous page are not considered revised.

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NOTICE

The information contained in this document is subject to change without notice.

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Table of Contents

Chapter 2: How To Fix It

Chapter 4: Replaceable Parts

Tables

Figures

Computer
Museum

Chapter 1

General Information

Introduction

This manual provides installation and maintenance information for the 9845B Desktop Computer. The various chapters in this manual include:

- General Information

- How To Fix It

- Assembly Access

- Replaceable Parts

- 9845B Model 200 Mainframe

This chapter contains general servicing information. Here are the topics discussed in this chapter:

- 9845A and 9845B Comparison

- Specifications

- Equipment supplied with the computer

- Product Support Packages

- Repair Philosophy

- Safety guidelines

- 9845B Installation

- Options available, including field installation of options

9845B Specifications

Environmental Range

Operating Temperature: +5°C to +40°C ambient

Storage Temperature: −40°C to +65°C

Ambient Humidity   5% to 80% at 40°C

Size/Weight

Height: 482.6mm (18.5 in.)

Width: 457.2mm (18.0 in.)

Depth: 666.75mm (26.25 in.)

Net Weight: 18.6 kg (41 lb) standard mainframe
                               10.43 kg (23 lb) standard CRT
                               0.9 kg (2 lb) graphics option
                               0.91 kg (2 lb) cartridge option
                               5.22 kg (11.5 lb) printer option

Power Requirements

AC Line Voltage: 110 volts ac + 15%, −20%
                               220 volts ac +15%, −20%

Line Frequency: 48 to 66 Hz (inclusive)

Power Consumption: 360 Watts max.

Data Storage

Read/Write Memory

Standard:	64k bytes
Option 204:	192k bytes
Option 205:	320k bytes
Option 206:	448k bytes

Tape Cartridge

Capacity:	217,000 bytes
Search Speed:	2286 mm/sec. (90 inches/sec.)
Read/Write Speed:	559 mm/sec. (22 inches/sec.)
Tape Length:	42.67 m (140 ft.)
Error Check:	Checksum

Thermal Printer/Plotter

Character Printing:	480 lines/minute (average)
Plotting:	3750 dot rows/minute (average)
Character Set:	128 standard ASCII characters plus optional character sets which provide 93 additional characters.

CRT Display

Screen Size:	261 mm x 193 mm (10.3 x 7.6 inches)
Refresh Rate:	60Hz
CRT Phosphor:	P31
Alpha Raster:	236 mm x 123 mm (9.3 x 4.84 inches)
Character Size:	2.3 mm x 2.95 mm (.09 x .116 inches)
Screen Capacity:	24 lines of 80 characters
Graphics Raster:	200 mm x 162.5 mm (7.9 x 6.4 inches)

Equipment Supplied

Table 1-1 lists the equipment supplied with each standard 9845B.

Table 1-1.   Equipment Supplied with the Standard 9845B

Item	HP Part Number
Operating and Programming Manual	09845-91000
Beginner's Guide	09845-91001
Owner's Manual	09845-91005
Quick Reference Manual	09845-91015
System Exerciser Manual	09845-91040
System Exerciser Cartridge	09845-91041
Workbook	09845-91090
Training Tape	09845-10024
Utility Library	09845-10200
Special Function Key Overlays (5)	7120-6164
Two blank tape cartridges	9162-0061
Dust cover	9222-0592
Magnetic head cleaner	8500-1251
Spare fuses	
8 Amp (90-126 Vac)	2110-0342
4 Amp (198-252 Vac)	2110-0365

Power cord - the appropriate power cord will be supplied based on the origin code of the sales order.

Product Support Packages

The following product support packages are available.

> 09845-67130   Tools
>
> 09845-67106   Carry Cases; for functional unit and tools
>
> 09845-67114   Carry Cases; for PC boards and tools

Repair Philosophy

The 9845B electronic assemblies are divided into those that can be exchanged and those that can be repaired in the field. Table 1-2 lists the 9845B electronic and electro-mechanical assemblies and whether they are to be exchanged on the Green Stripe Exchange Program or repaired in the field. Component repair items not repairable in the field should be ordered at list price but not returned.

Table 1-2.   Repair Philosophy

Assembly Part Number	Description	Assembly Exchange	Component Repair	Repair Level
Mainframe				
09845-66502	I/O Backplane (A2)		X	Fuse only
09845-66515	Language Processor - Memory controller	X		
09845-66516	Peripheral Processor - Memory controller	X		
09845-66526	128k-byte Read/Write Memory (A26)	X		
09845-66527	Peripheral RAM/ROM Assembly (A27)	X		
09845-66528	Language RAM/ROM Assembly (A28)	X		
09845-60302	Rear Panel		X	
09845-66500	Motherboard, Main Chassis (A0)		X	Connectors only
09845-66503	Alpha Control (A3)	X		
09845-66504	Graphics Interface (A4)		X	Replace
CRT				
09845-66571	CRT Motherboard (A71)		X	Connectors only
09845-66572	CRT Transistor Assembly (A72)		X	All Transistors and regulators
09845-66573	Display Logic (A73)	X		
09845-66574	CRT Analog (A74)	X		Adjustments only
09845-66575	High Voltage (A75)	X		Adjustments only
09845-66576	CRT Interface (A76)		X	Replace
09845-66577	Graphics Scanner (A77)	X		
09845-66579	Graphics Control (A79)	X		
09845-67701	Intensity Control		X	
Power Supply				
09845-67980	Power Supply Assembly	X		
Printer				
09845-66551	Printer Logic (A51)	X		
09845-66555	Printer Interface (A55)	X		Fuse only
09845-67951	Printer Bucket		X	All
09845-67163	Print Head		X	Red Stripe
09845-67161	Print Head Modules		X	Red Stripe
09845-67954	Paper Advance		X	Replace
Keyboard				
09845-66505	Bezel Interconnect (A5)		X	Replace
09845-66532	Keyboard Logic (A32)	X		
09845-66561	Cartridge Drive Logic (A61)	X		
09845-67962	Transport	X		
09845-68000	Keyswitch Assembly (without keycaps)		X	Key Switches
09845-67155	Keyswitch Assembly (with keycaps)		X	Key Switches and Keycaps

9845A and 9845B Comparision

The 9845B is similar to the 9845A. The 9845A and B are:

- The same physical appearance.

- The same size.

- Very nearly the same weight.

The following assemblies are common in both the 9845A and 9845B.

- Case parts

- Power Supply (09845-67980)

- I/O Backplane

    A2 09845-66502

- Thermal Printer

    A51 09845-66551 (Different Character ROM)

    A55 09845-66555

        09845-67951 - Printer Bucket

        09845-67952 - Print Mechanism Assembly (with label)

- CRT and Control Assemblies

    A3 09845-66503

    A71 09845-66571

    A72 09845-66572

    A73 09845-66573 (Different Character ROM)

    A74 09845-66574

    A75 09845-66575

    A76 09845-66576

- Keyboard Assemblies

    A5 09845-66505

    A32 09845-66532

    A61 09845-66561

        09845-68000 Keyswitch Assembly

        09845-67962 Cartridge Drive

- Graphics Assemblies

    A77 09845-66577

    A79 09845-66579

Here are the assemblies that have changed. First, the 9845A assemblies not used on the 9845B:

- Motherboard

- Processor Assembly

- Memory Address Extension

- Dual Port Memory Controller

- 16k byte LPU Read/Write Memory

- 8k byte PPU Read/Write Memory

- LPU ROM Drawer and ROM Packs

- PPU ROM Drawer and ROM packs

The new unique 9845B assemblies are:

- Motherboard

- LPU Memory Controller

- PPU Memory Controller

- Peripheral RAM/ROM Assembly

- Language RAM/ROM Assembly

- LPU 128k byte Read/Write Memory

- PPU ROM Drawer and ROM packs

- LPU ROM Drawer and ROM packs

Safety

WARNING

LETHAL VOLTAGES ARE PRESENT INSIDE THE 9845B. THERE ARE NO
CUSTOMER SERVICEABLE PARTS INSIDE THE 9845B.

Procedure For All Personnel Trained In Electrical or Electronic Installation, Maintenance and/or Repair

- Do all possible operations with the power source inactivated.

- If the installation, maintenance or repair has to be done while energized, the following precautions should be taken:

  a. Never work alone in high voltage areas. In case of accidental shock, a life may depend on rapid removal from the energized source and appropriate first-aid action.

  b. Employees working in high voltage areas should know where to obtain respiratory resuscitation and / or cardiac pulmonary resuscitation (CPR), in case a fellow worker needs assistance.

  c. In case of burns, treat only after the person is breathing and has a normal heartbeat.

These simple precautions can save a life.

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General Safety Guidelines for High Voltage Testing

Here is a list of safety guidelines to be followed when working with voltages in excess of 50vdc or 50vac RMS.

1. Know each step of the test procedure. Check the test set up to be sure the instruments are connected properly and that all control settings are correct.

2. Never defeat interlocks.

3. Never have one hand on chassis or other ground while measuring high voltages with a probe held in the other hand. Use the one hand method, i.e., probe in one hand, the other hand behind the back or in a pocket.

4. Make sure the probe being used has voltage insulation higher than the voltage being measured. Check wires and probes for cracked insulation and defects. If any defects are noted do not use until repairs are made.

5. Make certain that the instrument being worked on is turned off and all capacitors and high voltage circuits are discharged before any component or hardware is removed or touched. Remember that a circuit can be lethally charged if a component is open, missing, or if a wire is disconnected or open even with the ac power switch off. Isolated heat sinks will also be statically charged.

6. Make certain that instruments used for testing are used within their rated specification. Never use instruments floated above their specified rating.

7. Never reach around energized high voltage circuits. Always turn equipment off and discharge the high voltage before reaching.

8. NEVER WORK ALONE. Be familiar with location of power switches in your area and what they control. Know how to free a fellow worker from high voltage without energizing yourself.

9. Keep work area neat, free of any interfacing conductive material, and free of any sharp objects. Remember a reaction to a shock can cause one to strike nearby objects which can result in a serious injury.

10. Always leave safety shields in place unless work must be done on circuits behind the shields. Replace the shields after work is completed.

11. Never leave work area with high voltage equipment energized and high voltage circuits exposed.

12. Have available and use approved warning signs and tags where high voltage testing is in process.

13. Do not make measurements in a circuit where a corona is present. Corona can be identified by a pale-blue color, or from a buzzing sound emanating from sharp metal points in the circuit, or from the odor of ozone.

14. Hands, shoes, floor, and workbench must be dry. Avoid making measurements under humid, damp or other environmental conditions that could affect the dielectric withstanding voltage of the test leads or instruments.

15. All test procedures and safety procedures should be strictly followed at all times.

Power Cords

Power cords supplied by HP will have polarities matched to the power-input socket on the equipment, as shown below:

- L = Line or Active Conductor (also "live" or "hot")

- N = Neutral or Identified Conductor

- E = Earth or Safety Ground

WARNING

IF IT IS NECESSARY TO REPLACE THE POWER CORD, THE REPLACE-
MENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL.
OTHERWISE A SAFETY HAZARD FROM ELECTRICAL SHOCK TO PER-
SONNEL, WHICH COULD RESULT IN INJURY OR DEATH, MIGHT
EXIST. IN ADDITION, THE EQUIPMENT COULD BE SEVERLY DAM-
AGED IF EVEN A RELATIVELY MINOR INTERNAL FAILURE OCCUR-
RED.

Power cords with different plugs are available for the equipment; the part number of each cord is shown below. Each plug has a ground connector. The cord packaged with the equipment depends upon where the equipment is to be delivered.

8120-1351   8120-1369   8120-1689   CALCULATOR POWER-INPUT SOCKET

8120-1378 [1]   8120-0698 [2]   8120-2104
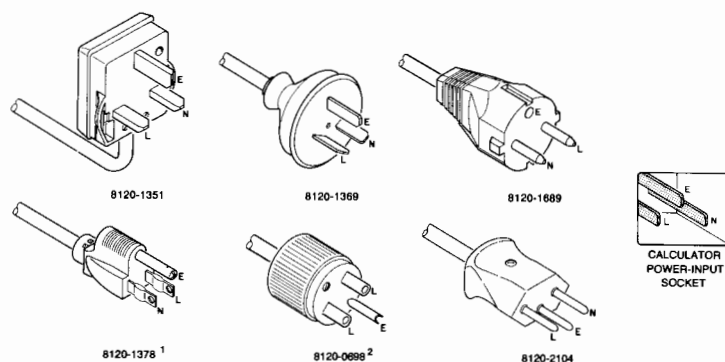
[1] UL and CSA approved for use in the United States of America and Canada with equipment set for either 100 or 120 Vac operation.
[2] UL and CSA approved for use in the United States of America and Canada with equipment set for either 200 or 240 Vac operation.

Grounding Requirements

To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the computer chassis be grounded. The computer is equipped with a three conductor power cable which, when connected to an appropriate power receptacle, grounds the computer chassis.

Installation

Computer Assembly

After unpacking the computer, the CRT assembly must be mounted onto the mainframe assembly. The CRT assembly will lock into place on top of the mainframe support legs. It is important that the guides on the CRT assembly and the mainframe support legs are aligned properly before assembly. Figure 1-1 shows the proper alignment necessary for the CRT assembly installation. Notice how the buttons on bottom of the CRT assembly align with the notches in the support legs.
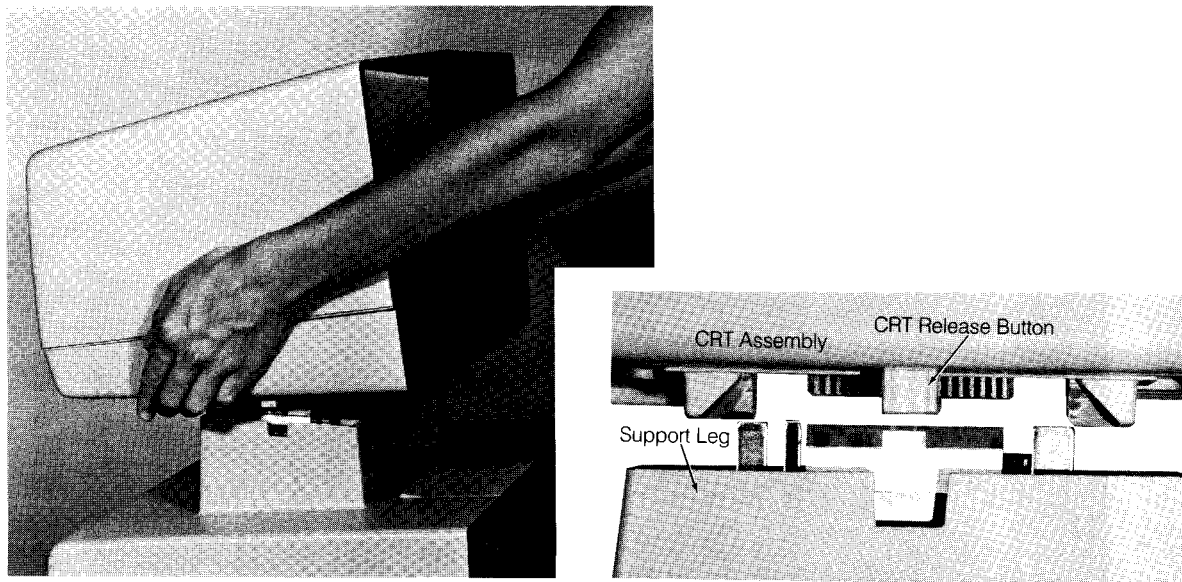
Figure 1-1: CRT Assembly Installation

Power Requirements

The 9845B can operate on nominal ac line voltages of 110 and 220 volts ac. The range of operation for each nominal voltage is shown below.

Table 1-3: Operating Ranges

Nominal Voltage	Operating Range
110	90-126 volts ac
220	198-252 volts ac

The line frequency must be within 48 to 66Hz. The 9845B requires a maximum of 360 Watts.

Line Voltage Selector Switch

The line voltage selector switch on the computer rear panel (see Figure 1-2) must be set to the nominal line voltage in your area.

CAUTION
CHECK THE SELECTOR SWITCH SETTING BEFORE APPLYING POWER. DAMAGE TO THE COMPUTER WILL OCCUR IF THE SELECTOR SWITCH IS SET TO 110 VOLTS AC AND 220 VOLTS AC IS APPLIED TO THE POWER INPUT CONNECTOR.

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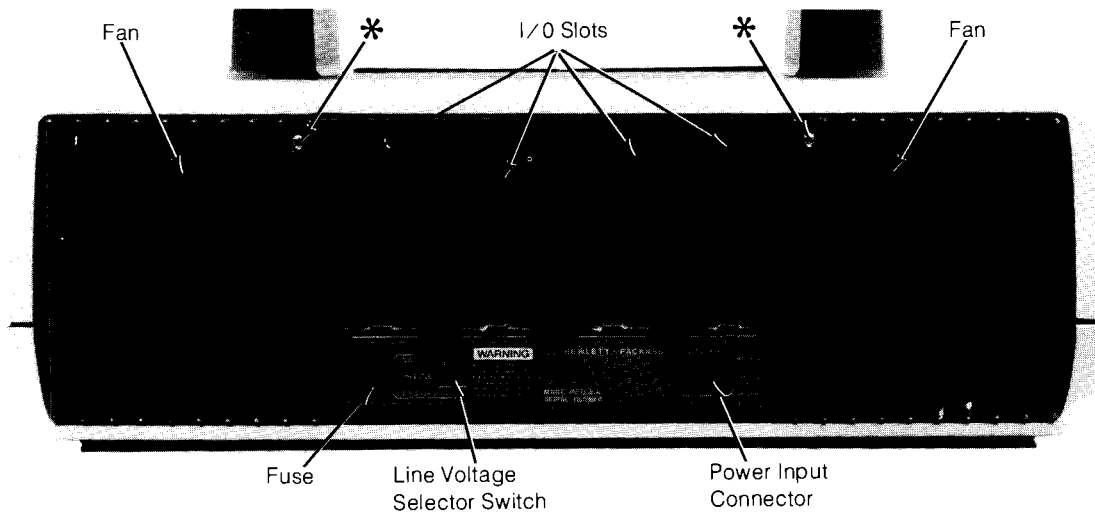
*Top cover screws on rear panel.

Figure 1-2: Computer Rear Panel

Fuse

The computer's fuse is located on the rear panel (see Figure 1-2). A 8 amp fuse is required for 110 volts operation and a 4 amp fuse is required for 220 volts operation. The fuse part numbers are listed in Table 1-4.

Table 1-4: Fuses

Fuse Rating	Nominal Voltage Range	Fuse Part Number
4 amp (SB)	198-252 Vac	2110-0365
8 amp (NB)	90-126 Vac	2110-0342

WARNING

BEFORE CHANGING THE FUSE, BE SURE THAT THE COMPUTER IS DISCONNECTED FROM ANY AC POWER SOURCE.

Initial Turn-on

Before applying power to the computer, check the following items.

- Disconnect power cord.

- Install CRT assembly.

- Set line voltage selector switch.

- Install proper fuse.

- Power switch set to off (right side of mainframe).

- Connect power cord.

Switch the power switch on, after a 20 second (approximate) warmup time the message "9845B READY FOR USE" will appear on the CRT display, followed by the blinking cursor. Adjust the intensity control located beneath the lower right corner of the CRT bezel, for the desired display intensity. If the turn-on memory test fails, "PART OF MEMORY FAILED SELF-TEST" is displayed.

Loading Printer Paper

Printer paper is loaded by using the following procedure. For this procedure the computer must be switched on.

1. Open the access cover on the top of the printer by pushing down on the raised surface at the rear of the cover.

NOTE

For easier access, remove the access cover by pulling it forward after it is opened.

---

2. Remove and discard the paper core of any previous roll. If the remaining roll is small and a new roll is to be used, remove the old roll by:

   a. Unrolling and lifting it upwards until the roll is above the printer, then

   b. Hold the roll firmly and pull it upward and forward; the paper guide will tear the paper off.

3. If any paper remains in the printer mechanism, remove it by pressing the PAPER ADVANCE button until the paper stops.

4. Remove the first layer of paper from a new roll. Be sure the paper has a cleanly torn or cut edge, as paper with a ragged edge may not feed properly.

5. Insert the new roll such that the free end is positioned beneath the roll when it is placed in the bucket. Reinstall the access cover (if removed) and close the access cover. Press the PAPER ADVANCE button until paper appears at the front of the printer. Ensure that the paper is positioned in front of the access cover.

Front Of Computer →
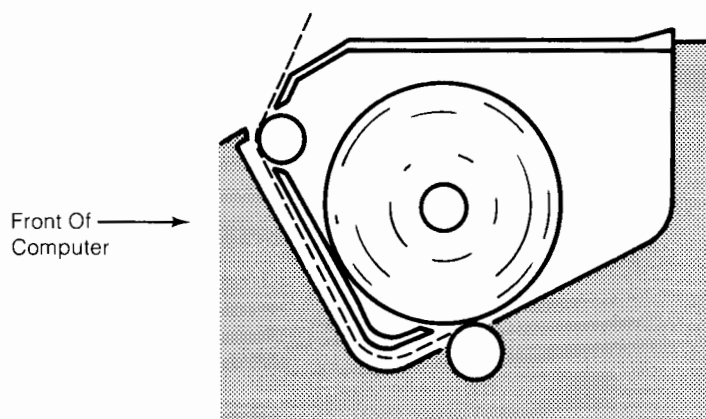
Printer Paper

Thermal printer paper is available in two widths, 8.5 inches and 210 mm. If 210 mm wide paper is to be used, a spacer (HP Part No. 5040-8145) must be installed in the printer bucket to properly position the paper roll. The spacer is not required in printers using 8.5 inch wide paper. Here is a summary of the paper available for use in the printer.

8.5 inch wide paper
      blue printout - Part No. 9270-0566
      black printout, perforated - Part No. 9270-0565

210 mm wide paper (spacer 5040-8145 required)
      blue printout - Part No. 9270-0569
      black printout, perforated - Part No. 9270-0568

Tape Cartridge Installation

Tape cartridges are loaded into the cartridge drive(s) with the clear plastic side facing up and the cartridge label facing the front of the computer (see Figure 1-3). Both the transparent window and the door beneath it will open when the cartridge presses on the lower door; the cartridge can then be inserted. To remove the cartridge, push the eject bar. If it is removed without using the eject bar, the transport will not accept another cartridge until the bar is pushed.

Figure 1-3: Tape Cartridge Installation

The ROM Drawers

The 9845B has two ROM drawers, one located on each side of the machine at the base of the dark stripe. Option ROMs can be installed in these drawers. The two drawers are color-coded as are the option ROMs that go in them.

The ROMs in the left hand drawer (PPU drawer) have green labels and those in the right drawer (LPU drawer) have black labels. It is important that the two not be interchanged. Both the ROMs and the ROM drawers are keyed.

ROM Installation

To add or change a ROM, first switch the computer off. Pull the appropriate drawer out and make sure the label color matches that of the ROM you wish to add. Then open the clear plastic cover to gain access to the connectors. To insert a ROM, position it so the printing on the ROM label is readable from the outside drawer edge and insert it vertically, making sure it goes all the way to the bottom of the connector. There is a small raised rib on the drawer top which should fit into the recess on the bottom of the pack; if it doesn't, make sure you've made the proper color and orientation matches.

When completed, snap the clear cover shut and reinsert the drawer until it is flush with the outside case.
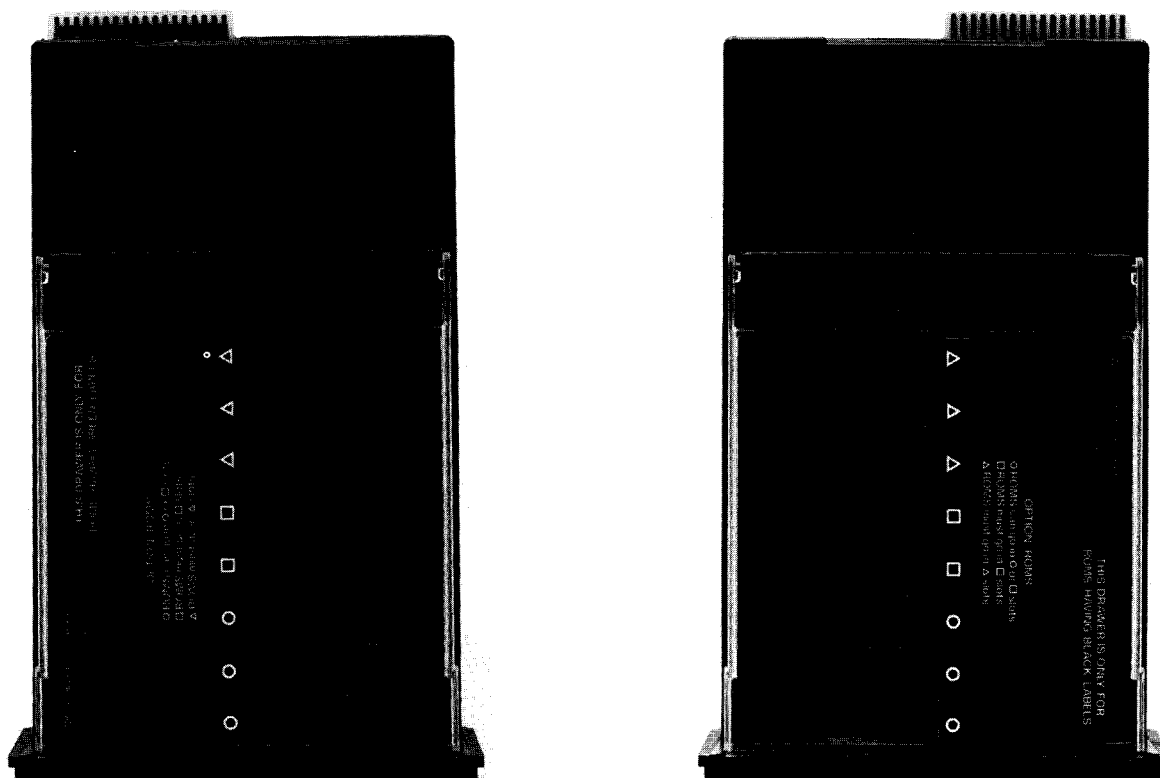
Figure 1-4: ROM Locations

Options

There are numerous options for the 9845B. The options are grouped as shown below.

Memory Options - 200 series numbers
ROM Options - 300 series numbers
Printer Options - 500 series numbers
Tape Cartridge Option - 600 series numbers
Graphics Option - 700 series numbers
Character set Options - 800 series numbers

Most of the options can be installed either at the factory or in the field. Table 1-5 is a summary of the 9845B options including the option numbers and the field installation kit (if available). Installation procedures for the field installation kits are given for the available options after the table. The ROMs (300 series options) are not included as they do not require an installation service call.

WARNING

REMOVE ANY AC POWER FROM THE 9845B BEFORE INSTALLING ANY OPTION.

NOTE

When installing the various options, computer disassembly may be required. Refer to the Assembly Access section of Chapter 3, for computer disassembly procedures.

Table 1-5:   9845B Options

Item	Factory Option	Field Installation Kit
R/W Memory		
192k	Opt 204	
320k	Opt 205	
448k	Opt 206	
128k		98425A
256k		98426A
384k		98427A
Graphics ROM	Opt 311	98411A
I/0 ROM Set (Includes ASYNC Data Comm)	Opt 312	98412A
Mass Storage 1 ROM	Opt 313	98413A
Advanced Programming ROM	Opt 314	98414A
ASCII/European Line Printer, 8½ in. paper (Includes ASCII and European character sets)	Opt 560	98456A
ASCII/European Line Printer, 210mm paper (Includes ASCII and European character sets)	Opt 561	68456A Opt 561
Katakana Line Printer, 8½ in. paper (1)	Opt 540	98454A
Katakana Line Printer, 210mm paper (1)	Opt 541	98454A Opt 541
Tape Transport	600	98460A
Graphics display subsystem (Opt 311 or 98411A required)	700	98470A
French Keyboard	Opt 810	
Spanish Keyboard	Opt 820	
German Keyboard	Opt 830	
Katakana Keyboard	Opt 840	
Swedish-Finnish Keyboard	Opt 850	

Memory Option Installation
98407A, 98425A, 98426A and 98427A Kits

Here is a summary of the memory.

Kit number	Contains	Adds
98407A	one A90 assembly (09845-66590) and one A29 assembly (09845-66529)	LPU R/W memory 500k-bytes plus new PPU RAM/ROM
98425A	one A26 assembly (09845-66526)	128k-bytes of LPU R/W memory
98426A	two A26 assemblies (09845-66526)	256k-bytes of LPU R/W memory
98427A	three A26 assemblies (09845-66526)	384k-bytes of LPU R/W memory

LPU Read / Write memory occupies even blocks (one block is 64k-bytes). Each memory assembly must be set to different block numbers. Each A26 assembly contains 2 blocks of memory. A jumper on each A26 assembly is used to select the block numbers to which each assembly will respond.

NOTE

Block 2 is not used. Block numbers are octal.

BLOCK 14 and 16
BLOCK 10 and 12
BLOCK 4 and 6
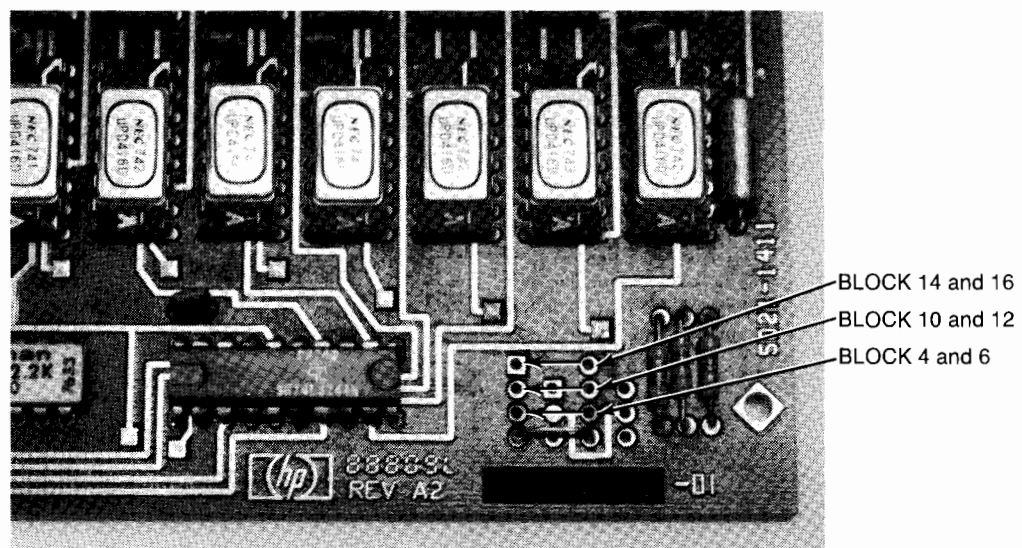
Block Configuration for A26 Assemblies

Installation Procedure

- Remove the CRT assembly and the mainframe top cover.

- Loosen the keyboard bezel and move it forward. There is room for four memory assemblies in the 9845B. Install the kit A26 assemblies in the slots adjacent to the last memory assembly (see Figure 1-5).

A27 LPU RAM/ROM Assembly

Optional A26 Read/Write Assemblies
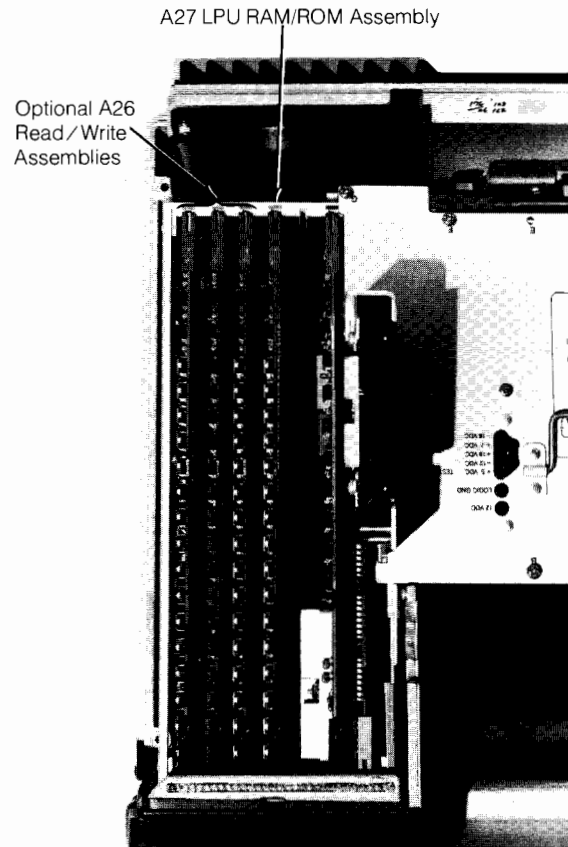
Figure 1-5:   Memory Assembly Locations

- Reassemble the computer and perform the test ROM memory tests described in the memory section of Chapter 2.

Printer Installation

98454A and 98456A Kits

Here is a summary of the printer kits.

Kit Number	Character Sets	Paper Width Used
98456A	ASCII, German, French, Spanish and Swedish/Finnish	8½ inch
98456A Option 561	ASCII, German, French, Spanish and Swedish/Finnish	210 mm
98454A	Katakana	8½ inch
98454A Option 541	Katakana	210 mm

Installation procedure

- Remove the CRT assembly and the mainframe top cover.

- Remove the keyboard and set it on the mainframe chassis as shown in Figure 1-6.

- Remove the filler panel (Figure 1-6) from the keyboard.

- Install the clear plastic paper tear bar on the keyboard assembly with the four screws already inserted in the keyboard (see Figure 1-6).
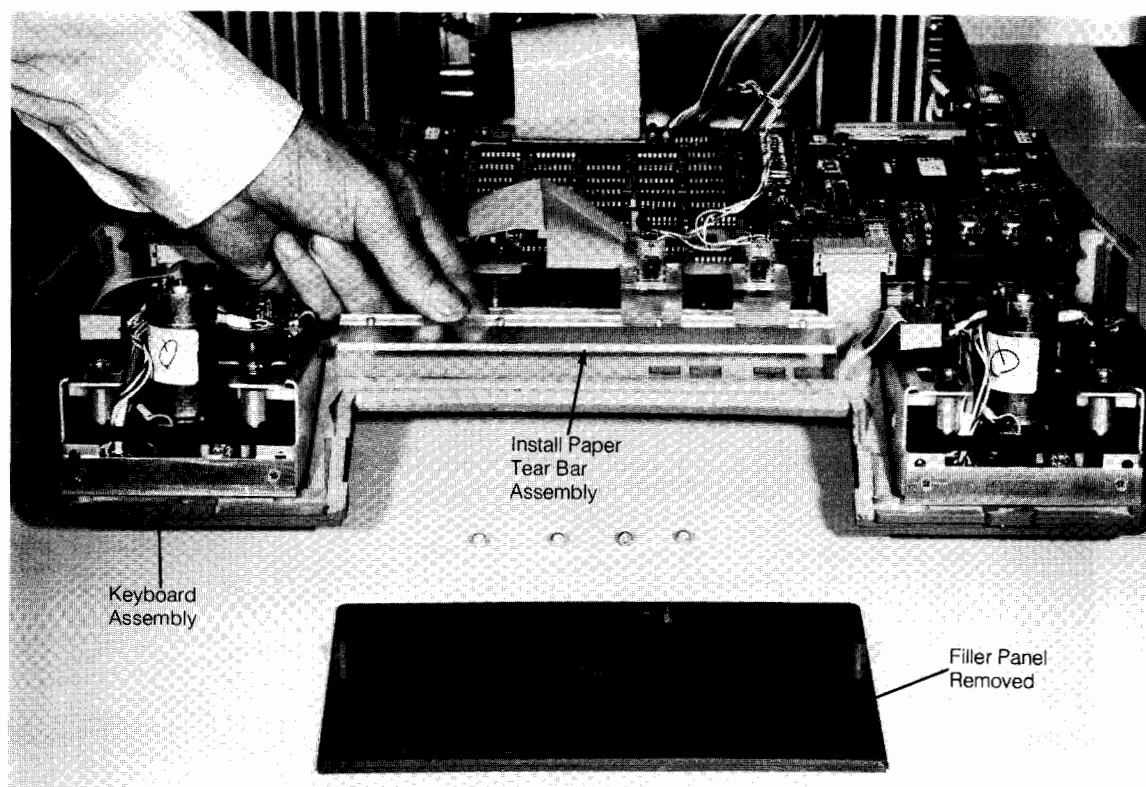
Figure 1-6:   Computer Disassembly

98407A
512K-byte Memory Assembly

IMPORTANT

The HP 98407A Memory Assembly is not compatible with most HP 9845B and HP 9845C computers equipped with less than 512k-bytes of memory UNLESS they have been properly updated with the optional update kits available with the first HP 98407A purchased for a given machine. Before attempting to use the HP 98407A in your computer, be sure it has been updated as explained in this installation note. All HP 9845 computers containing over 512k-bytes of memory are properly configured for use with the HP 98407A.

Available Options

The following options are available, and should be ordered with the first HP 98407A purchased for a given machine if it does not already have the proper updates installed:

Option 001

This option is for all HP 9845B/C models that have never had more than 512k-bytes of available memory, and contains the following items:

- Two new ROMs for 09845-66527 RAM/ROM board: 1818-1898 replaces 1818-0838 (CE4 LB); 1818-1899 replaces 1818-0834 (CE4 UB).

- New sticker and white PC board extractor to identify the updated board as 09845-66529.

Option 002

This option is for all HP 9845C computers, and HP 9845B computers equipped with a high-speed monochrome CRT. It includes the following items:

- Two additional replacement ROMs for the 09845-66527 RAM/ROM board: 1818-1591 replaces 1818-1208 (CE1 LB); 1818-1592 replaces 1818-1209 (CE1 UB). These are for use with the HP 9845C ONLY.

- Revision B or later Enhanced Graphics ROM replaces Revision A Color Graphics ROM or Revision A Enhanced Graphics ROM. The new ROM supplied supports both the high-speed monochrome CRT and the color CRT for HP 9845B/C models. The new ROM supplied provides expanded capability over the color graphics ROM.

Option 003

This option is for all HP 9845B/C models equipped with an IMAGE/45 Revision B ROM in the left-hand drawer. (If a Rev. A ROM is present, contact your Sales and Service Office for updating information.) A Revision C or newer IMAGE/45 ROM is supplied for the left-hand drawer only.

CAUTION

UNNEEDED PARTS SUPPLIED WITH OPTIONS ARE THE PROPERTY OF HEWLETT-PACKARD COMPANY AND SHOULD BE RETURNED TO THE NEAREST HP SALES AND SERVICE OFFICE. DO NOT ATTEMPT TO USE EXTRA OR REMOVED PARTS, OR IMPROPER OPERATION WILL RE-SULT.

Installation and Configuration Procedure

The 98407A Memory Assembly provides 512k-bytes of read-write memory for the HP 9845B/C Computer. Up to three boards can be installed in the slots formerly used for 09845-66526 128-kbyte memory boards. Installation of the 512k-byte board is identical to installation of 128k-byte boards EXCEPT for configuration.

Operation of the HP 9845B/C is unchanged when larger memory is installed, but any assembly language programs that use the Get_info utility may require alteration of the associated BSS storage space. Updated information is contained in Chapter 6 of the January 1982 edition of the Assembly Development ROM manual (09845-91083). The only change is that instead of reserving up to 39 words for the BSS information, up to 93 words can be reserved to accommodate larger arrays.

Memory Address Configuration Procedure

Before any new memory assembly is installed in the HP 9845B/C, it must be set up to respond to the correct block-select address range when selected by the CPU. Three configurations are available, and each board must use one of the three possibilities shown. Any other combination of settings results in improper system behavior. Note that no two boards may be set to the same address range.

To set the block address for each board, position the appropriate address switches in the upper left corner of the board as indicated in the table which follows. There are two pairs of switches in the cluster, and each switch within a pair must be set OPPOSITE to the other, as shown. Configure the boards, starting with Block 20 and adding Block 40 and 60 up to the maximum memory being installed. Be sure switch rockers are firmly sealed in their proper positions.

PRESS THIS SIDE FOR

0   1

- LSB
- $\overline{\text{LSB}}$
- MSB
- $\overline{\text{MSB}}$
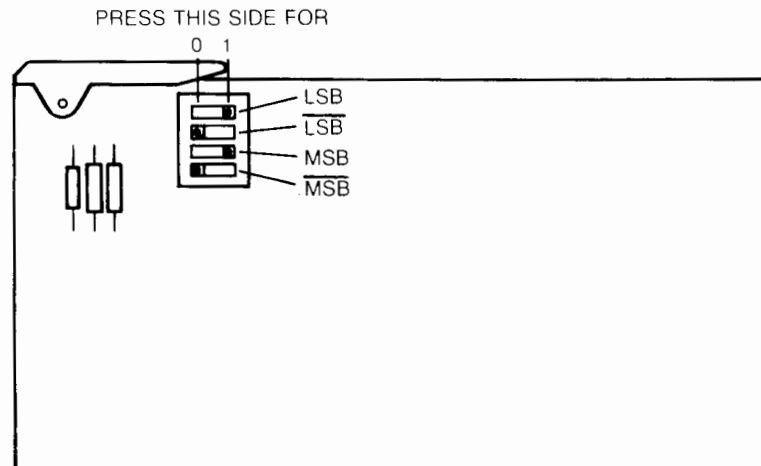
Block Select Configuration Switches

Blocks	MSB	$\overline{\text{MSB}}$	LSB	$\overline{\text{LSB}}$
20-36	0	1	1	0
40-56	1	0	0	1
60-76	1	0	1	0

Note that if the 512K-byte board is being used together with one or more 128K-byte boards, the 128K-byte boards do not require any alteration. After all boards have been properly configured for block select addresses, they are ready to install.

Installation and Test

If the computer already has more than 500K bytes of memory, no modifications are required. Install the memory board(s) as when installing the 09845-66526 128K-byte memory boards. Be sure the boards are fully seated, then re-install the retainer clip and screw.

If this is the first time a 98407A memory board is being installed, several changes are required before the computer can function properly. The 98407A Option 001 is used for first-time installation, and includes a set of replacement parts to update the computer for larger memory capability. These parts are installed as follows:

1. Remove the 09845-66527 RAM/ROM assembly from the right side of the computer and replace the two following ROMs:
   - Remove CE4 LB (1818-0838) and replace it with an 1818-1898 ROM.
   - Remove CE4 UB (1818-0834) and replace it with an 1818-1899 ROM.
2. If the computer is a 9845C, two additional ROMs must be replaced:
   - Remove CE1 LB (1818-1208) and replace it with an 1818-1591 ROM.
   - Remove CE1 UB (1818-1209) and replace it with an 1818-1592 ROM.

3. Install a new label over the current label identifying the board as 09845-66529. Remove the violet card extractor by pushing the pin out with a pin punch or other suitable tool. Replace the extractor with the white one provided. Plug the assembly back into the computer, then re-install the retainer clip and screw.

4. After the memory boards and updated RAM/ROM board have been installed, replace the cover and CRT.

5. Some computer configurations also require replacement of certain option ROMs. The configurations and changes required are as follows:

- 9845B Option 1xx: (Computer does not have bit-slice processor nor high-speed black/white CRT) No changes required.

- 9845B Option 2xx: (Computer has bit-slice processor AND high-speed black/white CRT) Remove Enhanced Graphics ROM, and replace with new ROM supplied.

- 9845C All Options: Remove Color Graphics ROM (or Enhanced Graphics ROM) and replace with the Enhanced Graphics ROM supplied.

- IMAGE/45: If the computer includes an IMAGE/45 ROM, remove the IMAGE ROM from the left-hand drawer, and replace it with the Revision C IMAGE/45 ROM supplied.
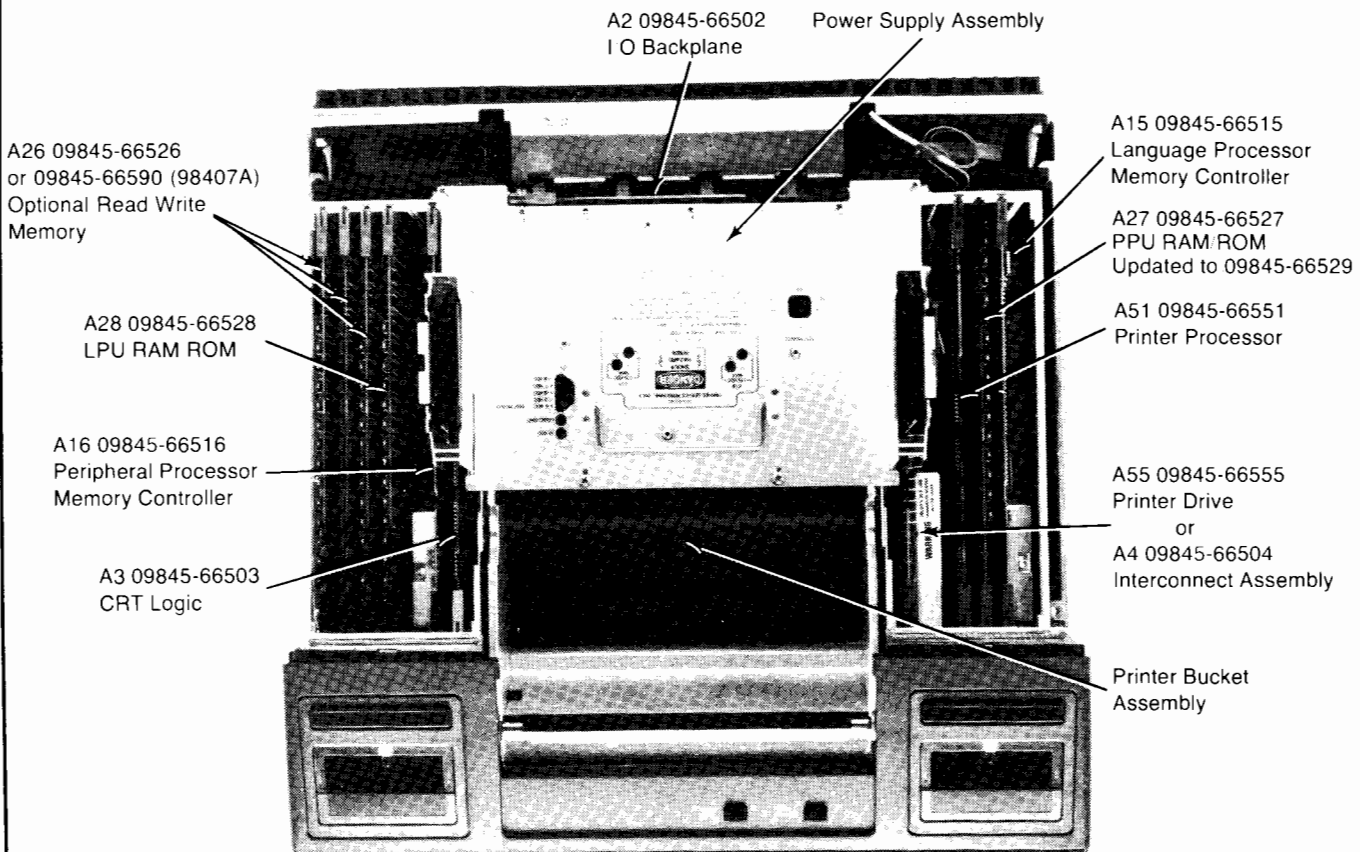
PC Board Location Guide

CAUTION

UNUSED PARTS SUPPLIED IN THE UPDATE KIT REMAIN THE PROPER-
TY OF HEWLETT-PACKARD COMPANY. THEY SHOULD BE RETURNED
TO THE NEAREST HP SALES AND SERVICE OFFICE AFTER COMPLET-
ING THE UPDATE. **OLD PARTS REMOVED FROM THE COMPUTER
SHOULD BE DISCARDED OR RETURNED WITH THE UNUSED NEW
PARTS. DO NOT ATTEMPT TO USE EXTRA OR REMOVED PARTS.**

To test the new installation, install a Revision C Test ROM as explained in the HP 9845B/C Service Manual. To perform full memory tests, use a **Revision C1** Test Binary tape. The earlier Revision C TBIN program cannot address the new, higher memory blocks. The MEMTST program on the customer Exerciser tape (09845-92041 Rev E) can also be used to perform memory tests. A full memory test requires extensive time to run to completion.

