HP 9825A/B
Desktop Computer
Service Manual

Manual Part No. 09825-91030
Microfiche Part No. 09825-98030

This manual replaces the 9825A Service Manual, 09825-90030.

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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.

The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive changes are incorporated.

July 1980...First Edition (replaces 09825-90030)

October 1980...Updated pages for 9825A Service: ii thru iv, vi, 1-1, 1-2, 2-7, 2-11, 2-12, 2-15 thru 2-18, 2-23, 2-24, 2-27, 3-2, 3-10, 3-11, 4-0 thru 4-6, 5-7, 5-8, 6-2, 6-4, 6-5, 6-7.

| September 1981...Second Edition

NOTICE

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Chapter 1

General Information

This manual provides service information for the HP 9825A and 9825B Computers. This manual replaces the 9825A Service Manual, 09825-90030. The manual covers these areas:

- Gaining access to the replaceable assemblies.

- Re-assembling the computer.

- Making adjustments.

- Theory of operation.

- Which assemblies are most likely at fault for a variety of failure modes.

- A block diagram of the computer.

- Replaceable parts and their part numbers.

Specifications

Physical

Height:	13 cm	(5.1 inches)
Width:	38.4 cm	(15.1 inches)
Depth:	52.3 cm	(20.6 inches)
with power cord:	57.2 cm	(22.5 inches)
with I/O cable:	64.0 cm	(25.2 inches)
Weight:	12.3 kg	(27 pounds)
Shipping weight:	24.6 kg	(54 pounds)

Electrical

100 V +5% −10%   2.0 Amps maximum
120 V +5% −10%   1.8 Amps maximum
220 V +5% −10%   0.85 Amps maximum
240 V +5% −10%   0.80 Amps maximum
Fuse size: 3 A Normal Blow for 100/120 V
             1.5 A Normal Blow for 220/240 V

Maximum peak power is 155 watts.

Typical operating power is 100 watts.

Line frequency can be from 48 Hz to 66 Hz

Environmental

Operating temperature:
   (without tape cartridge)   0°C to +55°C
Operating temperature:
   (with tape cartridge)   +5°C to +40°C
Storage temperature:
   (power off)   −40°C to +65°C
Humidity: <80% over temperature range

Useable Read/Write Memory

Standard 9825A   6844 bytes
9825A Option 001   15036 bytes
9825A Option 002   23228 bytes
9825A Option 003   31420 bytes
Standard 9825B   22918 or 32160 bytes
9825B Option 201 (9825T)   61670 bytes

Installation

Correct installation of the 9825B consists of setting the voltage selector switches, verifying the correct fuse value, and connecting it to the available line voltage.

Power Cords

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

- 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 SEVERELY DAM-AGED IF EVEN A RELATIVELY MINOR INTERNAL FAILURE OCCUR-RED.

Power cords with different plugs are available for the equipment; each plug has a ground connector. The part number of each cord is shown in Figure 1-1. 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
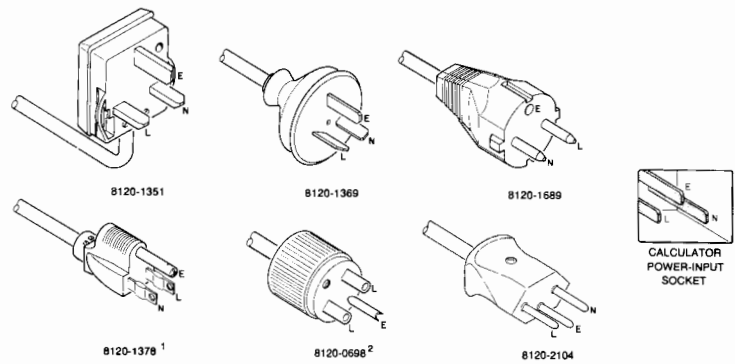
[1] UL and CSA approved for use in United States of America and Canada with equipment set for either 100 or 120 VAC operation.

[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.

Figure 1-1   Power Cords

Line Voltage

The computer will operate on a line voltage of either 100V, 120V, 220V or 240V (+5%, −10%). The line frequency must be from 48 to 66 Hz. The computer cannot operate at a line frequency of 400 Hz, nor from a square wave power source.

Table 1-1   Line Voltage

Nominal Line Voltage	Voltage Extremes	Fuse Size	*hp* Part Numbers
100 VAC	90 VAC 105 VAC	3 Amp Normal Blow	2110−0003
120 VAC	108 VAC 126 VAC		
220 VAC	198 VAC 231 VAC	1.5 Amp Normal Blow	2110−0043
240 VAC	216 VAC 252 VAC		

Fuses

The correct fuse size for a given voltage setting is shown in Table 1-1. The fuse is located under the printer paper access cover as shown in Figure 1-2.

WARNING

DISCONNECT THE AC POWER CORD BEFORE ATTEMPTING TO RE-MOVE OR INSTALL A FUSE.
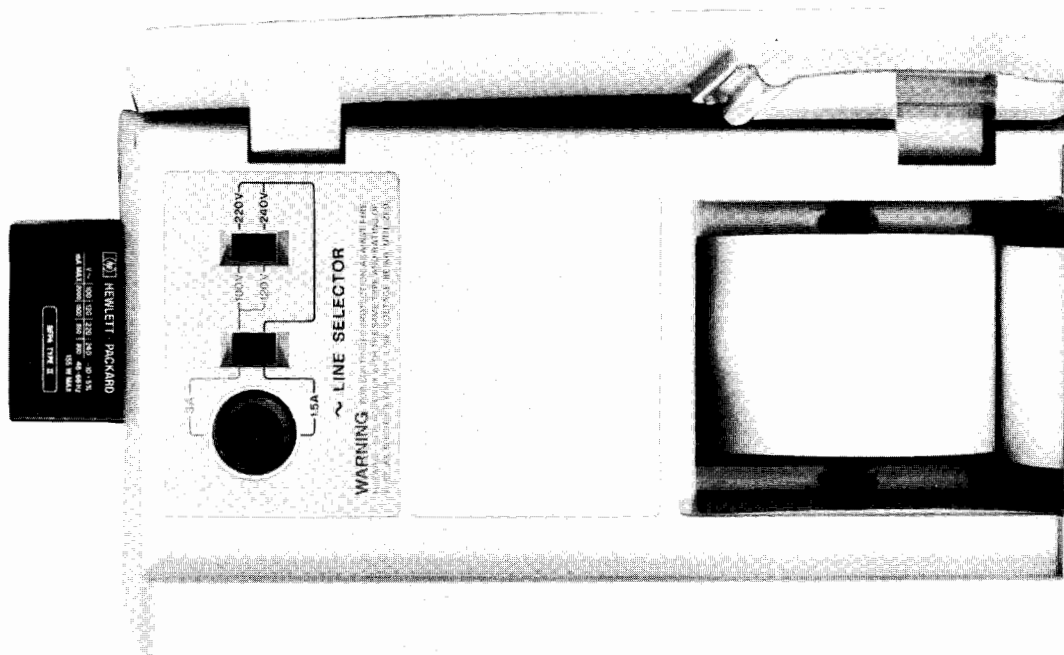
Figure 1-2   Fuse Location

To change the fuse:

1. Disconnect the power cord from the computer.
2. Remove the fuse cap by pressing inward while twisting it counterclockwise.
3. Remove the fuse from the cap.
4. Insert the correct replacement fuse (either end) into the cap.
5. Put the fuse and cap back into the fuse holder.
6. Press the cap while twisting it clockwise until it locks in place.