Verification of System Operation

If a test ROM is unavailable, correct memory installation can be verified by the AVAILABLE MEMORY listing after memory test is complete at system power-up. With memory installed, the available memory corresponding to installed capacities should match the following values within about 2 or 3 thousand bytes if no 128K-byte memory boards (09845-66526) are installed:

Memory Installed	Memory Available
512K bytes	578 000
1024K bytes	1 103 000
1536K bytes	1 626 000

Actual available memory varies, depending on how many and which option ROMs have been installed. If an incorrect (usually MUCH lower) value appears, make sure that no two memory boards are set to the same block select address. If all switches are correctly set, replace suspected boards until the defective memory board (including the 09845-66529) is isolated.

The memory test performed at power-up is not a comprehensive test. The TBIN and MEMTST programs mentioned earlier are more sophisticated, and result in a higher confidence, although they are not comprehensive either.

Partial Printer Cover

A

Remove
Strap

Static Grounding Strap

Printer Cover From Kit

Use Screws To
Assembly Cover

B

Printer Cover Assembled
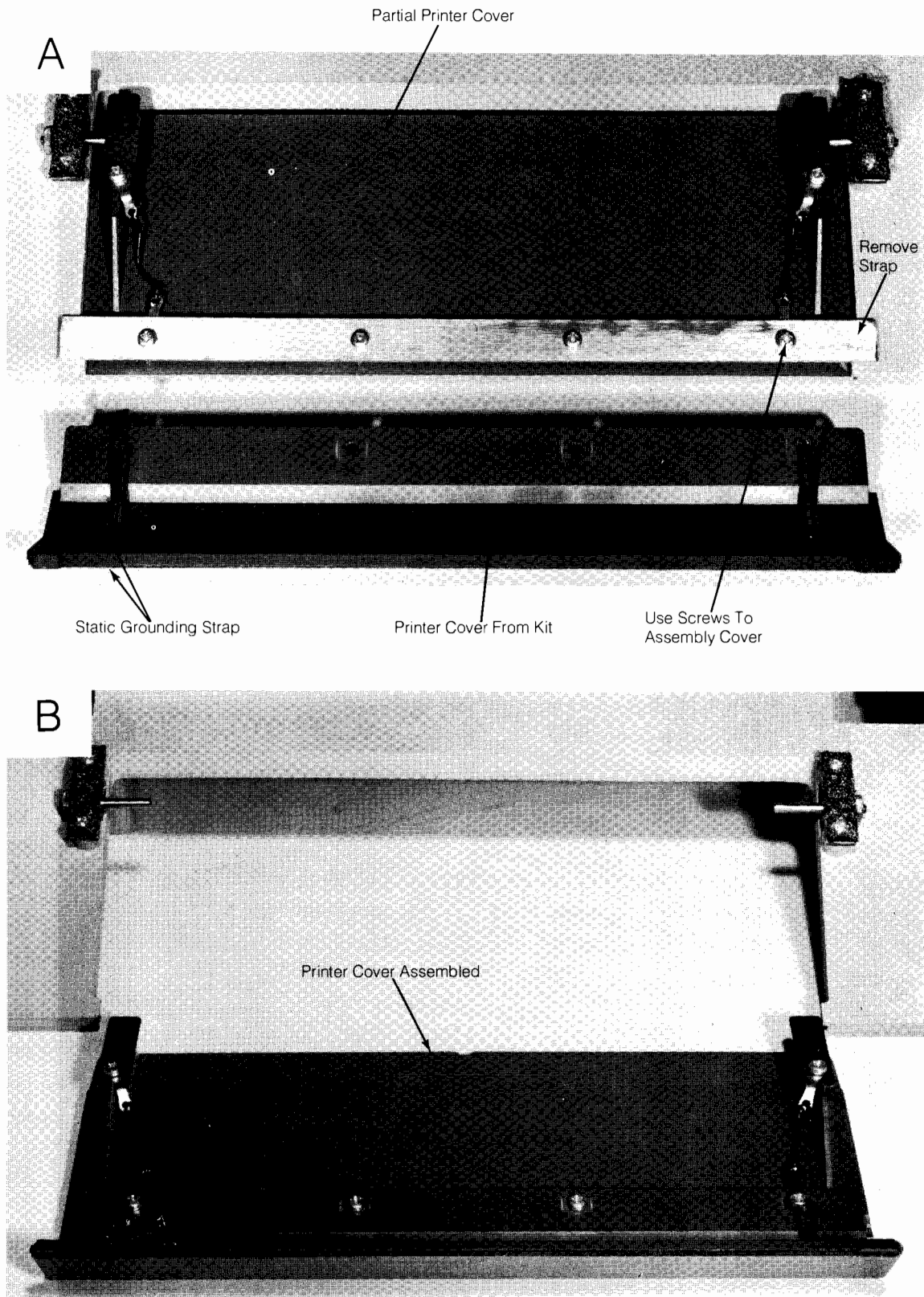
Figure 1-7: Printer Cover Assembly

• Remove the four screws that hold the partial printer cover (Figure 1-7A) to the top cover.

• Using the hardware from the previous step, assemble the printer cover from the piece removed from the top cover and the piece provided in the kit.

NOTE

Ensure that the static grounding strip is attached on either side of the printer cover as shown in Figure 1-7B.

• Remove the A4 and A3 assemblies (see Figure 1-8).

NOTE

When removing the A3, A4 or A55 assemblies, notice that the metal bracket attached to the PC assembly connector is part of the PC assembly. Remove the three screws that hold the bracket to the support leg bracket to remove the A3, A4 or A55 assemblies.
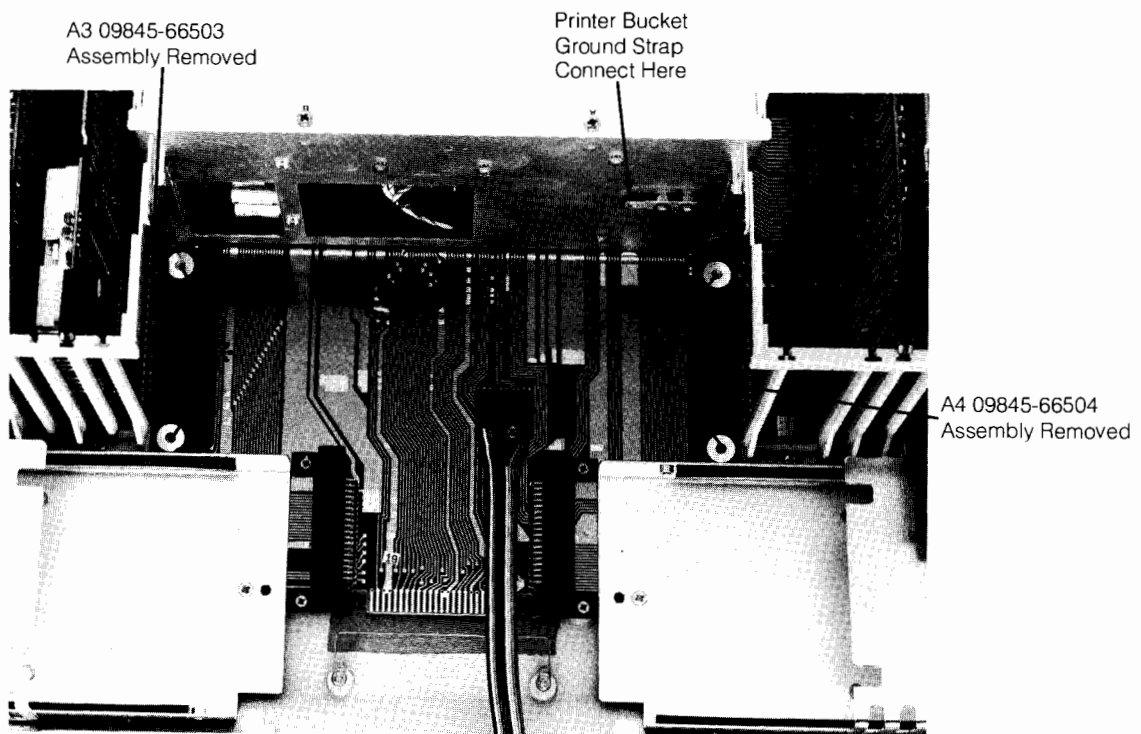
✶   Printer Bucket Installation Screw Locations

Figure 1-8:   Printer Bucket Installation

- Connect the bucket ground strap to the connector on the power supply chassis.

- Lower the printer bucket assembly into its position on the printer chassis (see Figure 1-8).

- Fasten the bucket assembly to the computer chassis with four screws (two located on either side of the bucket).

- Install the A51 and A55 assemblies from the kit (see Figure 1-9).

- Reinstall the A3 assembly and secure the A3 and A55 brackets to the support leg brackets.
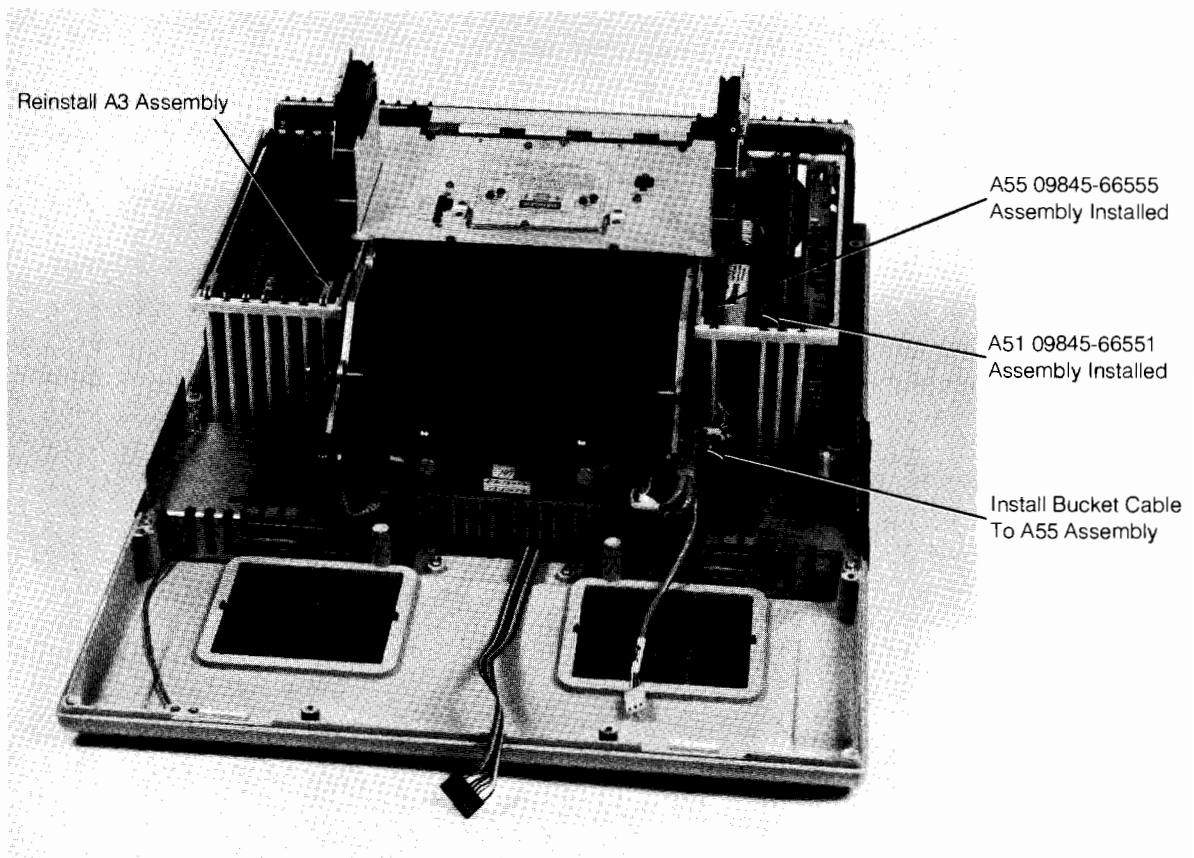
Figure 1-9:   Printer PC Assembly Installation

- Connect the printer bucket cable to the A55 assembly. Connect the paper advance cable to the bucket assembly.

- Reassemble the computer and perform the test ROM printer test described in the printer section of Chapter 2.

Tape Cartridge Drive Installation

98460A Kit

This kit adds the left tape cartridge drive to the 9845B.

Computer
Museum

Installation Procedure

- Remove the CRT assembly and mainframe top cover.

- Remove the keyboard and place it as shown in Figure 1-10.

- Remove the two screws holding the cartridge drive filler plate and remove the plate.

- Place the cartridge drive bezel in the opening as shown in Figure 1-11.

Remove These Screws
To Remove Filler Plate
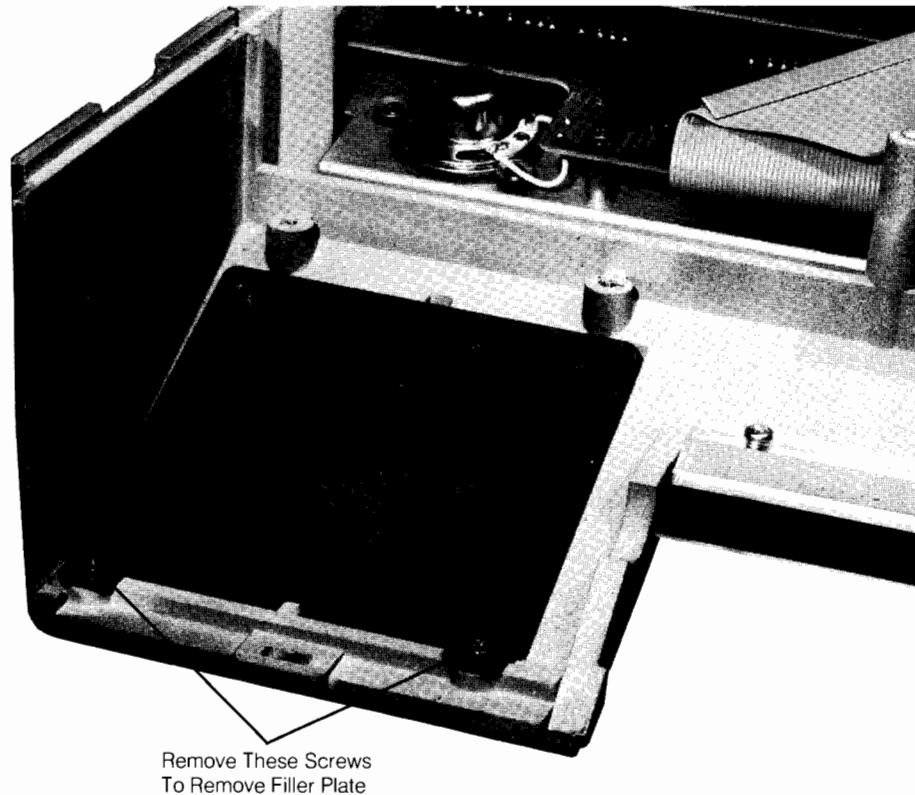
Figure 1-10:   Filler Plate Removal

*These screws hold the bezel and eject assembly in place.
* *Cartridge drive mounting holes.
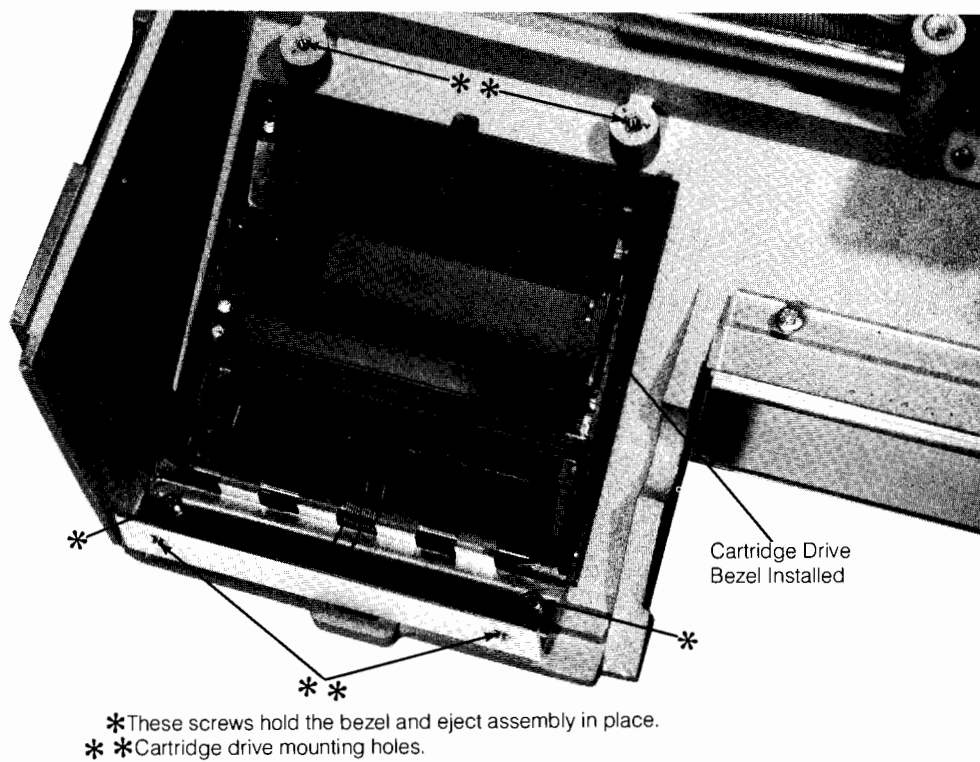
Figure 1-11: Transport Bezel Installation

● Install the cartridge eject assembly with the two screws that held the filler panel (see Figure 1-11).

● Connect the cartridge drive cable (09845-61611) to the cartridge drive assembly and install the assembly as shown in Figure 1-12.

09845-61611
Left Cartridge
Drive Cable

13
13
13

Cartridge Drive
Assembly Installed

* Cartridge drive mounting screws.
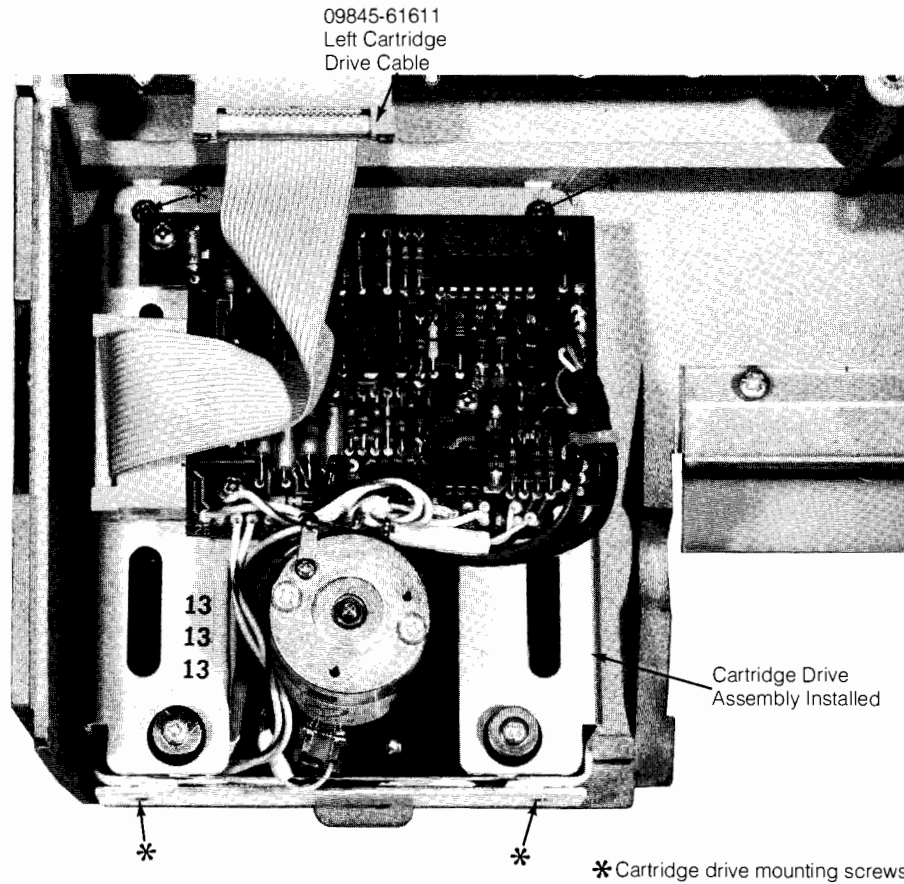
Figure 1-12:   Drive Installation

- Remove the five screws shown in Figure 3-11 and install the new A61 assembly.

- Connect the A61 cable to the A5 assembly and connect the cartridge drive cable to the A61 assembly.

- Replace the keyboard and ensure that a cartridge can be installed and ejected.

- Reassemble the computer and perform the test ROM cartridge drive test as described in the cartridge drive section of Chapter 2.

Graphics Installation

98470A Kit

This kit adds CRT graphics capabilities to the 9845B (Graphics ROM must be installed).

Installation procedure.

WARNING

WHEN THE CRT TOP COVER IS REMOVED, ALWAYS WEAR SAFETY
GLASSES AND ENSURE THAT OTHER PEOPLE IN THE AREA WILL
NOT BE EXPOSED TO AN ACCIDENTAL CRT IMPLOSION.

● Remove the CRT top cover. Remember to switch the computer off.

● Remove the pc assembly holding plates and install A77 and A79 assemblies in their pc assembly slots (see Figure 1-13).

● Reinstall the holding plates and the CRT top cover.

● Perform the test ROM graphics test as described in the graphics section of Chapter 2.

A77 09845-66577
Graphics Scanner

A79 09845-66579
Graphics Memory
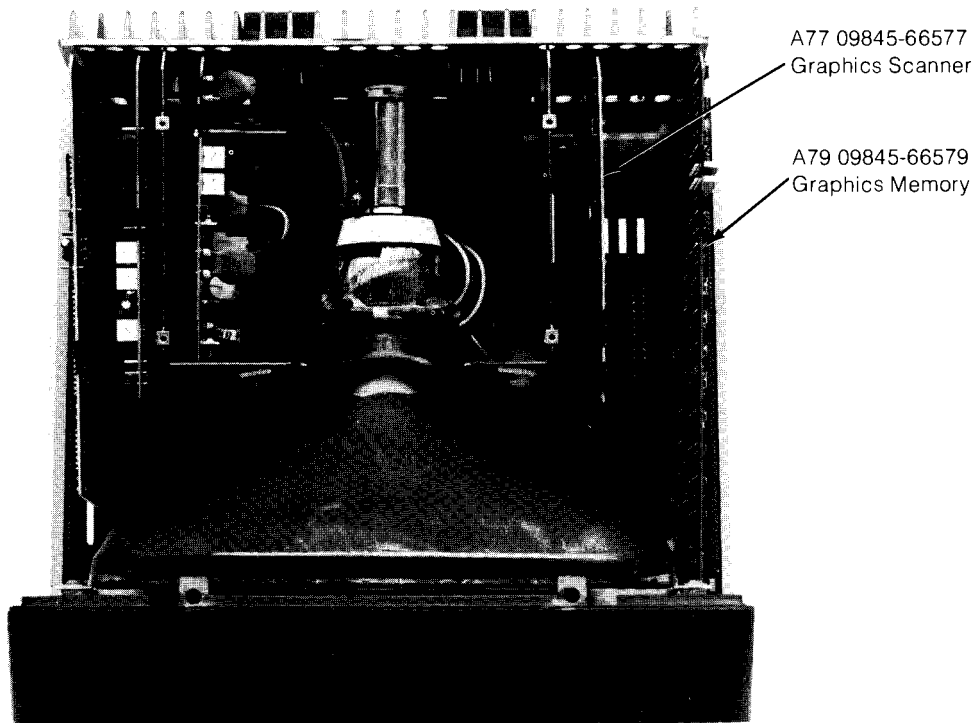
Figure 1-13:   Graphics Assemblies Installation

Chapter **2**

How To Fix It

Introduction

This chapter is divided into the major computer sections. Each section consists of the description of the tests for that section, any adjustments involved in that section and a block diagram and theory of operation of the section. The various sections of this chapter and the computer are:

Section	Starts on Page
Processor/Memory Addressing	2-15
Memory (ROM and Read/Write)	2-19
CRT Alpha	2-37
CRT Graphics	2-51
Keyboard	2-59
CartridgeDrive	2-65
Printer	2-71
Power Supply	2-81

Before you get to the various sections, use the trouble isolation procedures described in the on-site service procedure.

On-Site Service Procedure

If possible, ask the customer about the problem and get as many details as possible. This may enable you to go directly to one of the computer sections.

In any case before you do anything:

- Ensure that the computer is switched on.

- Check fan operation by feeling the air blowing from each fan.

  If you don't have airflow, check the fuse, the line voltage selector switch and the power cord. A blown fuse or an inoperative fan can be caused by:

  1. Defective power supply module (exchange).
  2. Defective fan (change).
  3. Defective primary power wiring (repair).
  4. Improper fuse (change).

If the fans are operating, the blinking cursor should appear in approximately 20 seconds.

Try adjusting the intensity control and press (CONTROL)(STOP). If you still don't have a cursor the problem can still be anywhere; continue on with the quick checks.

Quick Checks

At this point you may or may not have a cursor on the screen or you may have random characters displayed. From the keyboard you can perform three checks to determine the basic condition of the computer. Press (CONTROL)(STOP), then:

1. Press random alpha keys on the keyboard (three or four X's should do it) and press execute. This generates an "improper expression" or an "improper character" error and an audible beep. If a beep occurs, the processor and operating system are probably working correctly. The CRT section may be defective.

2. Here is a more demanding processor-memory test. See if a program can be entered into memory from tape. Install a tape and "GET" a file from it.

3. If the printer is installed, execute the following lines:
   PRINTER IS 0 (EXEC)
   PRINT "characters" (EXEC)
   If the characters are printed, the printer is basically working and the processor/memory addressing is basically operating.

To further isolate one of the sections listed above, use this procedure.

- Check the power supplies - (See power supply section)

- Install the test ROM and test cartridge (see 9845B Test Programs).

NOTE

The A3 assembly and the CRT assembly must be installed to perform the test ROM routines.

- Refer to the processor / memory control and memory sections and run the memory tests (the processor test is run automatically).

If these tests fail, exchange the processor / memory control assemblies (A15 and A16) or the memory assemblies and perform the tests again.

If the tests still fail, inspect the connectors for dirt and corrosion. Clean the chassis as necessary and replace the assemblies.

NOTE

The Test ROM and test cartridge can also fail; when in doubt about test results, try the system exerciser tape.

The Turn-on Fixture

A Turn-on Fixture, part no. 09845-66547, has been designed to aid in repairing the 9845 computer mainframe. It will allow the computer to turn-on without the CRT. This allows the engineer to troubleshoot the computer and/or verify operation without completely reassembling of the computer. When using the turn-on fixture:

1. Switch the computer off and install the turn-on fixture in the left leg only. Note that the arrow on the printed circuit board points toward the keyboard. Switch the computer on. The green LED should be lit.

2. Assign PRINT ALL IS 0 and latch the (**PRT ALL**) key.

3. Do not use GRAPHICS statements.

4. All program prompts will appear only on the printer. Care must be taken to assure proper entry.

5. Use the System Exerciser program to verify that the computer is functioning properly.

To use the Turn-on Fixture with the System Exerciser follow these steps:

1. Unlatch the (AUTOST) key.

2. Install the turn on fixture and turn the computer on.

3. Type PRINT ALL IS 0.

4. Latch the (PRT ALL) key.

5. Type LOAD "AUTOST",1.

6. Follow the prompts printed on the printer.

9845B Test Programs

The 9845B Test Programs are contained in a plug-in ROM and a data cartridge. The test programs will help you to:

● Confirm a failure using exerciser programs

● Identify the failure using error prinouts and displays

● Verify the solution using the exerciser program

Refer to Table 2-1 for a summary of the tests contained in the ROM and cartridge.

The programs are designed to test functional areas rather than assemblies. Functional areas often involve more than one PC assembly.

The functional areas of the 9845B are:

● Processor and Memory Addressing - Both the PPU and LPU are tested. Each contains a BPC, an IOC, an EMC and an AEC. Registers and functions of each chip are tested. Address lines from the processors to ROM and system R/W are also tested.

● I/O - The I/O backplane is tested. Interrupt, status and peripheral address lines are tested.

● CRT Alpha - CRT Alpha functions are tested and exercised. Test patterns are provided for adjustment of focus and alpha raster size of the CRT.

● Keyboard - All keyboard keys and features are checked for proper operations.

● Tape cartridge drives - The ability to read and write on a tape is checked and cartridge drive functions are verified.

- Printer - Printer logic circuits are checked and printouts are provided to check for missing dots, print intensity and character alignment.

- CRT Graphics - Graphics memory and CRT graphics functions are checked.

- System ROMs - System ROMs are checked.

- Memory - Check PPU and LPU memory.

Description

The plug-in ROM contains programs which test the functional areas required to load the other test programs from the data cartridge into read/write memory. Specifically:

- Processor test for both processors

- Memory Addressing test

- Read/Write Memory test for that portion of memory used to store the binary test programs

- Cartridge drive tests

- Read/Write Memory test for memory blocks other than block 1

The plug-in ROM and the data cartridge can be used together or separately. Each combination has its own unique characteristics which are described below. The most common use will be when both the ROM and cartridge are used.

Installation

In all cases:

- The ROM is installed in the PPU ROM drawer (left drawer).

- The binary test cartridge is installed in the right-hand drive (T15).

Table 2-2: Usage Combinations

	ROM and Cartridge	**ROM**	**Cartridge**
Tests Available	ALL	Processor/Memory Addressing Read/Write Memory test T14 and T15 cartridge drive test	All other mainframe tests See Table 2-1
Modes Available	Automatic Run Mode Operator Mode	Automatic Run Mode Operator Mode	Automatic Run Mode Operator Mode
9845B Operating System Requirements	Operating system can be: • Faulty • Operational	Operating system can be: • Faulty • Operational	Operating system must be operational
Installation	ROM installed in PPU ROM Drawer Cartridge installed in T15	ROM installed in PPU ROM Drawer	Cartridge installed in T15

Using both the ROM and Cartridge

With both the ROM and cartridge installed, tests are initiated by initial turn-on or pressing [CONTROL] [STOP].

NOTE

If the ROM tests are being performed, the binary tape must be loaded to do the binary tape tests. Once in the binary tests, press [CONTROL] [STOP] to return to the ROM tests.

Two modes are possible depending on the position of the autostart key.

Mode	Mode Determined By	Tests Are
Automatic Run Mode	Auto Start Key Down	Run automatically using the RACK TEST sequence
Operator Mode	Auto Start Key Up	Selected by the Operator

In the automatic run mode;

1. The processor and memory tests contained in ROM are performed (see Table 2-1).

2. Binary test programs are loaded from the data cartridge (See Table 2-1).

3. The "automatic rack test" sequence of tests is run.*

Refer to the individual sections for details on each test. Press [STOP] to exit the automatic run mode.

In the operator mode;

1. The tests contained in ROM are performed (See Table 2-1).

2. Press [STOP] to skip the memory tests.

3. Binary test programs are loaded from the data cartridge (See Table 2-1).

* See Page2-14 for the automatic rack test description.

4. The special function keys are defined as follows:

Key	Test	Described on Page
K0	CRT Alpha	2-38
K1	Keyboard	2-59
K2	Cartridge Drive	2-65
K3	Printer	2-71
K4	I/O Test	2-10
K5	CRT Graphic	2-51
K6	Results Display	2-12
K7	Rewind T15	2-13
K8	Memory Troubleshooter	2-20
K9	Read/Write Memory	2-23
K10	Choose Rack Test	2-13
K11	Automatic RackTest	2-14
K12	For factory use only	
K13	Not Used	
K14	Not Used	
K15	RunOperatingSystem	2-14

5. Select the test to be performed and refer to the appropriate section for test details.

NOTE

Errors during any test in any mode will halt the test to preserve the error condition. Press $\begin{pmatrix} \text{C} \\ \text{O} \\ \text{N} \\ \text{T} \end{pmatrix}$ to continue the same test. Press (STOP) to start another test.

Using the Plug-in ROM Only

When only the plug-in ROM is installed, testing is limited to the tests contained in the ROM (See Table 2-1). Initial turn-on or pressing (CONTROL) (STOP) will initiate the automatic run mode.

Requirements using only the ROM:

- Auto start key should be up.

- A known-good, blank cartridge should be installed in T15 or T14 if the cartridge tests are to be performed.

When the ROM's tests are complete, the read/write memory or the tape cartridge drives can be tested separately without the binary programs.

Using the Data Cartridge Only

Install the cartridge and press: LOADBIN "TBIN" (EXEC). Two modes are possible depending on the position of the auto start key.

Mode	Mode Determined By	Tests Are
Automatic Run Mode	Auto Start Key Down	Run automatically using the automatic rack test sequence
Operator Mode	Auto Start Key Up	Selected by the operator

Press (STOP) to exit the automatic rack test and enter the operator mode. The tests available on the cartridge are listed in Table 2-1.

Special Functions

Some of the test programs do not fall directly into a particular section. The test programs designated as special functions are:

Key	Special Function
K4	I/O test
K6	Display results
K7	Rewind T15
K10	Choose rack test sequence
K11	Automatic rack test
K15	Run operating system

Here is an explanation of what happens when each special function UDF key is pressed.

K4 I/O Test

To use this test, four general I/O interfaces (98032A) must be installed in the I/O slots on the back of the computer. Each interface must have a 98032A test connector installed (see Figure 2-1). Set the interface select codes to 1, 2, 4 and 8. Press ⬚K4⬚, the I/O test does the following:

- Checks IC1, IC2, status and flag lines.

- Writes data to the interface, then reads and compares the data.

- Checks DMA addressing and interrupt request.

98032 Interface

Test Connector
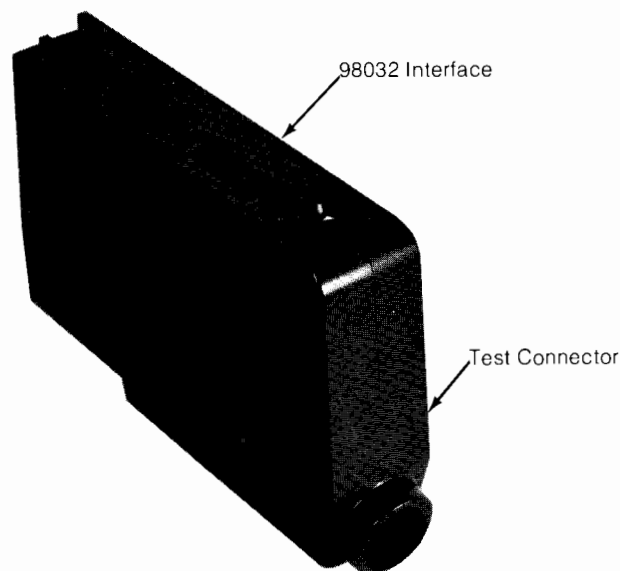
Figure 2-1: I/O Test Setup

NOTE

DMA transfers are not checked, just the DMA addressing is checked.

Here is a brief description of the I/O test.

The interface status lines are checked on select code 1, 2, 4 and 8.

If the lines are not true, SC (N) STATUS LINE NOT TRUE is displayed. In this case, the interface is either not installed or a bad status line is present. Press $\left[\begin{smallmatrix}C\\O\\N\\T\end{smallmatrix}\right]$ to continue with the test.

The interface flag line is checked on select codes 1, 2, 4 and 8. If the line is not true, SC (N) FLAG-LINE NOT TRUE is displayed. In this case, the flag line is defective. Press $\left[\begin{smallmatrix}C\\O\\N\\T\end{smallmatrix}\right]$ to continue with the test.

All interface registers are cleared and the first test pattern is written to select code 1. The pattern is read and an error message is displayed if an error occurs. The other three interfaces are checked to ensure they still are cleared. An error message is again displayed.

If an error occurs;
Press the spacebar to continue with the next pattern.

Press $\boxed{W}$ to do continuous writing of the test pattern to the interface.

Press $\boxed{R}$ to do continuous reads from the interface.

This part of the test is repeated on select codes 2, 4 and 8. Press $\boxed{\text{STOP}}$ to exit this part of the test.

After the patterns have been checked on all the interfaces, the IC1 and IC2 lines on all the interfaces are checked.

A 200 word input-mode DMA is done on all select codes which checks the DMA counter, DMA select code, DMA memory address and the IRL and IRH interrupt requests. Appropriate messages are displayed if an error occurs.

END I/O TEST is displayed when the test is completed.

If errors occur;
The problem can possibly be the A16, A2 or the interface assemblies.

K6 Display Results

Pressing ⬚ₖ₆ displays option and test result information.

- Memory blocks not present in the computer are not displayed. The block numbers are octal. The addresses are octal word addresses.

- Other options are shown as "not present" if they are not installed.

- The number of times the test has been run is displayed in "Test Count". This number is decimal.

- The number of errors that occurred during a particular test is displayed in "Error Count". This number is decimal.

Here is an example K6 display.

```
                                          TEST COUNT      ERROR COUNT
            BLOCK  1  000000-037777          00000           00000
            BLOCK  1  040000-077777          00007           00000
            BLOCK  0  000000-037777          00007           00000
            BLOCK  0  040000-077777          00007           00000
            BLOCK  2  000000-037777          00007           00000
            BLOCK  2  040000-077777          00007           00000
            BLOCK  4  000000-037777          00007           00000
            BLOCK  4  040000-077777          00006           00000
            BLOCK  6  000000-037777          00006           00000
            BLOCK  6  040000-077777          00006           00000
            BLOCK 10  000000-037777          00006           00000
            BLOCK 10  040000-077777          00006           00000
            BLOCK 12  000000-037777          00006           00000
            BLOCK 12  040000-077777          00006           00000
            BLOCK 14  000000-037777          00006           00000
            BLOCK 14  040000-077777          00006           00000
            BLOCK 16  000000-037777          00006           00000
            BLOCK 16  040000-077777          00006           00000

            GRAPHICS MEMORY                   00006           00000
            TRANSPORT-15                      00006           00000
            TRANSPORT-14                      00006           00000
            PRINTER                           00006           00000
            SYSTEM ROM                        00006           00000
```

Press ⬚ₛₜₒᵣₑ to print the displayed information on the printer.

Press ⬚ₛₜₒₚ to clear the display and to continue with the other tests.

K7 Rewind T15

Pressing ⬚k7⬚ rewinds a tape cartridge installed in the right-hand cartridge drive (T15).

K10 Choose Rack Test Sequence

This test allows you to arrange and set up your own rack test order.

NOTE

K11 provides an automatic rack test sequence.

When K10 is pressed, the sequence of desired tests can be entered. Here is a list of the tests and the key to press to select each test.

Keys to Press	Test
G	Graphics memory test
M	Read/Write memory test
O	Optional T14 Cartridge test
P	Printer test
R	System ROM checksum test
T	T15 Cartridge test

Up to ten choices can be entered. After the tenth choice, testing is automatic.

Press (CONT) to start the rack test sequence.

Press (S) to skip a test and continue with the next test.

Press (STOP) to exit the test.

Disconnect all interfaces from the computer during this test.

When (CONT) is pressed, information displayed on the CRT is printed if the printer is installed.

NOTE

The tests are performed only if the options are installed, otherwise, the tests are skipped. Likewise, if the printer has no paper the printer test will not be performed and if a tape cartridge is not installed the cartridge drive test will not be performed.

Refer to the appropriate sections in this chapter for test descriptions.

K11 Automatic Rack Test

This test is used to exercise the computer over an extended period of time. The K11 rack test runs the following tests continuously.

- System ROM checksum test
- Graphics memory test
- Tape cartridge exerciser tests (T15 and T14)

- Printer tests
- Read/write memory tests *

NOTE

The tests are performed only if the options are installed, otherwise, the tests are skipped. Likewise, if the printer has no paper the printer test will not be performed and if a tape cartridge is not installed the cartridge drive test will not be performed.

Press $\boxed{\text{S}}$ to skip a test and continue with the next test. This test starts automatically if the auto-start key is depressed when the computer is switched on or power is recycled. Refer to the appropriate section in this chapter for test descriptions.

K15 Return To Operating System 9845B/C Option 1XX

This special function allows you to return to normal computer operation. Press $\boxed{\text{k15}}$ to exit the tests and return to the 9845 operating system. Before returning to the system, however, the ROM checksum test is performed if no ROM tests have been previously performed.

Note

If the AUTOSTkey is latched, the operating system will look for k15 AUTOST file.

---

* The walking one and zero test is performed only if the print all key is down. Only 32k- bytes are tested on each rack test pass.

If ROM checksum errors occur, or if the system ROMs are not present, the following error message is displayed:

```
WILL NOT JUMP TO SYSTEM ROM ERROR
```

Press any key after an error to exit this routine.

K15 Return To Operational System, 9845B/C Opt. 2XX

Note

This test is the only valid bit-slice processor test.

When the k15 return to system SFK is pressed and the AUTOST key is latched, the LPU processor and ROM checksum tests are performed. At that point, an AUTOST file is loaded to run the BIT-SLICE MICROCODE tests as desired.

Entry point for the Bit Slice Microcode test is either from k15 by answering YES to conduct bit slice microcode tests, or by doing a LOAD "AUTOST", 1 with TBIN in.

Note

If the AUTOST key is unlatched, the message "Autost must be latched before returning to the system" is displayed. When the AUTOST key is latched the Autost file will be loaded.

If CTL STOP is pressed after the 9845B/C has returned to normal operation and the Test ROM is installed, the Test ROM turn-on test will run and the computer is back in the diagnostic mode.

Bit-Slice Tests

The following series of tests are intended for 9845B/C computers that have a bit-slice processor, rather than a BPC. The normal T-ROM and T-BIN tests adequately test a BPC LPU computer. If the computer you are testing has a bit-slice processor, you should run these tests in addition to the T-ROM/T-BIN tests.

Press "CONT" if you desire to run the bit-slice tests. Then answer the prompts that are displayed on the CRT.

Note

BIT SLICE MICROCODE tests will run on a BPC computer, however, no useful information will be obtained.

"Which internal printer for failure messages?" Type Printer is 16 and press CONT. Default = 0.

"Which internal printer for pass messages?" Type Printer is 16 and press CONT. Default = 0.

```
            ****RUNNING BIT SLICE MICROCODE TESTS****

Bit Slice Test  1 Passed
Bit Slice Test  2 Passed
Bit Slice Test  3 Passed
Bit Slice Test  4 Passed
Bit Slice Test  5 Passed
Bit Slice Test  6 Passed
Bit Slice Test  7 Passed
Bit Slice Test  8 Passed
Bit Slice Test  9 Passed
Bit Slice Test 10 Passed
Bit Slice Test 11 Passed
Bit Slice Test 12 Passed
Bit Slice Test 13 Passed
Bit Slice Test 14 Passed
Bit Slice Test 15 Passed
Bit Slice Test 16 Passed
Bit Slice Test 17 Passed
Bit Slice Test 18 Passed
Bit Slice Test 19 Passed
Bit Slice Test 20 Passed
Bit Slice Test 21 Passed


            ****BIT SLICE MICROCODE TESTS COMPLETE****
```

The final prompt to clear out the Binary is

```
Type "SCRATCH A" and press "EXECUTE"
```

The following is a typical failure printout:

```
Bit Slice Test 21 Failed.
The TAN Test Failed.


        ****The BIT SLICE MICROCODE Tests Have Failed****
```

Replace Bit Slice Processor and try this series of tests again. If the failure repeats, try replacing the LPU RAM/ROM next.

Be sure to place this failure information on the repair order, as it will help the bench repair people locate the problem.

Processor / Memory Control Section

The Processor / Memory Control section consists of:

A16 09845-66516
Peripheral Processor
Memory Controller

A15 09845-66515
Language Processor
Memory Controller
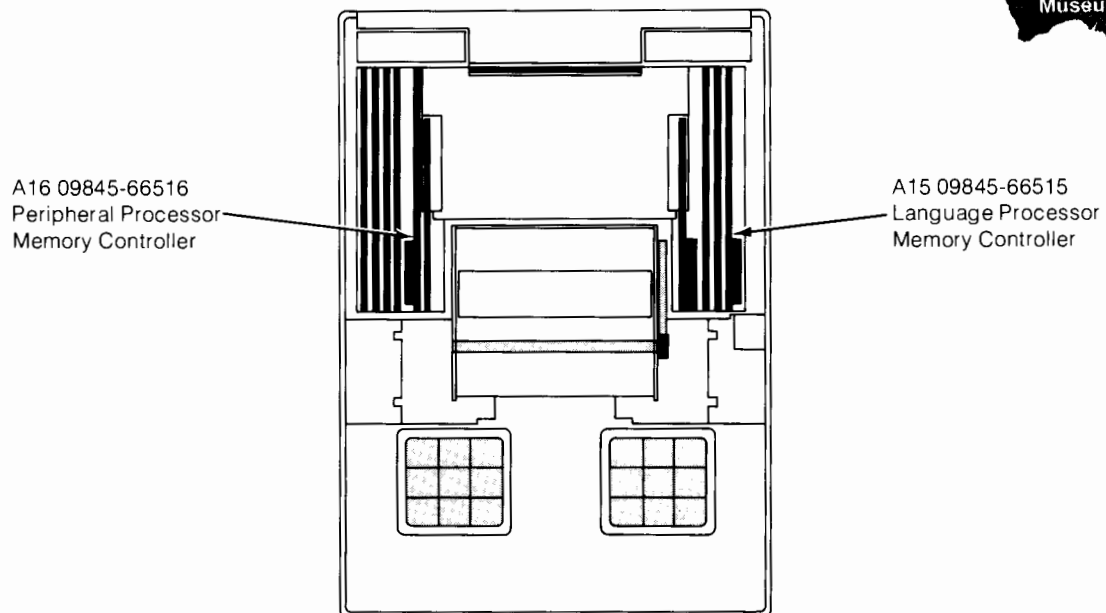
The A15 and A16 assemblies are exchange items.

Processor / Memory Control Test

The processor / memory control test is run immediately after the test ROM receives control of the system. The test includes:

- Binary Processor Chip (BPC) test

- Input / Output Controller (IOC) Chip test

- Extended Mathematics Chip (EMC) test

- Address Extension Chip (AEC) and memory addressing test

Registers, machine instruction execution and addressing are tested.

An error will abort the test, preserving the error condition. If possible, error messages will be displayed. The computer beeps and displays

```
PPU TESTED
LPU TESTED
BLK 0 SA-000000   EA-077777
```

when the test is complete. If failures occur try: A15 or A16

Processor Architecture

The 9845B processor/memory control section is divided differently than the 9845A. The 9845A featured two processors on one PC assembly. In the 9845B, the processors and the dual port are split. The language processor - memory controller (LMC) contains the LPU processor, a memory controller and half of the dual port. The peripheral processor - memory controller (PMC) contains the PPU processor, a memory controller and the other half of the dual port. Refer to Figure 2-24.

Unlike the 9845A, all of the 9845B memory (LPU R/W and ROM, PPU R/W and ROM) resides on the memory side of the dual port. Each processor has to go through the dual port to talk to memory. One advantage is that both processors can access all read/write and ROM memory.

A15 Language Processor - Memory Controller (LMC)
This assembly contains the system oscillator, clock synchronizer, Language processor (LPU), refresh request counter, Y-bus memory controller and the LPU memory bus switch.

The system oscillator provides a 11.4mHz clock to the two processors and the clock synchronizer insures proper phasing of both processors.

The LPU provides language processing to implement the computer's BASIC language. The refresh request counter insures that refresh occurs at the proper intervals. The Y-bus controller provides timing and control signals for the Y-bus and provides control for data and address switching on the Y-bus. The LPU memory bus switch connects the LPU to either the X or Y bus.

A16 Peripheral Processor - Memory Controller (PMC)
This assembly contains the Peripheral processor (PPU), X-bus controller and the PPU memory bus switch.

The PPU provides central processing for control of:

- The internal and external peripherals

- The I/O bus to communicate with the peripherals

- The means for the CRT to gain access to memory for its display buffer

The X-bus controller provides timing clocks and control signals for the X-bus and provides control for data and address switching on the X-bus. The PPU memory bus switch connects the PPU to either the X or Y bus. The switch transfers both addresses and data.

Processor Operation

When a Power On or a Control Stop is performed, a special circuit causes both the LPU and PPU to execute code from Block 45_8. Block 45_8 is the test ROM block. If the test ROM is not present, execution will revert back to the system in Block 5. Both processors will start executing the same system code within block 5. At this time, the HALT line is used to help identify which processor is which. On the LPU the HALT line is grounded. On the PPU, the HALT line is driven by the CRT with the following waveform:

$$\overline{\text{HLT}} \quad \text{--> } \quad \text{<--- < 1ms}$$
$$\text{<------- 16.6ms ----->}$$
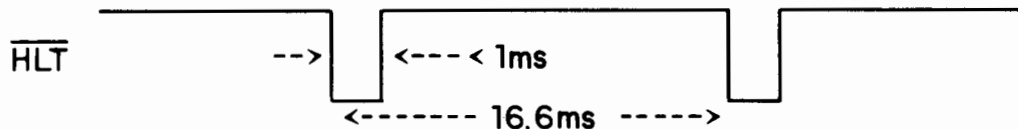
If the PPU finds HALT high, it knows it is the PPU. If the PPU is testing the HALT line when HALT is being driven low by the CRT, it must re-test HALT after waiting a sufficient amount of time to guarantee that HALT will be high. The LPU will test HALT, find it to be low, retest HALT after a wait, again find it to be low and thus determine it is the LPU.

Because the HALT line has been assigned to the CRT for raster synchronization it can no longer be used to identify CONTROL-STOP. For this reason, whenever a POWER ON or CONTROL-STOP occurs, a check on the key code must be made to identify what caused the RE-START.

The Address Extension (AEC) is a chip that is part of the processor hybrid chip set. It monitors the IDA-BUS and control lines to make decisions about which one of 6 internal registers (R32-37) to use for the BLOCK SELECT CODE (BSC). The following table shows the typical use for each of the registers:

Register	Selects the current
R32	SYSTEM R/W block
R33	SYSTEM ROM block
R34	OPTION ROM block
R35	OPTION R/W block
R36	BASE PAGE block
R37	DMA block

Each processor has its own read/write and ROM memory that can be accessed by the other processor. Refer to the Memory Section for more details.

Memory Section

The read / write memory and read-only-memory assemblies that make up the memory section are:

PPU   LPU

A28 09845-66528
LPU RAM/ROM
Assembly (LRR)
64K-Bytes of RAM
64K-Bytes of ROM

A26 09845-66526
Optional Read/Write
128K-Bytes Per Assembly

A44 09845-66544
PPU ROM Drawer

A27 09845-66527
PPU RAM/ROM
Assembly (PRR)
32K-Bytes of RAM
64K-Bytes of ROM

A42 09845-66542
LPU ROM Drawer
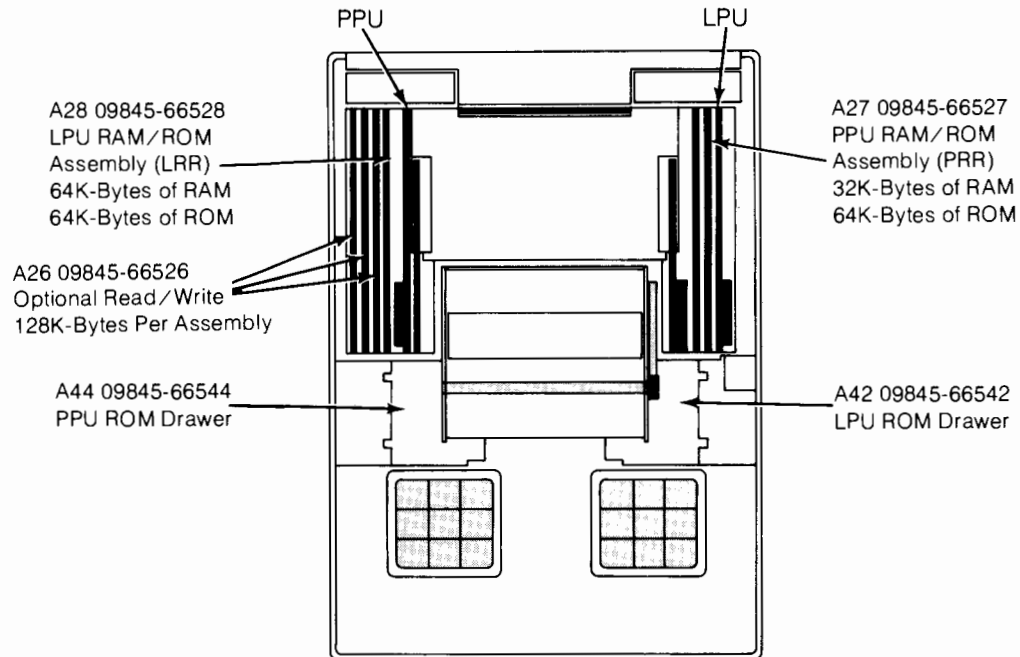
The A26, A27 and A28 assemblies are exchange items. The ROM drawers and the plug-in ROMs are to be replaced but not returned to the factory.

ROM and Read/Write Memory Tests
General Information

The test binary is originally loaded into block 0. When memory tests are performed on block 0, the binary is transferred into the next highest block available which has no error. If the binary can not be transferred into another block, then "UNABLE TO TEST BLOCK 0" is displayed.

The test binary uses block 1 for basepage read/write locations. When testing block 1, these basepage locations are temporarily transferred to another block. If the transfer can not be made, "UNAB-LE TO TEST BLOCK 1" is displayed.

Part of block 1 is used by the display. When block 1 is tested, the display is lost. If an error in block one is found, it is displayed, however, this destroys the test conditions in block 1 and causes other errors.

Initial Memory Test

The initial memory test is run automatically after the processor test. It tests the areas of memory needed to load and run the binary programs from the test cartridge.
Specifically:

- Unique block test determines if any block is answering to two block address

- Block 1 PPU read/write test

- Block 0 LPU read/write test

An error will stop the test, preserving the error condition.

Press (STOP) to exit this test.

K8 Read/Write Memory Troubleshooter

This test allows you to select specific memory tests. If the (SHIFT LOCK) key is down, the test will not stop on an error.

More than one test can be selected. Here is a list of the available tests and the key to press to select each test.

The (M), (R), (B) and (W) keys select different memory tests. Pressing the (P) key enters the "peek and poke" portion of the memory troubleshooter program. Peek and poke is described at the end of this test description.

Press	Test
(M)	Marching Pattern - A test pattern is stored in memory. The first word is read and verified and the complement of the test pattern is stored in the first word. This sequence is continued for every word in the block of memory. Once the pattern has been "walked up" memory, it complement is walked down. The marching pattern test walks up and down six different patterns. This test verifies that ones and zeros can be stored in all memory cells, and checks for opens and shorts in data bus lines.
(R)	Refresh - Zeros are stored in memory. The memory is left alone for ten seconds and then verified. Ones are then stored in memory and the sequence repeated. This test checks the refresh circuitry.

(B) Byte - Zeros are stored in memory. Ones are then stored in the right-byte using the byte operation. Memory is then verified. Zeros are stored in memory and ones are stored in the left byte. Memory is verified. The sequence is then repeated with ones stored in memory and zeros stored in left and right bytes. This test checks memory byte operations.

(W) Walking bit (ones and zeros) - Every cell in a 32k byte block of memory is set to zero. A one is written in the first cell, and all other cells are read to verify that it is still one. The tested cell is then restored to a zero and the next cell is set to a one. All cells are again read to verify their contents. The sequence is continued for every cell in the block. Its complementary pattern walking zeros completes the test. This test checks for memory cell row and column interactions. This test takes about three hours to test each 32k byte block of memory.

Select the tests in the order you want them to run; then press (CONT). If no tests are specified all the tests will be run.

Enter the octal block address of the memory block to be tested and press (CONT). If the specified block is not present, BLK NOT PRESENT is displayed. Press (CONT) to enter another block address. If no block address is entered, the default is to test all blocks of memory.

Press (A) to test all blocks.

Once a block address has been entered, enter one of the following keys to select which portion of the block is to be tested.

Key	Selects the
(U)	Upper 32k bytes (addresses 40000 - 77777)
(L)	Lower 32k bytes (addresses 00000 - 37777)
(B)	Test full block (addresses 00000 - 77777)

NOTE

Since block 1 is only 32k bytes, block 1 testing is automatic (if selected) without the above block portion selection.

Then press $\begin{pmatrix}\begin{smallmatrix}c\\o\\n\\t\end{smallmatrix}\end{pmatrix}$ to start the test.

Blocks are continuously tested. The block number and the starting and ending addresses are displayed (no display during block 1 testing).

Press (STOP) to exit the test.

Memory errors are displayed with the following format in inverse video:

MEMORY ERROR BLK **BB** ADDRESS **AAAAAA** HAS **XXXXXX** NOT **YYYYYY**

BB -	Octal block number
AAAAAA -	Octal memory address
XXXXXX -	Actual octal data
YYYYYY -	Expected octal data

To recover from an error:

Press $\begin{pmatrix}\begin{smallmatrix}c\\o\\n\\t\end{smallmatrix}\end{pmatrix}$ to continue with the next address.

Press (A) to continue testing with the next block.

Press (STOP) to exit the test.

After recovering from an error, the inverse video on the error message is turned off.

Peek and Poke
This feature allows you to read data from a specified memory location and to write data into a specified memory location.

16-bit octal addresses are accepted. The high order bit is a "don't care" and may be either a zero or a one.

Locations 0 through 37 in any block should not be written into. These locations correspond to processor register numbers. Accessing these locations may cause an "out to lunch" condition.

The test binary and the basepage can be destroyed by writing in the blocks that contain them (usually blocks 0 and 1). Read location 33 for the current binary block and location 36 for the current basepage block.

Press $\boxed{\text{P}}$;

>To read the contents of a memory location use this syntax,
>
>>6 digit octal address : octal block number $\boxed{\substack{\text{E}\\\text{X}\\\text{E}\\\text{C}}}$
>
>To write into a memory location use this syntax,
>
>>6 digit octal address : octal block number = 6 digit octal pattern $\boxed{\substack{\text{E}\\\text{X}\\\text{E}\\\text{C}}}$
>
>To write or read continuously, include a / after the pattern.
>
>Multiple statements can be executed by separating them with a comma.

K9 Read/Write Memory Test

This test performs marching pattern, refresh and byte tests on a selected memory block. Enter the octal block number and press $\boxed{\substack{\text{C}\\\text{O}\\\text{N}\\\text{T}}}$.

If 100000 is entered, all even blocks are tested.

The block starting address and ending address are displayed. The block is continuously tested until $\boxed{\text{STOP}}$ is pressed. Errors are treated as described in the memory troubleshooter.

ROM Checksum Test

The ROM checksum test is a part of the K10 choose rack test and the K11 automatic rack test. The contents of each option and system ROM are read and a checksum for each ROM is computed. If the checksum for a particular ROM is all zeros, the ROM is not there. If the checksum is all ones, the ROM is correct. If the checksum is other than all ones or zeros, a checksum failure is displayed in the following form.

ROM CHECKSUM FAILURE BLK X ADDRESS YYYYYY—ZZZZZZ

>>>X = the octal block number
>>YYYYYY = the ROM starting address
>>ZZZZZZ = the ROM ending address

Press $\boxed{\substack{\text{C}\\\text{O}\\\text{N}\\\text{T}}}$ to continue the test after an error occurs.

Here is a summary of the system ROMs and their locations. Use this information and the A27 and A28 drawings in "Memory Troubleshooting" to isolate a bad ROM chip on the A27 and A28 assemblies.

Table 2-3. System ROM Summary

	Block	Address	ROM Part Numbers	
LPU RAM/ROM A28	3	00000_8 - 17777_8	1818-0827 (Low byte) 1818-0823 (High byte)	
	3	20000_8 - 37777_8	1818-0828 (Low byte) 1818-0824 (High byte)	
	3	40000_8 - 57777_8	1818-0829 (Low byte) 1818-0825 (High byte)	
	3	60000_8 - 77777_8	1818-0830 (Low byte) 1818-0826 (High byte)	
PPU RAM/ROM A27	5	00000_8 - 17777_8	1818-0835 (Low byte) 1818-0831 (High byte) or 1818-1208 CRT Driver 1818-1209 Color	CRT Driver B/W
	5	20000_8 - 37777_8	1818-0836 (Low byte) 1818-0832 (High byte) or	U.S. Characters
			1818-0844 (Low byte) 1818-0839 (High byte) or	French Characters
			1818-0846 (Low byte) 1818-0841 (High byte) or	German Characters
			1818-0845 (Low byte) 1818-0840 (High byte) or	Spanish Characters
			1818-0848 (Low byte) 1818-0843 (High byte) or	Swedish/Finnish Characters
			1818-0847 (Low byte) 1818-0842 (High byte)	Katakana
	5	40000_8 - 57777_8	1818-0837 (Low byte) 1818-0833 (High byte)	
	5	60000_8 - 77777_8	1818-0838 (Low byte) 1818-0834 (High byte)	

Memory Troubleshooting

Memory errors in the read/write memory tests or the ROM checksum test can be translated to give the physical location of the memory error. Generally multiple failures indicate that the memory control logic is defective.

Read/Write Memory Errors

Read/write memory errors are displayed in the following form.

Sample Display:

```
                         Octal        Actual      Expected
              Block       Word        Octal        Octal
             (Octal)     Address       Data         Data
                ↑           ↑           ↑            ↑
MEMORY ERROR BLK 04 ADDRESS 02052 HAS 000400 NOT 000000
```

1. First determine which memory assembly contains the block indicated in the error display. Refer to the memory jumper table on page 2-29.

2. The upper digit of the octal word address indicates either the top half (high address) or the lower half (low address) of a block (see Figure 2-2).

    If the upper digit is 0 through 3, the low address is indicated (bottom row of chips in a block).

    If the upper digit is 4 through 7, the high address is indicated (top row of chips in a block).

   3. Decode the data into binary values and compare the bits.

Actual Data   0 000 000 100 000 000◄————————Bit 0
Expected Data   0 000 000 000 000 000
                                 │
                                 └————————————————————Bit 8 does not compare

4. The bits that do not compare indicate a defective RAM location. The following figure shows the RAM chips that correspond to each bit position.

ROM Checksum Errors

ROM checksum errors are displayed in the following form.
Sample display:

```
                                 Octal       Octal
                    Block      Starting      Ending
                   (Octal)     Address      Address
                      ↑           ↑            ↑
ROM CHECKSUM FAILURE BLK 5 ADDRESS 060000 – 067777
```

1. First determine where the indicated ROM block is physically located. Refer to the following figures and the information in "ROM Checksum Test".

2. The starting address can now be used to find the bad chip or chips by using the following figures. Notice that a starting address is associated with two ROMs, a high byte and a low byte. Either one of these may be defective.

Bit Position
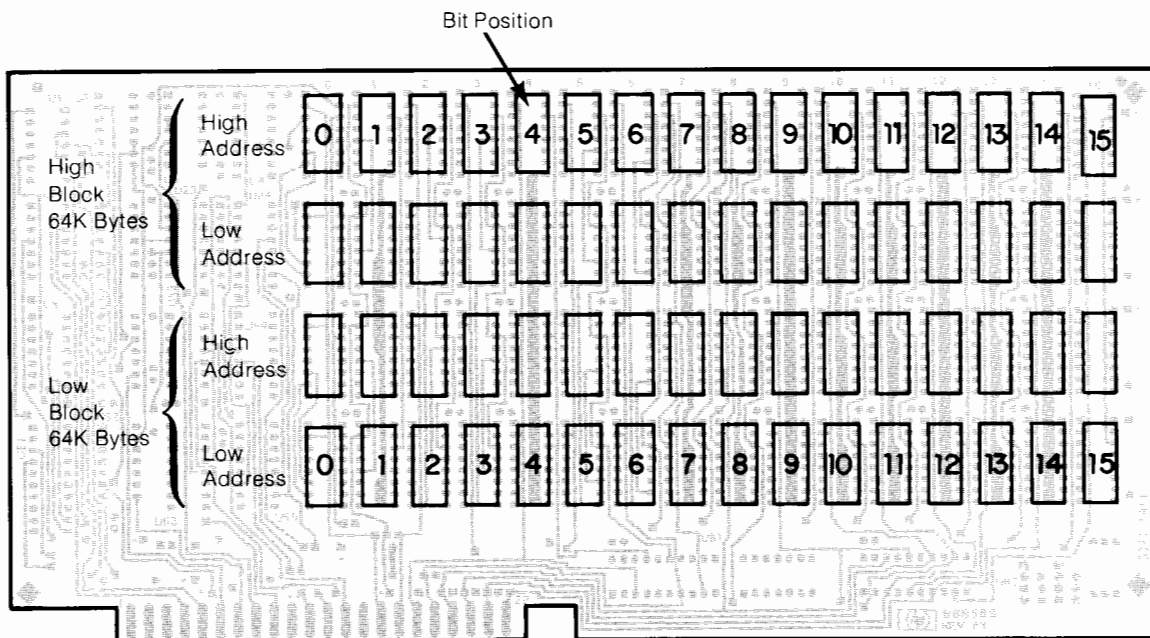
A26 Assembly
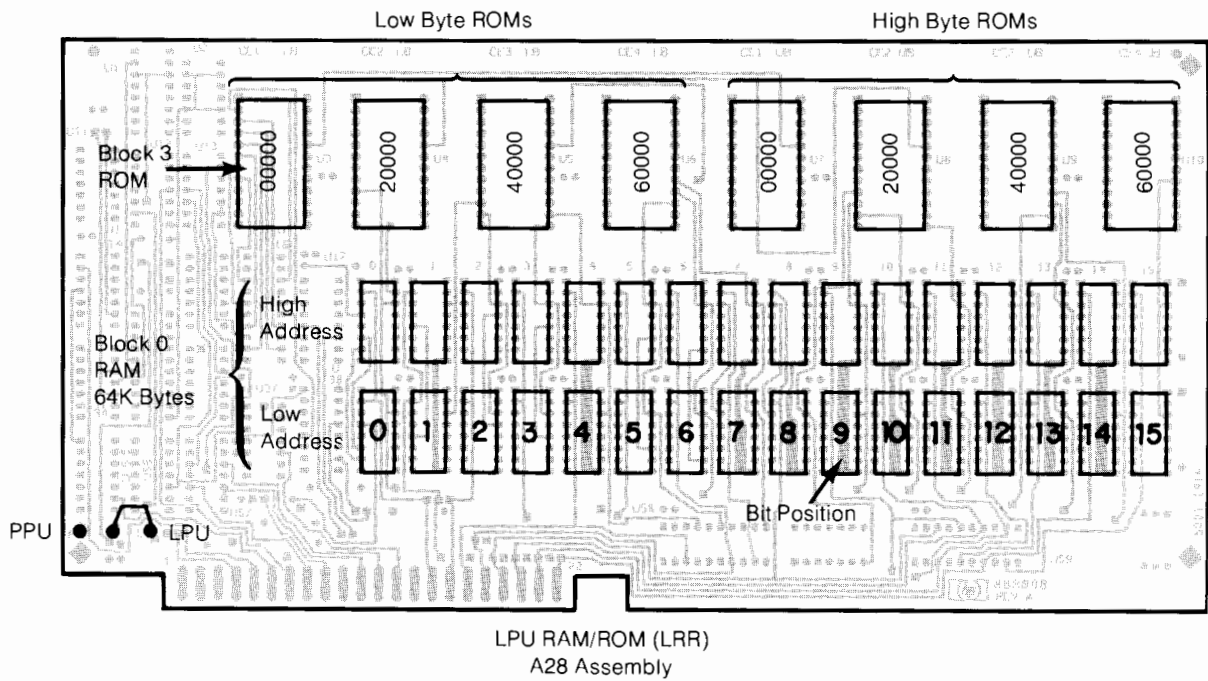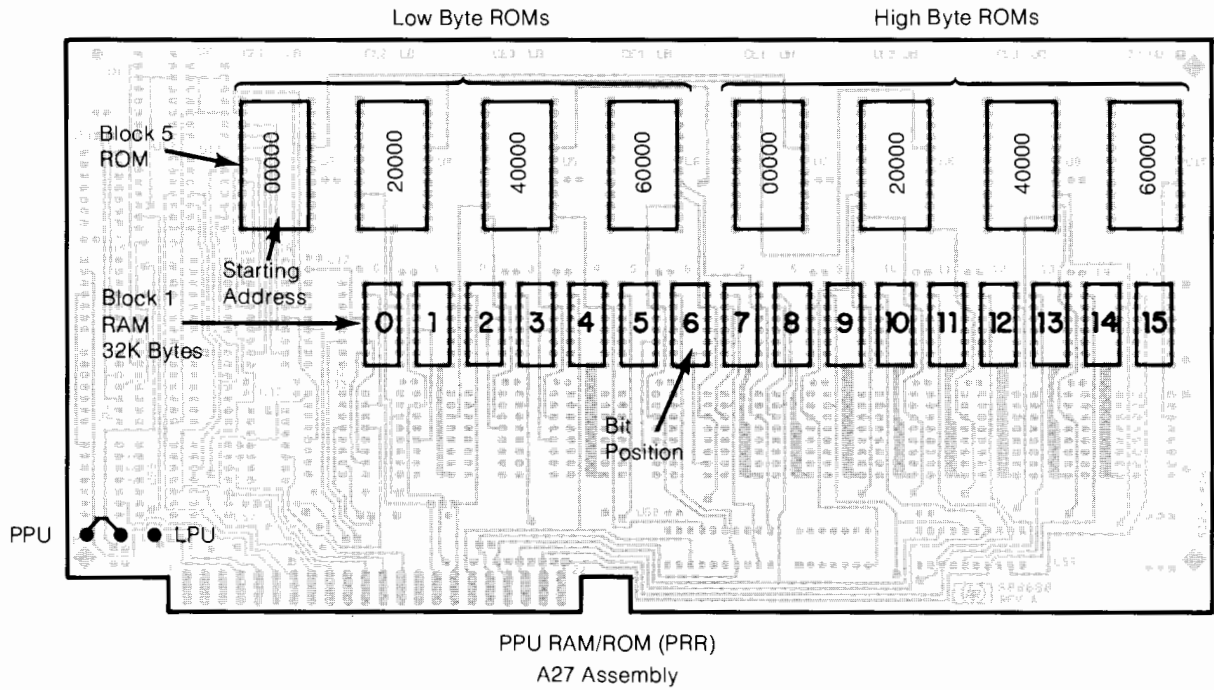
Figure 2-2: **RAM and ROM chip locations**

ROM Pack Intermittent Failures

A ROM pack may appear defective if it is not making good contact with the ROM drawer. If you have a failure, possibly intermittent, that appears to be related to the ROM packs, polishing the gold contacts on the ROM pack may fix the problem. The gold contacts on the ROM pack may be polished by using the eraser end of a pencil and rubbing across the contacts. You will be able to see the gold surfaces brighten. It is possible to rub through the gold by rubbing vigorously, so be careful; once the surface brightens, stop rubbing.

Read/Write Memory Operation

The PPU and LPU read/write assemblies (A26, A27 and A28) vary in how much memory is loaded on the assembly and which bus the assembly resides on.

Assembly	Memory Size	Used On
A26	128k-byte (two blocks) RAM	LPU Option RAM
A27	32k-byte (half block) RAM 64k-byte ROM	PPU RAM/ROM assembly
A28	64k-byte (full block) RAM 64k-byte ROM	LPU RAM/ROM assembly

The A26, A27 and A28 assemblies provide:

- Address decoding

- Memory timing derived from memory clock sequence

- Handshake between processor and memory

- Refresh timing for the RAMs

- Memory storage

Memory addresses are sent from either the PMC or the LMC via the X or Y buses to the RAM address decoder. The memory address together with the block select and memory control signals identify a specific memory location.

During a write cycle the LMC or PMC changes from sending an address to sending data. Data is then written into the specified memory address location.

During a read cycle the LMC or PMC switches from sending an address to receiving data from the specified memory address.

Memory cycles can be done as word cycles or byte cycles. During a word cycle an entire 16-bit data word is read from or written into a specified memory address. During a byte write cycle either the upper half or lower half of a word is disabled. For byte read, all 16 bits are read from memory.

The A26 assemblies can be set to a variety of block combinations by changing a jumper. Here are the jumper positions and the corresponding octal blocks.

BLOCK 14 and 16
BLOCK 10 and 12
BLOCK 4 and 6

ROM
Address

ROM
Memory
Chips

13 Lines

Data Out

Read/Write
Memory
Chips

X Or Y Bus
To A15 Or A16

16 Lines

Data In

RAM Address 14 Lines

RAM
Address
Multiplexer

A0-A6

RAS CAS WRT

Bit 14

Block
Select
Lines

BS Lines

Block
Decode

Memory
Control
Timing

RAS

CAS

Memory
Control
Lines

MC Lines

Memory
Refresh
Control

R/W
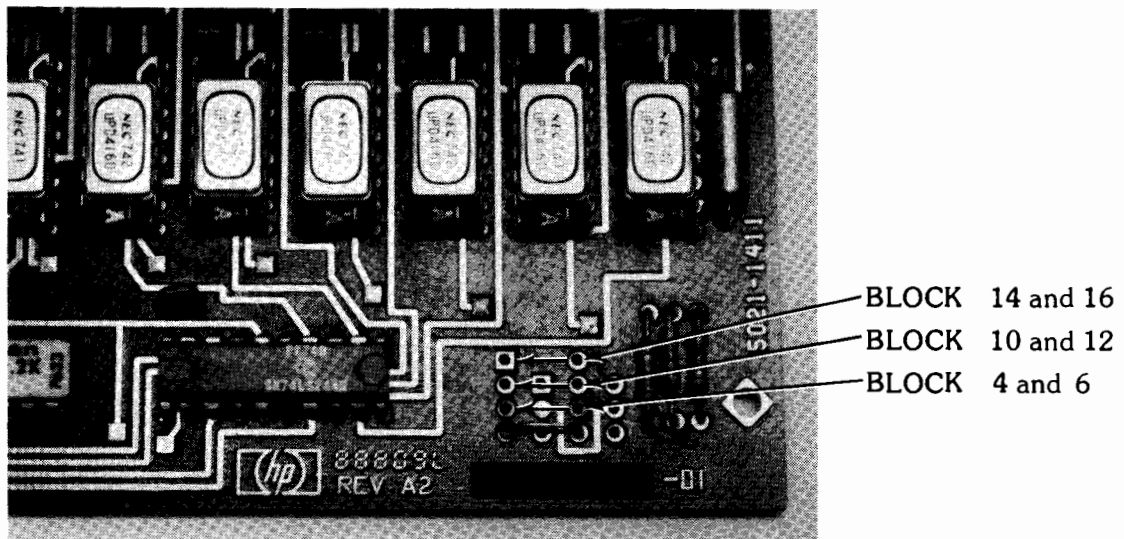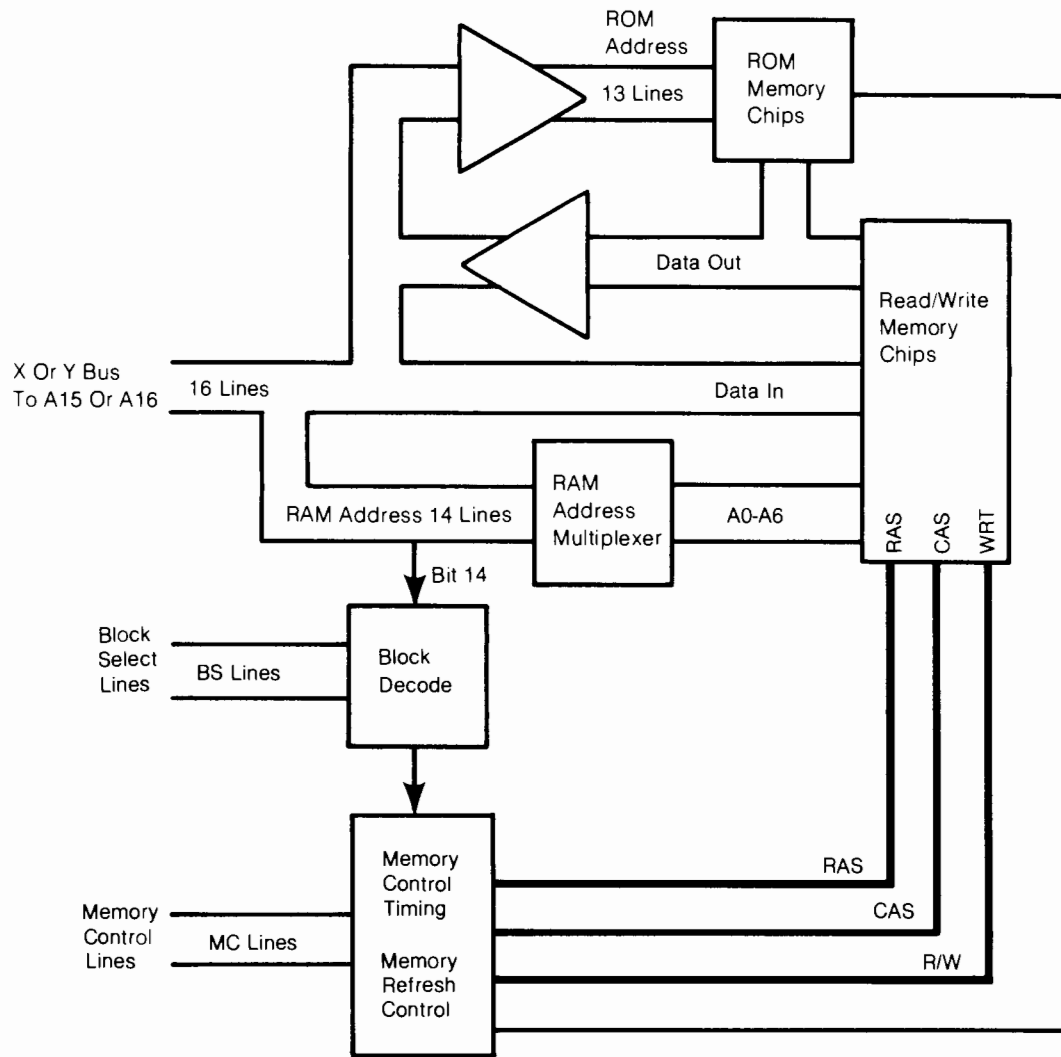
A27 and A28 Assembly
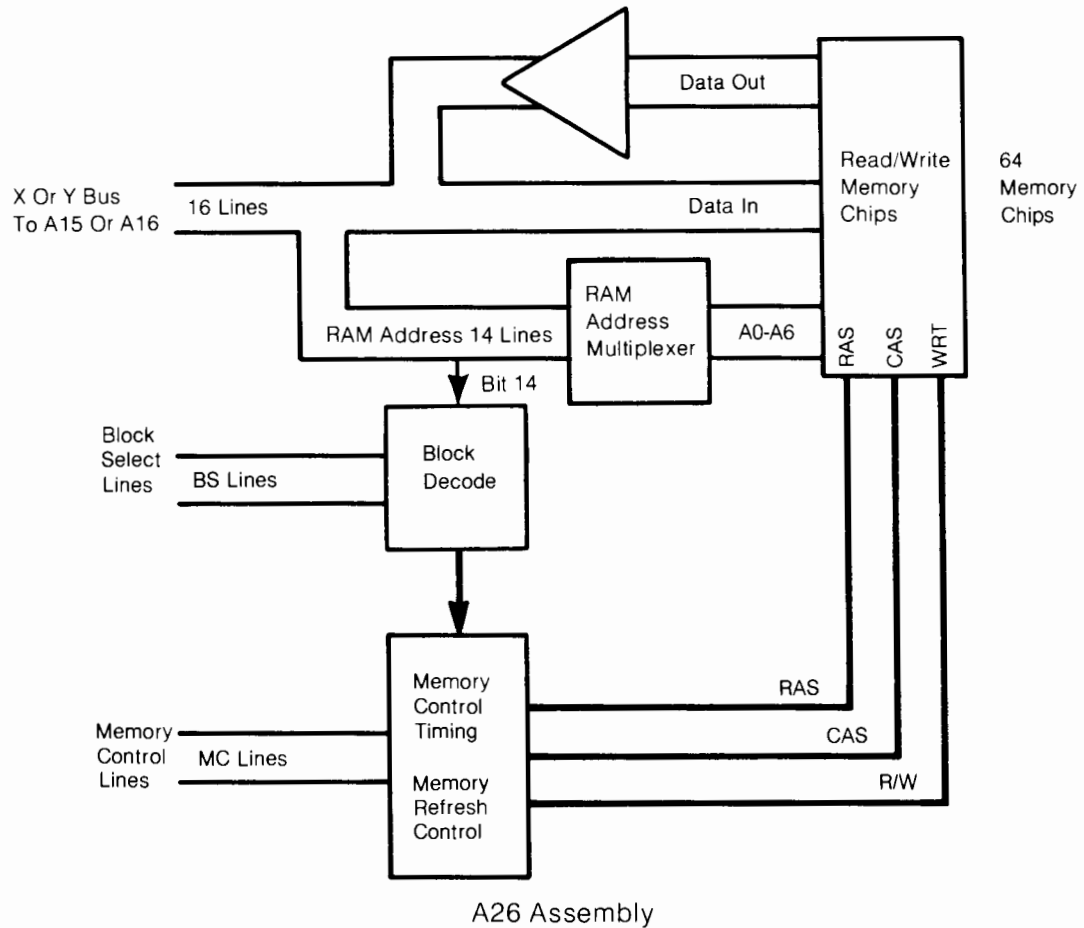
Figure 2-3:   Read/Write Memory Block Diagram

LPU System ROMs (block 3) are located on the LPU RAM/ROM assembly (A28).

PPU System ROMs (block 5) are located on the PPU RAM/ROM assembly (A27).

ROM Drawer Operation

The LPU and PPU ROM drawers contain the optional Read-Only-Memory. Each plug-in ROM actually can have up to seven ROM chips inside. The PPU ROM Drawer plugs into the left side and the LPU ROM Drawer plug into the right side. The ROM drawer assemblies provide the word contents of a particular addressed location to either the PMC or the LMC. The address and block decoding is done within the ROM itself, thus the ROM is not restricted to its position in the drawer. Because of loading limitations, each ROM drawer contains three buses.
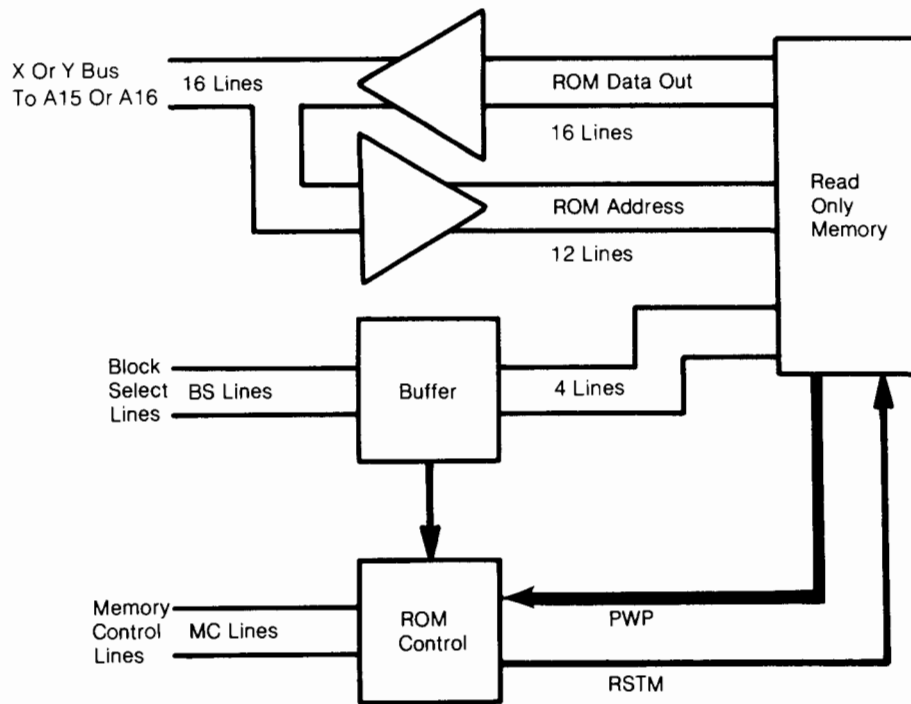
Figure 2-4:   ROM Drawer Block Diagram

Memory Map

Figure 2-5 and 2-6 graphically present the 9845B memory. Each read/write represents 64k-bytes of memory except for block 1 which is only 32k-bytes. ROM blocks may have up to 64k-bytes.
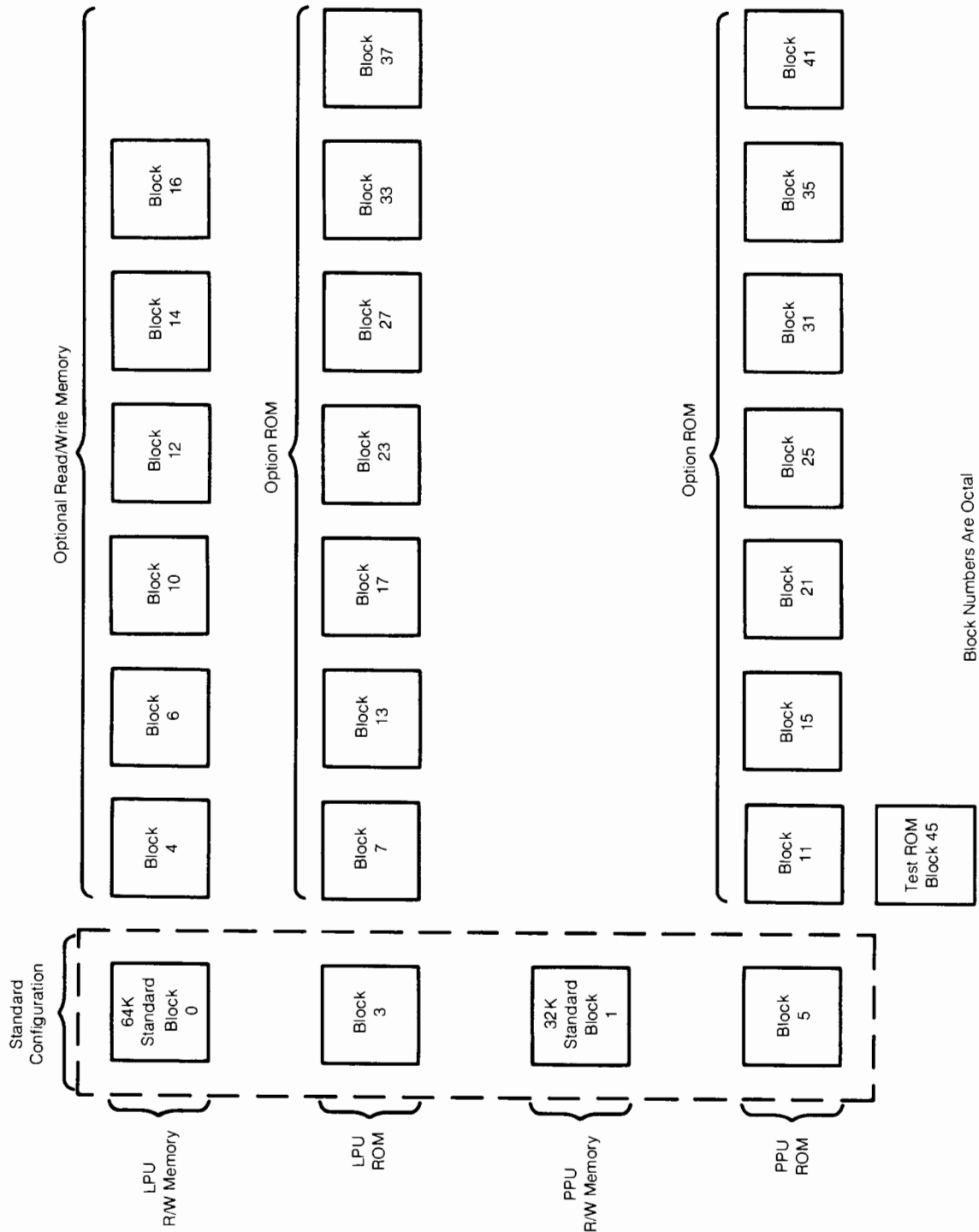
Figure2-5: Memory Structure

LPU R/W
BLOCK 0

177777

System Common Area {

| Base Page |
| Prgm Counter Buffers |
| LPU System R/W |
| Option ROM R/W |
| Binary Prgms |
| Execution Stack |
| Processor Buffers |
| Main Prgms & Sub Prgms |
| Value Area |
| Common |
| Assy Develop R/W |

0

PPU R/W
BLOCK 1

177777

| Base Page |
| CRT Buffer |
| Reserved |
| Recall Buffer |
| CRT Temporary |
| T15 Directory |
| T14 Directory |

100000

BLOCK 2

| Not Assigned |

LPU ROM
BLOCK 3

177777

| LPU System ROM on A28 |

0

LPU R/W
BLOCK 4

177777

| 64K byte |

0

PPU ROM
BLOCK 5

177777

| Available |
| CRT Alpha & Graphics |
| Keyboard & System |
| Operating System |

0

LPU R/W
BLOCK 6

177777

| 64K bytes |

0

LPU ROM
BLOCK 7

177777

| Lost |
| I/O ROM |
| Advanced Programming ROM |
| Reserved |
| Graphics ROM |
| Lost |

100000

Figure 2-6:   Memory Blocks

CRT Section (Alpha)

WARNING

REFER TO THE SAFETY GUIDELINES IN CHAPTER 1 BEFORE DISAS-
SEMBLING THE CRT ASSEMBLY.