Voltage Selector Switches

Ensure that the two voltage selector switches under the printer paper access cover are at the correct line voltage setting. Figure 1-3 shows the correct switch positions for each nominal line voltage. If it is necessary to alter the setting of either switch, insert the tip of a small screwdriver into the slot on the switch and slide the switch so that the position of the slot corresponds to the desired voltage.
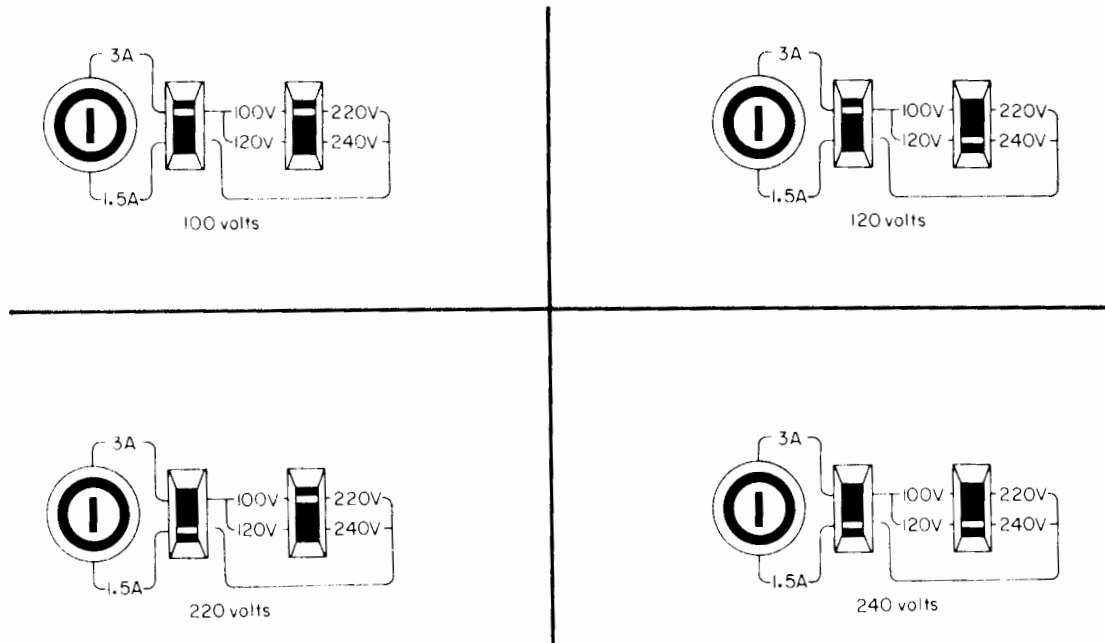
Figure 1-3   Voltage Selector Switch Positions

Table Mounting

The computer can be mounted to the top of a desk or table by following these steps:

1. Drill 5 holes in the top of your desk or table to accommodate #6-32 screws according to the diagram below.

2. Remove the #6-32 Phillips head screws that hold the rubber feet to the bottom of the computer.

3. Use #6-32 machine screws that are ½ inch longer than the thickness of the table top. This ½ inch allows for the thickness of the rubber feet and the hole for the screw in the bottom of the computer.

Front of Computer
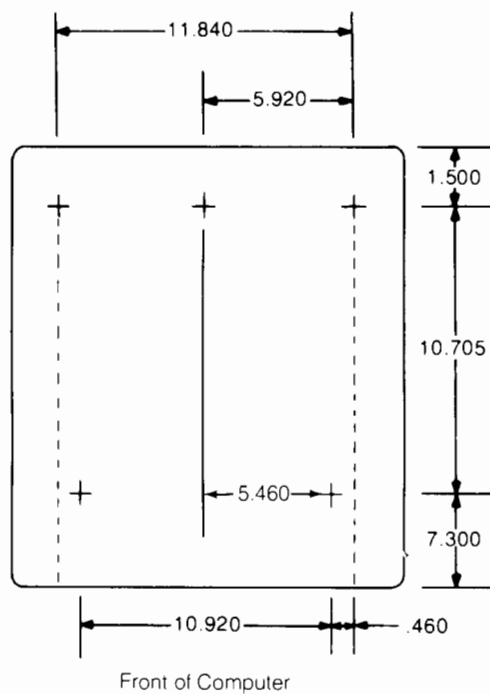
Figure 1-4   Table Mounting Dimensions

Printer Paper

To install the printer paper (HP part number 9270-0480), use the following procedure.

1. Lift the printer paper access cover.

2. Insert the spindle through the center of the roll of paper.

3. Position the spindle in the guides so that the paper will unwind from the bottom of the roll (see Figure 1-5).

4. Insert the end of the paper into the slot in the front of the paper well and turn the printer's thumb wheel to advance the paper through the printer.
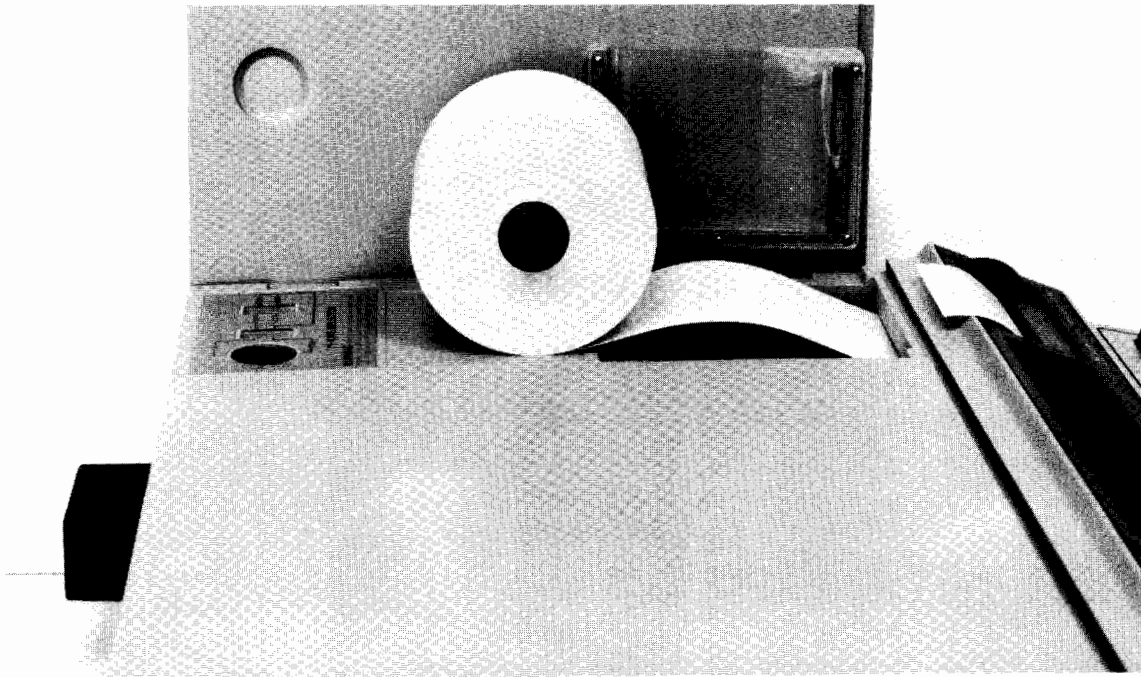
Figure 1-5   Loading Printer Paper

Cartridge Installation

To install a tape cartridge (part number HP 98800A), slide it into the cartridge drive with the label of the cartridge facing the back of the computer.

To remove the cartridge, press the cartridge eject bar.

Keeping the Computer Clean

Case

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

Dust Filter

The dust filter is a foam disk on the back of the computer. It should be cleaned weekly, more often if the computer is operated in a dusty environment. To remove it, pinch the foam and pull it out. Clean the filter in warm soapy water and rinse it in clean water. Then dry it thoroughly and replace it.

Magnetic Tape Head

To ensure 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.