The CRT alpha section is made up of the following assemblies:

A3 09845-66503
CRT Logic

A72 09845-66572
Regulator Assembly

A75 09845-66575
High Voltage

A71 09845-66571
CRT Motherboard

A74 09845-66574
CRT Analog

A73 09845-66573
Display Logic
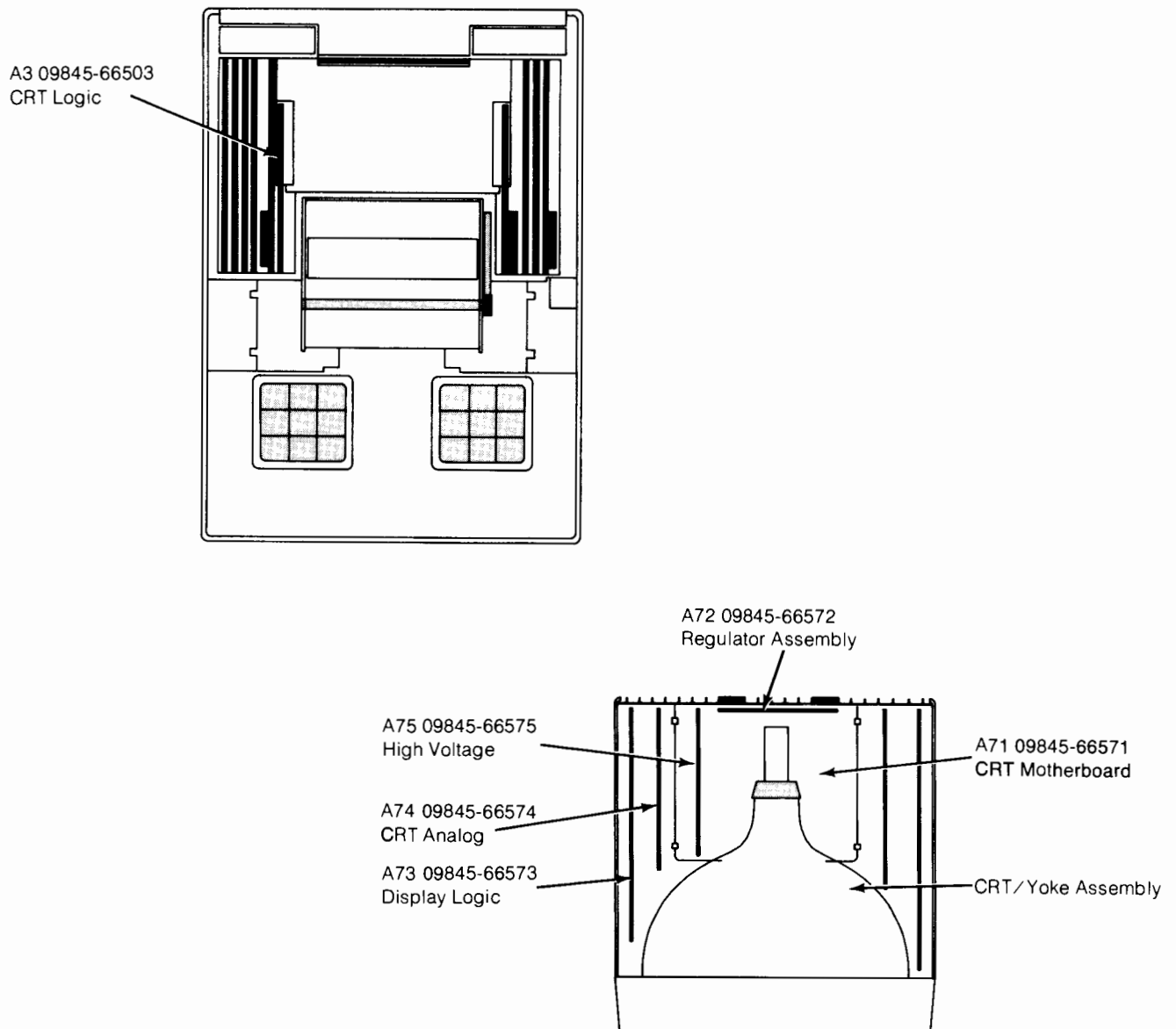
CRT/Yoke Assembly

The A3, A73, A74 and A75 assemblies are exchange items. The A72 assembly should be repaired to a component level.

When replacing the CRT/Yoke assembly the defective CRT should be disposed of in the shipping container in a safe manner.

K0 CRT Alpha Test

This test will check and exercise all the CRT alpha functions and provide test patterns for the following CRT adjustments:

- Focus

- Alpha raster size

The adjustment procedures are found after this test procedure.

To exit this test press (stop).

Press (ko); the CRT displays;

```
Press B   For full buffer
      H   For He He
      L   For Linearity
      G   Graphics
      C   For Character Set
      O   For Optional Char. Set
      F   For Features
```

Here is a description of the test performed when each of the letters listed above is pressed.

Press ⓑ; the CRT displays:
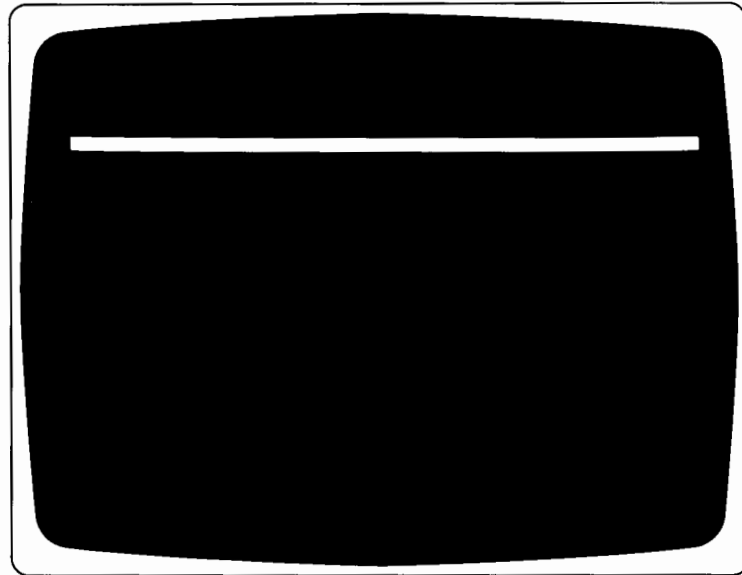
A failure on this display indicates a probable A73 assembly failure.

Press ⒣; the CRT displays:
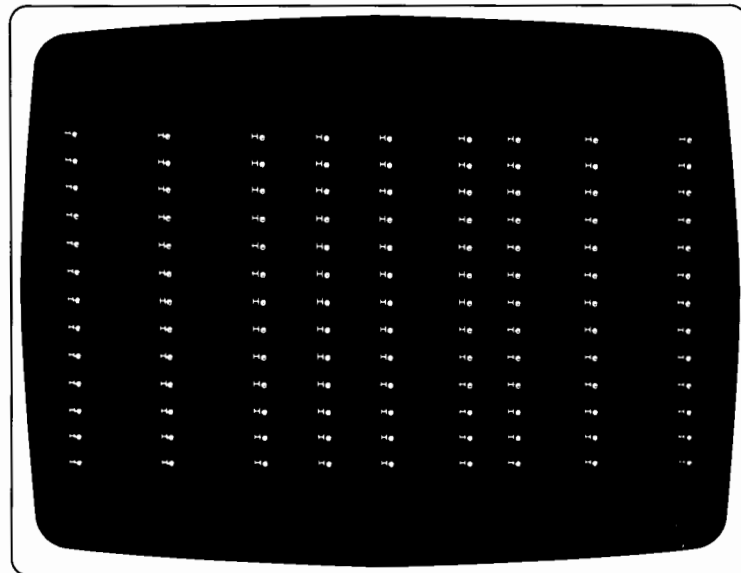
Use this pattern to adjust the focusing adjustment (described after this test) until the "He" characters are sharp and clear. The focus control is on the A75 assembly.

Press (L); the CRT displays:
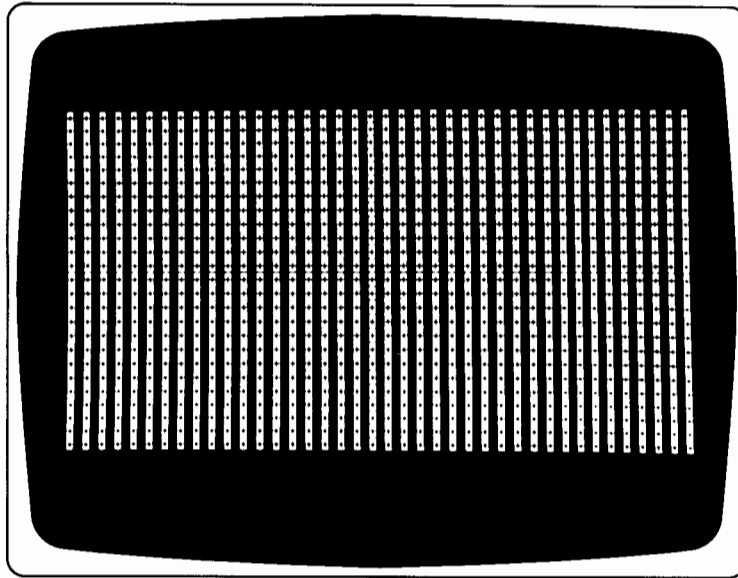
Press (G); if the graphics option is installed, a full screen graphics cursor is displayed and the computer is in the graphics mode. See the Graphics section for details.

Press (STOP) to exit the graphics test and return to the CRT Alpha Test.

If the graphics option is not installed, the G key will be ignored.

Press (C);the CRT displays:
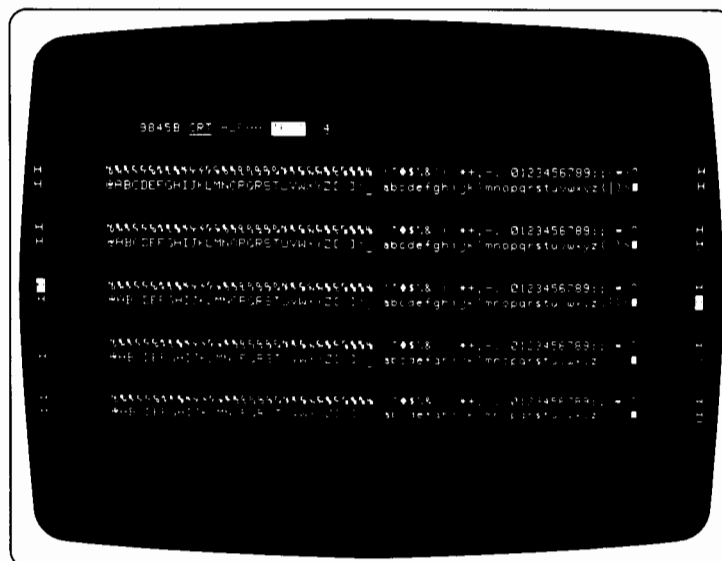
The character set is repeated five times. This test exercises all the CRT features. If the pattern is deformed, the A73 assembly may be defective.

Press (O); the CRT displays the optional characters if the option ROM is installed. When the option ROM is not installed the CRT shows:
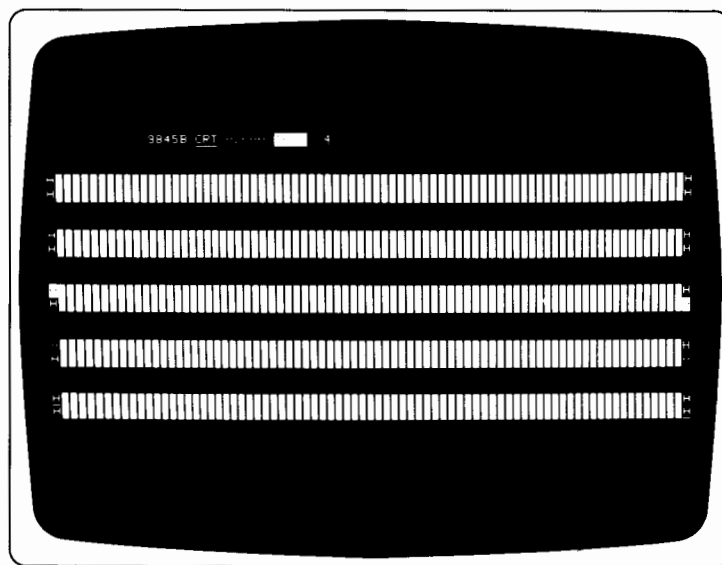
Press (F); all the CRT display features can now be checked. The CRT displays:

PRESS CONTINUE

Press (C/O/N/T) 15 times, noting each time the feature being displayed. The features are shown in the following order.

    inverse video
    normal blinking video
    normal video underlined
    normal video with cursor
    blinking inverse video
    underlined inverse video
    inverse video with cursor
    blinking inverse video underlined
    inverse video with underline and cursor
    blinking inverse video with cursor
    blinking inverse video with underline and cursor
    blinking video and underline
    blinking video and cursor
    blinking video cursor and underline
    normal video cursor and underline

At the end of the feature test, the CRT will again display the message seen when ⊏ᴷᴰ⊐ was pressed.

If errors occur;
The problem can possibly be the A3, A72, A73, A74 or A75 assemblies. See the A72 voltages and waveforms.

CRT Self Test Switch

The CRT self test switch can help you quickly isolate a problem to either the CRT assembly or the mainframe assembly.

To access the switch, remove the CRT top cover. The switch is located on the A73 assembly as shown in Figure 2-7.

Normally, pressing the CRT test switch will result in an inverse video alpha raster. This checks about 90% of the CRT assembly operation and the operation of the +5 volt, ±12 volt and ±18 volt power supplies.

- If the inverse video appears, the problem is probably in the mainframe assembly (Try the A3 assembly).

NOTE

The optional graphics assemblies are not checked by the CRT test switch.

- If the inverse video does not appear, the problem is probably in the CRT assembly or the power supplies that feed the CRT assembly.
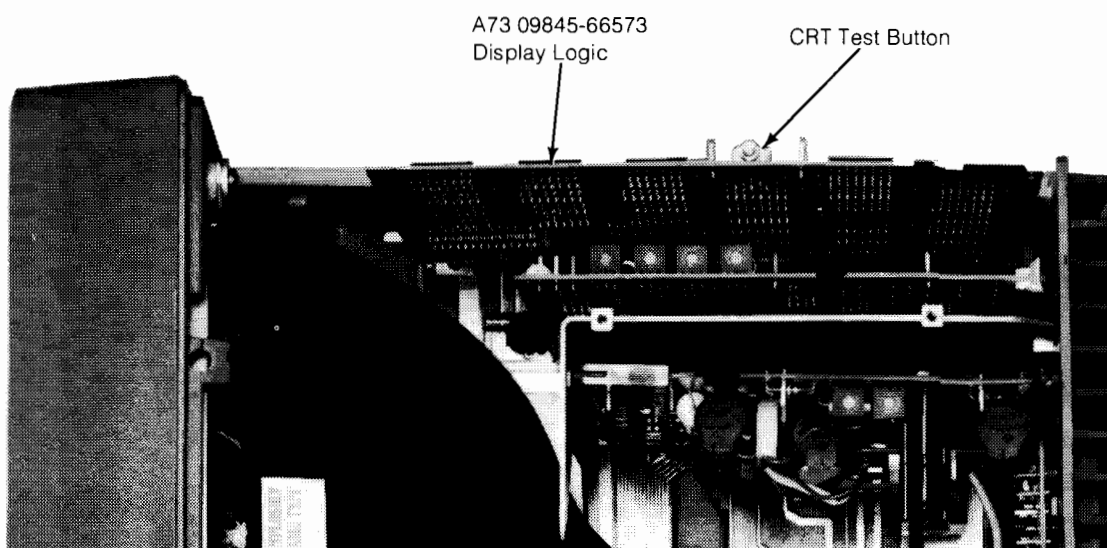
Figure 2-7: CRT Test Button

CRT Alpha Raster Size

The alpha raster size should be checked whenever one of the CRT section assemblies has been changed. To adjust the alpha raster, use this procedure.

- Install the CRT alignment mask on the face of the CRT (if available).

- Remove the CRT top cover.

- Press the CRT test button on the A73 assembly, shown in Figure 2-7, to display the alpha raster in inverse video.

- Use the A-wide and A-high controls on the A74 assembly to align the edges of the inverse video to the alpha raster outline on the CRT alignment mask (if available). If an alignment mask is not available, use the raster dimensions given in the Specifications in Chapter 1.

If the entire raster is not centered in the raster outline or if the raster is skewed in the raster outline, it may be necessary to reposition the centering magnet tabs located at the rear of the CRT yoke (see Figure 2-8). Figure 2-9 gives an example of improper centering magnet tab positioning.

WARNING

HIGH VOLTAGE IS PRESENT IN THE HIGH VOLTAGE CAGE. USE AN INSULATED TOOL SUCH AS A SOLDERING AID OR PLASTIC ALIGN-MENT TOOL TO MOVE THE TABS.

- Remove the high voltage cage cover to access the tabs and move as necessary.

NOTE

Moving the centering magnet tabs will also effect the graphics raster.
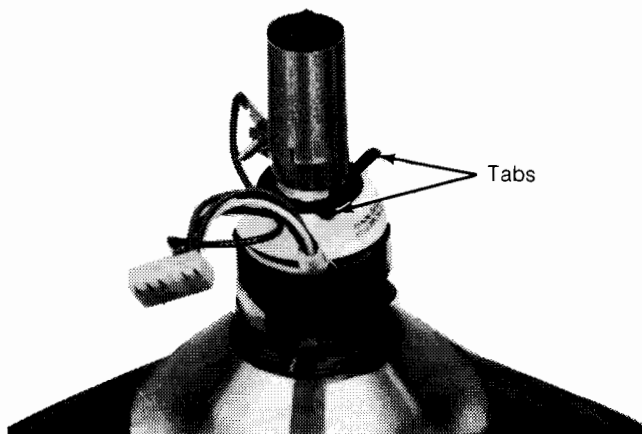
Figure 2-8:   Centering Magnet Tabs

If the edges of the raster are not straight (i.e., the edges bow in or out in reference to the raster outline on the mask) the yoke's "pincushion" alignment is improper. Pincushion cannot be aligned in the field. If this problem occurs, the CRT/yoke assembly should be changed. Figure 2-9 gives an example of bad pincushion alignment. The centering magnet tabs effect the pincushion somewhat. Its a good idea to try to correct for minor improper pincushion alignment with the centering tabs first before replacing the CRT/yoke assembly.
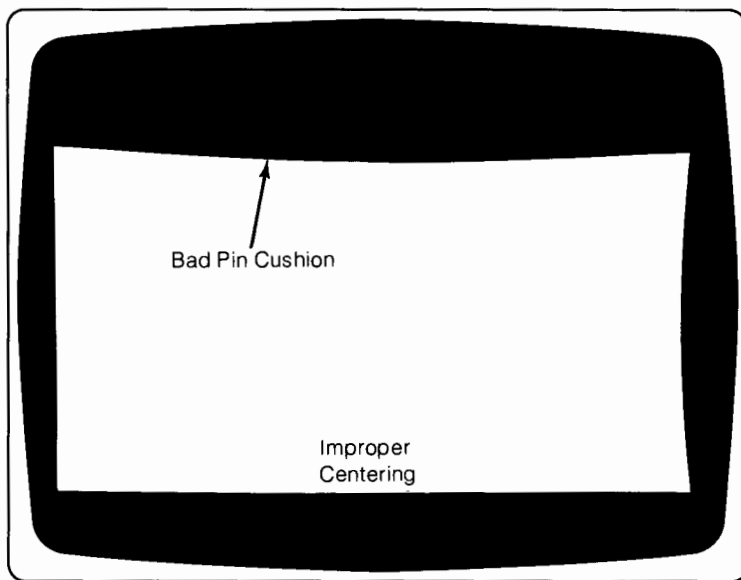
Figure 2-9:   Improper Tab Positioning

● Reassemble the computer after the raster is aligned.

CRT Display Focus

The focus should be checked whenever the A75 or the CRT/yoke assembly has been changed.

The focus control is located on the A75 assembly inside the high voltage cage. Remove the CRT top cover and the high voltage cage cover to access the A75 assembly (see Figure 3-2).

Display a full raster pattern of characters; the test ROM CRT alpha test will provide these patterns. Adjust the focus control to sharpen the appearance of the displayed characters. It may not be possible to focus all areas of the display at a particular control setting; in this case, the focus control should be set at the point that gives the best overall display appearance.

CRT Intensity

The intensity should be checked whenever the A75 or the CRT/yoke assembly has been changed.

The intensity control is located on the A75 assembly inside the high voltage cage. Remove the CRT top cover and the high voltage cage cover to access the A75 assembly (see Figure 3-2).

To adjust the CRT intensity, use the following procedure.

1. Advance the A75 intensity control and the operator's intensity control on the lower right corner of the CRT bezel to maximum intensity.
2. With both controls at maximum settings, horizontal retraces should appear on the CRT. Adjust the A75 intensity control until the retraces are no longer visible.
3. Press the CRT test button and notice the intensity of the full raster display.
4. Use the A75 intensity control to reduce this intensity by approximately ½. This control setting is between ⅛ and ¼ of a turn less on the A75 intensity control.
5. Adjust the operator's intensity control for the desired intensity.
6. Reassemble the computer.

A72 Voltage Checks

The transistors and regulators on the A72 assembly can be replaced if they should become defective. Figure 2-10 describes the normal voltages and waveforms to be found on each device. This can also be used to determine which assembly is not providing the correct input to the A72 assembly.

Actual Waveform May Vary Slightly

View From Inside The Rear Panel.

−18V

+ 300 Peaks

100

0

−18

Flyback
Pulse
(Volts)

15

10

5

0

Average Value

*

Correction
Voltage
(Volts)

Ground

From A75

* To A74

− Correction Voltage
From A74 To Yoke

Q4

Q5

Q6

−18V From
Power Supply

−15V To A74
and A75

−18V From
Power Supply

+18V From
Power Supply

+18V From
Power Supply

Ground

+6V From A74

−5 to +3V to
A74 and A75

*To A74

Q1

Q2

Q3

+15V to
A74 and A75

+5V From
Power Supply

Ground

+ Correction Voltage
From A74 To Yoke

*

Q1   + 15V Regulator   7815KC   1826-0203
Q2   B + Regulator Pass Transistor   2N5875   1853-0305
Q3   Horizontal Correction Amplifier (− Swing)   2N5875   1853-0305
Q4   − 15V Regulator   LM320K - 15   1826-0619
Q5   HV Switching Transistor   2N6583   1854-0783
Q6   Horizontal Correction Amplifier (+ Swing)   2N5877   1854-0518

Figure 2-10:   A72 Voltages

CRT Display Circuits

The display circuits are contained on a CRT control logic assembly, a CRT display logic assembly and the CRT monitor itself. The display is a 12 inch magnetic deflection CRT using a dual raster scan. Up to 24 lines of 80 characters can be displayed at one time from a standard 128 ASCII character set and European character sets. Information can be highlighted by inverse video, underlining and blinking.

Display Interface

Figure 2-11 shows how the display interfaces to the computer mainframe. The standard alphanumeric circuits interface directly to the PPU memory bus via the CRT control logic assembly. The optional graphic circuits interface to the PPU I/O bus. The interface connections to the mainframe are located in the display support legs. The alphanumeric interface is located in the left leg and the graphics interface is located in the right leg. Power for the display is also brought from the power supply through the support legs.

The display is allocated addresses 70000₈ to 74116₈ of Block 1 Read/Write memory for data to be displayed. This space is enough to store one full display with a different feature for each character. Blanks to the right of displayed information are not stored.

Display Assemblies

The following presentation describes the theory of operation of the various display assemblies. Refer to the display block diagram (Figure 2-12) when reading this presentation.
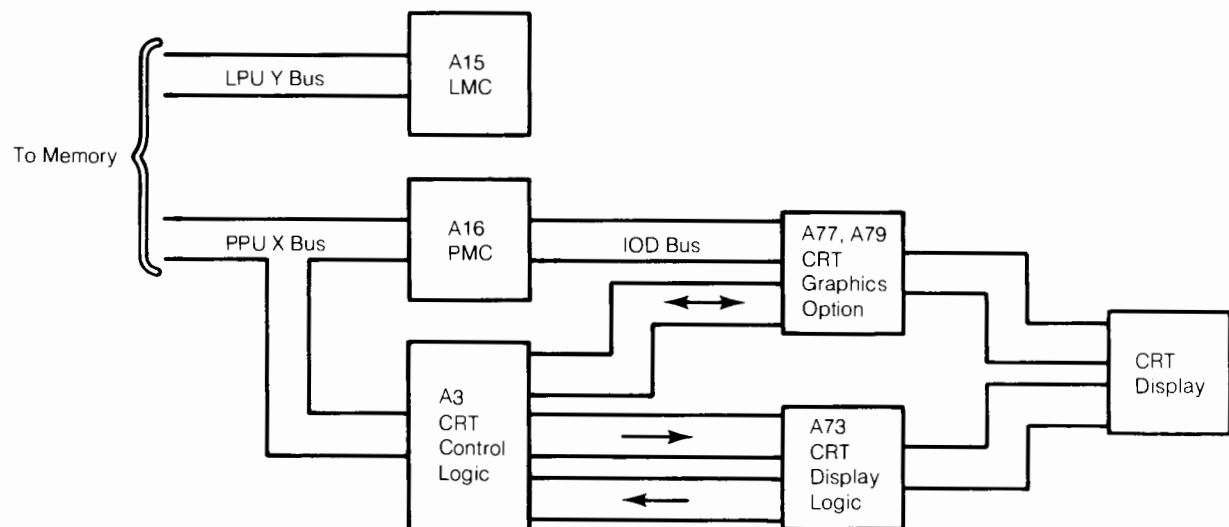
Figure 2-11:   Display Interface

Control Logic Assembly (A3)

The control logic assembly is the interface between the computer mainframe and the display. The control logic assembly reads memory, processes the data and decodes it to a form that the display can use. Each byte of data received represents a combination of features, an ASCII character or a control code. As each byte is processed, the data is placed into a 12-bit word. The first 8 bits contain the character code for the displayed character and the last 4 bits indicate if any highlighting features should be applied to the character.

Display Logic Assembly (A73)

The display logic assembly generates all the necessary timing signals required to display the data received from the control logic assembly. The display logic provides four signals to the CRT monitor, they are:

HS1	Horizontal sync 1 is the signal that starts horizontal retrace.
HS2	Horizontal sync 2 controls the horizontal waveform generator during retrace.
VR	Vertical reset is the signal that resets the vertical ramp generator.
V1	Video information is transferred on this line to the video amplifier.

The display logic receives two control signals from the control logic; full line buffer (FLB) and graphic select (GS).

The display logic sends three control signals; new page (NP), new line (NL) and new word (NW).

CRT Display (A72, A74, A75)

The CRT display circuits contain the horizontal, vertical and video driver circuits.

The video driver is basically an inverting level shifter which provides the large voltage swings (20 to 30 volts peak to peak) required at the cathode of the CRT to turn the electron beam on and off.

Video data comes from both the alphanumeric and optional graphics sections (V1 and V2 signals). In addition, the optional graphics section provides a two level brightness control signal (FB). Two cathode drivers with a common output are used to obtain the two levels of brightness. The intensity adjustment controls the output of the intensity supply.

The video multiplexer circuit sums the V1 and V2 video signals and sends the resulting video signal to the proper intensity supply.

The horizontal driver provides a modified ramp waveform to the horizontal deflection yoke to sweep the CRT electron beam in horizontal scan lines. Inputs to the horizontal driver are the HS1, HS2 and GS lines. The GS signal determines whether graphics or alphanumerics will be displayed. The horizontal driver uses this information to change between the two horizontal raster widths. The horizontal size control circuit controls the yoke current and thus the horizontal width.

Retrace generates a high voltage pulse (approximately 300 volts) which is used as the input voltage for the high voltage flyback transformer. The high voltages used to operate the CRT are derived from this transformer.

They are:

+12kV	anode voltage
+400V	first accelerator grid
0 to 400V	variable for focus grid
−15 to −85V	variable for control grid

A reference signal generator supplies an ideal sweep waveform which is compared to the actual sweep current waveform. The actual waveform can then be corrected. A current sense transformer provides the actual waveform for comparison. Any errors in the actual waveform are amplified in an error amplifier. During the display portion of a sweep cycle, a power amplifier uses the sweep current error signal to generate a correction voltage to correct the yoke current.

The vertical driver provides current to the vertical yoke to scan the display from top to bottom. The VR signal is used to synchronize the vertical retrace. The vertical ramp generator supplies a linear ramp voltage. The slope of this ramp is determined by the vertical size control.

The vertical drive amplifier uses the ramp voltage as a reference and uses feedback to control the current through the vertical yoke. The vertical yoke current is sensed in the vertical linearity correction circuit. The corrected output signal is compared to the ramp voltage at the input of the drive amplifier to modify the ramp voltage.

CRT Control Logic

TO A16 PERIPHERAL PROCESSOR UNIT

LINE BUFFER # 2

OUTPUT LATCH MULTI-PLEXER

CHA

HIG

PPU IDA BUS

BI-DIRECTIONAL BUFFER

MEMORY ADDRESS REGISTER

MEMORY DATA REGISTER

LINE BUFFER # 1

GRAPHICS

ENABLE BYTE 1
ENABLE BYTE 2
NWA
ENABLE SMC
DISABLE REG

BUFFER CLK
RECIRCULATE

ADD CLEAR
ADD LOAD

ENABLE DATA

ADD INC.

ENABLE ADD

DATA DECODER AND CONTROLLER

WORD SELECT

FLB

GS

*
GS

CONTROL BUS

COMPUTER INTERFACE AND SM CONTROL

STATUS BUS

START

STATE MACHINE

NW

NP

NL

9845A-J-51243

(ORIGINAL)
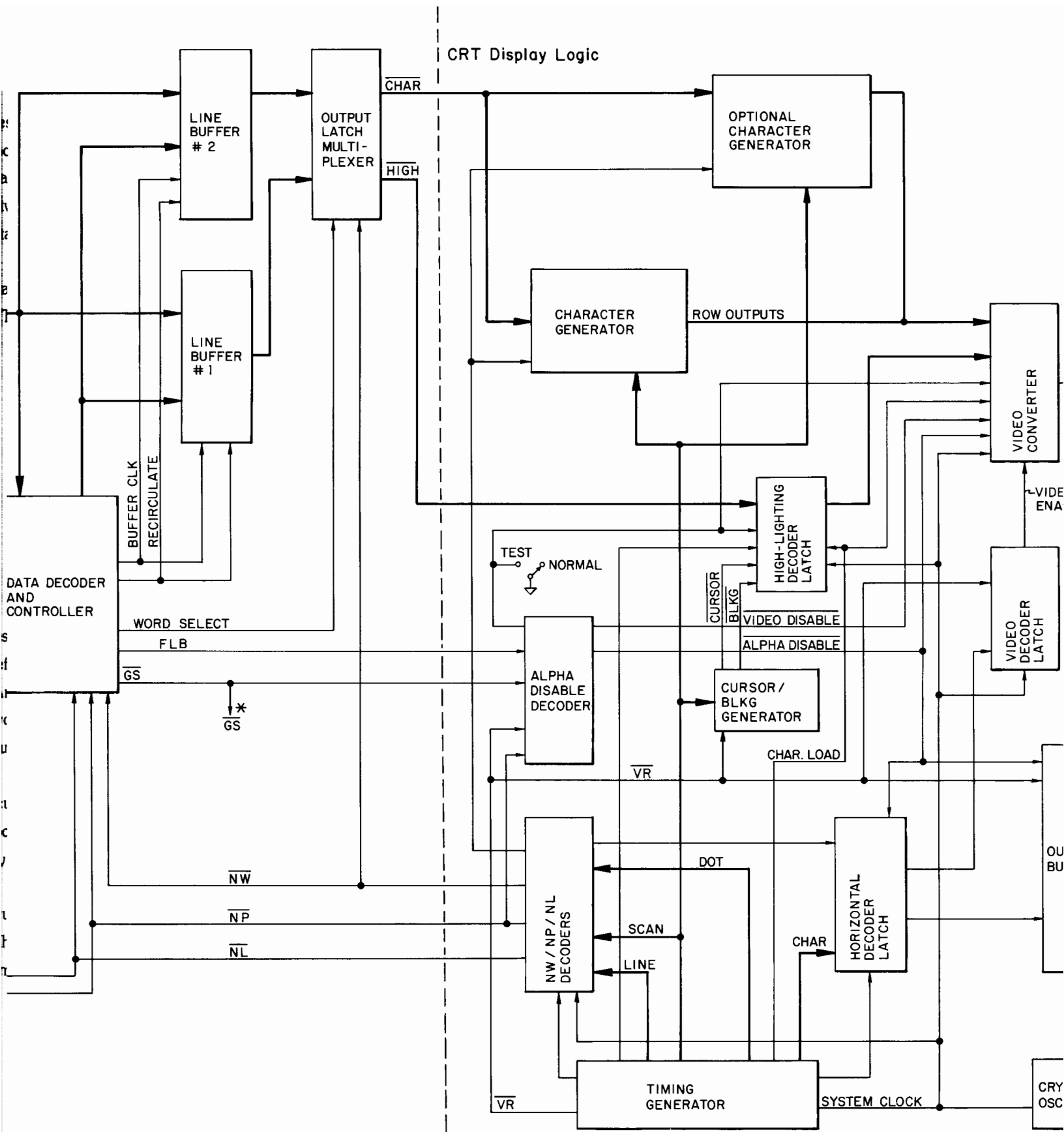
Figure 2-12: Display Block Diagram

CRT Monitor

INTENSITY
CONTROL

INTENSITY
SUPPLY

CRT

CATHODE

$\overline{FB}$
*

VIDEO
MULTIPLEXER

VIDEO
DRIVERS

V1

V2
*

VIDEO
CONVERTER

~VIDEO
ENABLE

+400V G2
−85 TO −15V GI
O TO+400V G4
+12KV ANODE

HIGH
VOLTAGE
SUPPLIES

VIDEO
DECODER
LATCH

*
HS1

HORIZONTAL
SWEEP
DRIVE

HORIZONTAL
SIZE
CONTROL

CURRENT
SENSE
TRANSFORMER

OUTPUT
BUFFER

$\overline{HS2}$
*

FET
SWITCH
DRIVER

HORIZONTAL
REFERENCE
WAVEFORM
GENERATOR

−

+

ERROR
AMPLIFIER

AUTO
LEVEL
CONTROL

POWER
AMPLIFIER

$\overline{VR}$
*

FET
SWITCH
DRIVER

*
G CLK

*$\overline{GS}$

VERTICAL
RAMP
GENERATOR

+

−

VERTICAL
DRIVE
AMPLIFIER

CRYSTAL
OSCILLATOR

VERTICAL
SIZE
CONTROL

VERTICAL
LINEARITY
CORRECTION

* INPUTS FROM A77 GRAPHICS SCANNER

K

Graphics Section

The graphics section consists of:

A4 09845-66504
Interconnect Assembly

Or

A55 09845-66555
Printer Drive

A77 09845-66577
Graphics Scanner

A79 09845-66579
Graphics Memory
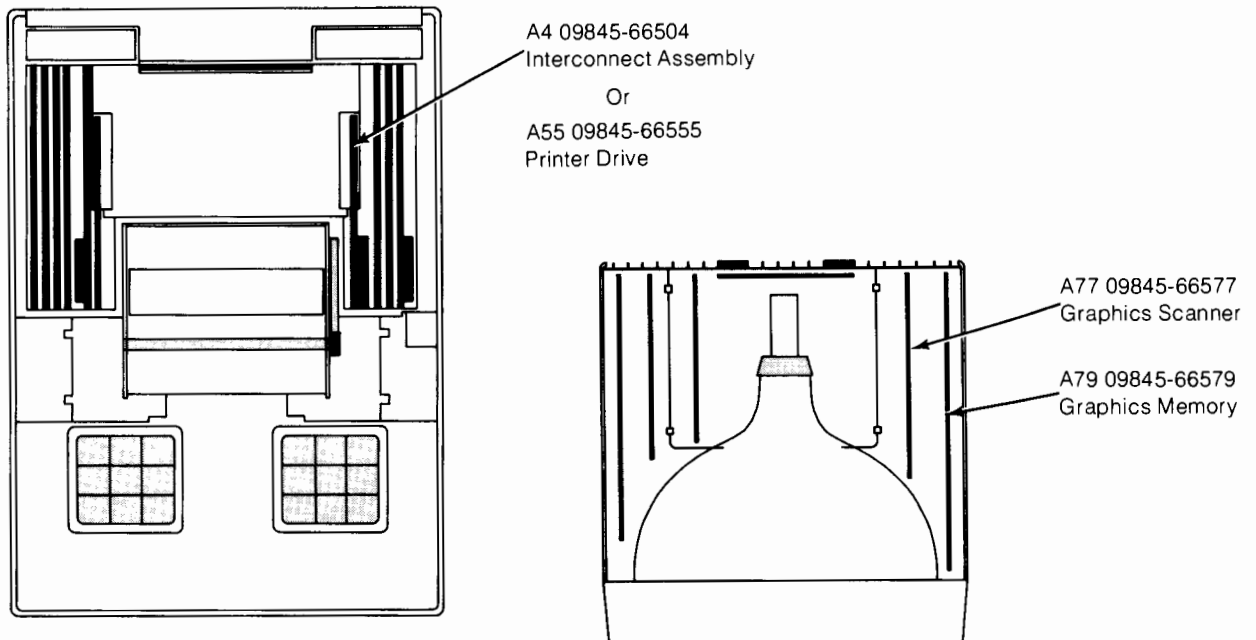
The A77 and A79 assemblies are exchange items, however you can change defective R/W ICs on the A79 assembly.

K5 CRT Graphics Test

This test checks the 32k-byte graphics memory and tests all the CRT graphics commands.

Press ⌤, the graphics memory test runs automatically. The test lasts about one minute. To exit the graphics memory test before it is completed, press (CONT). Errors in the graphics memory test are displayed, for example:

GRAPHICS (octal address) HAS (octal pattern) NOT (octal pattern)

When the graphics memory test is completed manual control of the cursor and display is enabled. Here is a description of the control features and the key to press for each feature.

⌫ Moves the cursor to the left

⌦ Moves the cursor to the right

⌤ Moves the cursor up

⌤ Moves the cursor down

NOTE

Pressing the above keys once moves the cursor one step. Pressing the keys all the way down moves the cursor ten steps at a time.

(B) A box outlining the graphics raster is displayed.

(C) Causes three different cursors to appear. One type is displayed each time (C) is pressed. Press (C) three times to view the cursors listed below.
The alpha cursor ($-$).
The graphics cursor ($+$).
The full screen graphics cursor.

(E) Clears the display. Pressing (SHIFT) at the same time clears the display faster.

(F) Fills the entire display with dots.

(G) Displays grid referenced from the current X,Y position of the cursor.

(L) Causes any function being performed to loop or be performed continuously until (L) is pressed again.

(P) Displays the cursor position on the display and the corresponding position in memory.
To continue press another key.

(R) Random pattern check.

(S) Skip a particular test. (exits the graphics test)

(STOP) Exits the graphics memory test.

(T) Begins the graphics memory test.

(W) Walking bit test.

(X) Places the cursor in the center of the display. (SHIFT) (X) moves the cursor off the display.

Press any key to continue after an error occurs.

To exit the test, press (STOP) once to stop the operation then press (STOP) again to exit the graphics test.

CRT Graphics Raster Size

To adjust the graphics raster use this procedure:

- Install the CRT alignment mask on the face of the CRT (if avalable).

- Remove the CRT top cover.

- Install the test binary cartridge and switch the power switch to on.

- Answer the questions and press k5 when its time to select a function key.

- Use the G-wide and G-high controls on the A74 assembly to align the edges of the inverse video to the graphics raster outline on the CRT alignment mask.

If the entire raster is not centered in the raster outline or if the raster is skewed in the raster outline, it may be necessary to reposition the centering magnet tabs located at the rear of the CRT yoke (see Figure 2-8). Figure 2-9 gives an example of improper centering magnet tab positioning.

WARNING

HIGH VOLTAGE IS PRESENT IN THE HIGH VOLTAGE CAGE. USE AN INSULATED TOOL SUCH AS A SOLDERING AID OR PLASTIC ALIGN-MENT TOOL TO MOVE THE TABS.

- Remove the high voltage cage cover to access the tabs and move as necessary.

NOTE

Moving the centering magnet tabs will also affect the alpha raster.

If the edges of the raster are not straight (i.e., the edges bow in or out in reference to the raster outline on the mask) the yoke's "pincushion" alignment is improper. Pincushion cannot be aligned in the field. If this problem occurs, the CRT/yoke assembly should be changed.

Figure 2-9 gives an example of bad pincushion alignment. The centering magnet tabs affect the pincushion alignment somewhat. Its a good idea to try to correct for minor improper pincushion alignment with the centering tabs first before replacing the CRT/yoke assembly.

- Reassemble the computer after the raster is aligned.

Graphics Memory

The graphics memory is located on the A79 assembly (see Figure 2-13).

- To determine which chip is bad, compare the two octal patterns that appear in the error display by decoding the 6 digit pattern into 16-bit binary numbers, for example:

Address HAS 017777   NOT 013777

Bit 11 does not compare

Bit Position ⟶	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
017777 Octal = 0	0	0	1	1	1	1	1	1	1	1	1	1	1	1		1	Binary
013777 Octal = 0	0	0	1	0	1	1	1	1	1	1	1	1	1	1		1	Binary

- If any bit position does not compare, that particular bit is bad. Use Figure 2-13 to determine which chip corresponds to each bit position.

- Other memory failures can occur that are caused by the graphics control logic located on the memory assembly. These failures are not as easy to locate.
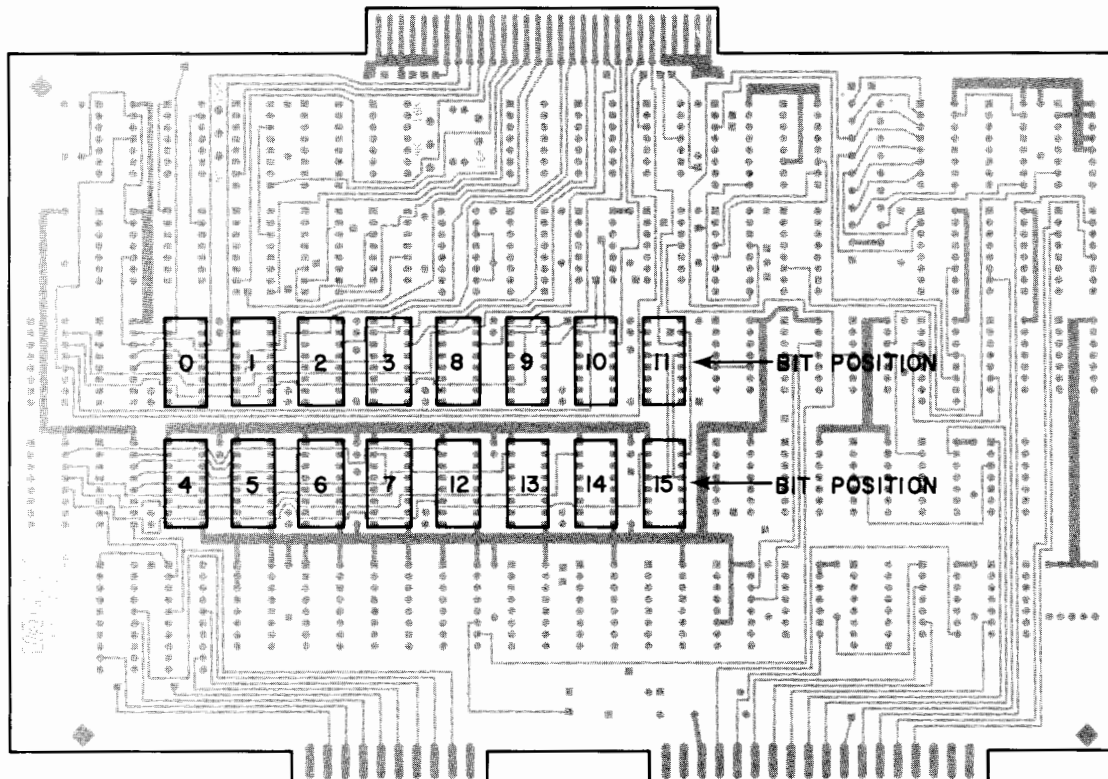
Figure 2-13: Graphics Memory Locations

Graphics Operation (A77, A79)

The 9845B graphics option is composed of two printed circuit assemblies which are installed in the CRT assembly. The graphics hardware includes a 256k-bit (32k-byte), bi-directional memory enabling images to be either displayed or printed on a printer.

The A79 control assembly controls all graphics operations and contains the graphics memory.

The A77 scanner assembly provides horizontal and vertical graphic raster scan signals and the graphics cursors. Refer to the graphics block diagram, Figure 2-16.

Communications between the graphics and the computer's PPU take place via the I/O bus. The GPIO decoder on the A79 assembly takes care of the I/O bus handshake and select code decoding. Control codes from the computer are received by the control code register. The code in this register defines the graphics operation to be performed. The control code is sent to the controller which executes and provides the proper state sequences for each operation. Here is a list of the graphics operations.

- Y load (graphics cursor)

- Y load (full screen graphics cursor)

- Y load (alpha mode cursor)

- X load

- Mass write

- Mass read

- Graphic load

- Memory clear

Before describing the various operations, here is a brief discussion of the graphics memory. The following figure describes the relationship of the graphic memory address to the CRT dot location.

The graphics raster is 560 dots across and 455 dots vertically. Each bit location in the graphics memory corresponds to a dot on the CRT display. Any X, Y location on the graphics raster can be converted to a word address as follows:

Word Address $-$ 36Y + integer (X/16)
Bit Address $-$ remainder of (X/16)
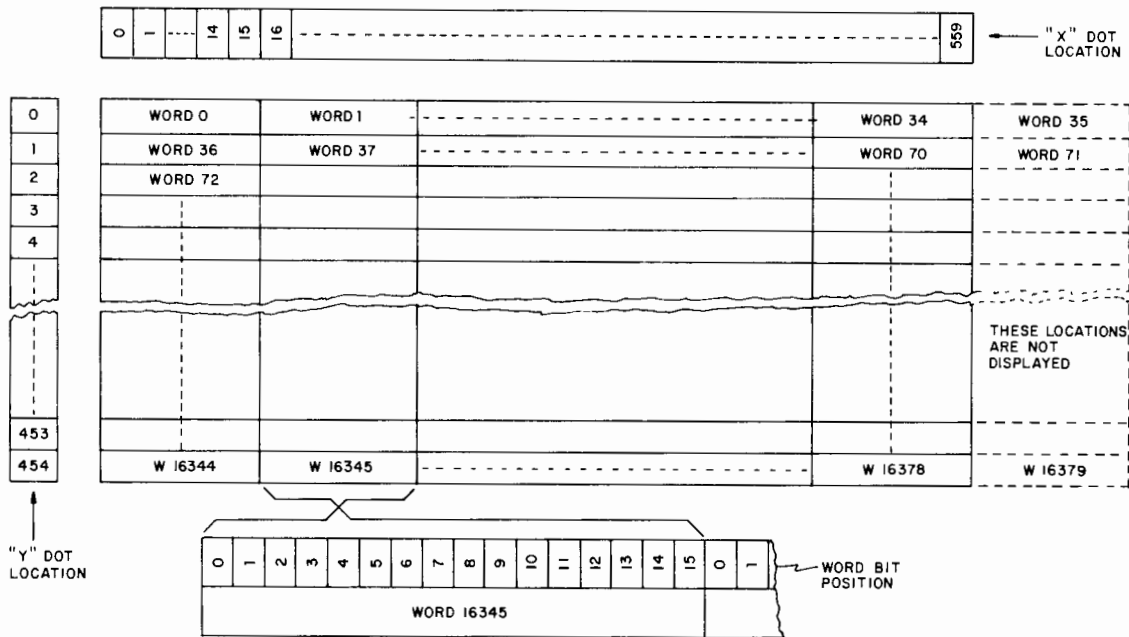
Figure 2-14: Graphics Memory Map

Conversely if the word address and bit address are known:

The Y location = integer (word address / 36)
The X location = 16 (remainder (word address / 36)) + bit address.

The X range is from 0 through 559 and the Y range is from 0 through 454.

A graphic load operation loads individual bits in the graphic memory without modifying the rest of that particular word. Each bit to be modified is represented by two data words from the computer. The first word is the ones complement of the word address and the second word is the bit address and the value of the bit as shown below.
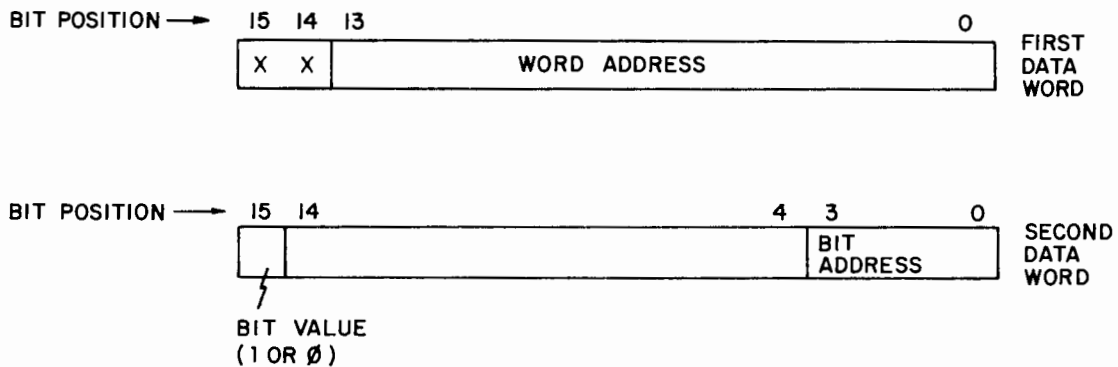
Figure 2-15: Graphics Word Addressing

A mass write operation entails loading data words from the computer starting from a specified memory address. The mass write control code initiates the operation in the graphics controller. The first data word is interpreted as the starting word address in the memory address multiplexer. No bit address is used in this operation since full 16 bit words will be loaded. Subsequent data words are loaded into sequential addresses following the starting address.

A memory clear operation works the same way as the mass write operation except that after the first data word (starting address) the data is ignored and zeros are written into the memory locations instead.

A mass read operation requires some extra effort to load the starting address. First, a mass write control code must be issued along with one data word representing the starting address. Immediately after the starting address is given, a mass read control code must be sent. Data is read from sequential locations in the graphics memory beginning with the starting address.

There are four cursor operations. The X load loads the X cursor address. The three Y loads load the Y cursor address. The difference between each of the three Y loads is the resulting cursor image. The three cursors are:

- A small blinking cross hair with the horizontal and vertical lines each being nine dots long.

- A large non-blinking cross hair with the horizontal and vertical lines spanning the entire raster.

- A blinking horizontal line (alpha cursor) nine dots long.

The X and Y cursor addresses define the center or crossing dot of the cross hair cursors and the midway dot the alpha cursor.

The horizontal counter is used to generate the horizontal sweep signals (HS1, HS2). Similarly, the vertical counter is used to generate the vertical sweep signals.

The blink counter is operated by a signal from the vertical decoder. The blink counter, oddly enough, causes the cursor to blink. Note that the full scale cursor does not blink.

The DSP signal indicates to the controller when a display cycle can occur. DSP is low during retrace and high to indicate a display cycle. It should be noted also that when DSP is low (retrace), I / O data can be loaded. During a display cycle, the graphics memory is read one word at a time and sent to the parallel to serial register. The parallel to serial register converts the 16-bit memory words into a serial bit stream (GD) which is sent to the video-cursor mixer. The output of the mixer is the graphics video signal. The intensified video signal (I) is used to brighten the cursor on the display.
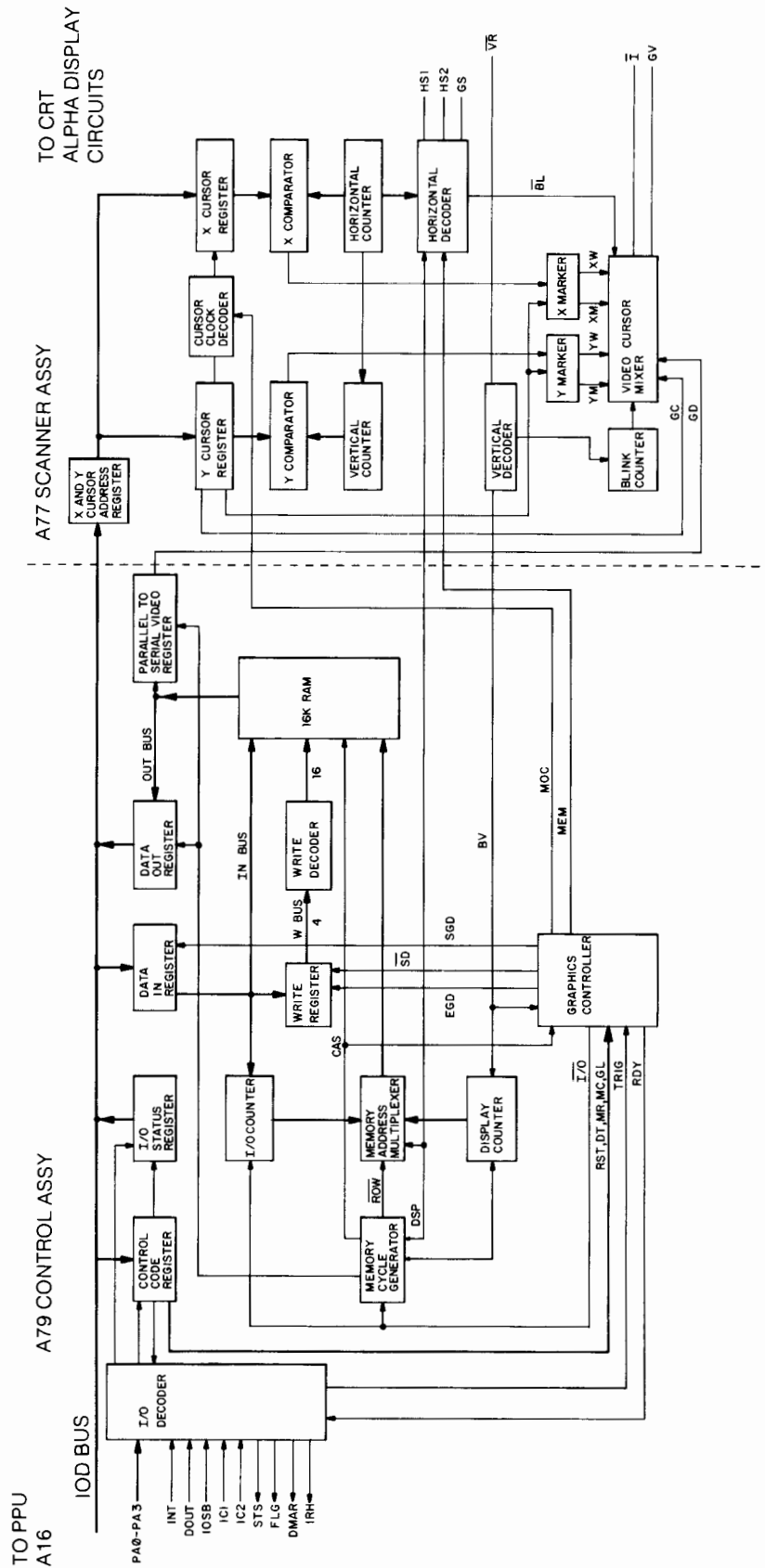
Figure 2-16: Graphics Block Diagram

Keyboard Section

The keyboard section is made up of the following assemblies, all of which are attached to the keyboard bezel.

Keyswitch Assembly
09845-67155

A5 09845-66505
Bezel Interconnect

A32 09845-66532
Keyboard Logic
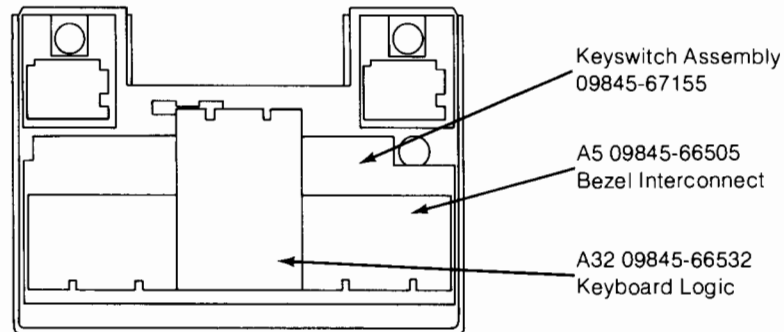
The A32 assembly is an exchange assembly, the 09845-67155 Keyboard assembly is repaired by changing the key caps and key switches.

The A5 assembly is to be replaced but not returned to the factory.

K1 Keyboard Test

This test is used to check all the keyboard keys and features for proper operation.

Before starting the test, all double-position keys like PRT ALL, AUTO ST and SHIFT LOCK must be in the up position.

Press K1;

If any of the double-position keys mentioned above are down, the display will tell you to release that key and then to press A.

If all the double-position keys are up, the CRT displays:

```
WHICH KEY TO START
   TO END PRESS +
```

Press the key that you wish to start the test with. Any key shown below may be selected. The display tells you which key to press next.
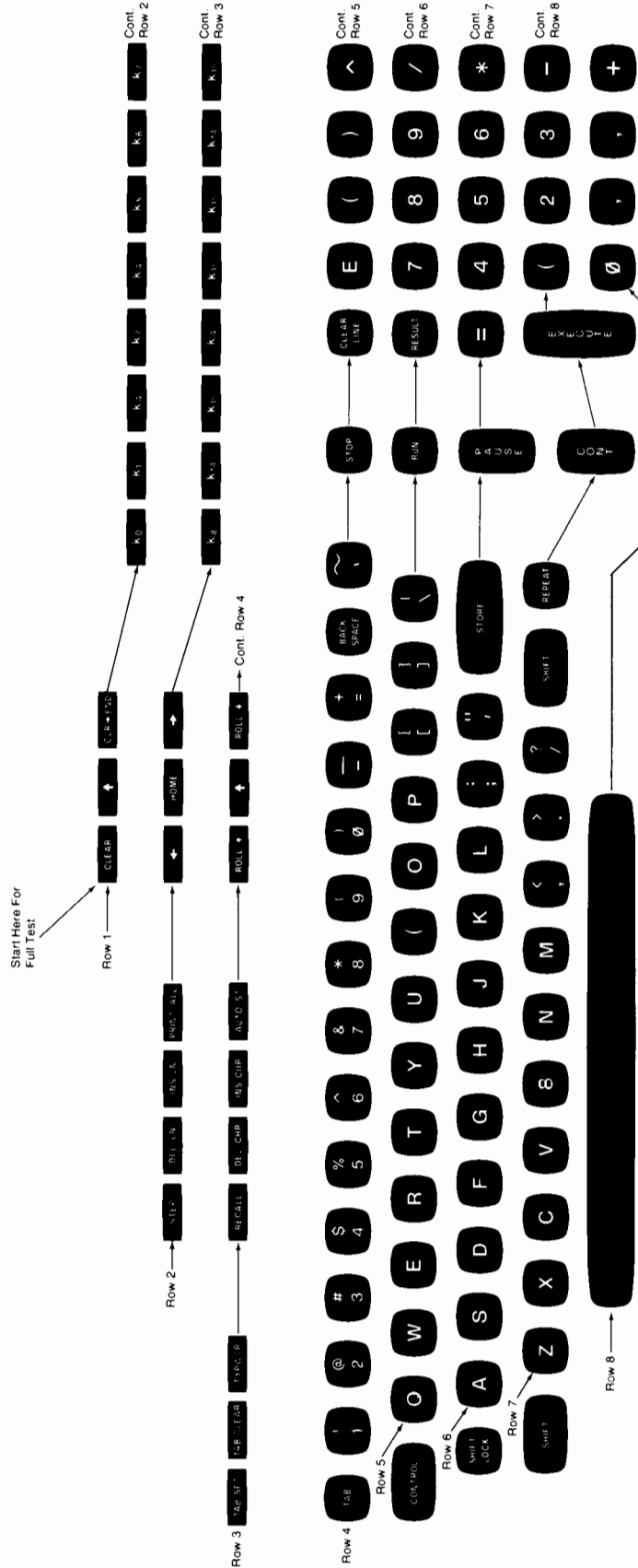
Figure 2-17: Keyboard Test Sequence

After selecting a key to begin, press the keys in the sequence shown above. To end the test press the ⊕ key. A bad key or a key pressed out of sequence will result in a beep and a message describing the key pressed in error. The key sequence described in Figure 2-17 can be used for any keyboard option although the key caps and characters will be different.

If the spacebar is pressed as the first key, the test starts with the special keys (i.e., ⌨CONTROL, ⌨SHIFT LOCK, ⌨SHIFT).

If a bad key is found, restart the test and continue with the key after the bad key to test the rest of the keyboard.

The ⌨⌨⌨⌨ keys have to be pressed lightly and then pressed down fully. Pressing the arrow keys down fully will check the repeat function of these keys. A continuous beep should be heard when these keys are fully depressed.

Test the ⌨REPEAT key by pressing a key and the ⌨REPEAT key at the same time. A continuous beep should occur.

Keyboard Troubleshooting

Bad keys indicated in the test ROM keyboard test can be isolated to either a bad key switch or bad column and row logic on the A32 assembly. If a key switch is bad, usually no other keys will be bad and the key switch can be replaced using procedures in Chapter 3.

If a row or a column is bad, all the keys in a particular row or column will appear bad. Figure 2-18 shows the row and column for each key. If a row or column is bad, the cause is usually the A32 assembly.

The numbers above each key indicate the row and column of the key. The first number is the key row and the second number is the key column.
Double depression keys also have numbers below the keys.
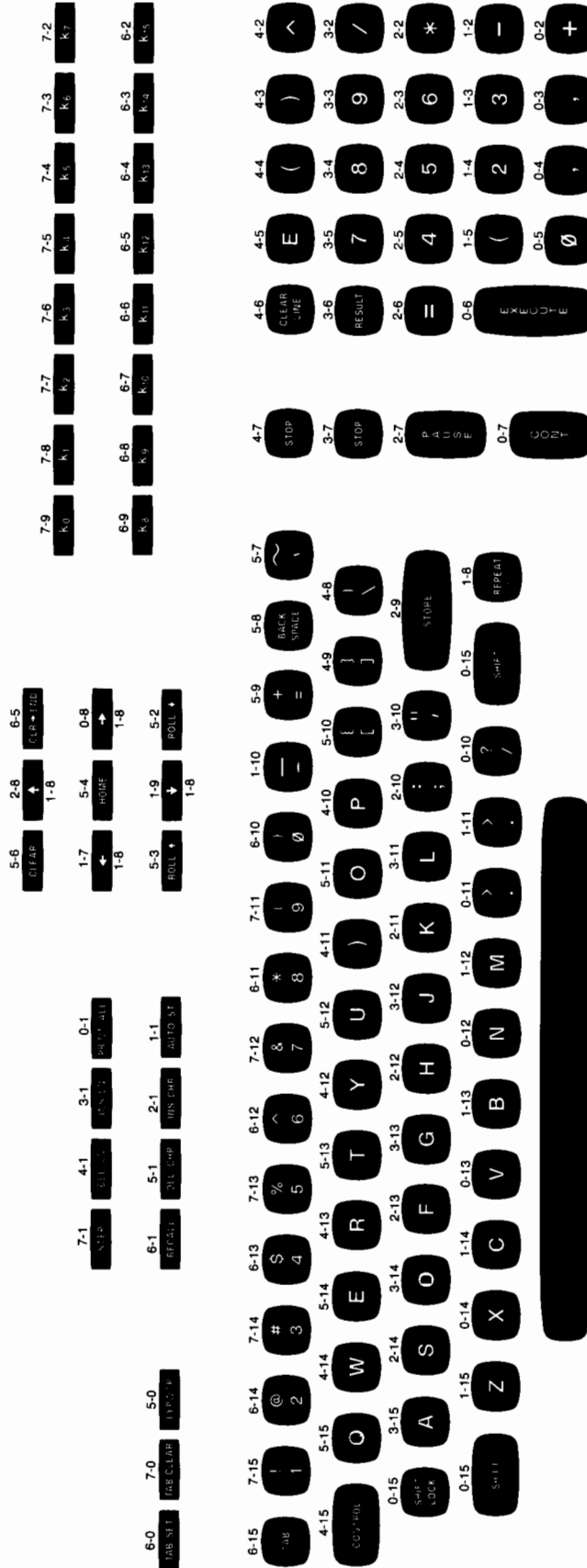
Figure 2-18: **Keyboard Rows and Columns**

Keyboard Theory

The keyboard is the primary input device to the computer and allows the user to control the computer. When a key is pressed, the keyboard generates a switch code, status information and an interrupt bit to the computer. One feature of this keyboard is the n-key rollover; that is, a character is entered from the keyboard when the key is pressed regardless of the present or previous state of any data key on the keyboard. A data key is any key except shift, shift lock, control and auto start; these are status keys.

Keyboard Operation

Here is a basic description of the keyboard operation. Refer to Figure 2-19, the keyboard block diagram.

The heart of the keyboard is a keyboard encoder integrated circuit capable of addressing 128 keyboard keys, interrupting when a key is depressed and implementing the n-key rollover feature. This circuit also generates clock signals for the data and status latch.

The row/column enable decodes a seven bit address of a key into column and row information to the scan counter. It also provides proper timing for the key column current pulse from the column drive circuit.

An analog amplifier is used to amplify the key sense pulse to a TTL level, to prevent multiple key entries and to gate the key signal when the key is valid.

The special key decode circuit determines if the pressed key is a special key. The special keys are defined as shift, control, auto start, repeat, stop and print all.

The keycode from the scan counter or the special key decode circuit is applied to the data and status latch and gated (when the computer reads the latches) to the computer on the IOD lines.

When a key is pressed, a pulse from the strobe generator is applied to the interrupt generator which will pull the IRL line low. This line indicates a low priority interrupt to the computer. IOD0 is also pulled low to indicate that device 0 (keyboard) is interrupting. The repeat generator causes the same interrupt, only it will be repeated at the rate of 18 interrupts per second.

The halt flag circuit is set when the stop key is pressed. The halt signal is sent directly to the computer. When the control key is pressed along with the stop key, the INIT signal and the halt signal are sent causing the computer to reset to its power up state. This is a keyboard reset and not a power up reset (memory is saved).

The peripheral address and register decoder decodes the PA lines to determine if the keyboard select code (0) is being sent. The IC1, IC2, DOUT and DAV lines are decoded to determine what action the computer is expecting the keyboard to perform (i.e., output keycodes or input beeper signal).

The signal to sound the computer's beeper is input to the keyboard through the data-in latch. The beeper outputs a 640Hz tone to a speaker mounted on the keyboard assembly.
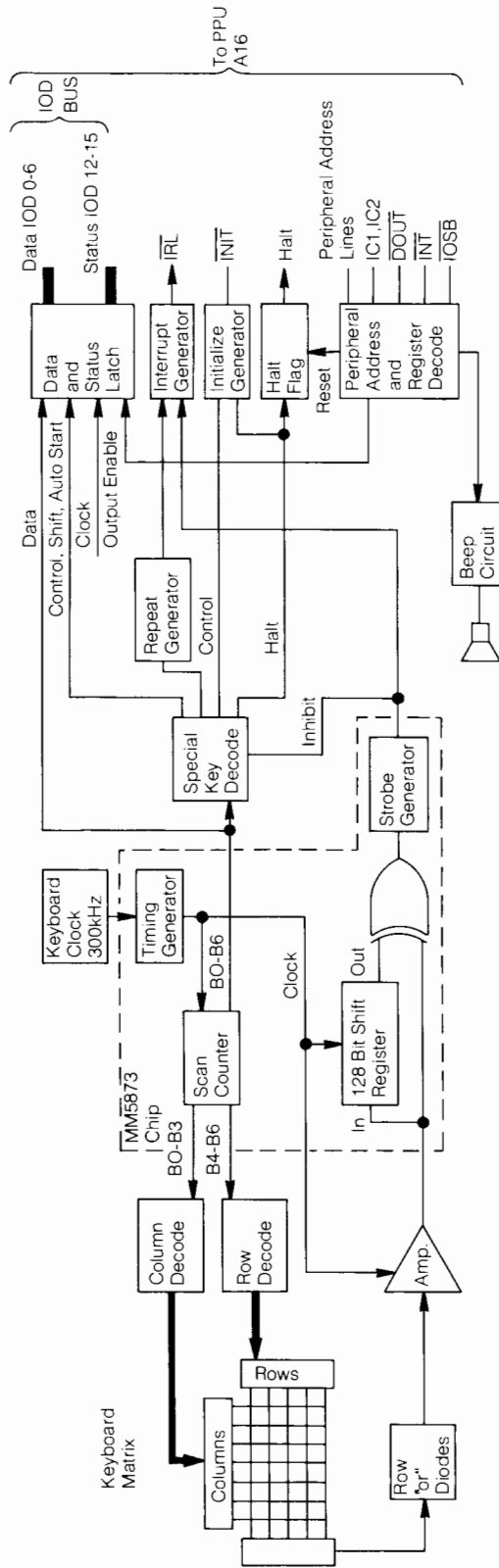
Figure 2-19: Keyboard Block Diagram

Cartridge Drive Section

The cartridge drive section contains the following assemblies:

09845-67962 Standard Cartridge Drive	09845-67962 Optional Cartridge Drive
A61 09845-66561 Standard Cartridge Drive Logic	A61 09845-66561 Optional Cartridge Drive Logic
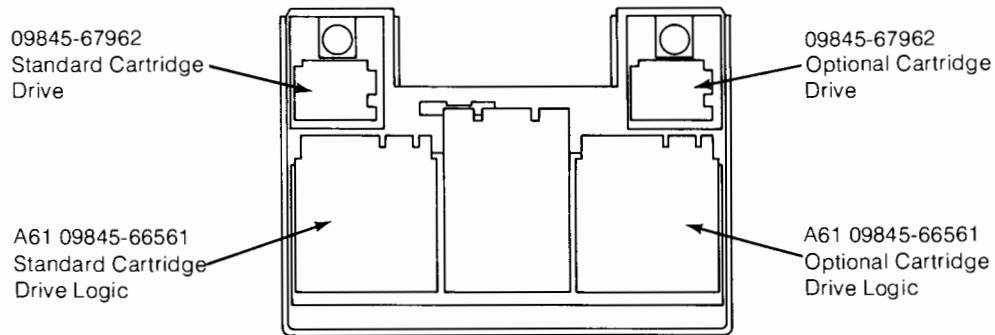
Both assemblies are exchange items.

K2 Cartridge Drive Exerciser

This test checks the ability of the cartridge drive to read and write data on tape and verifies the drive functions.

Before starting the test, install an unprotected blank cartridge in the cartridge drive you will be testing.

Results of the cartridge drive exerciser along with the memory test are displayed by pressing ⌷k6⌷.

Pressing (stop) at any time during the test exits the cartridge drive exerciser.

Press ⌷k2⌷; if two cartridge drives are installed, the CRT displays:

$$\text{WHICH TRANSPORT (S/O)?}$$

S = standard (right-hand side)
O = optional (left-hand side)

Press either (S) or (O).

NOTE

If only the standard cartridge drive is installed, the first question is skipped.

Then the CRT displays:

```
SELECT TEST ROUTINE? (Y/N)
```

If (N) is pressed, the exerciser is run. The exerciser does the following:

- Rewinds the tape

- Initializes the tape

- Writes 16 records on each track

- Verifies the records

- Reads the records

An error causes the test to stop. The following conditions are checked and errors are displayed if they occur.

- Cartridge out switch

- Write protect switch

- Tachometer pulse failure

- Servo Failure or hole error

- 9845A tape format

- No contact (electronics not connected)

- Tape not initialized

- Record not found

- Checksum error

- Verify error

If (Y) is pressed a test mode is established and TEST? is displayed on the CRT.

In this mode pressing certain keys on the keyboard initiates different cartridge drive tests.

CAUTION

THE TAPE CAN BE UNSPOOLED BY USING THE KEYS ASSOCIATED
WITH THE (M) KEY.

Here is a description of the tests and the key to press to initiate each test.

(R) Rewinds the tape

(W) Writes a continuous pattern on the tape. A message is displayed:

ENTER PATTERN FROM KEYBOARD

Enter a 6 digit octal number in the range of 000000 to 177777. After a pattern is selected the tape rewinds and the pattern is written.

(C) The entire tape is read forward and reverse (continuously).

(L) sets a low threshold

(H) sets a high threshold

(STOP) stops operation

(M) Enables you to move the drive motor.

results in slow reverse tape motion (pressing twice or fully down results in fast reverse motion).

results in slow forward tape motion (pressing twice or fully down results in fast forward motion).

(HOME) pressing home once stops tape motion.

(STOP) stops the test.

(T) Starts a turn-on test which checks the cartridge drive control and logic circuits.

(E) Runs the exerciser described earlier when (N) was pressed after SELECT TEST ROUTINE? (Y/N) was displayed. This stops on an error. Press (CONT) to continue the test.

If errors occur;
The problem can possibly be the A61 or the transport assembly.

Tape Cartridge Drive (A61)

The tape cartridge drive assembly performs numerous operations. Here is a list of the major functions:

- Controls the drive motor (fast, slow, forward, reverse, stop).

- Controls tape acceleration and deceleration.

- Reads data from and writes data on tape.

- Double buffering of data words.

- Precompensates bits when writing.

- Synchronizes the bit pattern read from tape.

- Calculates a checksum during a read or write.

- Writes gaps and counts gaps on tape.

Refer to the tape cartridge drive block diagram, Figure 2-20.

A large scale integrated circuit acts as a cartridge drive controller and interfaces the rest of the cartridge drive circuits to the computer processor (PPU). Cartridge drive instructions and data from the PPU are input to the cartridge drive controller. Data read from tape and status information are sent to the PPU from the cartridge drive controller.

Magnetic Recording

Information is stored on the tape by causing the magnetic alignment of the tape surface to change direction at specified points along the tape.

Changes in magnetic alignment are called "flux reversals". The cartridge drive uses a differential distance coding scheme to distinguish one bits from zero bits. A one bit is nominally 1.75 times the length of a zero bit, where the length of a bit is the distance between flux reversals. A threshold value to distinguish one bits from zero bits is set at 1.33 times the nominal length of a zero.

Because of the high bit density written on the tape (up to 1600 flux reversals per inch), the bit lengths approach the size of the magnetic head gap. Thus when reading, the flux lines of the bits on either side of the current bit influence the apparent length of that bit.

This bit interaction is compensated for during the write operation by lengthening or shortening (precompensating) bits from their nominal length according to the current bit and the bits on either side of it. Precompensation therefore compensates for bit interaction encountered by the magnetic head during a read.

Read reliability is also increased by constantly updating the threshold value based on the bit length of the bits currently being read. This also allows tracking of tape speed variations.

Servo Control

Controlled tape acceleration and deceleration occurs from 2 inches / second to 90 inches / second at a rate of 1200 inches / second per second. The frequency feedback signal (FF) controls the servo. There are 968 pulses from the tachometer for every 1 inch of tape. At slow tape speed FF equals 21276Hz (21.98 inches / second) and at fast speed FF equals 87196Hz (90.08 inches / second). The GO signal is used to clamp the servo drivers when the tape is stopped. When the tape has decelerated to 2 inches / second, GO will stop the tape completely. The tape remains stopped until another tape movement instruction is given.

The SIGN and DA0 through DA4 signals provide sign and speed error magnitude signals to the motor drivers.

The digital-to-analog converter converts the DA0 through DA4 line codes into current values.

When either the INIT or GO signals are low, the drive circuits are turned off. This eliminates tape creeping during power-on, power-off or when the tape is supposed to stop.

When writing data, the read / write control circuits isolate the read circuit from the magnetic head, and the WDT signal changes the direction of the current to write the data.

Data read from tape is amplified and applied to a low pass amplifier which provides a signal gain and reduces high frequency noise.

The threshold detector detects signals from the head that are greater than the threshold set by the cartridge drive controller.

The differentiator differentiates the magnetic head signal to detect the peak of the signal. The threshold detector enables a zero-crossing detector to determine the exact point of flux reversal.

Phototransistor detectors are used to sense tape holes (HOL), write protect (WPR) and tachometer pulses. A switch is used to determine if a cartridge is installed (CIN).
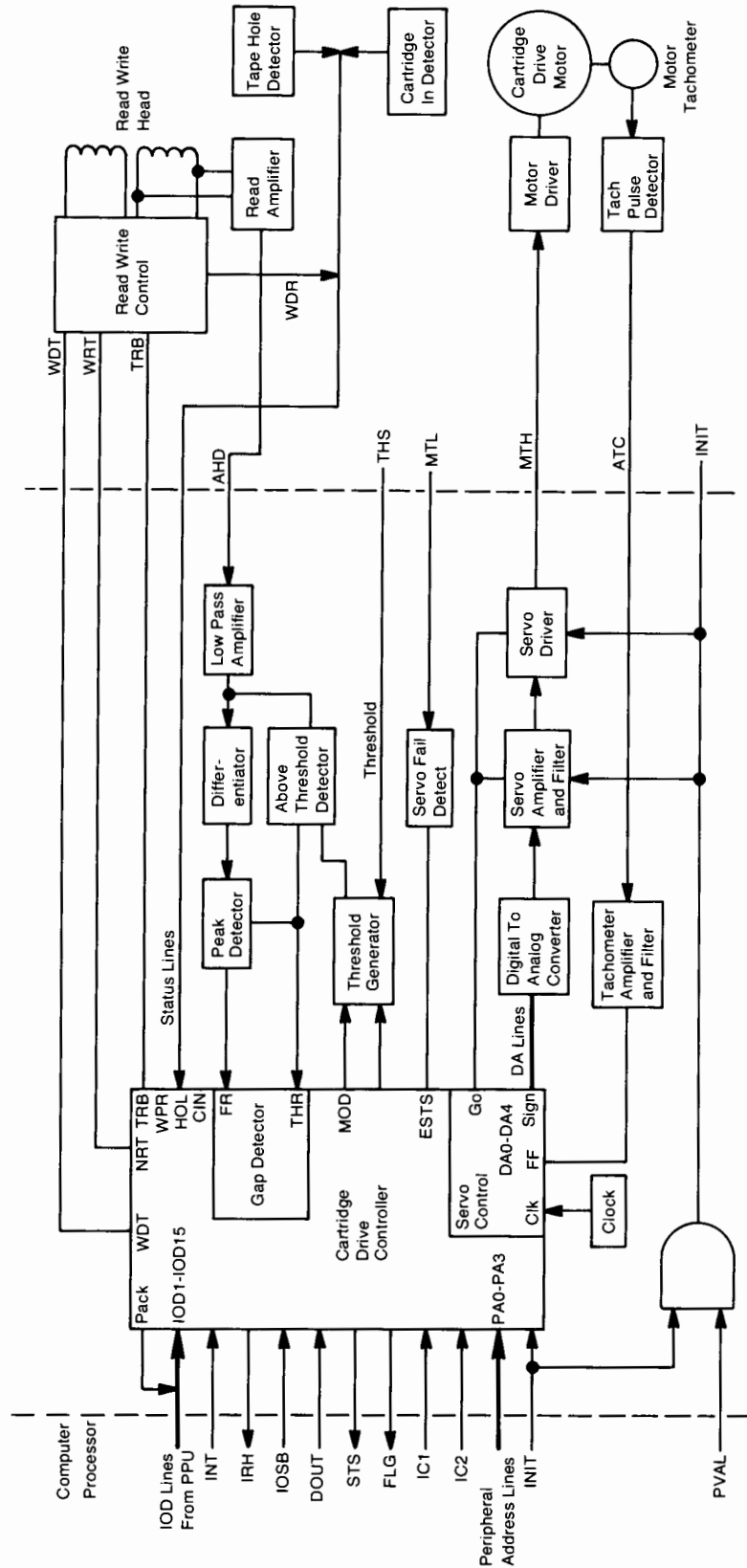
Figure 2-20: Tape Cartridge Block Diagram

Printer Section

The printer section contains the following assemblies:

A55 09845-66555
Printer Drive

A51 09845-66551
Printer Logic

09845-67951
Printer Bucket Assembly
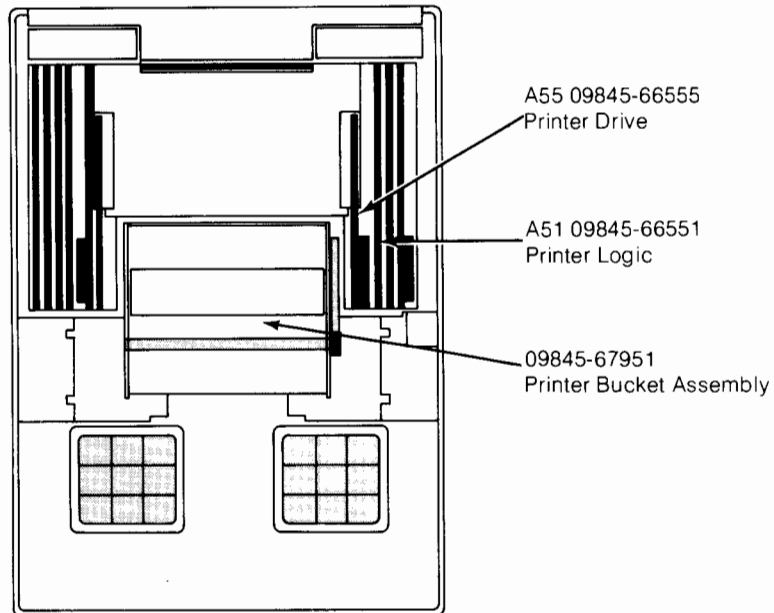
The A51 and A55 assemblies are exchange assemblies. The printer bucket is repaired to a component level. Exploded view drawings are provided at the back of this manual.

K3 Printer Test

This test checks the printer logic circuits and provides a printout to check for missing dots, print intensity and character alignment.

Press ⬜, if paper is loaded in the printer the following printout occurs;

```
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
```

```
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~
```

UNDERLINE

```
+++
Normal Big XX) XXX)), BIG,Normal 123

++Nor XX) XXX)), BIG,Normal 123
```

CARRIAGE RETURN

When the printout is completed, the CRT displays:

PRESS STOP TO EXIT
ENTER CHARACTER

At this point you can select a character to be printed for alignment or intensity purposes. 80 character rows of the selected character will be repeated until ⬚ or ⬚ is pressed.

Here is an example printout when the ⬚ Z ⬚ key is pressed.

```
ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
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ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
```

If you wish to change the character that is being printed, simply press the desired key.

Pressing ⬚ whether a character was selected or not, ends the printer test.

Pressing ⬚ stops the printing; entering a character will begin printing again.

If a non-character key is pressed, E's are printed.

If the ⬚ key is pressed, all dots are printed.

When printing the characters, the default page length of 70 lines is used.

Printer Troubleshooting

It is somewhat difficult to isolate some printer problems. A particular problem may be caused by any one of the three printer assemblies (A51, A55, print head assembly). There are some general problem areas that will indicate a particular assembly. Here is a summary of the general problems associated with each printer assembly.

A51 Hints

- Its the easiest to replace and has the most logic.

- Responsible for data conversion problems (e.g., "A" sent to printer and "a" or other character printed.)

- Responsible for random and unrelated dot patterns being printed instead of desired characters

A55 Hints

- Responsible usually for big failures, paper won't move, nothing printed, etc.

- Check the head protection circuit LED on this assembly. If light is lit, printer is disabled.

Print Head Hints

Symptom	Probable Cause
Missing Dots ◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀◀ pattern of test printout	1. Defective chip module 2. Defective print head resistor 3. Defective connector
Extra dots ‹ ‹ ‹ ‹ ‹ pattern of test printout	1. Short on chip module 2. Short on print head resistor
Cyclical light spots in print field - usually 1¾ inches apart vertically	1. Poor print head adjustments 2. Defective platen
No burn, non-uniform burn or random dots affecting part of the print field.	1. Chip module failure 2. Flexible connector failure

---

NOTE

Each chip module is used to produce 80 dots. Thus errors in an 80 dot section can indicate a chip module failure.

Head Protect

If the head protect LED on the A55 assembly is lit, the printer is disabled. See the A55 theory of operation for disabling conditions.

A "one time" printer disable problem can be corrected by pressing paper advance, top of form or (CONTROL) (STOP).

Printer Print Intensity

Print intensity is adjusted by positioning the print head via two adjustment cams. The top cover and keyboard will have to be removed to access the cams.

One is located on each side of the print head assembly as shown in Figure 2-21.

Print
Intensity
Adjustment
Cams

Left Side

Right Side
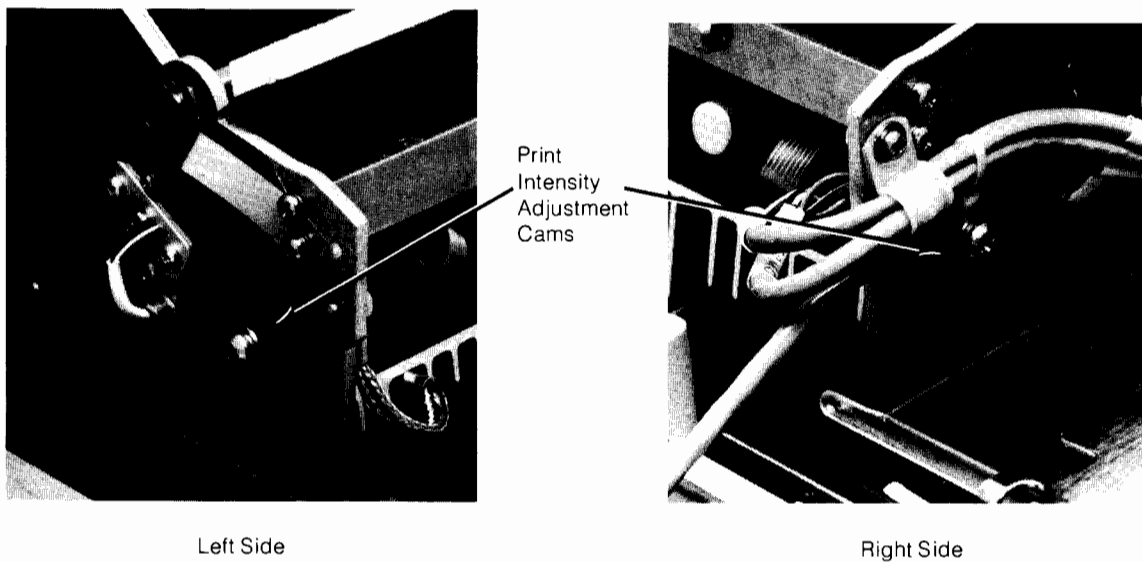
Figure 2-21: Printer Adjustment

Install the test ROM drawers and run the test ROM printer test. While the printer is printing rows of "E" characters, loosen the locking screw on each cam and rotate the cams until the best printout over the entire print line is achieved.

Tighten the locking screws and recheck the print intensity. Reassemble the computer.

Thermal Printer (A51, A55, A53)

The optional thermal printer allows "hard copy" output of data and program listings. The printer can print 80 characters per line or 560 dots per row when plotting.

The printing speed is 3 to 8 lines per second depending on the number of characters per line. When plotting, 11 to 77 dot rows per second can be printed; again, the speed depends on the number of dots per row.

The printer has 256 characters in its character set. Characters are printed in a 5 x 7 dot matrix with an additional row for ascending characters and two additional rows for descending characters. The printer can perform underlining and can print characters that are 150% of normal size. Thermal paper 8½ inches or 21cm wide can be used.

The printer consists of the A51 and A55 pc assemblies and the printer bucket assembly which contains the print heads and the A53 assembly. Refer to the printer block diagram, Figure 2-22.

A51 Printer Control Logic Assembly

The A51 assembly interfaces the printer to the 9845B

Here is a summary of the major A51 assembly functions.

- Receives ASCII character codes from computer (8-bit latch).

- Provides printer status information for the computer.

- Controls all printer operations (nanaoprecessor).

- Contains the nanoprocessor routines (16k program ROM).

- Contains character bit patterns (16k character ROM).

- Stores character codes to be printed (256 byte RAM).

- Stores dot patterns for new defined characters (256 byte RAM).

- Stores replacement character strings (256 byte RAM).

Data Input
Any time the computer sends a byte of data to the printer it is latched into the 8-bit latch. When the proper control logic states exist, the nanoprocessor reads the data character code. At this point the nanoprocessor program will read the RAM to determine if any new characters or replace characters have been defined for the data character just read. If a new or replace character exists, the address of the new character is stored in the RAM address buffer. Assuming no new or replace characters are found and the character can not be executed immediately, the character is stored in the RAM at the next available location. Any control bits for that character (e.g., underline, tab, new character) are stored in the next location in the RAM.

The A51 assembly continues to accept data bytes until one of the four following conditions occurs.

- Receipt of a linefeed command.

- Receipt of a character other than a linefeed after a carriage return.

- Receipt of the 81st printable character.

- Receipt of a carriage return while in display functions mode.

When one of the aforementioned conditions occurs, the contents of the RAM's print buffer will be printed.

Printing
When a print cycle is initiated, the nanoprocessor with the help of the program ROM, determines if there is enough space to print the present line in the already defined rows per line. The nanoprocessor's program can advance or back-up the paper the correct number of rows through the STEP F and STEP R signals. Next, the nanoprocessor's program starts to scan the print line. During the scanning, the character codes for the print line and any control bits are read from the RAM and stored in the nanoprocessor and the 8-bit shift register. The appropriate dot pattern for each character is read from the character ROM. The dot patterns for new characters are read from the RAM. The dot patterns are loaded into the 8-bit shift register where they are sent serially to the print head assembly (BSD line) to form a dot row.

The LOAD signal causes the print head to latch the dot patterns into the print head drivers. Once the dot patterns for a particular dot row are latched, the BURN signal enables the dot row to be printed. No more than 62 dots are burned at one time; therefore it may take several burns to complete a single dot row.

After each dot row of a line of characters is printed, the nanoprocessor program steps the paper to the next row. When the last row of a character line has been burned, the nanoprocessor steps the paper to the first dot row of the next character line.

Plotting

When using the printer for dot plotting, the nanoprocessor's program accepts 70 bytes (560 dots) of data and stores them in the RAM buffer. After the 70th byte, the nanoprocessor program automatically burns the dots corresponding to the bits just read in. When plotting, the character ROM is not read since the dot pattern corresponds to the 70 bytes in the RAM buffer.

NOTE

When printing characters the RAM print buffer is scanned 8 to 12 times, once
for each row. When plotting, the RAM print buffer is scanned only once.

A55 Motor Control Assembly

The A55 assembly performs the following functions:

- Drives the printer motor.

- Models the print head resistor temperatures and controls the BURN signal.

- Provides drivers for all other print head signals.

- Senses print head fault conditions and disconnects power to protect the print head in a fault condition.

The printer's stepper motor has a permanent magnet armature and two center tapped field coils. The motor has 200 major steps per revolution. The motor controller receives MOTOR, STEP F and STEP R signals from the A51 assembly. These signals are then translated into motor movement commands.

The burn controller produces the steady state burn temperature quickly and holds it for a given burn time. An analog feedback circuit is used to control the print head resistor temperature. The feedback works like a basic house furnace controller; however, in this case only the analog voltage is sensed.

Conditions can exist which will cause the print head resistor temperature to rise too high. A high temperature condition may destroy the print head or driver chip modules.

A head protect circuit on the A55 assembly is used to protect the print head and print head drivers. The protect circuit attempts to ensure that:

- The print head signals are not locked up at the print head.

- A print resistor does not burn twice on a single row of dots.

- The burn control modulates the burn signal.

When an error condition occurs, the protect circuit disconnects the +12 volt and +13 volt supplies from the print head. An I/O error on device 0 is also indicated. An LED on the A55 assembly will light when the head protect circuit has disabled the printer.