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 1-6).
3. Remove any other dust that has accumulated in the vicinity of the tape head.
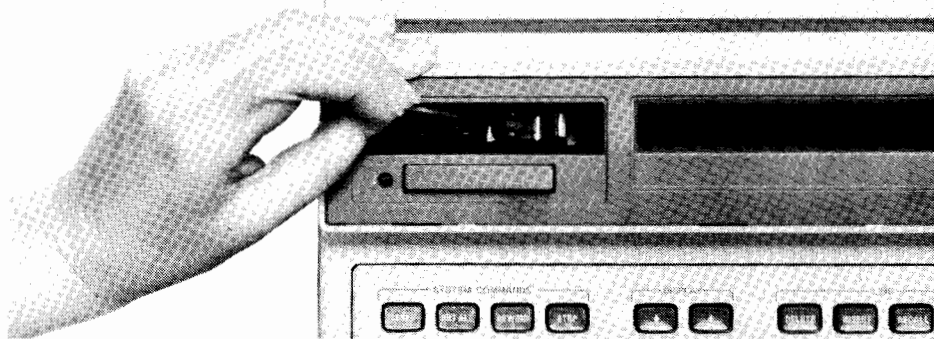
Figure 1-6   Cleaning the Tape Head

Tape Cartridge Considerations

It is a good idea to remove a tape cartridge from the computer when the computer is not in use. The tape transport capstan may develop a temporary flat spot if a tape cartridge is left in the computer for a long period. This could cause errors when using the tape. The temporary flat spot can be corrected by running to the end of the tape (`fdf 9999`) and rewinding again. Figure 1-7 shows the tape in its rewound condition.

The tape drive belt may lose its tension with age. A loose drive belt is indicated when the tape is not wound smoothly on the tape reels, as seen through the cartridge cover. A cartridge in this condition should be replaced.

A tape cartridge in which the tape has become de-spooled can be repaired by the following procedure:

1. Remove the four screws that attach the clear cartridge cover to the black bottom plate.
2. Turn the cartridge over so the bottom plate is on a clean flat surface.
3. Lift the cover off and set it aside.
4. Thread the tape around the tape guides as shown in Figure 1-7.
5. Moisten the end of the tape so that it will cling to the reel.
6. Use a set of tweezers or a pointed object, such as a pencil, to keep the end of the tape in this position while removing all slack from the tape. Place the moistened end of the tape onto the outside edge of the empty reel, close to the point where the drive belt comes into contact with the reel.
7. Wind at least 1.8 m (6 feet) of tape onto the empty reel. While winding the tape, guard against the rollers' tendency to rise off their posts as they are rotated.
8. If all the tape is on the right hand reel, you will pass three sets of double holes about 305 mm apart; then, after 610 mm of tape, a single hole. That single hole should be at least 1.8 m from the beginning of the tape.
9. If all the tape is on the left hand reel, you will pass three individual holes spaced 305 mm apart; then, after 610 mm of tape, another single hole. This single hole should be at least 1.8 m from the end of the tape.
10. Re-assemble the tape cartridge.

Before re-inserting the tape cartridge into the computer, check the tape transport assembly to verify that both incandescent bulbs are lit. If they are not, correct this situation before using any tape cartridge operations.

Place the tape cartridge in the computer, rewind it, then run it to the end of the tape and rewind it again. This is to allow the tape drive belt, which was not disturbed during the re-spooling process, to correct the tape tension as it was designed to do.
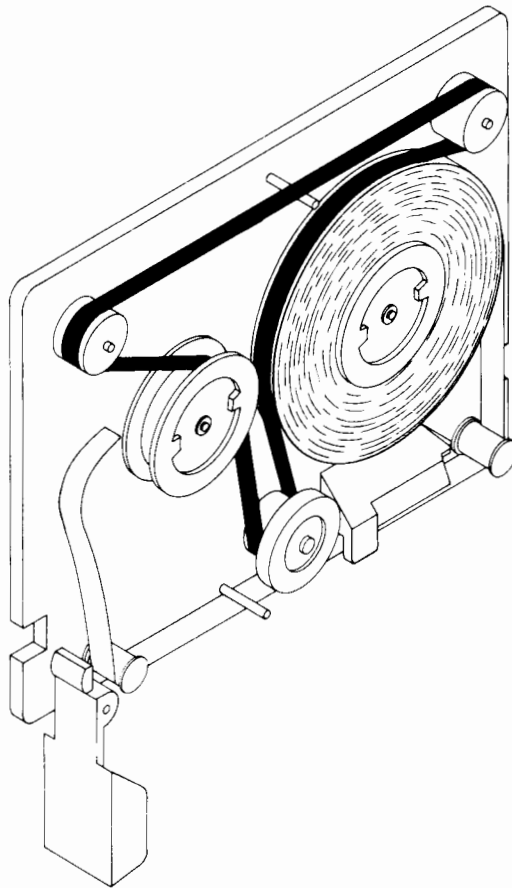
Figure 1-7. Tape Cartridge

Related Documentation

Part Number	Manual Title/Comments
09825-81010	**9825 Documentation Kit**[1]
09825-87901	**9825B Manual Kit**[2]
09825-90012	Quick Reference (replaces -90011)
-90015	Error Booklet
-90020	Strings Programming Manual
-90021	Advanced Programming Manual
-90022	Matrix Programming Manual
-90023	9862 Plotter Programming Manual
-90024	General I/O Programming Manual
-90025	Extended I/O Programming Manual
-90026	9872 Plotter Programming Manual
-90027	Systems Programming Manual
-90032	Extended Testing Package
-90034	Keyboard Upgrade Installation Note
-90037	System Test Booklet
-90041	9863A Operating Note (98032 Opt. 063)
-90042	9864A Operating Note (98032 Opt. 064)
-90043	9866A/B Operating Note (98032 Opt. 066)
-90044	9869A Operating Note (98032 Opt. 065)
-90045	9871A Operating Note (98032 Opt. 071)
-90046	9883A Operating Note (98032 Opt. 083)
-90047	9884B Operating Note (98032 Opt. 084)
-90048	9881A Operating Note (98032 Opt. 081)
-90054	98035 Operating Note
-90060	Interfacing Concepts
-90066	9866 Cradle Installation Note
-90075	9875 (HP-IB) Operating Note
-90200	9825B Operating & Programming Reference (replaces -90000)
-90210	9825B I/O Control Reference
-90220	9885/9895 Disc Programming Manual (replaces 09885-90000)

1 09825-81010 includes 09825-90200, -90210, -90220, -90012, -90060, 98032-90000, 98033-90000, 98034-90001, 98035-90000, 98036-90001, 98040-90000 and two binders.

2 Includes same manuals as above, less interface manuals.

Chapter **2**

Assembly Access

This chapter shows the location of the 9825B assemblies. It also describes how to gain access to these assemblies to remove them. Re-assembling the computer is the reverse of the disassembly sequence except where noted. Assembly or disassembly operations requiring special procedures are described in greater detail.

The case of the computer has three major components: the base, the bezel, and the shell. Any assembly that can be repaired or replaced is part of either the base assembly or the bezel assembly. The shell is only a cover and does not contain any replaceable or repairable assemblies.

Tools Required

The following tools are necessary for correctly disassembling and re-assembling the computer.

HP Part Number	Description
8710-0004	Longnose Pliers
9810-0899	#1 Pozidriv
8710-0900	#2 Pozidriv
8710-0580	Connector Extractor
5040-7433	Keycap Puller
	7/64 in. Hexagonal Wrench

Shell

The shell must be removed in order to service any computer assembly.