In case the head protect circuit has been erroneously set, the printer can be reset by pressing the paper advance, top of form or [CONTROL] [STOP] keys of the keyboard. Some conditions may exist that will not allow printer recovery by this method.
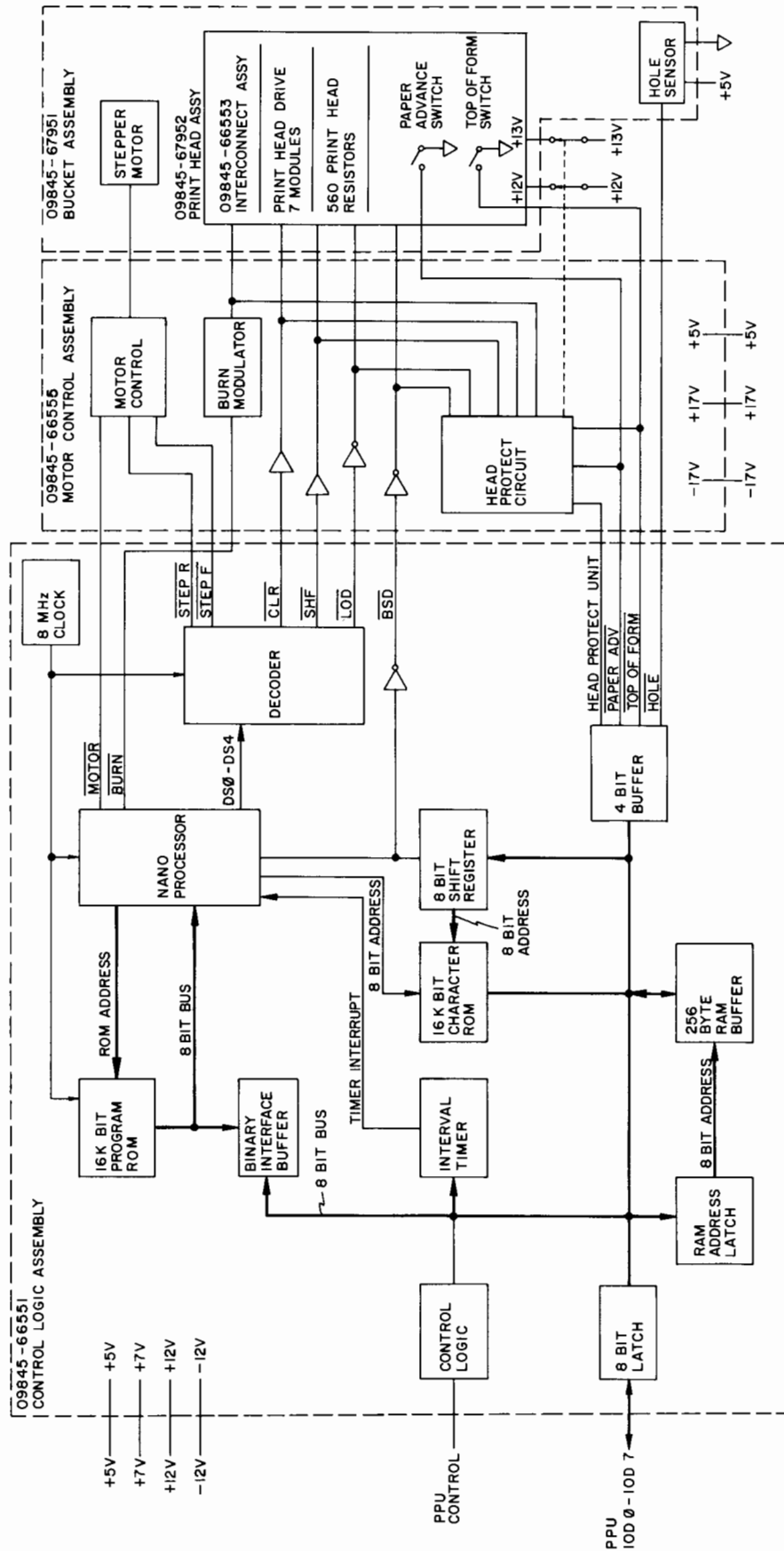
Figure 2-22: Printer Block Diagram

rev: 7/81

Power Supply Section

The power supply (09845-67980)contains the following assemblies:

A85 (09845-66585)
Regulator Assembly

A82 (09845-66582)
Internal Power

A84 (09845-66584)
Motor Voltage

A83 (09845-66583)
Logic Voltage

A81 (09845-66581)
Primary Power
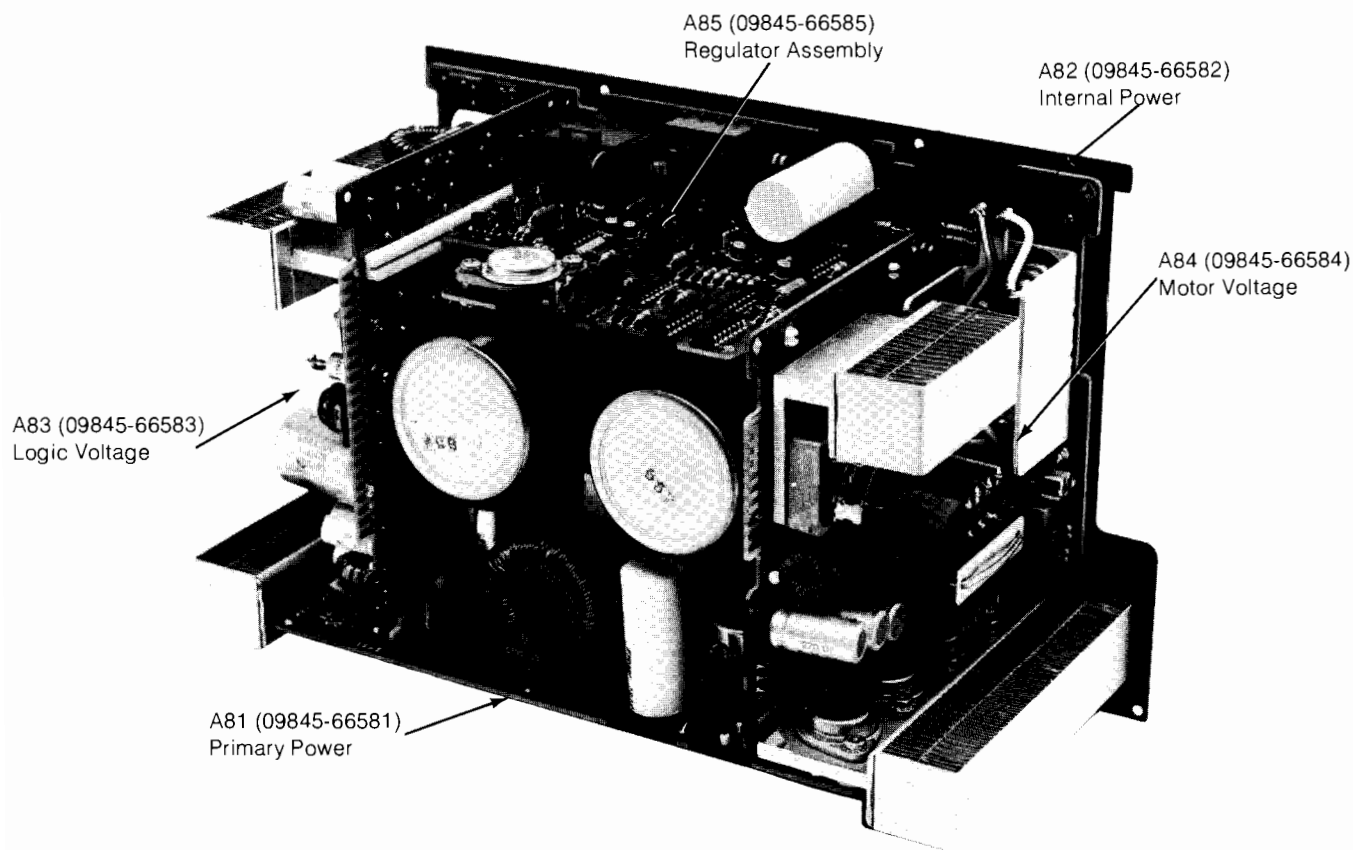
The entire power supply is an exchange item.

There are no tests for the power supply.

Power Supply (A81, A82, A83, A84, A85)

The power supply assembly is located in the computer mainframe behind the printer bucket. Ac power is supplied from the power module under the I/O slots on the rear panel of the computer. The power supply assembly consists of five printed circuit assemblies (A81-A85). The A82 assembly is fastened to the sheet metal top of the power supply and acts as a motherboard for the four other assemblies.

Besides acting as a motherboard, the A82 assembly contains the input rectifiers, filter capacitors and a 60Hz startup transformer.

The A81 assembly contains the primary input circuits, a switching dc preregulator and two dc to dc converters that supply power to the A83 and A84 assemblies.

A83 contains the ±18 volt, ±12 volt, +7 volt and +5 volt power supplies. The transformer for these supplies receives power from converter number 1 on the A81 assembly.

A84 contains the ±17 volt and +13 volt power supplies. The transformer for these supplies receives power from converter number 2 on the A81 assembly.

A85 contains a 20kHz power supply clock, a pulse width modulator, a +5 volt regulator and an initialize circuit.

Voltage outputs leave the power supply assembly through A83 and A84 which plug into the computer's motherboard.

Table 2-4 lists the power supply voltages, voltage specifications and where the voltage is used in the computer.

Table 2-4:   Power Supply Specifications

Voltage	Voltage Tolerance	Maximum Current	Ripple and Noise	Used By
−18V	±1V	.7 amps	150mV	CRT
−17V	±1V	.9 amps	300mV	Cartridge drive, printer motor
−12V	±5%	.85 amps	100mV	Processors, external I/O, ROM, RAM, printer, CRT, keyboard
+5V	±2%	15 amps	100mV	Processors, external I/O, ROM, RAM, tape transport printer, CRT, keyboard
+7V	±5%	1.3 amps	100mV	Processors, ROM, printer
+12V	±3%	5.5 amps	100mV	Processors, external I/O, ROM, RAM, cartridge drive printer, CRT
+13V	±1V	3.7 amps	500mV	Printhead, printer motor
+17V	±1V	.9 amps	300mV	Cartridge drive, printer motor
+18V	±1V	1.1 amps	150mV	CRT

Power Supply Operation

Refer to the power supply diagram (Figure 2-23).

When the ac line voltage is in the range of 90 to 126 volts ac, it is applied to a voltage doubler to obtain from 198 to 252 volts dc across the input filter. When the ac line voltage is in the range of 198 to 252 volts ac, a full wave bridge rectifier is used to obtain the 180 to 350 volts dc.

The preregulator chops the high dc voltage at a fixed frequency of 20kHz. The duty cycle of the 20kHz signal is controlled by feedback from the +5 volt power supply. The feedback is applied to a regulator and transferred to a pulse width modulator through an optical isolator. The feedback holds the filter output at 160 volts dc. This regulation holds the +5 volt supply within 2% of +5 volts.

The 160 volts dc is applied to two dc to dc converters. A 20kHz square wave from the power supply clock is also applied to the converters. The output of each converter is a 20kHz square wave going from −80 volts to +80 volts.

Each converter is protected by an overcurrent latch that shuts the converter off if a current overload condition occurs.

The output of converter number 1 is used to generate the logic supply voltages. The output of converter number 2 is used to generate the motor supply voltages.

The +12 volt regulator is a switching regulator operating at a constant 40kHz frequency. The output of the regulator drives an optical isolator which determines the duty cycle of the pulse width modulator (PWM). The output of the pulse width modulator is applied to the preregulator which regulates the 160 volts dc to the converters. This feedback circuit regulates the +5 volt supply as well as all the other dc output voltages.

A 60Hz transformer is used to supply power to the primary drive circuit (start-up power) only when the computer is first switched on.

The initialize circuit generates two signals used to initialize the computer's circuits.
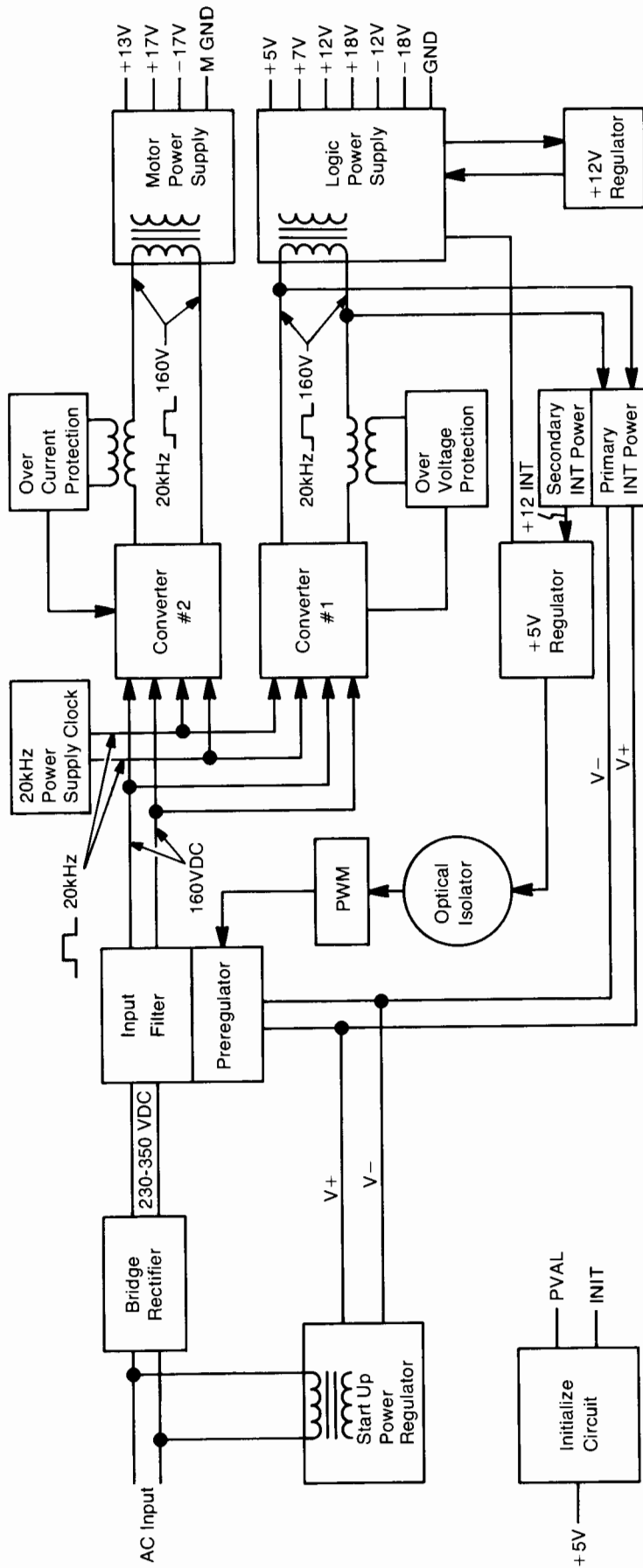
Figure 2-23: **Power Supply Block Diagram**

Block 1
PPU Read/Write Memory
32K Bytes
A27 Assembly
09845-66527

Y Bus
Block Select

Block 5
PPU System ROM
A27 Assembly

Blocks 11, 15, 21,
25, 31, 35, 41, 45
PPU Option ROM
Left ROM Drawer
A44 Assembly

Block 3
LPU System ROM
A28 Assembly

Blocks 7, 13, 17,
23, 27, 33, 37
LPU Option ROM
Right ROM Drawer
A42 Assembly

X Bus
Block Select

Blocks 0, 4, 6,
10, 12, 14, 16
LPU Read/Write Memory
Up To 4 Assemblies
A28 Block 0 Assembly
A26 128K Byte Assembly

Y Memory Control Lines

Y Bus
Controller

Y Bus 16 Lines

X Bus 16 Lines

Bus
Switch

Inter
Switch
Communications

Y Bus 16 Lines

Bus
Switch

X Bus 16 Lines

X Memory Control Lines

X Bus
Controller

Figure

Figure 2-24: 9845B Block Diagram

Computer Museum

Keyboard

Cartridge Drive

CRT Alpha

CRT Graphics

Printer

nes

Control Bus

Status Bus

I/O Backplane
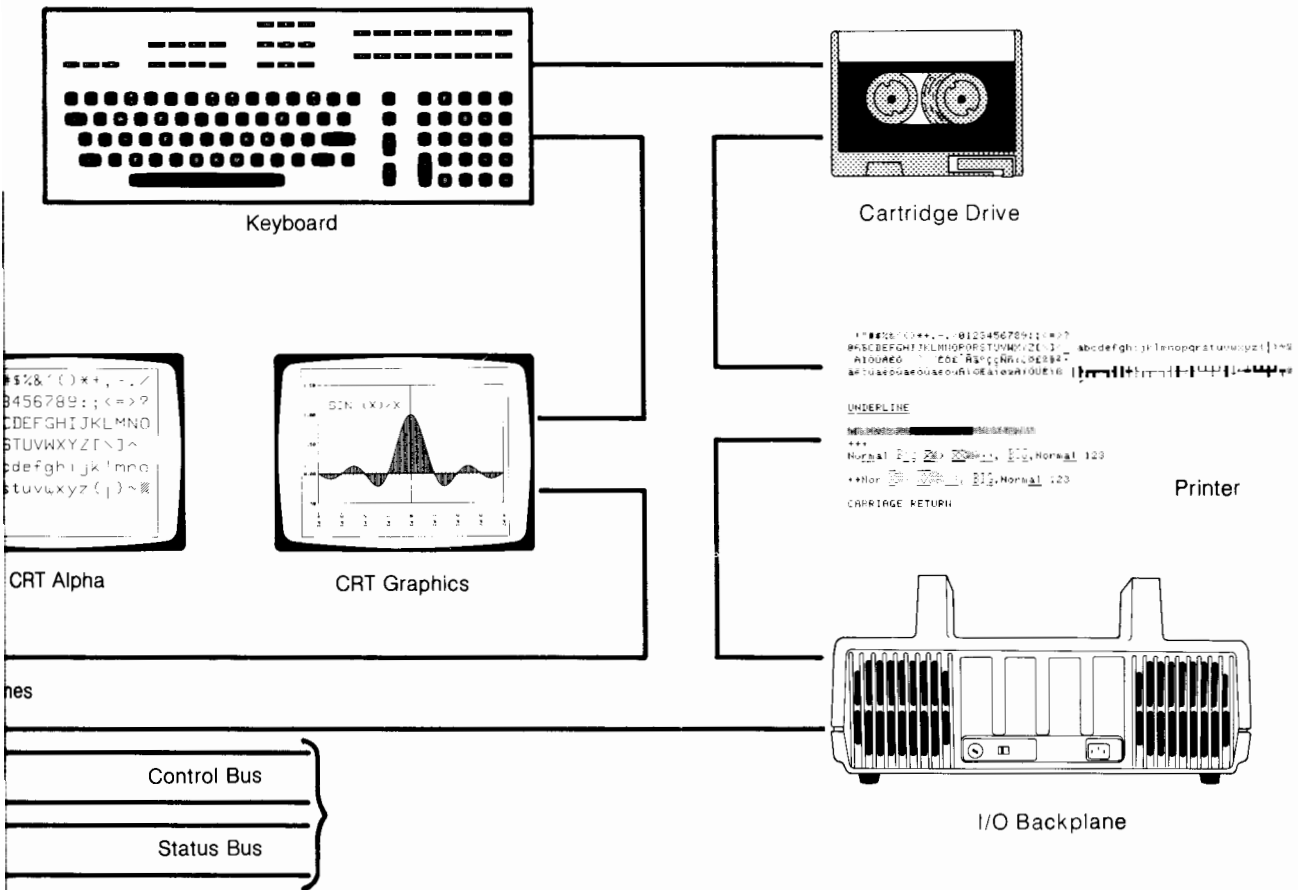
Chapter 3
Assembly Access

Introduction

This chapter describes how to access the various 9845B assemblies.

The following procedures will help you to disassemble the computer to access its assemblies. The following tools are required to disassemble the computer.

- #1 Pozi-drive screwdriver

- #2 Pozi-drive screwdriver

- Flat-blade screwdriver

- Needle nose pliers

- Tweezers

WARNING

REMOVE ANY AC POWER FROM THE COMPUTER BEFORE REMOVING
ANY ASSEMBLY.

CRT Assembly Removal

The CRT assembly must be removed before the top cover, keyboard or rear panel can be removed. To remove the CRT assembly press in on the CRT release button located on the side of each CRT support. Then lift the assembly from the computer (see Figure 3-1). When replacing the CRT assembly on the CRT supports, be sure that the guides in the CRT assembly are aligned with the CRT supports. The assembly will lock into place easily when the guides are aligned.
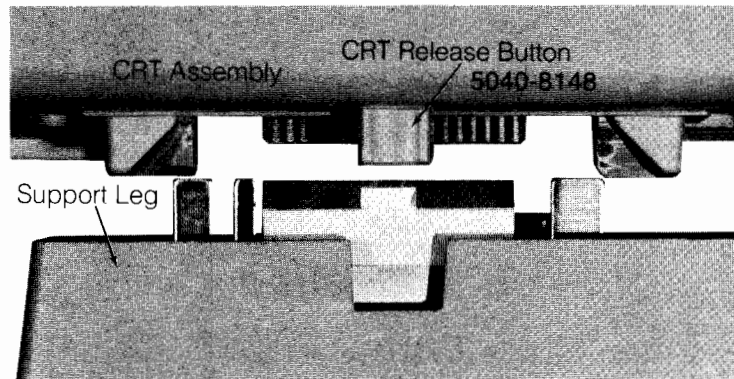
Figure 3-1: Removing the CRT Assembly

CRT Subassemblies

WARNING
WHEN THE CRT TOP COVER IS REMOVED, ALWAYS WEAR SAFETY
GLASSES AND ENSURE THAT OTHER PEOPLE IN THE AREA WILL
NOT BE EXPOSED TO AN ACCIDENTAL CRT BOTTLE IMPLOSION.

To access the CRT subassemblies, first remove the CRT top cover by removing the screw on the upper left and
right corners of the CRT rear panel. Remove the PC assembly holders and the high voltage cover. Figure 3-2
shows the CRT subassemblies.

NOTE
Remove the plug-in character ROM before exchanging the A73 assembly.
Replacement A73 assemblies are shipped from the factory without the ROM
installed.

Intensity Control

Focus Control

A73 09845-66573
Display Logic

CRT Test Button

Alpha Width Control

Graphics Width Control

Alpha Height Control

Graphics Height Control

A74 09845-66574
CRT Analog

A75 09845-66575
High Voltage Assembly

A76 09845-66576
Interconnect Assembly
(Located On Bottom
Side Of A71 Assembly)

High Voltage Cage

A71 09845-66571
CRT Motherboard

A77 09845-66577
Graphics Scanner

CRT Yoke*

A76 09845-66576
Interconnect Assembly
(Located On Bottom
Side Of A71 Assembly)

A79 09845-66579
Graphics Memory

CRT Bottle*

CRT Bezel

Figure 3-2: CRT Subassemblies

*CRT and Yoke are one
Assembly (09845-67160)

CRT Safety

The CRT bottle should be handled with care to avoid breakage and possible implosion of the bottle.

Tension
Band

Anode
Connector

Safety
Face
Plate

Neck
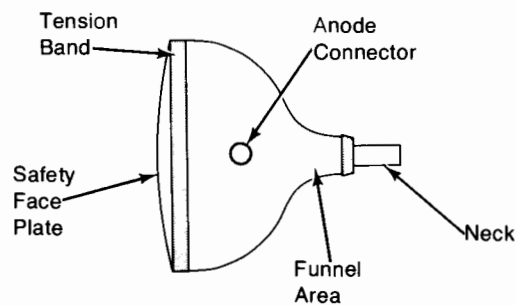
Funnel
Area

Figure 3-3: CRT Bottle Designation

Implosion

The CRT bottle can implode if it is dropped, hit by a tool or other object, or subjected to stress exceeding the glass strength. The most critical area on the bottle is the funnel area. A break in this area will almost always result in an implosion.

Safety Precautions

Here is a list of precautions that should be followed when handling the bottle.

1. The bottle acts as a big capacitor when the computer is turned off. Always allow 10 minutes for the bottle to discharge before you touch the anode connector.

2. Always wear safety glasses.

3. Use a protective shop jacket or coat.

4. Use a rubber mat or carpet on the floor in the working area to reduce the possibility of breakage if the bottle is dropped.

5. When the bottle is removed from the display chassis, place it face down on a thick soft pad.

6. When storing the bottle put it someplace where it can't fall or be bumped.

CRT Bottle Packaging

The CRT bottle packing box is used to store the bottle when it is not installed in the computer and when disposing of a defective bottle.

To remove the bottle from the box, first place the box on the floor with the top of the box up. Open the top of the box and hold the base of the box with your feet. Pull up on the cardboard insert surrounding the bottle and remove the insert with the bottle from the box. Do not handle the bottle by its neck.

WARNING
WEAR SAFETY GLASSES AND REMOVE ITEMS THAT COULD FALL
OUT OF YOUR SHIRT POCKET AND STRIKE THE BOTTLE BEFORE
REMOVING THE BOTTLE FROM THE BOX.

Always store the bottle (new or defective) in the box. Dispose of defective bottles in a proper manner.

A72/Rear Panel Removal

NOTE
The plastic covers on the CRT rear panel can be removed by pressing down
on the top of the cover and then pulling the cover back and off the rear
panel.

- Remove the CRT assembly top cover.

- Remove the four screws holding the rear panel to the chassis (see Figure 3-4).

A72 Connector
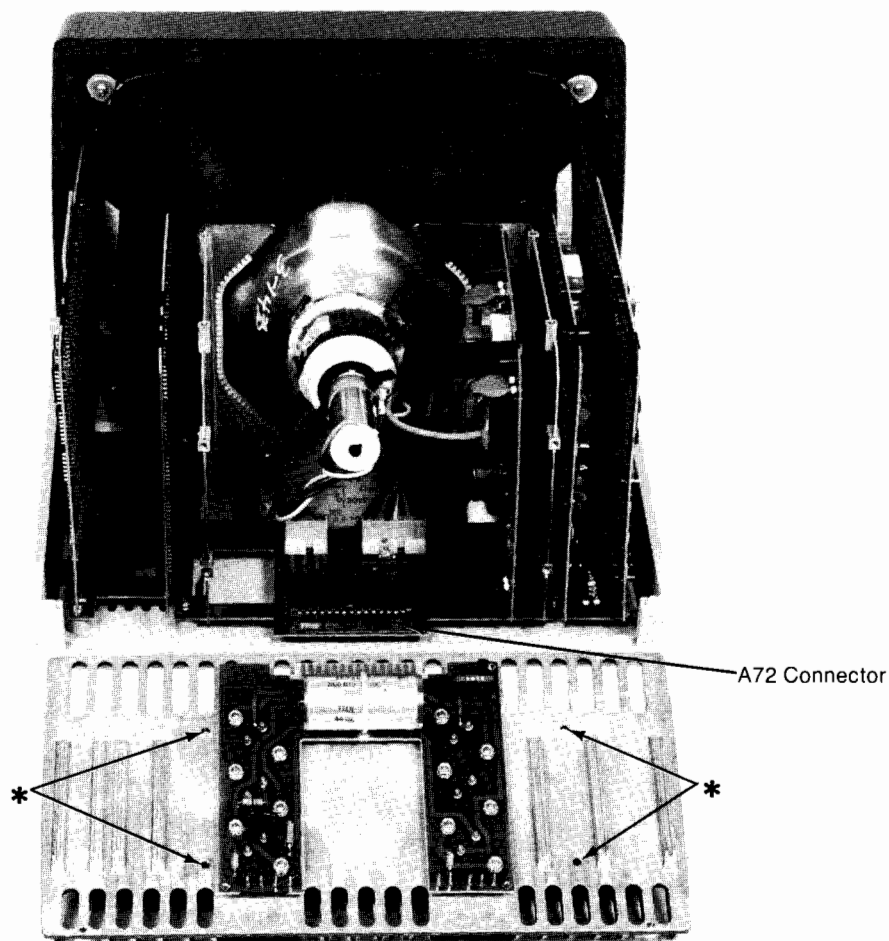
*CRT rear panel screws removed.

Figure 3-4:   CRT Rear Panel Removal

- Lift the rear panel up to remove the A72 / rear panel assembly.

- To separate the A72 assembly from the rear panel, remove the six transistors that hold the assembly to the rear panel.

CRT Bottle Removal

WARNING

ALLOW THE CRT BOTTLE TO DISCHARGE AT LEAST 10 MINUTES
BEFORE TOUCHING THE CRT BOTTLE ANODE CONNECTOR.

- Remove the CRT assembly.

- Remove the CRT assembly top cover.

- Remove the CRT rear panel.

- Remove the PC assemblies.

- Place the CRT on the front bezel (see Figure 3-5).

- Remove both CRT bottle connectors (Figure 3-5) from the A71 assembly, and remove the connector from the back of the CRT bottle.

- Remove the 2 screws shown in Figure 3-5 that hold the CRT bottom chassis to the front bezel.

✱ Remove these screws

Figure 3-5: Bottle Removal Position

• Set the bottom chassis down (see Figure 3-6).
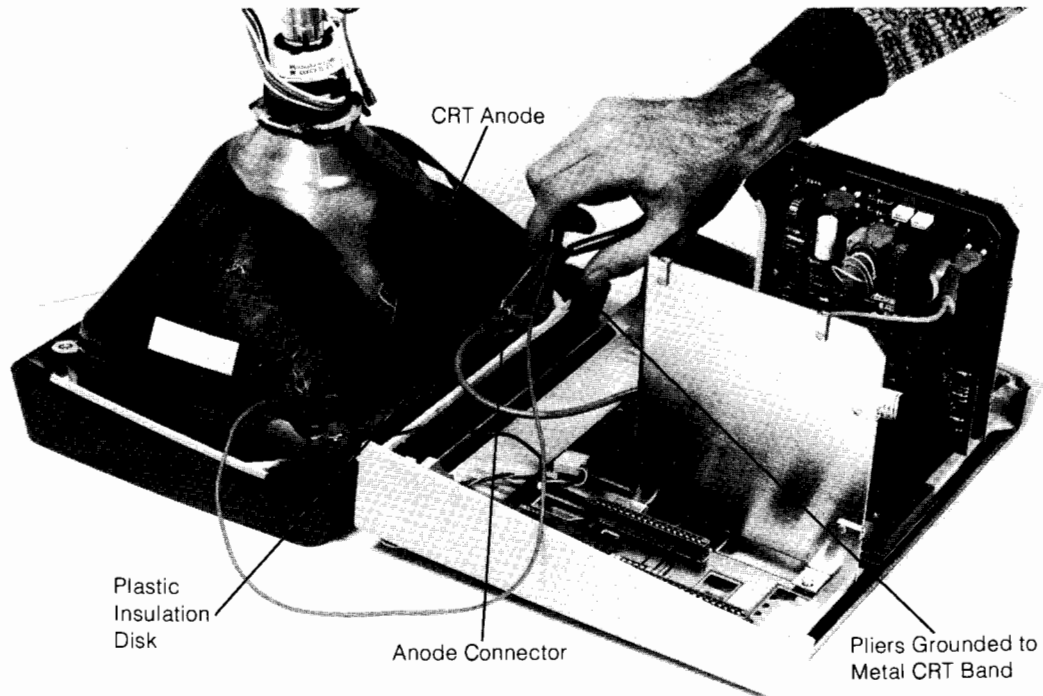
Figure 3-6:   Anode Connector Removal

• Use grounded needlenose pliers with insulated handles to remove the anode connector (see Figure 3-6). Lift the plastic insulation disk of the anode connector. Pinch the connector wires together and remove the anode connector.

• Remove the remaining two screws holding the CRT bottle to the bezel.

• Use the box from the new CRT bottle to store the old bottle.

WARNING

WHEN REINSTALLING THE CRT BOTTLE ENSURE THAT THE GROUND WIRE IS CONNECTED TO ONE OF THE CRT MOUNTING SCREWS (SEE FIGURE 3-7). THE WIRE MUST TOUCH THE METAL BAND ON THE CRT. THIS WIRE GROUNDS THE CRT BOTTLE STATIC SHIELD COATING. IF THE WIRE IS NOT CONNECTED, A SHOCK HAZARD EXISTS.

CRT ground wire
must touch metal
band on CRT

CRT Metal Band
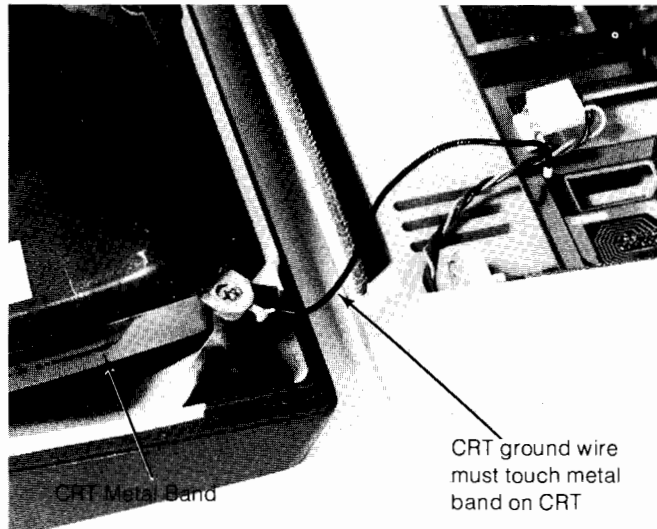
Figure 3-7: CRT Ground Wire

After the assembly is reinstalled, perform the test ROM CRT display tests and the CRT alignment procedures found in the CRT section of Chapter 2.

Top Cover Removal

After the CRT assembly has been removed, the top cover can be removed. Remove the two screws on the rear panel (see Figure 3-8) that hold the top cover to the rear panel. Remove the four screws shown in Figure 3-9 that hold the top cover to the computer chassis. Place the computer at the edge of a table to access the screws while the computer is on its feet. Figure 3-10 shows the assemblies accessed after the top cover is removed.

Top Cover Removal
Screws On Rear Panel

(2360-0199)
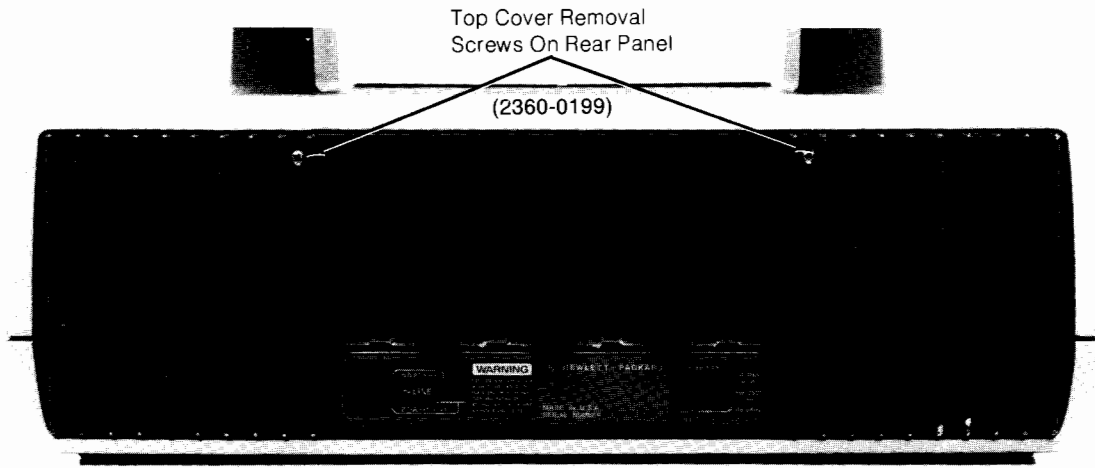
Figure 3-8:   Top Cover Screws on Rear Panel

2360-0133

Air
Intake
Filter

1. Keyboard removal screws
2. Top cover removal screws
3. Rear panel removal screws
4. Power module removal screws

2360-0137

2360-0137

2360-0203

Figure 3-9:   Access Screws

A2 09845-66502
I/O Backplane

A26 09845-66526
Optional Read/Write
Memory

A28 09845-66528
LPU RAM/ROM

A16 09845-66516
Peripheral Processor
Memory Controller

A3 09845-66503
CRT Logic

Power Supply Assembly

Printer Bracket
Assembly

A15 09845-66515
Language Processor
Memory Controller

A27 09845-66527
PPU RAM/ROM

A51 09845-66551
Printer Processor

A55 09845-66555
Printer Drive
or
A4 09845-66504
Interconnect Assembly

✱ Power supply removal screws

Motherboard is
Located Under
Assemblies

Figure 3-10: Assemblies Under the Top Cover

NOTE

When removing the A3, A4 or A55 assemblies, notice that the metal bracket
attached to the PC assembly connector is part of the PC assembly. Remove
the three screws that hold the bracket to the support leg bracket to remove
the A3, A4 or A55 assemblies.

NOTE

Remove the plug-in character ROM before exchanging the A51 assembly.
Replacement A51 assemblies are shipped from the factory without the ROM
installed.

Keyboard Assembly Removal

After the top cover has been removed, the keyboard assembly can be removed. Remove the four screws that hold the keyboard assembly to the computer chassis (see Figure 3-9). Place the computer at the edge of a table to access the screws while the computer is on its feet. Disconnect the various connectors that connect the keyboard to the computer chassis. Lift the keyboard from the chassis. Figure 3-11 shows the keyboard subassemblies.
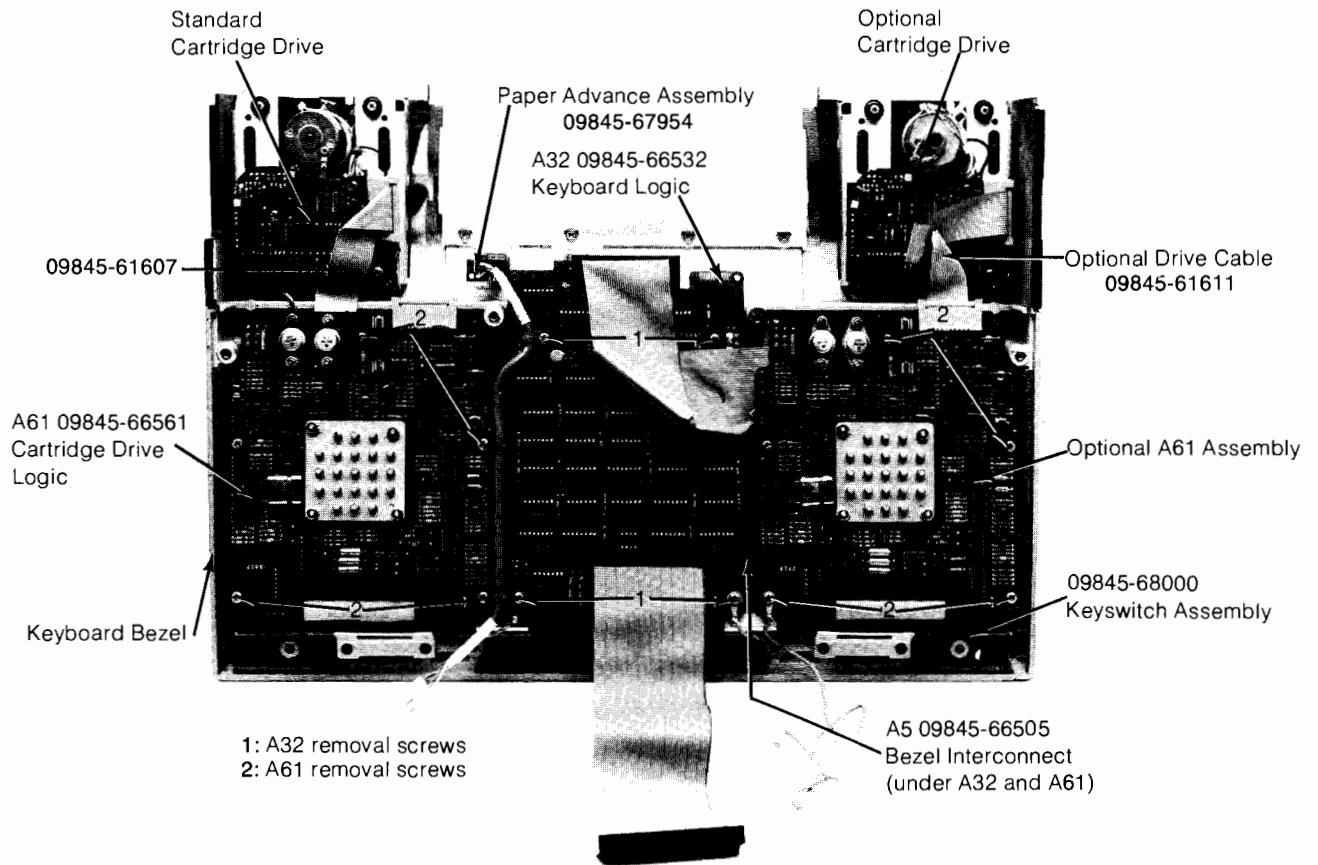
Figure 3-11:   Keyboard Subassemblies

Rear Panel Removal

After the top cover has been removed, the rear panel can be accessed by removing the four screws that hold the rear panel to the chassis (see Figure 3-9). Place the back edge of the computer at the edge of a table to access the screws while the computer is on its feet. Lean the panel to the rear of the computer to access the fans and the primary power filter module (see Figure 3-12).
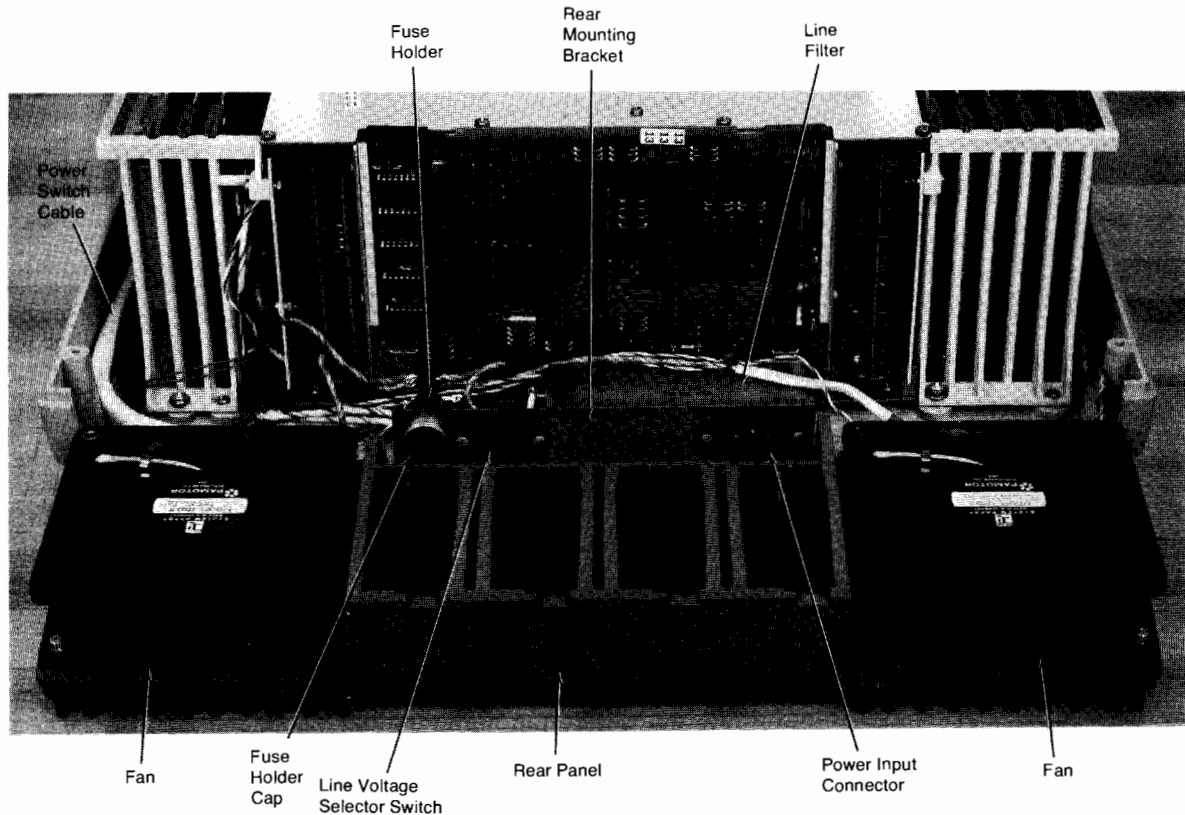
Figure 3-12:   Rear Panel Components

Chassis Assemblies

Printer Bucket Removal

Disconnect the printer connector from the printer drive (A55) assembly (see Figure 3-13). Remove the A55 and A3 assemblies. Remove the four screws that hold the printer bucket to the computer chassis. Remove the bucket ground wire from the power supply sheet metal bracket.
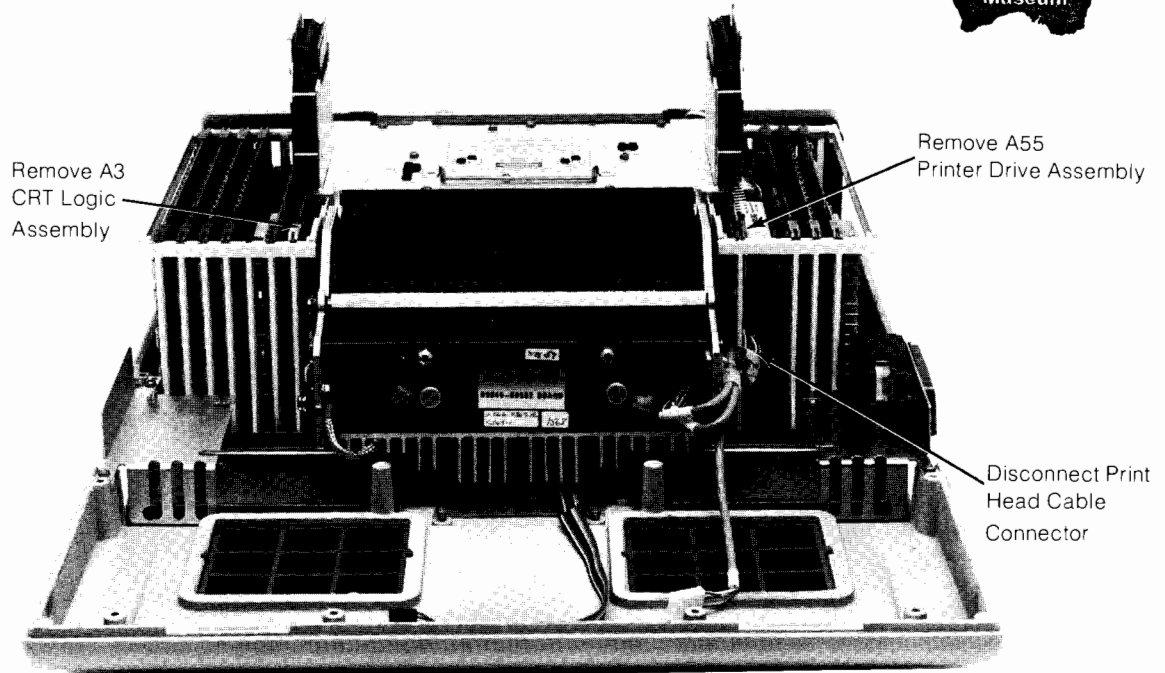
Printer bucket screw locations are shown in Figure 1-8.

Figure 3-13:   Printer Bucket Removal

Print Mechanism Disassembly

The print mechanism assembly can be removed without removing the printer bucket. To remove the print mechanism assembly first disconnect the print mechanism cable connector, then;

- Remove the tension springs and tension spring bar (see Figure 3-14).

- Remove the ground strap from the printer bucket side frame.

- Remove the screw holding the adjusting cam on each side of the printer bucket and remove the print mechanism assembly.

CAUTION

DO NOT SET THE PRINT MECHANISM ASSEMBLY DOWN ON THE TWO
CAPACITORS EXTENDING FROM IT; DAMAGE TO THE CAPACITORS
AND PC ASSEMBLY CAN OCCUR.