1. Remove the two screws attaching the shell to the base. See Figure 2-1.
2. Lift the rear of the shell about two centimetres and slide it to the rear. It can then be set aside while working on other assemblies.
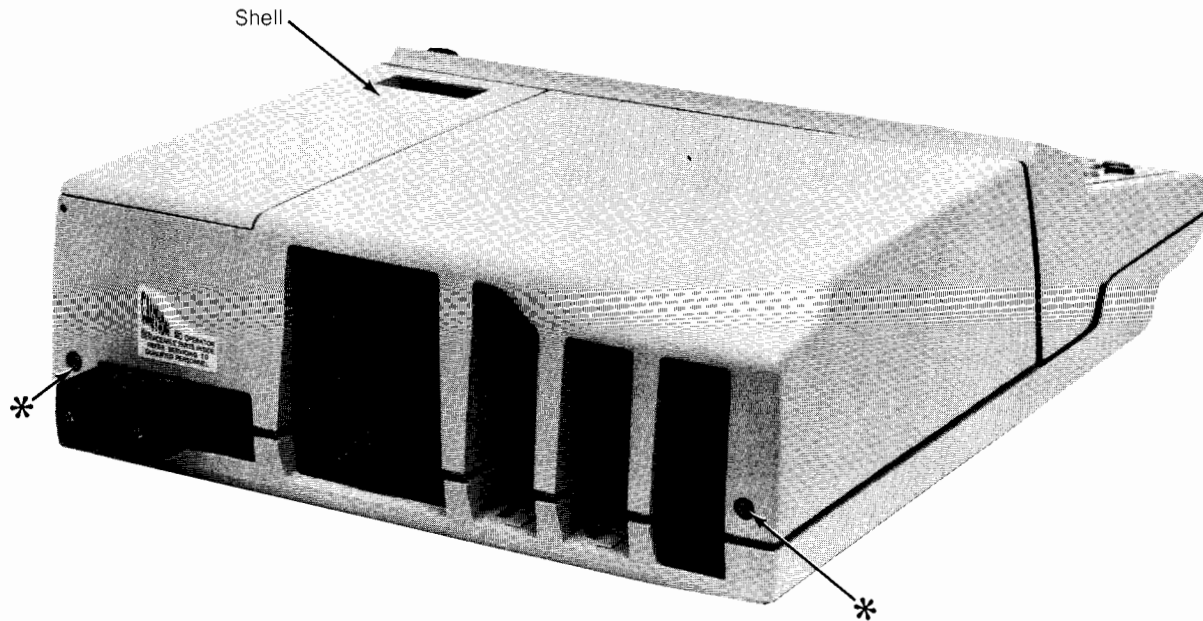
Figure 2-1 Computer Rear Panel

To reinstall the shell:

1. Slip the front upper lip of the shell under the corresponding edge of the bezel.

2. Keeping these edges together, lower the rear of the shell until the screw holes are aligned. Loosening the two screws on the power line filter may be necessary to accomplish this.

3. Install and tighten the two shell screws. Then tighten the line filter screws if they were loosened.

WARNING

POWER TO THE COMPUTER MUST BE DISCONNECTED BEFORE ATTEMPTING TO REMOVE OR INSTALL ANY OF THE FOLLOWING ASSEMBLIES.

Bezel Assembly

The bezel assembly contains five major subassemblies:

- KDP

- Key-switch

- Printer

- Single line display

- Tape transport

Printer

Tape Transport

Single Line Display

Bezel

KDP

Key Switch
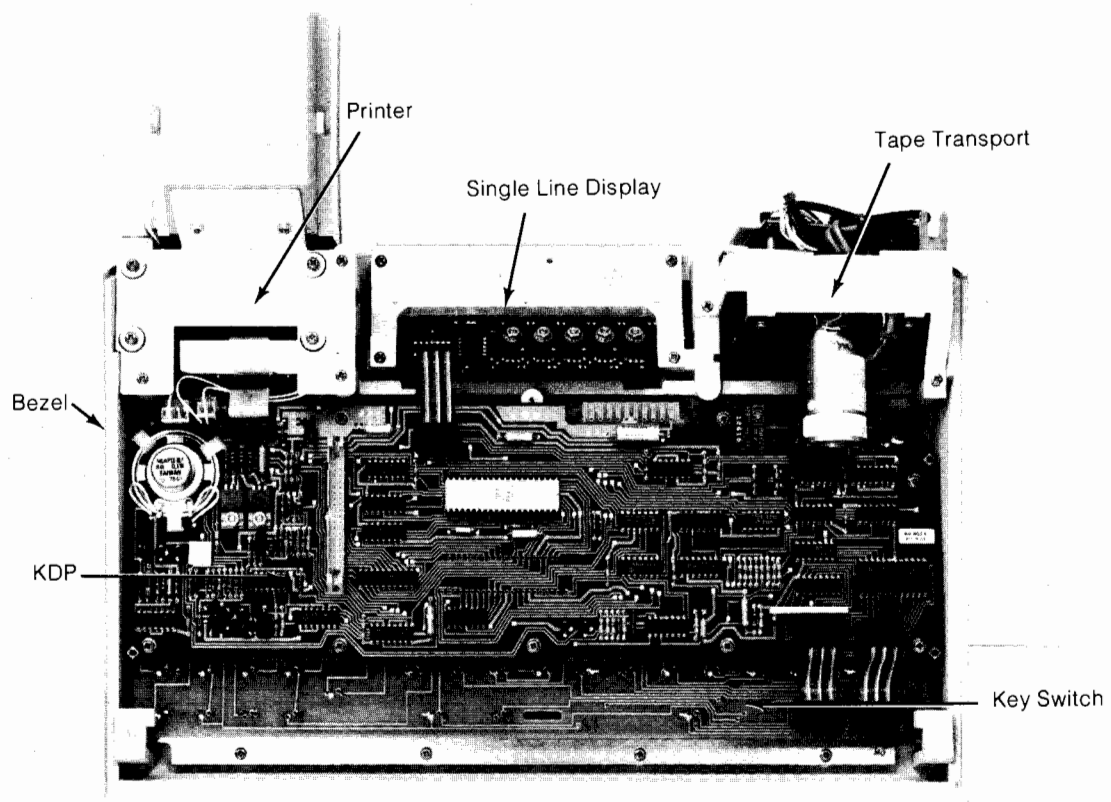
Figure 2-2   Bezel Assemblies

Bezel Removal

CAUTION

REMOVE ALL OPTION ROMS FROM THEIR SLOTS IN THE FRONT OF
THE COMPUTER. ATTEMPTING TO REMOVE THE BEZEL ASSEMBLY
WHILE OPTION ROMS ARE INSTALLED COULD PHYSICALLY DAM-
AGE THE COMPUTER.

To remove the bezel:

1. Loosen the two bezel retaining screws shown in Figures 2-3A and 2-3B. Do not remove these screws, three or four turns should be sufficient.