Remove Tension
Spring Bar

Remove Adjustment
Arm Screw

Remove Adjustment
Arm Screw (Same
as other side)

Remove Ground
Strap

✱ Tension Spring Bar
Removal Screws

Print Mechanism
Assembly

Disconnect Print
Head Cable
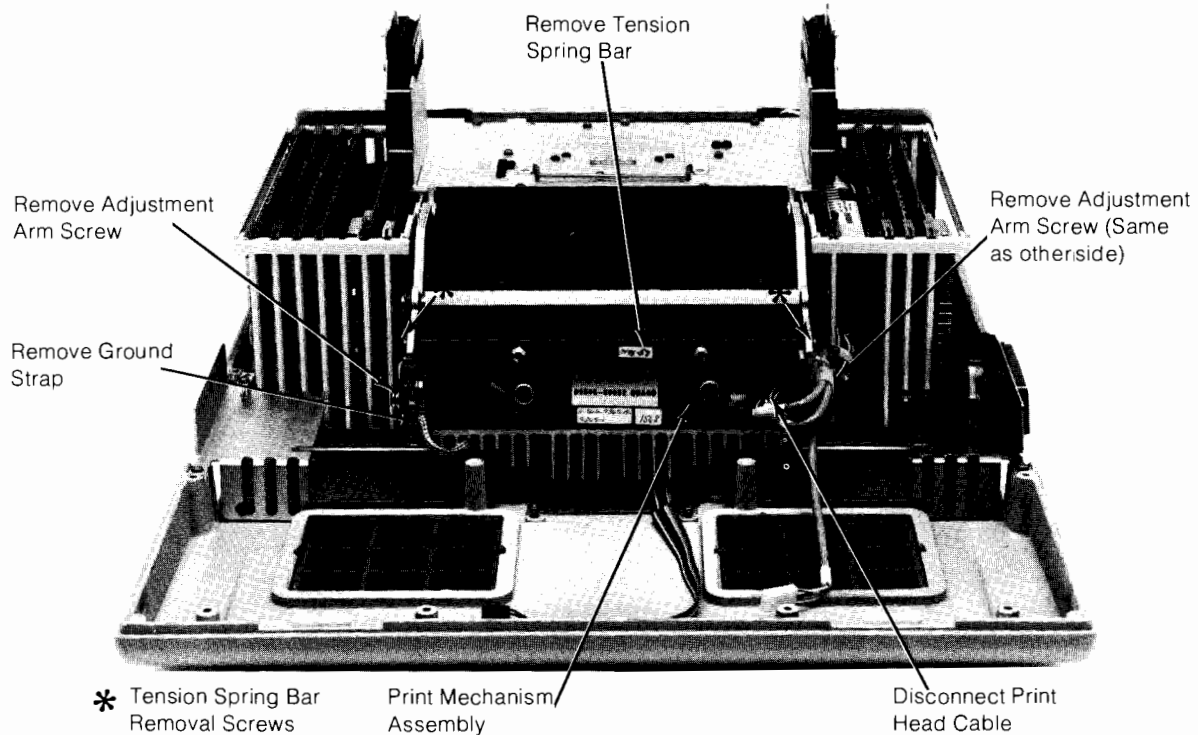
Figure 3-14:   Print Mechanism Assembly Removal

CAUTION

THE PRINT HEAD DRIVER MODULES CAN BE DAMAGED BY STATIC
CHARGES. BE SURE TO DISCHARGE ANY BODY STATIC BEFORE
HANDLING THE DRIVER MODULES.

To remove the print head driver modules or to replace the printhead; continue with this procedure.

- Remove the heat sink (see Figure 3-15).

- Remove the aluminum block covering the print head driver modules. Loosen the screws evenly to relieve pressure on the modules gradually.

- Remove the bad driver modules by lifting it off the print head assembly (see Figure 3-15).

- Handle the modules by the edges only; the traces are easily scratched.

Aluminum Block   Print Head Resistor

Print Head Resistor Assembly

Driver Modules

Driver Module

Heat Sink
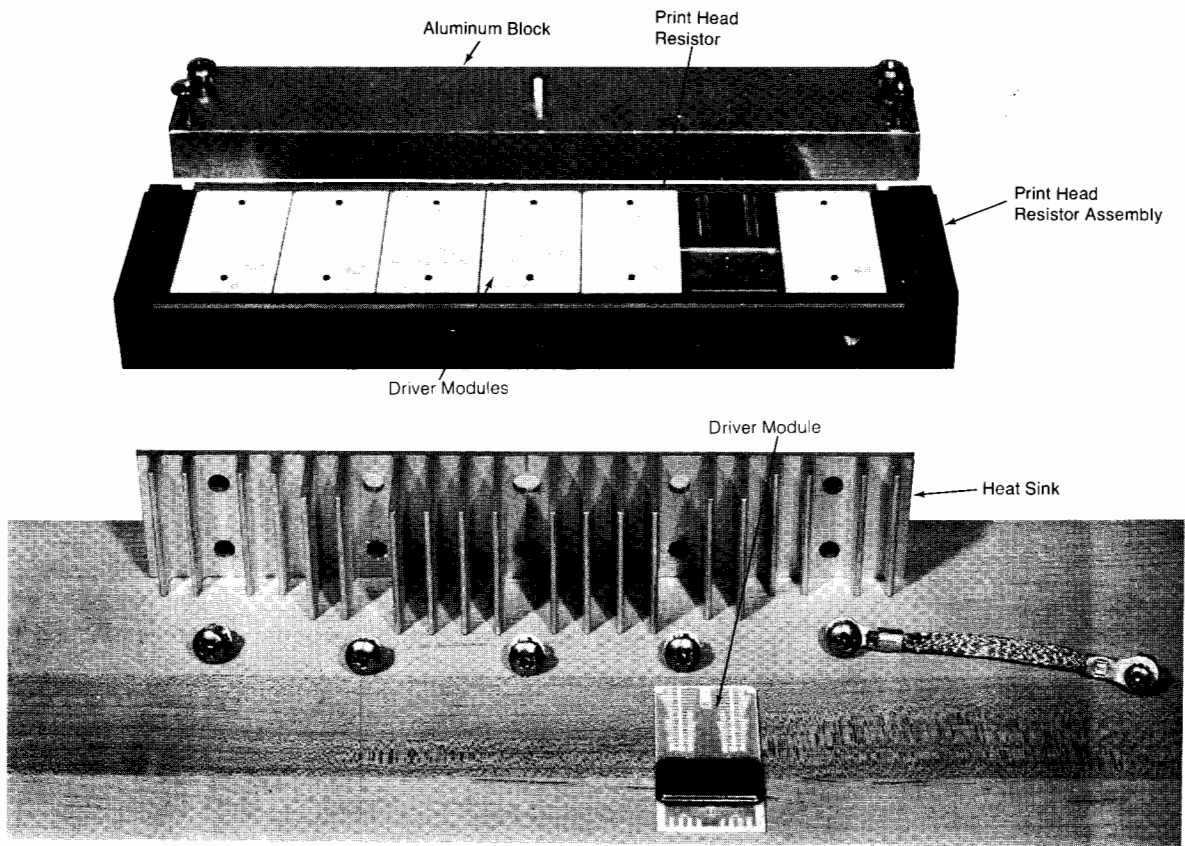
Figure 3-15:   Print Mechanism Disassembly

Print Head Resistor Assembly

A53 Assembly

Flexible Contact Bars

Contact Frame
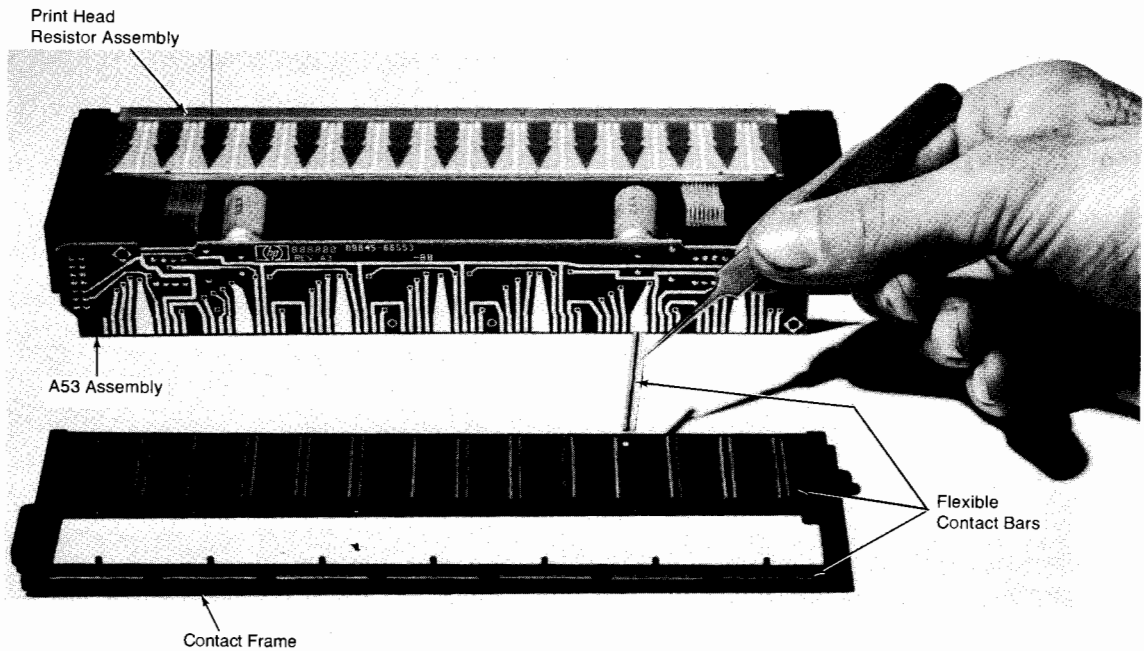
Figure 3-16:   Flexible Contact Removal

NOTE

To minimize contact corrosion do not touch the flexible contact bars. Use a pair of tweezers.

• When replacing the print head resistor assembly you will have to remove the driver modules, the flexible contact bar assembly and the A53 assembly.

NOTE

The contact bars are loose and come in two sizes. Replace any damaged contact bars.

• When reassembling, ensure that the contact bars are properly installed and that the driver modules are seated on their locating pegs. Also ensure that the connector frame is properly seated.

CAUTION

IF THE DRIVER MODULES ARE NOT PROPERLY SEATED, THEY WILL BE BROKEN WHEN THE SCREWS ARE TIGHTENED.

• Place the aluminum block on the driver modules and slightly snug, but do not tighten, the block's screws. Check again to see if everything is properly seated.

• Tighten the aluminum block screws using small, even steps (similar to torquing an engine cylinder head); then install the heat sink and the print mechanism ground strap.

• Reinstall the print mechanism assembly and the printer bucket.

Power Supply Removal

WARNING

LETHAL VOLTAGES EXIST THROUGHOUT THE PRIMARY CIRCUITS
OF THIS SUPPLY. UNTRAINED PERSONNEL SHOULD NOT TOUCH
THIS POWER SUPPLY. ALWAYS DISCHARGE CAPACITORS C17 AND
C18 USING THE POWER SUPPLY DISCHARGE TOOL (P/N 98440-
67901) BEFORE REMOVING THE POWER SUPPLY.

Remove the screws shown in Figure 3-10. Pull up on the power supply handle to remove the power supply.
The power supply assemblies are shown in Figure 3-17.

A85 (09845-66585)
Regulator Assembly

A82 (09845-66582)
Internal Power

A84 (09845-66584)
Motor Voltage

A83 (09845-66583)
Logic Voltage

A81 (09845-66581)
Primary Power
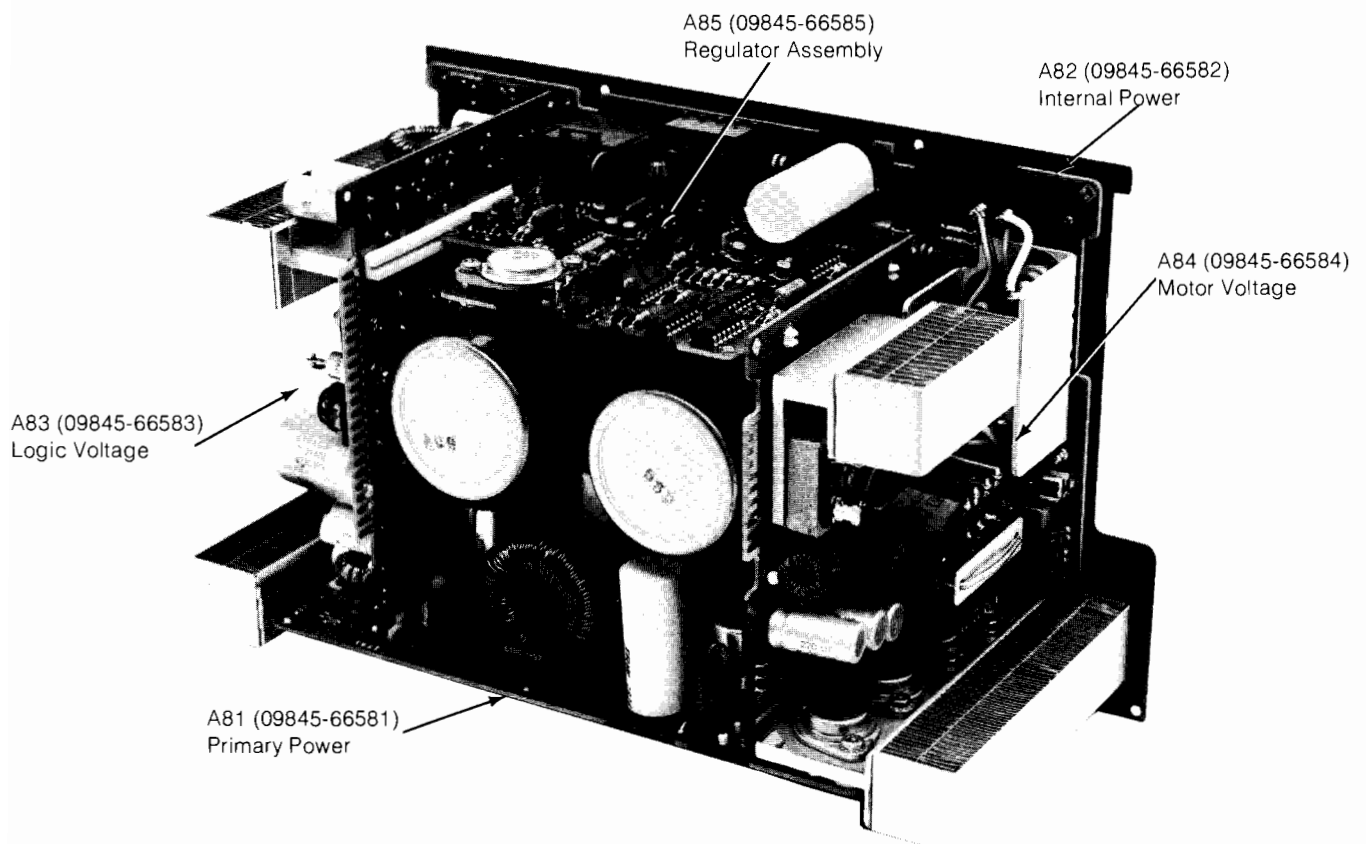
Figure 3-17:   Power Supply Assemblies

Printed Circuit Assemblies

The printed circuit assemblies shown in figure 3-10 can be removed (after moving the keyboard bezel forward) by pressing outwards on their colored extractors and then lifting the assemblies from the chassis. The printed circuit assemblies adjacent to the power supply (A3, A4 and A55) are integral parts of the CRT supports. Remove the three screws on each CRT support that hold the assembly to the support (see Figure 3-10); then remove the assembly.

Keyboard Key Cap and Key Switch Removal

To change the key cap or a key switch, use the following procedures.

Key Cap Removal

Computer disassembly is not required to replace a key cap on the keyboard.

- Use a paper clip to fashion a key cap removal tool (see Figure 3-18) or use the removal tool in the tools PSP.

- Install the tool over the key cap so that the curved ends are under the edge of the key cap on either side.

- Pull firmly upwards to remove the key cap (see Figure 3-19).

- Install the new key cap by pressing it firmly into place on the key switch.
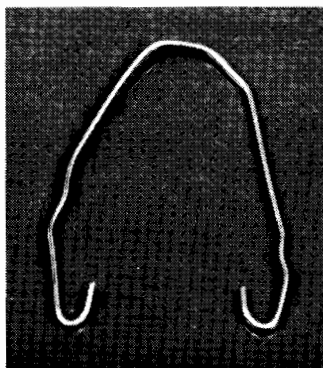
Figure 3-18: Homemade Key Cap Removal Tool

Figure 3-19:   Removing A Key Cap

Key Switch Removal

NOTE

There are six types of switches on the keyboard. Refer to Figure 3-22 to determine which switch you need before replacing it.

To remove a key switch, the keyboard assembly should be removed from the computer.

- Remove the screws holding the A32, A61 and A5 PC assemblies to the keyboard bezel, see Figure 3-20, and remove the PC assemblies.

- Remove the key cap from the defective switch.

- Unsolder the defective switch from the key switch assembly (four solder joints per switch).

- Press in on the two tabs (Figure 3-21) that hold the key switch in place and pull the switch up out of the switch mounting plate.

- When reinstalling a switch,

    1. Ensure that it is the proper type.

    2. Be sure it is installed according to the keyed switch leads as shown below.
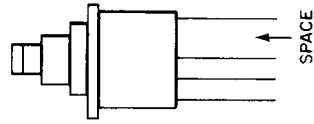
- Don't forget to solder the switch leads, then replace the key cap.
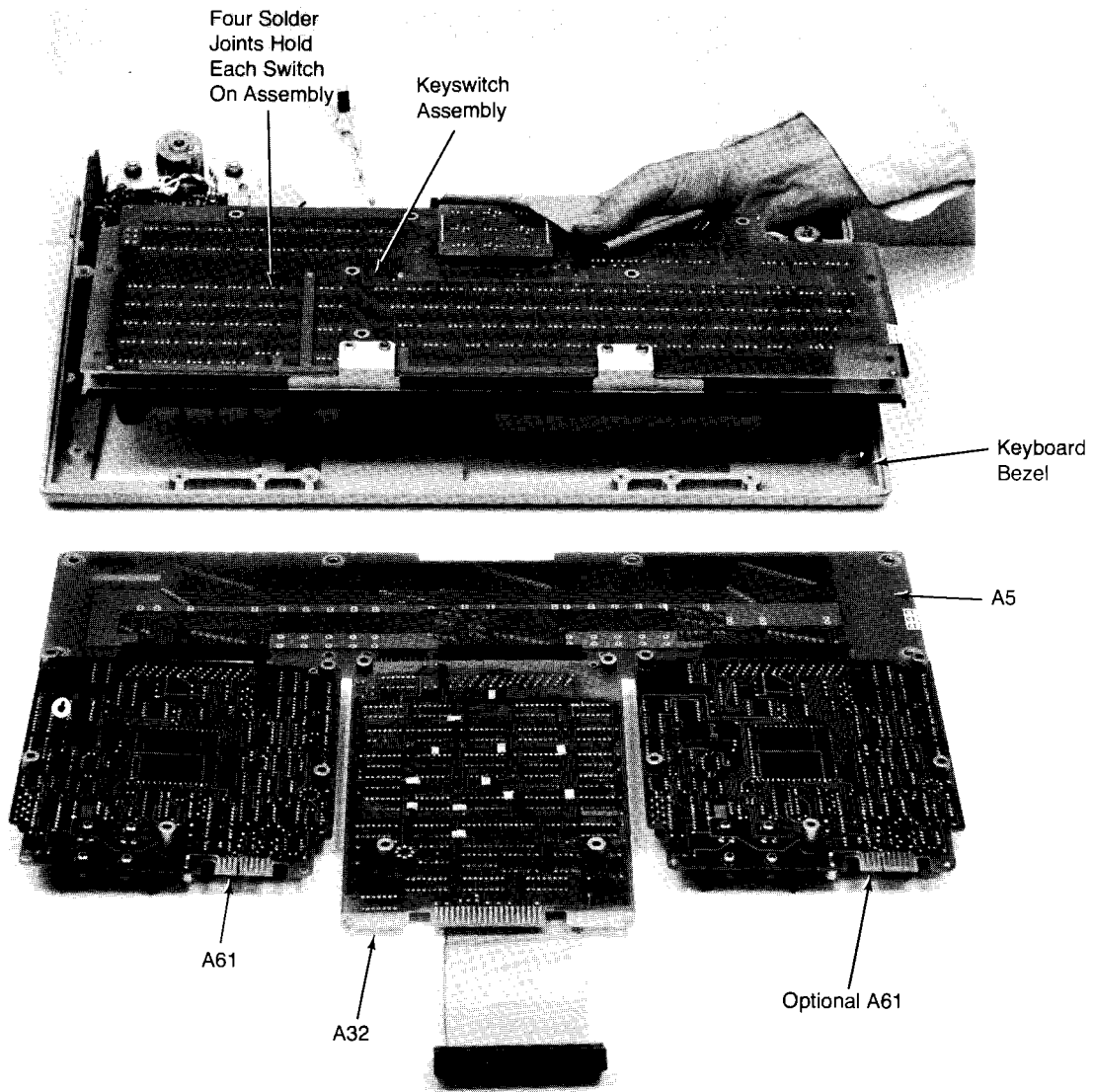
Figure 3-20: Removing Keyboard PC Assembly

Keyswitch
Mounting
Tabs
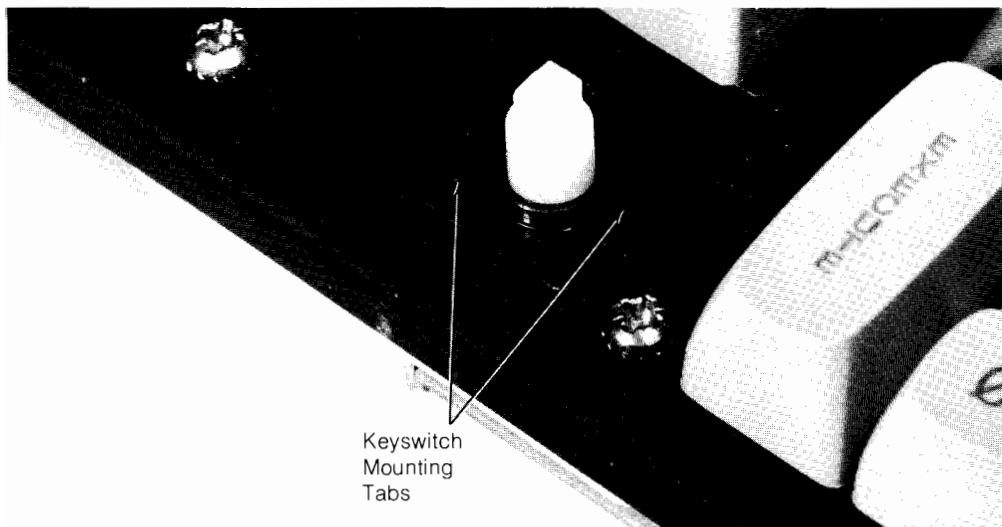
Figure 3-21: Removing a Key Switch

P/N 3101-2134
Straight Key Head
Single Position
Short Leads

P/N 3101-2203
Straight Key Head
Single Position
Long Leads

P/N 3101-2133
Straight Key Head
Dual Position
Long Leads

P/N 3101-2132
Straight Key Head
Dual Position

P/N 3101-2134
Straight Key Head
Single Position
Short Leads

P/N 3101-2201
Angle Key Head
Single Position

P/N 3101-2202
Angle Key Head
Dual Position
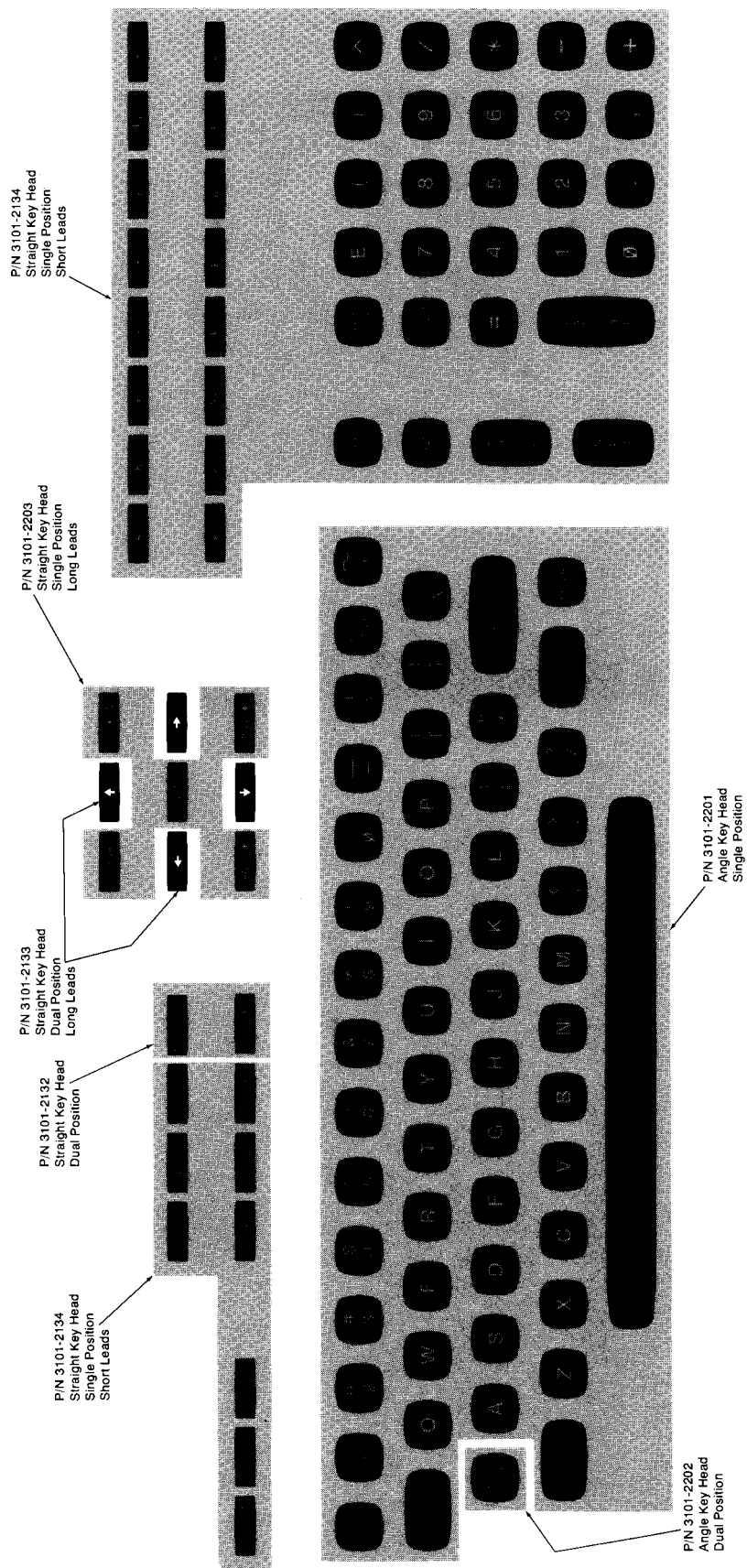
Figure 3-22: Key Switch Types

Hints

If one of the space bar guides breaks, simply reverse the two guides.

Detent problems on the dual position switches can sometimes be repaired by reshaping the "U" shaped detent wire near the top of the switch and applying a small amount of grease to the guides that the wire rides in.

Tape Cartridge Considerations

The following describes tape cartridge anomalies and their cures.

- It is a good idea to remove a tape cartridge from the computer when you are not using the computer. If a cartridge is left in the computer, a flat spot may develop on the friction drive wheel in the cartridge drive unit. This condition will cause errors when using the tape. The flat spot is only temporary and can be corrected by running the tape forward to the end of tape, and then rewinding the tape.

- The tape drive belt may lose its tension with age. A loose drive belt is evident when the tape is not wound smoothly on the tape reels. This condition can be seen through the front of the cartridge. A cartridge with this condition should be replaced.

- If the tape unwinds completely from one of the reels, refer to the following drawing and use the procedure below to rewind the tape.

    1. Remove the 4 screws holding the cartridge cover and remove the cover.
    2. Thread the tape around the guides as shown in drawing.
    3. Moisten the end of the tape so that it will stick on the tape reel.
    4. Using a sharp pencil, guide the end of the tape between the drive belt and the reel.
    5. As you wind the tape onto the reel, ensure that there is no slack in the tape. If the tape is not tight, start over again.
    6. Wind at least 10 turns of tape onto the reel.
    7. Reassemble the cartridge.

Tape Drive Belt
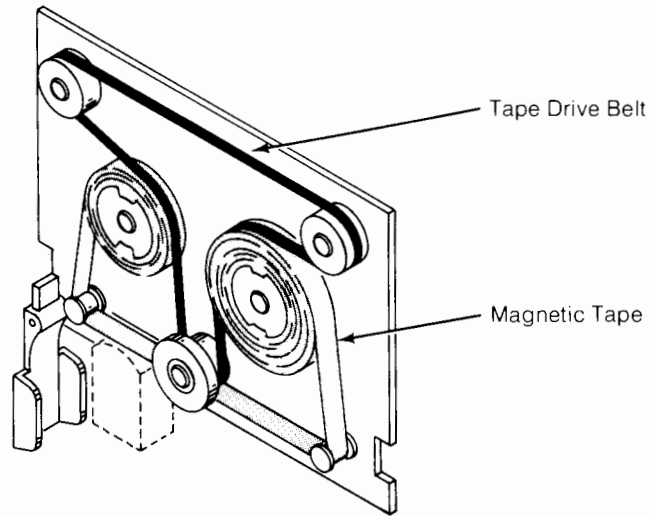
Magnetic Tape

Figure 3-23:   Tape Cartridge

Computer Cleaning

Case

The computer case can be cleaned by using a soft, moist cloth. Do not use harsh or abrasive detergents, and do not allow moisture to enter the computer.

Magnetic Tape Head

To improve the reliability of tape operation, it is recommended that the tape head be cleaned after every eight hours of tape operations. It's a good idea to clean the tape head before making important recordings.

Magnetic   Swab Dampened With
Tape Head   Head Cleaning Solution
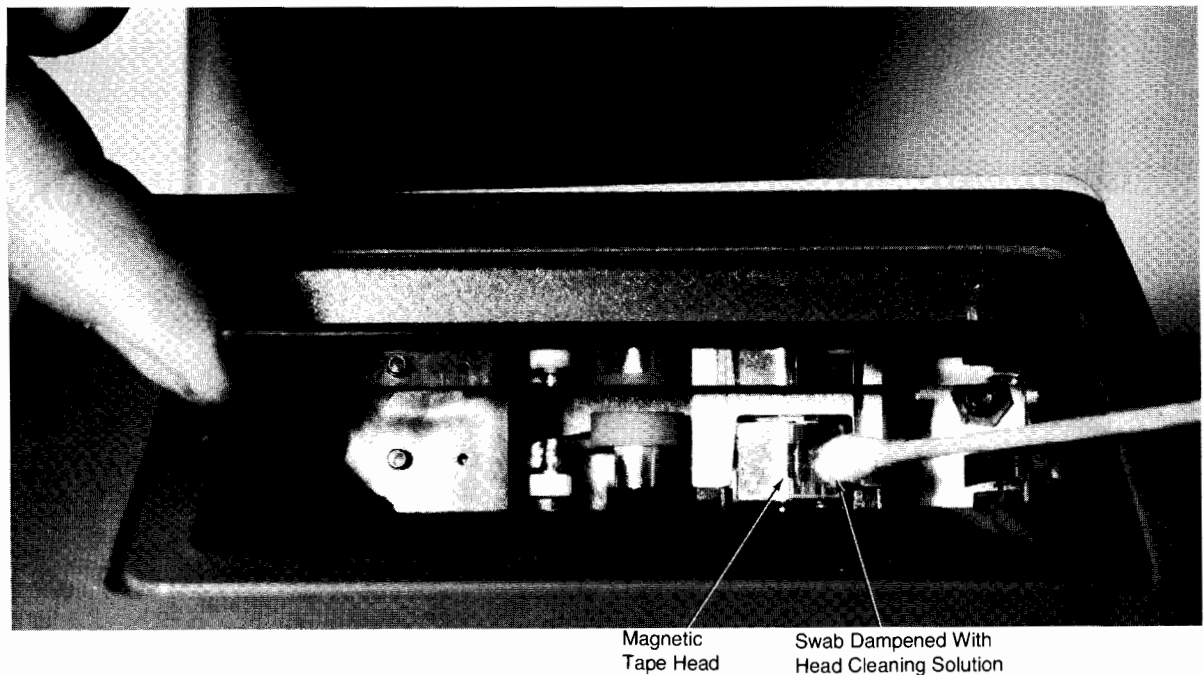
Figure 3-24:   Cleaning the Tape Head

The tape head is cleaned as follows:

1.   Remove the tape cartridge if installed.

2.   Clean the tape head with a cotton swab that has been dampened with head cleaning solution (see Figure 3-24). Wipe the face of the tape head a few times with the cotton swab. Remove any other dust that has accumulated in the vicinity of the tape head.

Air Filters

The air filters are located on the bottom of the computer beneath the keyboard. The filters should be cleaned about every three months. To remove the filters, first switch the computer off and then move the computer so that the keyboard extends over the edge of the table. Insert a screwdriver or other tool into one of the slots on either side of the filter frame and pry the filter out. Clean the filters by washing them in warm, soapy water and rinsing in clean water. Dry the filters throughly and reinstall them in the computer.

Chapter 4
Replaceable Parts

Introduction

This chapter provides parts ordering information. Table 4-1 lists the 9845B replaceable parts.

Here is a description of each table column.

Assembly Level: The level numbers indicate which items are part of a particular sub-assembly and which sub-assemblies are part of major assemblies. A "1" level item is a major assembly. The major assembly may have sub-assemblies and other parts listed as "2" and "3" levels after the "1" level part number. This gives you a choice as to which level of assembly you wish to order and also tells you what you get with a major assembly. Remember, all parts listed after a "1" level are associated with that "1" level part until the next "1" level part appears. Likewise with "2" and "3" level parts.

Reference Designator: Electrical components on a particular PC assembly are listed in the order of their component designators.

CD: The number in the "CD" column, immediately preceding the part number, is the part number's check digit. Include the check digit with the part number when ordering a part.

Part Number: The HP part number.

TQ: The total quantity of a part used on an assembly. The quantity is given the first time a part is listed for a particular assembly. Thus, some parts used more than once on an assembly, such as electrical components listed in reference designator order, may not have a number in this column.

Description: Description of the part.

The figures after Table 4-1 identify the major mechanical parts.

Table 4-1: Replaceable Parts

Assembly Level	Reference Designator	CD	HP Part No.	TQ	Description
					ROM Drawers
1		8	09845-60350	1	Right ROM Drawer Assembly
2		8	0624-0418	6	.625 in., 82°, FH pozidriv tapping screw
2		5	09845-04119	1	Right ROM Drawer Bottom
2	A42	8	09845-66542	1	LPU Option ROM PC Assembly
2		0	5040-8368	1	ROM Drawer Cover
2		4	5041-1439	1	Right ROM Drawer Top
1		9	09845-60355	1	Left ROM Drawer Assembly
2		5	09845-04119	1	Left ROM Drawer Bottom
2	A44	0	09845-66544	1	PPU Option ROM PC Assembly
2		0	5040-8368	1	ROM Drawer Cover
2		3	5041-1438	1	Left ROM Drawer Top
					Mainframe Top Cover
1		6	09845-67902	1	Mainframe Top Cover Assembly
2		6	0624-0333	2	.250 in., PH Pozidriv Tapping Screw
2		6	0624-0408	4	.375 in., 100°, FH Pozidriv Tapping Screw
2		1	09845-04412	1	Shell, Top Cover
2		4	09845-21203	2	Printer Door Bracket
2		1	09845-23701	2	Printer Door Shaft
					Mainframe
1		9	09845-67921	1	Mainframe Assembly
2	A2	0	09845-66502	1	I/O Backplane Assembly
3		8	1251-2026	4	36-Pin PC Edge Connector (2X18)
3		6	2110-0447	1	3A 125V Fuse ⎫ I/O Backplane
3		6	2110-0546	1	5A 125V Fuse ⎭
2	A3	1	09845-66503	1	CRT Alpha Control Assembly (98750A)
	A34		98770-66534	1	Alpha Control Logic Assembly (98770 or 98780)
3		0	0624-0402	2	.250 in., PH Pozidriv Tapping Screw
3		6	09845-04706	1	Left Support Latch
3		3	1251-4978	1	36-Pin PC Edge Connector (2X18)
3		7	5040-7995	1	Connector Support
2	A15	5	09845-66515	1	LPU Processor-Memory Control Assembly
2	A16	6	09845-66516	1	PPU Processor-Memory Control Assembly
2	A27	9	09845-66527	1	PPU RAM/ROM Assembly
3			1818-0391	16	16k RAM for Graphics Memory
					Base Assembly
2		7	09845-67911	1	Base Assembly
3		3	1403-0106	4	Rubber Foot
3		8	0403-0268	4	PC Guide, 4.5 in. long
3		1	0624-0403	17	.375 in., PH Pozidriv Tapping Screw
3		5	0624-0407	2	.250 in., 100° FH Pozidriv Tapping Screw
3		6	0624-0408	6	.375 in., 100° FH Pozidriv Tapping Screw
3		0	0624-0410	14	.437 in., PH Pozidriv Tapping Screw
3		3	09845-01212	1	Base Strap
3		5	09845-01214	1	Power Switch Strap
3		6	09845-01215	1	Left PC Clamp
3		7	09845-01216	1	Right PC Clamp
3		0	09845-04411	1	Base
3		5	09845-04713	1	Left ROM Drawer Guide
3		6	09845-04714	1	Right ROM Drawer Guide
3		6	09845-05001	1	Right Latch Hook

Table 4-1: Replaceable Parts (cont.)

Assembly Level	Reference Designator	CD	HP Part No.	TQ	Description
3		9	09845-05004	1	Left Latch Hook
3		9	09845-60181	1	Power Supply Chassis Assembly
4		3	0360-1841	1	Terminal Block
4		7	0403-0225	6	PC Guide
4		5	09845-01206	1	PC Guide Bracket
4		8	09845-60180	1	Power Supply Sheet Metal Chassis
					Rear Panel
3		6	09845-60304	1	Rear Panel Assembly
4		7	09845-04111	1	I/O Port Cover
4		3	09845-04414	1	Rear Panel
4		2	09845-61603	1	Power Switch Cable
5		4	3101-2267	1	Switch, Main Power
			9135-0066	1	Old Line Filter
			9135-0132	1	New Line Filter
			2110-0342	1	8 Amp Fuse for 220V Operation
			2110-0365	1	4 Amp Fuse for 120V Operation
3		0	09845-61601	1	10 Conductor Ribbon Cable (Power, A0 to A5)
4		6	1251-3808	2	Polarizing Plug
4		1	1251-4182	18	Crimp Terminals
4		4	1251-4565	2	10-Pin Connector Housing
3		8	09845-66500	1	Motherboard
4		4	1251-0472	1	12-Pin PC Edge Connector (2X12)
4		6	1251-1365	7	44-Pin PC Edge Connector (2X22)
4		8	1251-2026	1	36-Pin PC Edge Connector (2X18)
4		8	1251-2034	2	20-Pin PC Edge Connector (2X10)
4		1	1251-2582	2	48-Pin PC Edge Connector (2X24)
4		3	1251-4572	1	10-Pin Connector
4		9	1251-4677	2	36-Pin PC Edge Connector (2X18)
4		4	1251-5000	2	56-Pin PC Edge Connector (2X28)
4		4	1251-5597	2	Connector
3		4	09845-66605	1	Left PC Card Cage Assembly
3		5	09845-66606	1	Right PC Card Cage Assembly
3		8	1460-1603	1	Wire Form
3		8	2360-0333	6	6-32, .250 in., FH Pozidriv Screw
3		9	2360-0433	6	6-32, .500 in., FH Pozidriv Screw
3			5061-4201	2	Foam Filter and Frame
3		5	5040-8230	1	Switch Bezel, Power Switch
			3160-0311	2	Fan
			3160-0365	2	Fan Opt. #200
					Display Assembly
1		8	09845-67970	1	Display Assembly
2		1	0510-0595	1	Retainer Clip
2		6	0624-0276	6	.188 in., PH Pozidriv Tapping Screw
2		1	0624-0403	2	.375 in., PH Pozidriv Tapping Screw
2		2	0624-0404	2	.563 in., PH Pozidriv Tapping Screw
2		6	0960-0480	1	Tripler
2		5	09845-04101	1	High Voltage Cage
2		1	09845-04107	1	Card Cover
2		6	09845-04417	1	Display Bottom Panel Assembly
2		3	09845-60309	1	Display Rear Panel Assembly

Table 4-1: Replaceable Parts (cont.)

Assembly Level	Reference Designator	CD	HP Part No.	TQ	Description
3		6	0340-0583	4	Transistor Mounting Insulator
3		9	0340-0619	2	CRT Transistor Insulator
3		9	0590-0305	12	6-32 Hex Washer with Lockwasher
3		2	09845-24601	1	Heat Exchanger
3	A72	4	09845-66572	1	Display Power Transistor Assembly
3	Q1	8	1826-0203	1	7815KC Voltage Regulator
3	Q2,Q3	8	1853-0305	1	TSTR: 2N5857 PNP
3	Q4	5	1826-0169	1	LM320K Voltage Regulator
3	Q5	8	1854-0783	1	TSTR: 2N6583 NPN
3	Q6	7	1854-0518	2	TSTR: 2N5877 NPN
		2	2360-0436	12	6-32, .688 in., PH Pozidriv Screw
3		3	5040-8147	2	Transistor Cover
2		4	09845-61671	1	Intensity Control Cable
3		3	1251-3277	1	4-Pin Connector
3		9	2100-3156	1	200 Ω Variable Resistor
2		5	09845-61672	1	CRT Tube Connector
2	A71	3	09845-66571	1	Display Motherboard
3		4	1251-0513	1	5-Pin Male Connector
3		6	1251-1365	2	44-Pin PC Edge Connector (2X22)
3		8	1251-2026	3	36-Pin PC Edge Connector (2X18)
3		8	1251-2034	1	20-Pin PC Edge Connector (2X10)
3		9	1251-2035	1	30-Pin PC Edge Connector (2X15)
3		5	1251-2916	2	36-Pin PC Edge Connector (2X18)
3		1	1251-3192	2	3-Pin Male Connector
3		6	1251-3618	1	2-Pin Male Connector
3		8	1251-3826	1	4-Pin Plug
2	A73	5	09845-66573	1	Display Logic Assembly
3			1818-2690	1	Katakana CRT Character ROM
3			1818-2688	1	ASCII CRT Character ROM
2	A74	6	09845-66574	1	CRT Analog Assembly
2	A75	7	09845-66575	1	High Voltage Assembly
2	A76	8	09845-66576	2	CRT Interconnect Assembly
2			09845-67972	1	CRT/Yoke Assembly
3		4	09845-04415	1	CRT Bezel
2		6	1600-0639	2	Ground Clip
2		6	2190-0142	6	.156-ID, .050-OD, Flat Washer
2		3	2360-0370	4	6-32, .375 in., PH Pozidriv Screw
2		4	5040-8148	2	CRT Release Buttons
2		5	5040-8149	1	Intensity Thumb Wheel
					Power Supply
1		0	09845-67980	1	Power Supply Assembly
			2110-0580		Internal Fuse
					Keyboard
1		8	09845-81805	1	ASCII Keyboard Assembly and ROMs
			67155		Key Switches & Caps No Logic
2		0	09845-68805	1	Bezel Assembly, ASCII, Fully Loaded
3		3	0380-0106	1	.688 in.long, Round Spacer
3		5	0380-0554	4	.312 in. long, Round Spacer
3		6	0624-0333	3	4-20,.250 in., PH Pozidriv Tapping Screw
3		0	0624-0402	4	6-19,.250 in., PH Pozidriv Tapping Screw
3		2	09845-01211	1	Printer Door Strap
3		6	09845-04110	1	Printer Filler Door
3		0	09845-04114	1	Cartridge Eject Bar
3		1	09845-04115	1	Cartridge Drive Filler Plate

Table 4-1: Replaceable Parts (cont.)

Assembly Level	Reference Designator	CD	HP Part No.	TQ	Description
3		4	09845-04423	1	Keyboard Bezel, Plastic Only, 9845B
			09845-04413	1	Keyboard Bezel, Plastic Only, 9845A
			09845-04433	1	Keyboard Bezel, Plastic Only, 9845C
		8	09845-05003	2	Plate Latch
3		2	09845-23702	1	Hinge Pin
3		6	09845-61607	1	Cable from Cartridge Drive to A61 (T15)
					T14 Cable is 09845-61611
3	A61	1	09845-66561	1	Cartridge Drive Logic Assembly
3		3	09845-67800	1	Keyboard Switches Only
					(See keyboard drawings for keycap part numbers)
4	A5	3	09845-66505	1	Bezel Interconnect Assembly
4	A32	6	09845-66532	1	Keyboard Logic Assembly
4		3	09845-68000	1	Key Switch Assembly Only
5		8	09845-00201	1	Keyboard Panel
5		8	09845-01215	1	Left PC Hold Down Bracket
5		1	09845-01216	1	Right PC Hold Down Bracket
5		8	09845-61609	1	Cable from A31 to A32
5		5	9160-0246	1	Loud Speaker
3		7	09845-67961	1	Cartridge Drive Bezel Assembly
4		5	0624-0340	6	.188 in., Slot Tapping Screw
4		9	1460-1589	1	Extension Spring
4		7	1600-0656	4	Window and Ramp Retainer
4		0	2260-0014	1	4-40, .135 in. ID, Nut
4		9	5040-8226	1	Cartridge Drive Ramp
4		2	5040-8229	1	Cartridge Drive Window
4		6	5040-8231	1	Lower Link — Small Piece for Opening Tape Door
4		7	5040-8232	1	Upper Link — Large Piece for Opening Tape Door
4		4	5040-8263	1	Bezel
3	A62	8	09845-67962	1	Cartridge Drive
			2140-0221		End of Tape Lamp
3		8	1460-1588	1	Torsion Spring
3		8	2200-0521	6	4-40, .250 in., PH Pozidriv Screw
3		8	2360-0333	4	6-32, .250 in., FH Pozidriv Screw
3		6	2360-0422	10	6-32, 1.562 in., PH Pozidriv Screw
3			2360-0423	2	6-32, .562 in., PH Pozidriv Screw
					Miscellaneous
1		7	09845-04301	1	USA Serial Plate
1	A4	2	09845-66504	1	Graphics Interconnect Assembly
2		0	0624-0402	2	.250 in., PH Pozidriv Tapping Screw
2		5	09845-04705	1	Right Support Latch
1		3	2360-0370	4	6-32, .375 in., PH Pozidriv Screw
1		6	7120-4930	1	Serial Plate Label
1		5	7120-6167	1	Information Label
1		4	7120-6851	1	Left Center Error Card
1		1	7120-7301	1	Information Card
1		2	7120-7302	1	Syntax Card
1		3	7120-7303	1	Error Card
1		5	7120-7305	1	Option Error Card
			7120-7844	1	9845B Paste on Logo
			7120-7836	1	9845B Paste on Serial Tag

Table 4-1: Replaceable Parts (cont.)