✱ Loosen This Screw

✱ Loosen This Screw
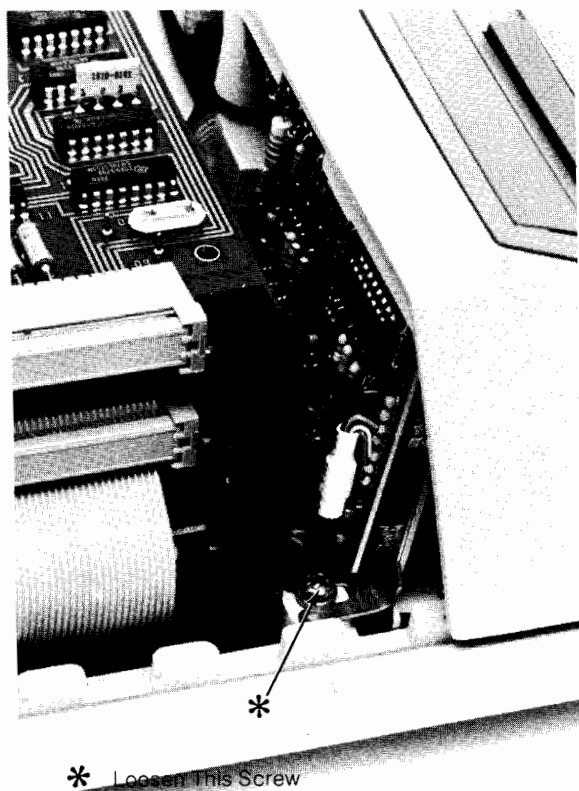
Figure 2-3A   Left Hand Bezel Retaining Screw   **Figure 2-3B   Right Hand Bezel Retaining Screw**
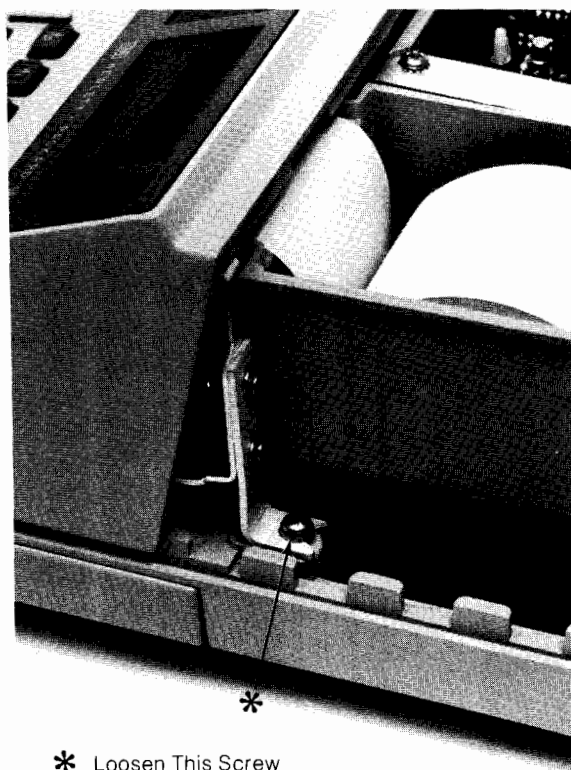
2. Slide the bezel forward with respect to the base. Do this by holding the base in position with the heels of your hands (as shown in Figure 2-4) and then pushing the bezel forward with your fingers about 10 mm until it stops.
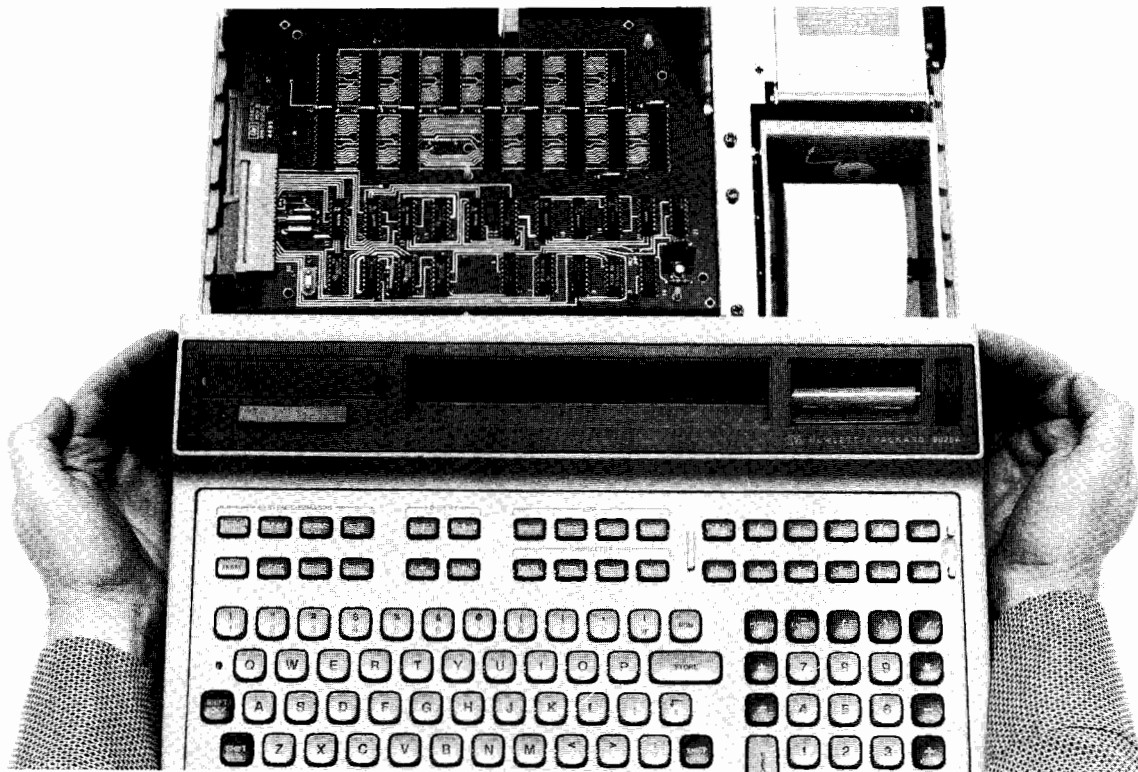
Figure 2-4 Sliding the Bezel Forward

3. Lift the bezel slightly and move it forward about 90 mm. The bezel can be lowered to rest on the base in this position.

4. ROMs can now be reinstalled and power can be applied to the computer.

If access to the underside of the bezel is required, stand the bezel on its edge beside the main chassis as shown in Figure 2-5. The front of the base may have to be raised to remove tension from the cables. The computer can be operated in this position.
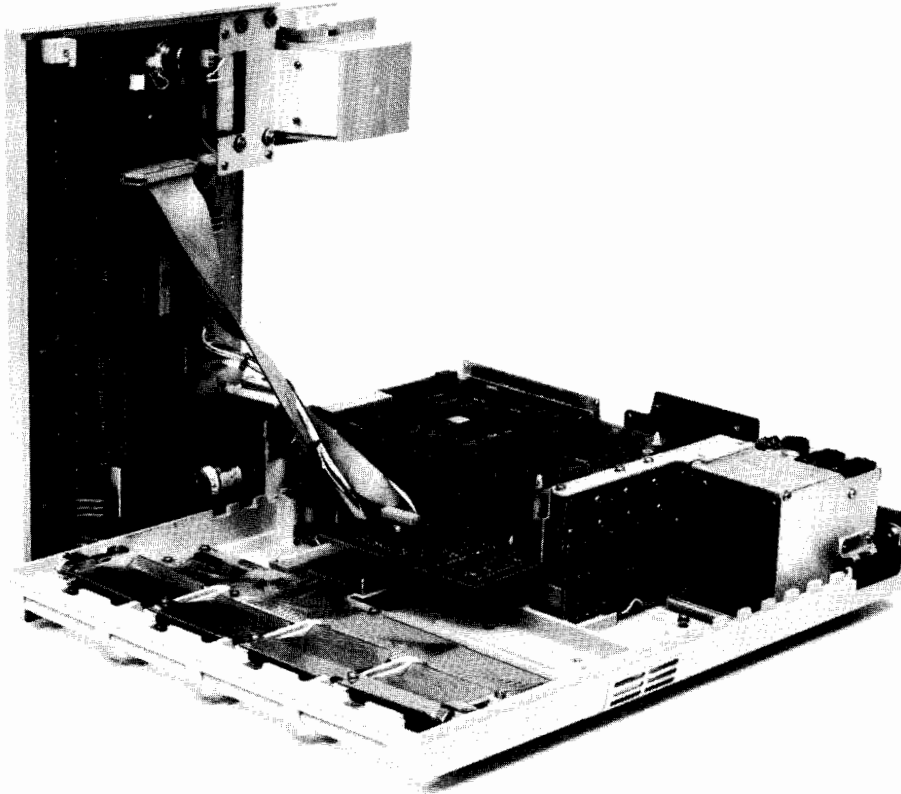
Figure 2-5   Assembly Access

Removal of Bezel Subassemblies

To replace or repair any of the bezel subassemblies the bezel should be disconnected from the base assembly. To do this:

1.   Disconnect the power cable.
2.   Disconnect the tape transport cable.
3.   Disconnect the I/O cable. This requires the use of the extractor tool (HP part number 8710-0580).

At this time the printer paper should be torn off and the roll removed from the paper well. The reason for this becomes apparent to anyone chasing both paper roll and spindle across the floor, especially while the paper is still threaded in the bezel that was just inverted.

KDP Removal

To remove the KDP assembly:

1. Disconnect the four cables to the printer.
2. Disconnect the ribbon connector to the display.
3. Disconnect the two ribbon connectors to the key-switch assembly.
4. Remove the nine screws attaching the KDP assembly to the key-switch assembly.
5. Keep the KDP insulator in place on the bezel.
   (9825A keyboard only).

The KDP assembly can be removed with any or all other assemblies still in place on the bezel.

✳   Remove These Screws
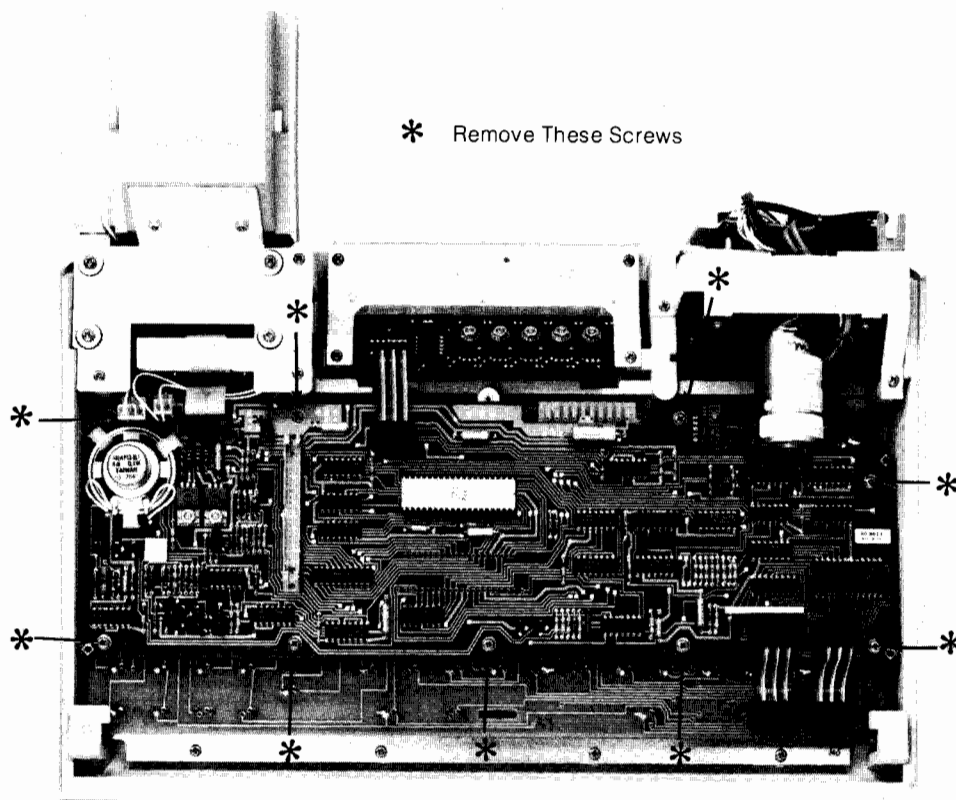
Figure 2-6   KDP Assembly Removal (9825B shown)

Printer Removal

To remove the printer assembly:

1. Disconnect the four cables that connect the printer to the KDP assembly.

2. Remove the four screws that attach the printer to the bezel. Three of them are visible in Figure 2-7; the screwdriver is on the fourth screw.

The printer can be removed with any or all other assemblies still in place on the bezel.
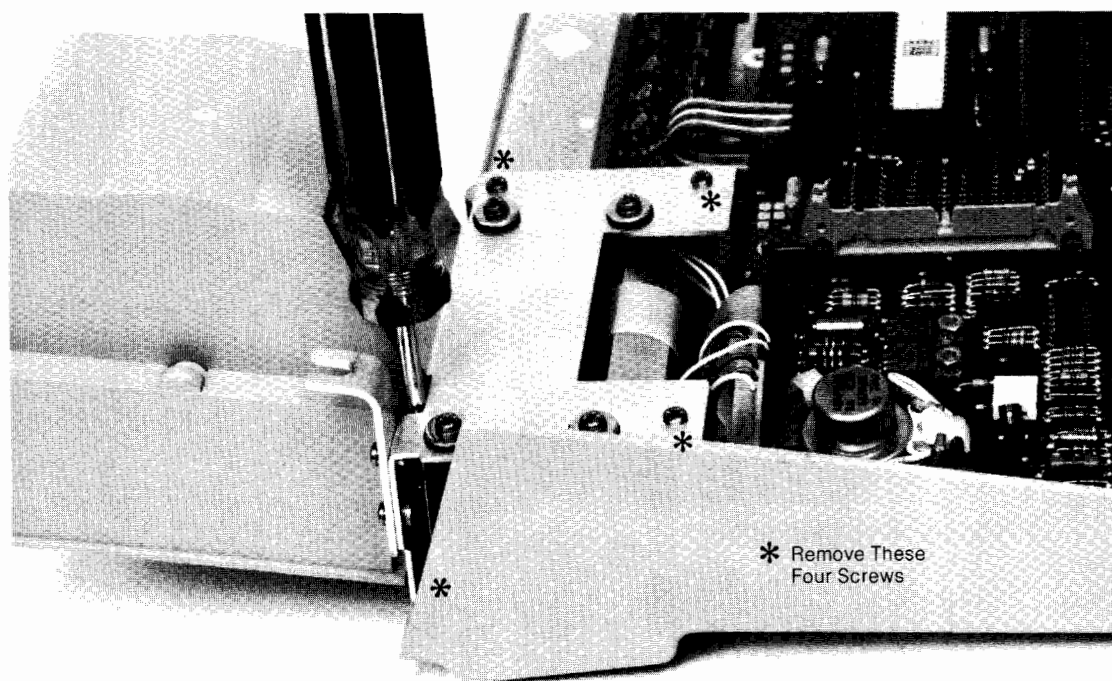
Figure 2-7   Printer Assembly Removal

Display Removal

To remove the single line display assembly:

1. Disconnect the ribbon connector at the KDP assembly.

2. Remove the four screws that attach the display to the bezel.

The display can be removed with any or all other assemblies still in place on the bezel.

* Remove These
Four Screws
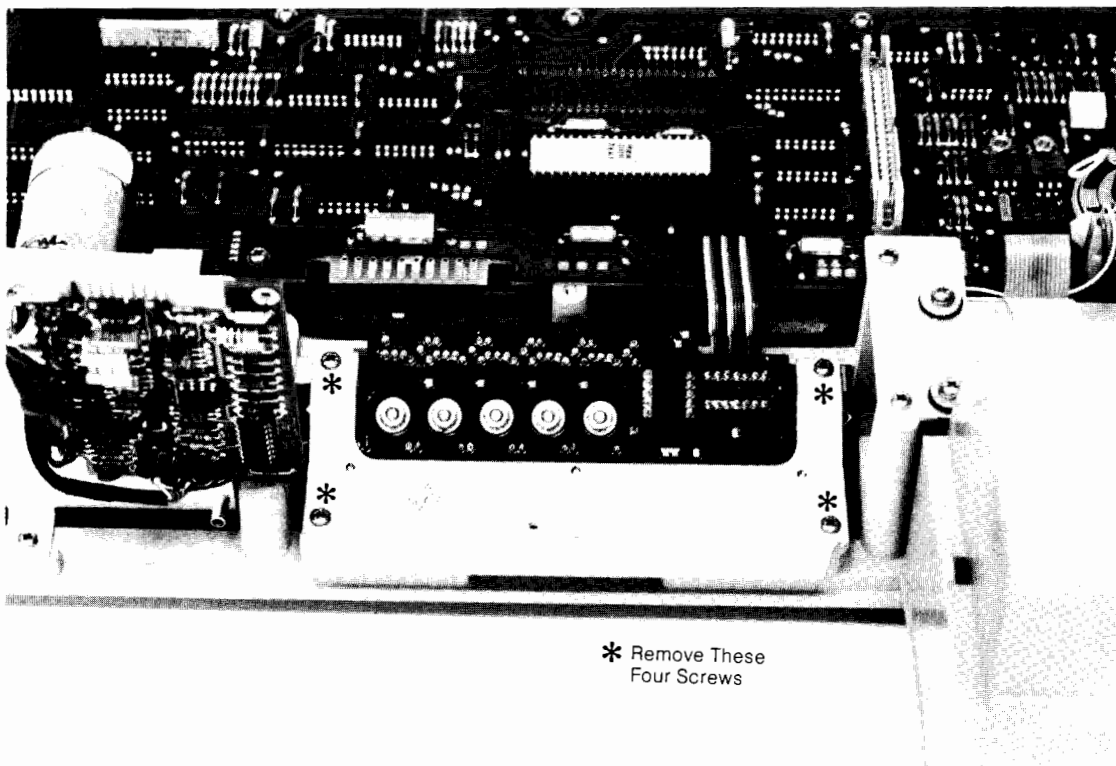
Figure 2-8   Display Assembly Removal