Assembly Level	Reference Designator	CD	HP Part No.	TQ	Description
					Option 204, 205 and 206
1	A26	8	09845-66526	1	128k-Byte Memory Assembly
					Option 311
1		5	09845-65517	1	Graphics ROM Pack
2		3	5041-1446	1	LPU ROM Cap
1		3	7120-6834	1	Graphics Error Card Label
2		0	7120-7293	1	Graphics ROM Label
1		6	09845-91050	1	Graphics Manual
					Option 312
1		6	09845-65518	1	I/O ROM Pack (LPU)
2		3	5041-1446	1	LPU ROM Cap
2		8	7120-7291	1	I/O ROM Label (LPU)
1		7	09845-65519	1	I/O ROM Pack (PPU)
2		9	5041-1442	1	PPU ROM Cap
2		7	7120-7290	1	I/O ROM Label (PPU)
1		8	09845-92060	1	I/O Manual
			7120-7309	1	Error Card Sticker
					Option 313
1		4	09845-65516	1	Mass Storage ROM Pack
2		9	5041-1442	1	PPU ROM Cap
2		9	7120-7292	1	Mass Storage ROM Label
1		0	09845-92070	1	Mass Storage Manual
			7120-7640	1	Error Card Sticker
					Option 314
1		1	09845-65521	1	Advanced Programming ROM Pack (LPU)
2		3	5041-1446	1	LPU ROM Cap
					Option 540, 541
1	A51	9	09845-66551	1	Control Logic Assembly
1	A55	3	09845-66555	1	Motor Control Assembly
1		9	09845-67905	1	Printer Door
1		5	09845-67951	1	Bucket Assembly (see exploded drawing)
1		8	09845-67954	1	Paper Advance Assembly
1		4	1818-2691	1	Katakana Printer Character ROM
1		1	5040-8145	1	Spacer Plate for Option 541 (Metric Paper Spacer)
					Option 560, 561
1	A51	9	09845-66551	1	Printer Control Logic Assembly
1	A55	3	09845-66555	1	Printer Motor Control Assembly
1		9	09845-67905	1	Printer Door Assembly
1		5	09845-67951	1	Bucket Assembly (see exploded drawing)
1		8	09845-67954	1	Paper Advance Assembly
1		9	1818-2687	1	ASCII Character ROM
1		1	5040-8145	1	Spacer Plate for Option 561 (Metric Paper Spacer)
					Option 600
1		9	09845-01218	1	Cartridge Drive Bracket
1		2	09845-61611	1	T14 Cable from A61 to Cartridge Drive
					See keyboard parts for other drive parts.
					Option 700
1	A77	9	09845-66577	1	Graphics Scanner Assembly
1	A79	1	09845-66579	1	Graphics Control Assembly

Table 4-1: Replaceable Parts (cont.)

Assembly Level	Reference Designator	CD	HP Part No.	TQ	Description
					ROMs
			09845-65526		Data Base Management ROM (LPU)
			09845-65527		Data Base Management ROM (PPU)
			09845-65524		Assembly Language Execution
			09845-65525		Assembly Language Development and Execution
			09845-67985		Data Comm
			09845-67986		Data Comm
			98770-65501		98770 Color Graphics
			1818-1208		Color Graphics System ROM
			1818-1209		Color Graphics System ROM
			98780-65501		Enhanced Graphics
			1818-1591		Enhanced Graphics ROM
			1818-1592		Enhanced Graphics ROM
					Paint
			6010-0694	1	Spray Paint — Cocoa Brown
			6010-0695	1	Spray Paint — Pearl Gray
					Normal Printer Paper
			9270-0565	1	Black Standard Paper Perforated
			9270-0566	1	Blue Standard Paper Continuous
			9870-0568	1	Black Metric Paper Perforated
			9270-0569	1	Blue Metric Paper Continuous
					High Contrast Printer Paper
			9270-0649	1	Black Standard Paper Perforated
			9270-0650	1	Blue Standard Paper Continous
			9270-0661	1	Black Standard Paper Continous
			9270-0651	1	Black Metric Paper Perforated
			9270-0652	1	Blue Metric Paper Continuous
			9270-0662	1	Black Metric Paper Continuous

09845-04416
CRT Top Cover

09845-04115
Blank Tape Filler

09845-04110
Blank Printer Filler

09845-67961
Cartridge Drive
Bezel Assembly

09845-04423
Keyboard Bezel
Assembly

09845-04417
CRT Bottom Panel

09845-04412
Shell Assembly

09845-04411
Base Assembly

5040-8230
Switch Bezel

See Figure
For Keycap Part
Numbers

09845-60350
Right ROM
Drawer Assembly
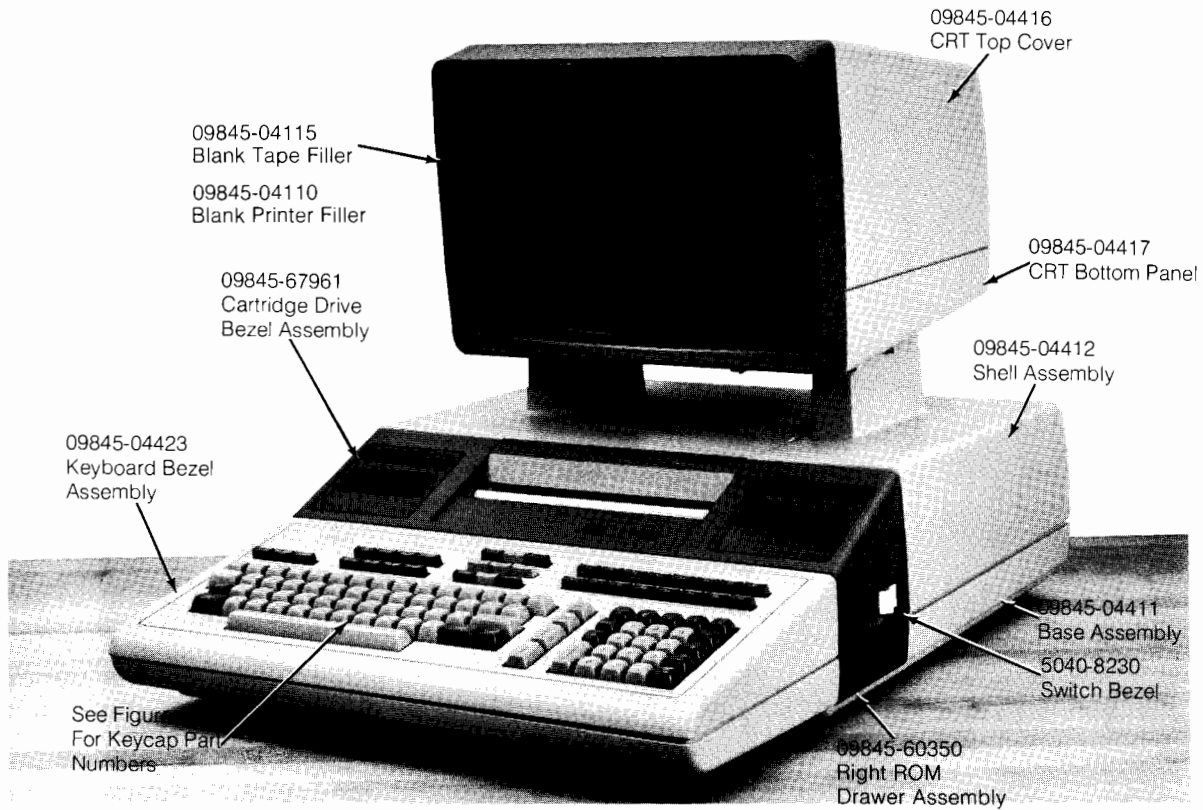
Figure 4-1: 9845B Front View

5040-8147
Transitor Cover

09845-60309
CRT Rear Panel
Assembly

09845-60302
Rear Panel
Assembly

09845-60355
Left ROM
Drawer Assembly

0403-0106
Rubber Foot

2110-0545
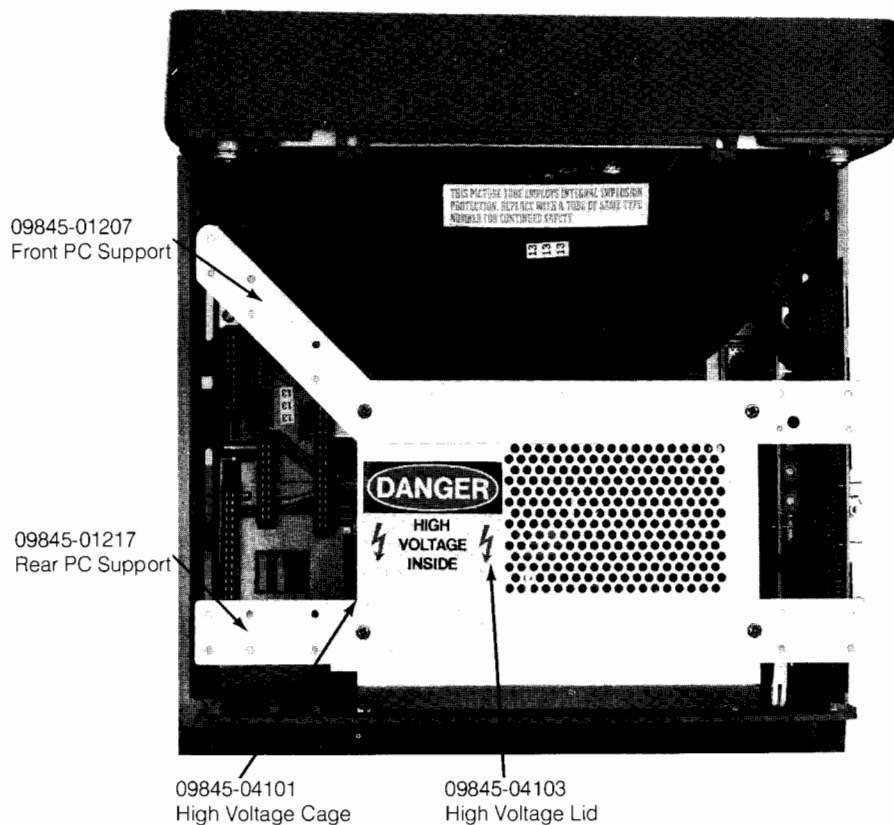Fuse Holder Cap
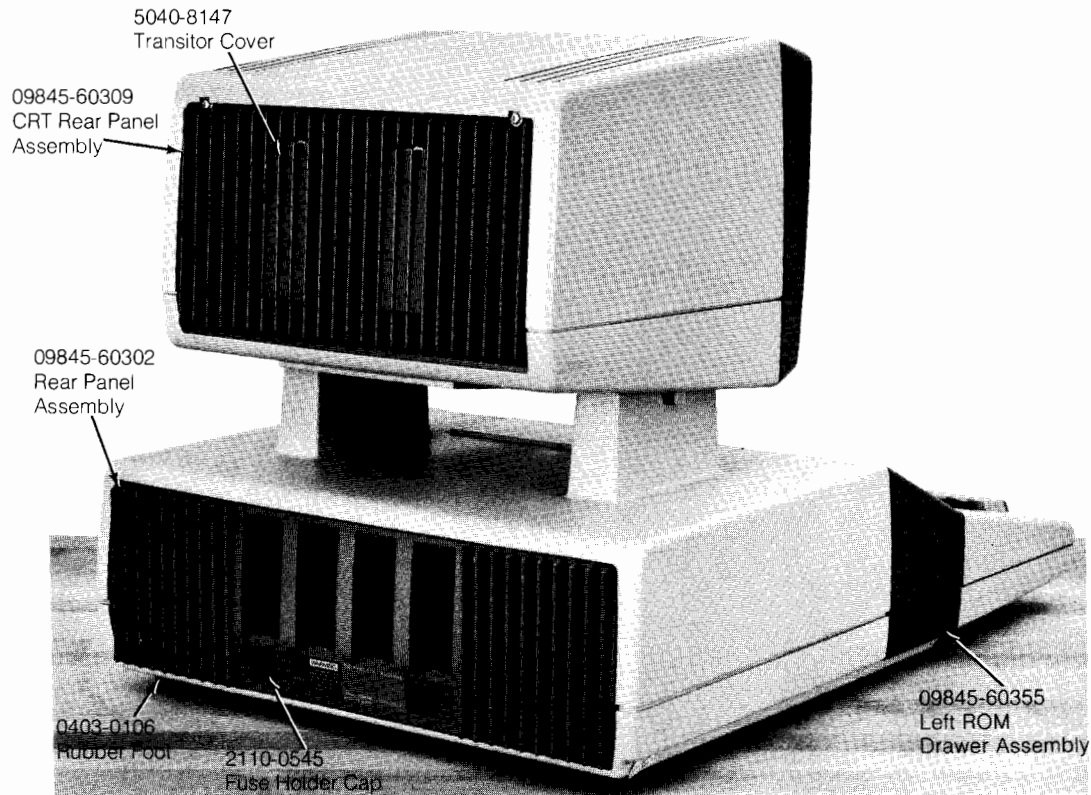
Figure 4-2: 9845B Rear View
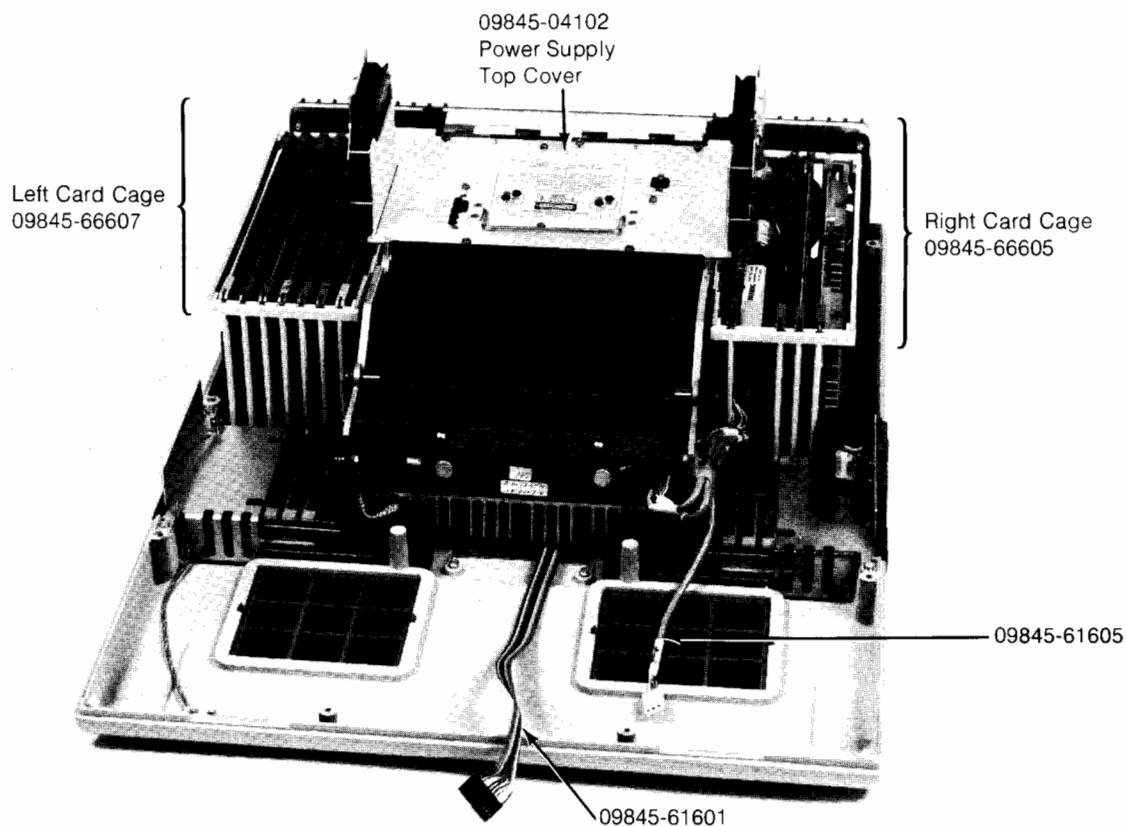
rev: 7/81

Figure 4-3:   9845B CRT Top View

Figure 4-4:   9845B Main Frame Internal View

Table 4-2: Print Mechanism Parts

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
	09845-67952		**Print Mechanism Assembly (order 09845-67162)**
1	09845-67953	1	Print Head (order 09845-67163)
2	09845-66553	1	PC Assembly
3	5040-8239	1	Connector Frame
4	09845-21101	2	Heat Sink
5	2190-0011	10	#10 Washer
6	2680-0099	5	10-32 x .375 Screw
7	1251-4819	28	Ampliflex Connector, long
8	1251-4820	7	Ampliflex Connector, short
9	5061-3020	7	Hybrid Module Chip (order 09845-67161)
10	09845-01205	1	Module Backing Plate
11	2510-0115	2	8-32 x 1 Screw
12	2510-0111	2	8-32 x .750 Screw
13	2510-0107	2	8-32 x .500 Screw
14	2190-0009	6	#8 Washer
15	09845-24704	1	Pivot Pin
16	8120-2514	2	Cable Assembly
18	09845-61608	1	Ground Strap
19	0340-0654	1	Insulator
20	7120-7642	1	Identification Label
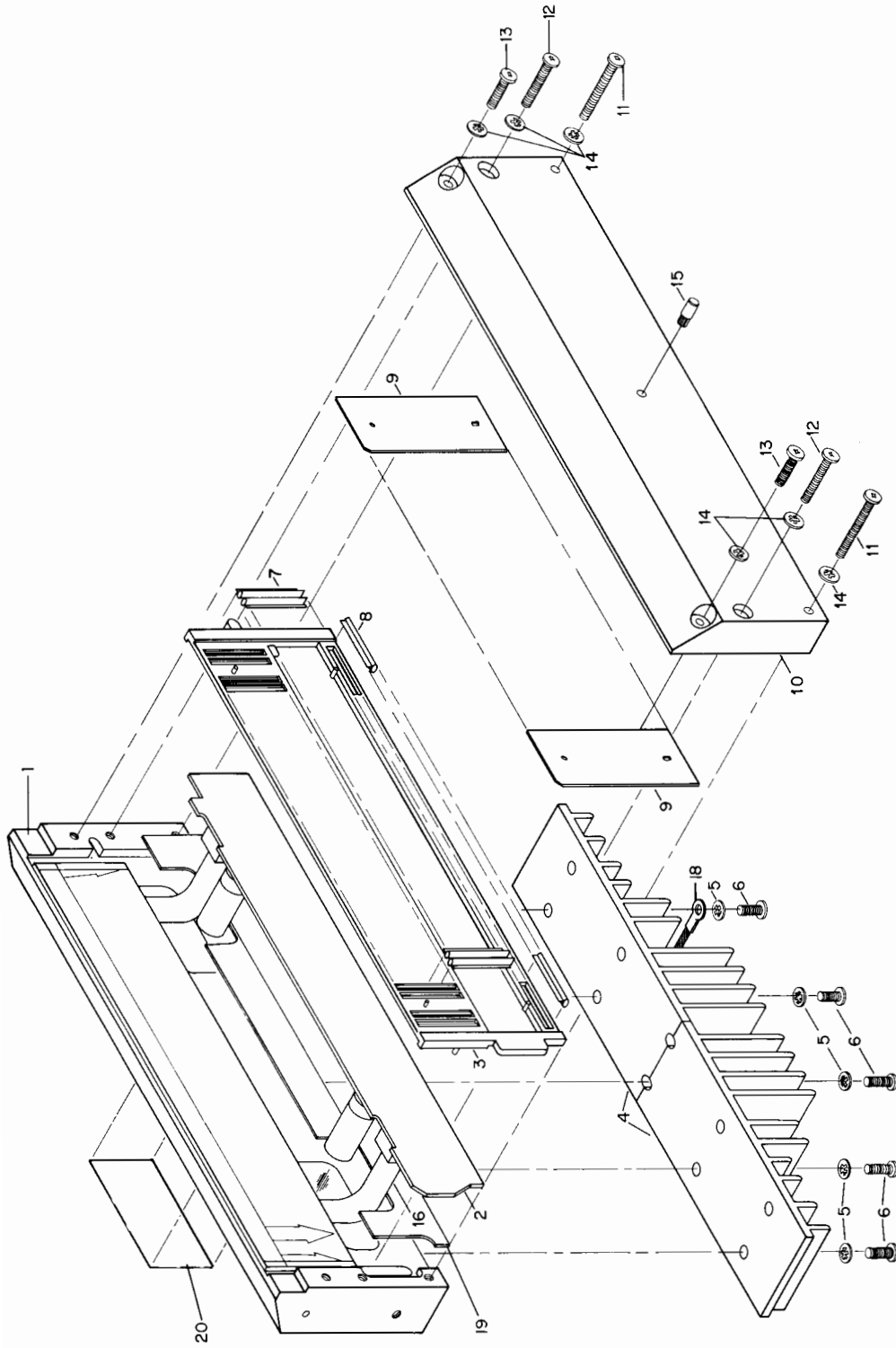
Figure 4-5: Print Mechanism Parts

Table 4-3: Printer Bucket Parts

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
	09845-67951			**Bucket Assembly**
1	09845-66603		1	Printer Side Frame (Right)
2	09845-04707		1	Left Side Plate
3	09845-04708		1	Right Side Plate
4				Not Assigned
5	N/A		1	Safety Wire
6	2360-0359		7	6-32 x .375 Machine Screw
7	09845-27903		1	Guide
8	2190-0112		4	#2 Lock Washer
9	0520-0130		4	2-56 x .375 Machine Screw
10	09845-27902		1	Front Guide
11	0624-0209		8	6-32 x .750 Tapping Screw
12	09845-27901		1	Rear Guide
13	1530-2025		1	Roller
14	1530-2026		1	Platen
15	1410-0635		4	Bearing
16	0510-0028		2	.375 Retainer Ring
17	0510-0060		4	.375 Grip Retainer Ring
18	0510-0054		1	.250 Grip Retainer Ring
19	5040-8144		1	Motor Pulley
20	3140-0603		1	Stepper Motor, order with 10 crimp pins, 1251-0688
21				Not Assigned
22	5040-8143		1	Roller Pulley
23	5060-7463		1	Platen Pulley
24				Not Assigned
25	1500-0494		1	Drive Belt
26	1400-0031		1	Cable Clamp
27	3050-0066		1	#6 Flat Washer
28	1400-0015		1	Wire Clamp
29				Not Assigned
30	09845-67168		1	Paper Sensor
31	09845-01213		1	Sensor Bracket
32	2360-0117		1	6-32 x .375 Machine Screw
33				Not Assigned
34	2420-0001		2	#6 Hex Nut
35	0624-0097		2	4-40 x .188 Tapping Screw
36	09845-21201		1	Load Bar
37	5040-8138		2	Print Head Cam
38	2680-0260		2	10-32 x .812 Machine Screw
39	2190-0034		2	#10 Lock Washer
40	3050-0257		2	#10 Flat Washer
41	1460-0636		2	Load Spring
42	09866-22301		2	Spring Holder
43	2360-0199		1	6-32 x .438 Machine Screw
44	09845-24705		1	Support Wire
45	2190-0007		1	#6 Star Washer
46	09845-66604		1	Side Frame (Left)
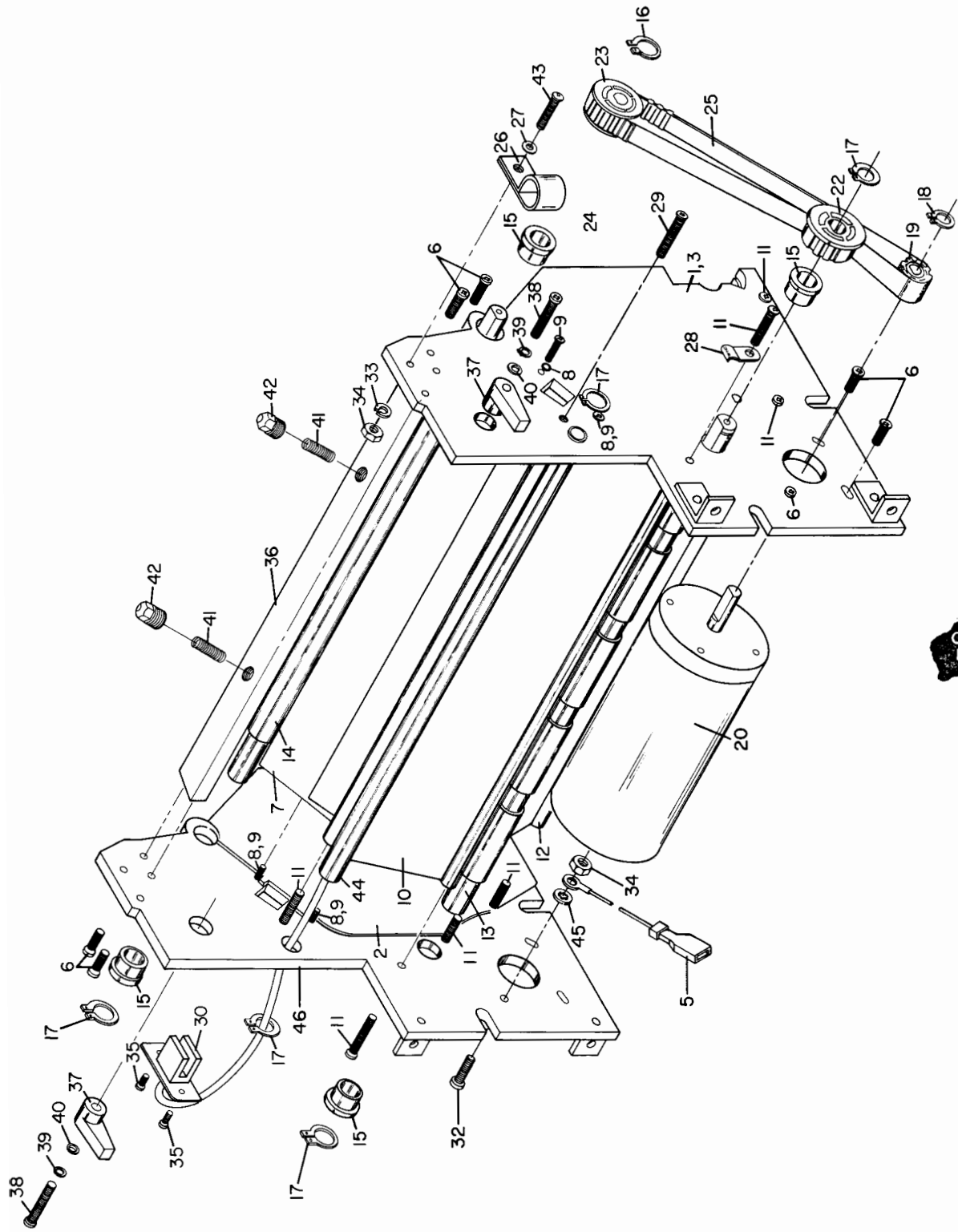
Figure 4-6: Printer Bucket Parts

Key Switches

|		
3101-2132	PAT A11 Autost (2)	3101-2202 Shift Lock (1)
3101-2133	Cursor Arrows (4)	3101-2203 CLR-End Roll↑ Home (5) / CLR Roll↓
3101-2134	Non Tilted Keys (53)	3101-3201 ASCII Keyboard (55)

All key cap part numbers are prefixed by 0371-.
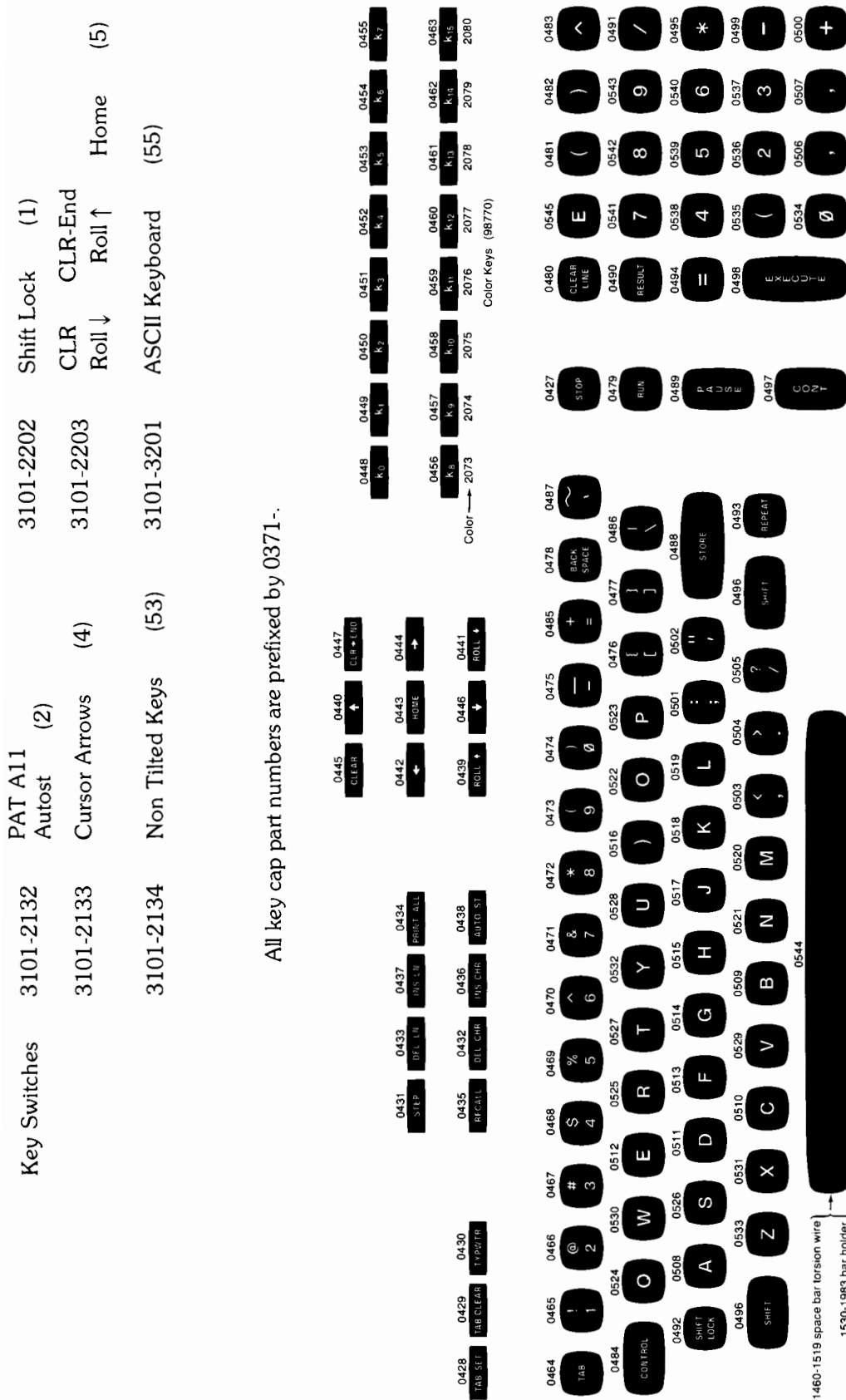
ASCII Keyboard

Use these drawings for key cap part numbers and correct key cap locations. Part numbers for all the ASCII keyboard key caps are given. For the other language keyboards, the part numbers for the unique key caps (key caps different from the ASCII keyboard) are given. If no key cap number appears above a particular key cap, refer to the same key on the ASCII keyboard for the part number. The actual position of the key cap on the keyboard (compared to the ASCII keyboard) will vary according to the language.
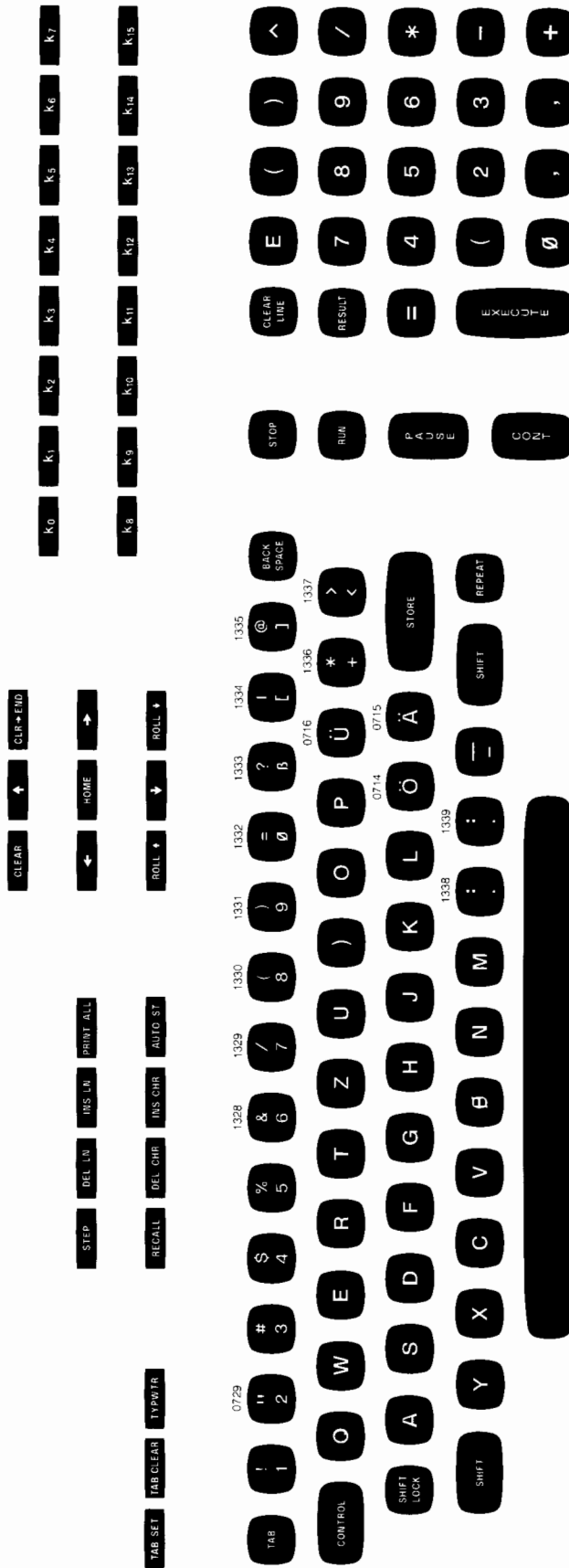
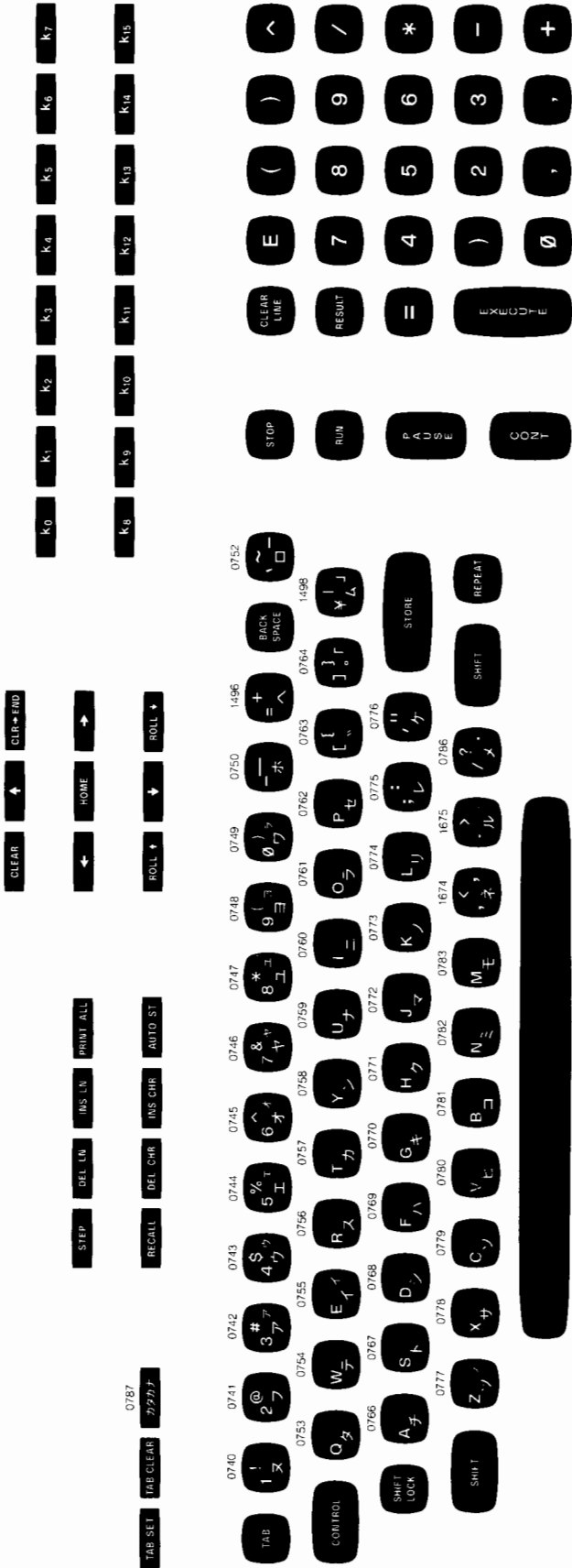**Figure 4-7: Key Cap Part Numbers**
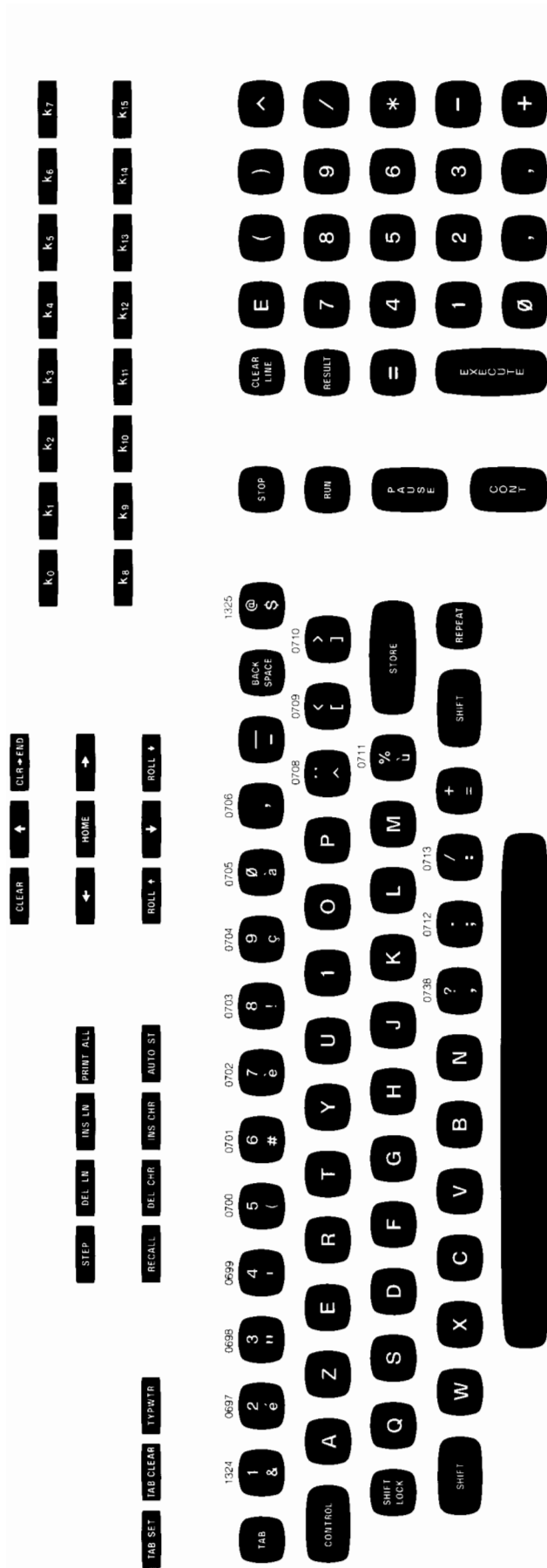
French Keyboard

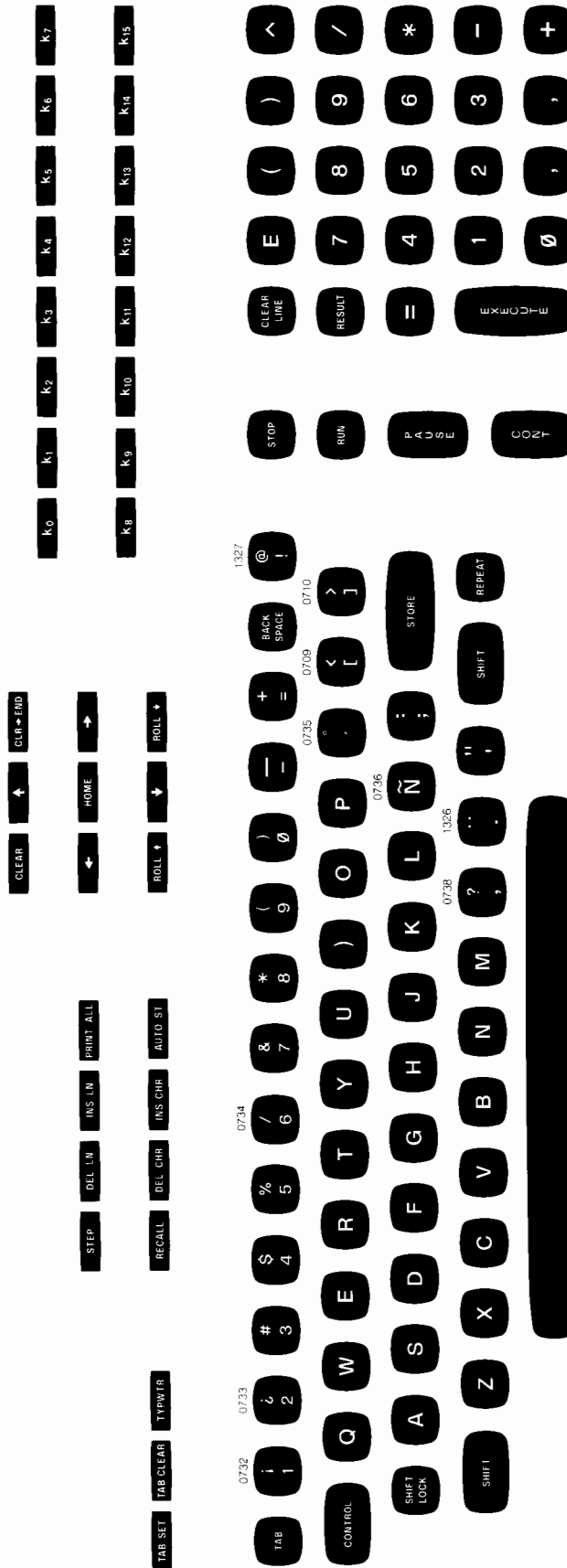Figure 4-7: Key Cap Part Numbers (cont.)

German Keyboard

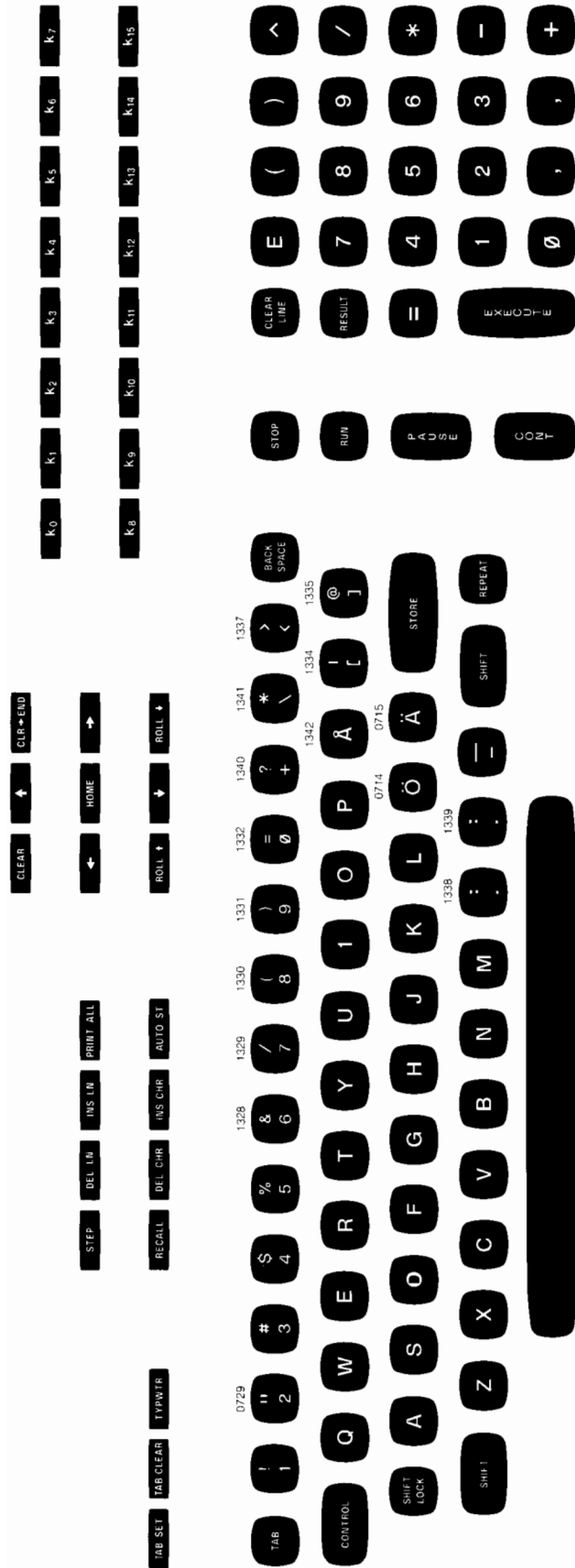Figure 4-7: Key Cap Part Numbers (cont.)

Katakana Keyboard

Figure 4-7: Key Cap Part Numbers (cont.)

Spanish Keyboard

Figure 4-7: Key Cap Part Numbers (cont.)

Swedish-Finnish Keyboard

Figure 4-7: Key Cap Part Numbers (cont.)