Tape Transport Removal

To remove the tape transport assembly:

1. Remove the three screws that attach the analog board assembly to the rest of the tape transport assembly.

2. Carefully move the analog board so that the screw underneath it can be removed. Figure 2-9 shows the analog board rotated 90 degrees to give access to the lower screw.

3. Remove the other two screws that attach the tape transport to the bezel.

The tape transport can be removed with any or all other assemblies still in place on the bezel.

✱ Remove These Screws
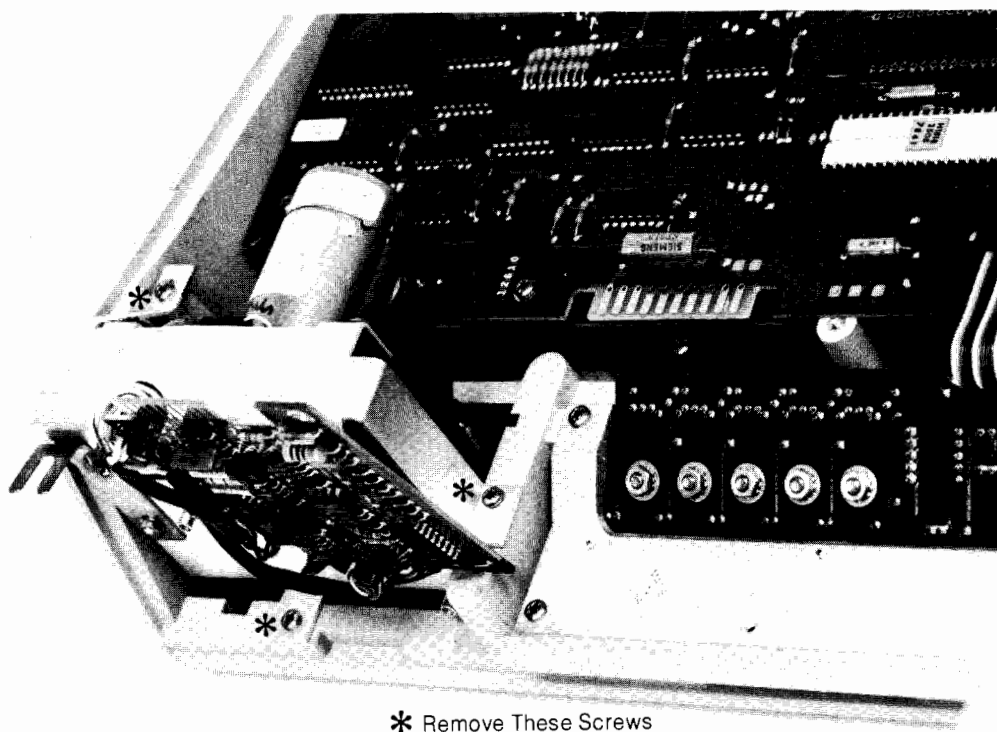
Figure 2-9   Tape Transport Assembly Removal

Key Switch Assembly Removal

To remove the 9825B key switch assembly:

1. Remove the KDP assembly (see page 2-7).

2. Remove the eight screws that attach the keyswitch assembly to the bezel.

To remove the 9825A key switch assembly:

1. Remove the two ribbon connectors at the KDP assembly. These cables will remain with the key switch assembly.

2. Remove the three screws that attach the front of the key switch assembly to the bezel.

3. Loosen the four screws that attach the rear of the key switch assembly to the bezel. These screws do not have to be removed, two or three turns are sufficient.

4. The key switch assembly can be removed by pressing the front edge down (as viewed in Figure 2-10) and sliding it frontward until the rear tabs are free.

5. Keep the key switch insulator on the bezel.

The key switch assembly can be removed with any or all other assemblies still in place on the bezel. Figure 2-10 shows them removed. Older revisions of the KDP assembly (HP part number 09825-66532) are of a different shape; holes in that assembly provide access to key switch screws.
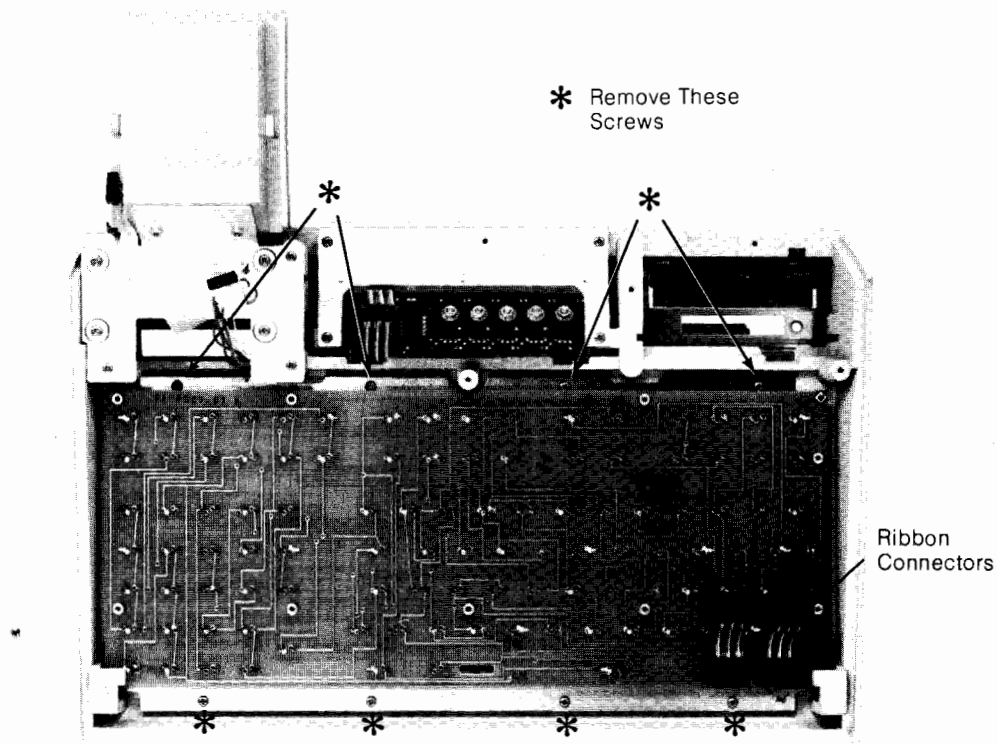
Figure 2-10   Key Switch Assembly Removal (9825A shown)

9825B 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.

1. Use a paper clip to fashion a key cap removal tool (see Figure 2-11) or use the removal tool in the tools PSP.

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

3. Pull firmly upwards to remove the key cap (see Figue 2-12).

4. Install the new key cap by pressing it firmly into place on the kev switch.
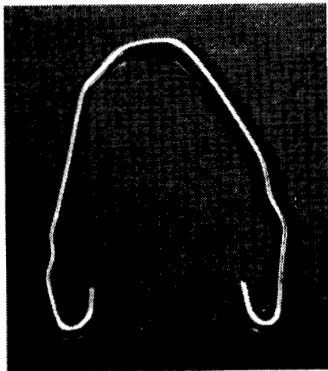
Figure 2-11   Homemade Key Cap Removal Tool

Figure 2-12   Removing a Key Cap

Key Switch Removal

NOTE

There are three types of switches on the keyboard. Refer to Figure 2-14 to determine which switch you need before replacing it.

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

1. Remove the key cap from the defective switch.

2. Unsolder the defective switch from the key switch assembly (two solder joints per switch).

3. Press in on the two tabs (Figure 2-13) that hold the key switch in place and pull the switch up out of the switch mounting plate.

4. When re-installing a switch, endure that it is the proper type.

5. Don't forget to solder the switch leads, then replace the key cap.

Keyswitch
Mounting
Tabs
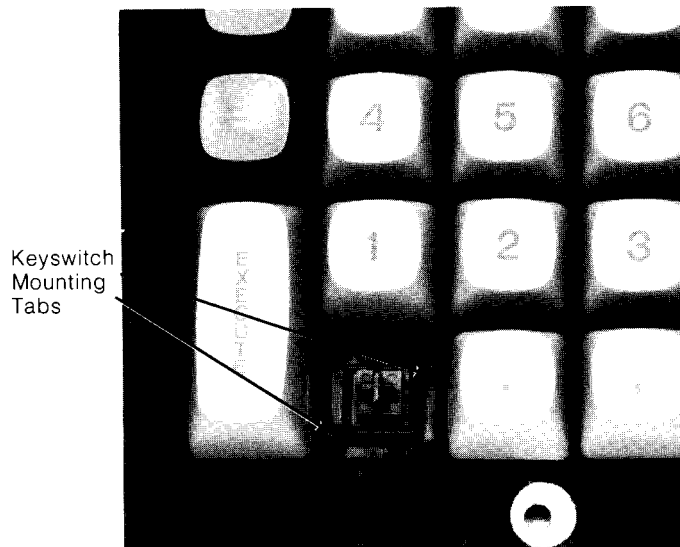
Figure 2-13   Removing a Key Switch

The key cap part numbers appear above each key.
Each key cap part number is prefixed by 0371-.
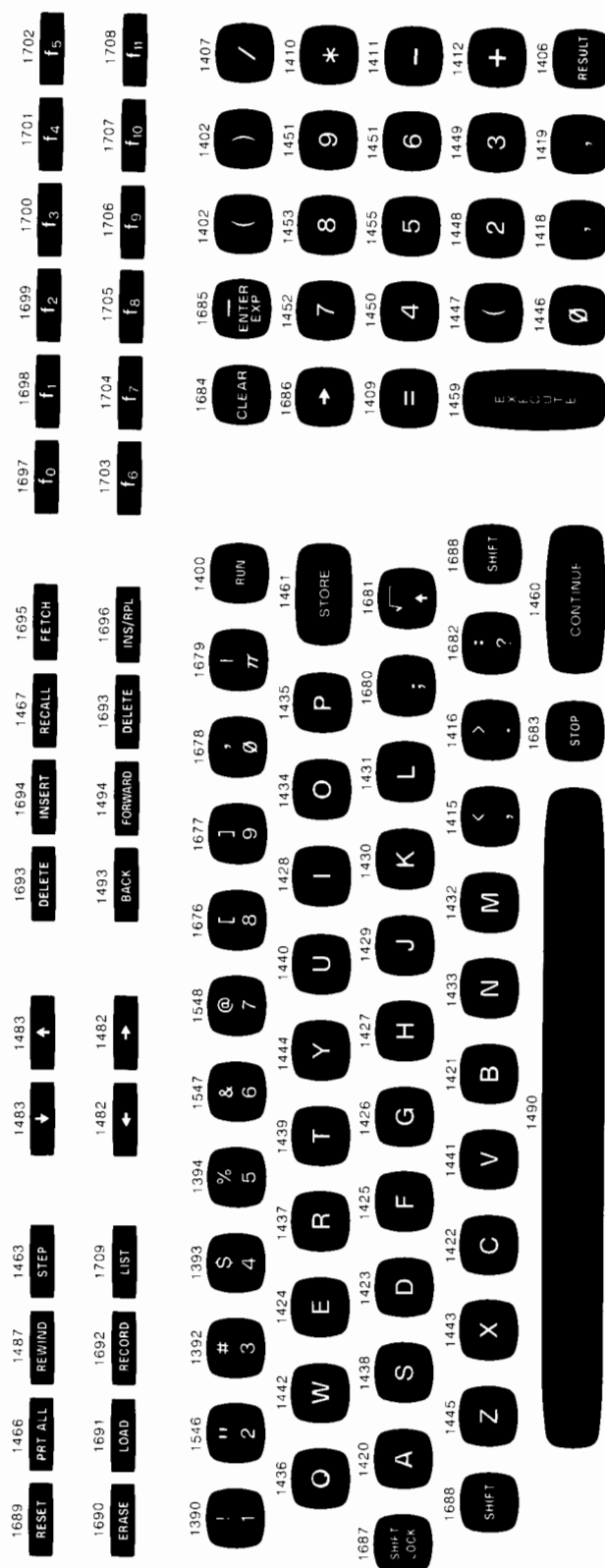
All the key switches have the same physical appearance. The difference between the switch types is the strength of an internal spring and the lubricant used. Stronger springs are needed for the larger keys.

3101-2390 — All Small and Normal Size Keys
3101-0468 — Store, Continue, Execute (Double Size Keys)
3101-0469 — Spacebar

Figure 2-14   Key Switch Types

Base Assembly

The base assembly contains eight major subassemblies:

- Read/Write memory

- Tape transport logic

- Processor

- ROM interface

- I/O interface

- Power supply

- Power module

- Fan

In addition there are three or four cable assemblies that are replaceable:

- Memory cable

- I/O cable

- Power distribution cable

- Memory interconnect cable (9825T only).

Removal of any of the base subassemblies is easier if the bezel assembly is out of the way. The bezel assembly can be moved forward, raised up alongside the computer, or simply disconnected and set aside. The base subassemblies are shown on the next page.
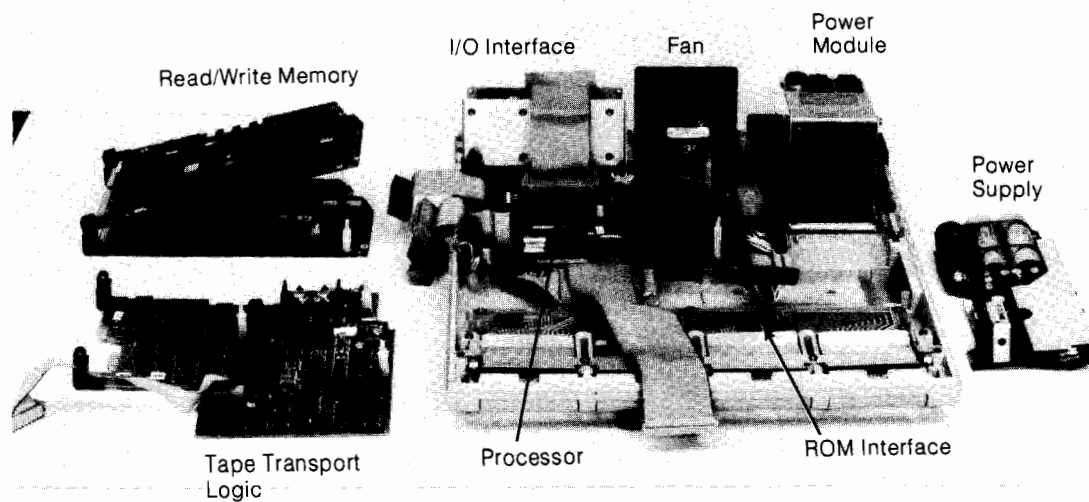
Figure 2-15A   9825B Base Assemblies
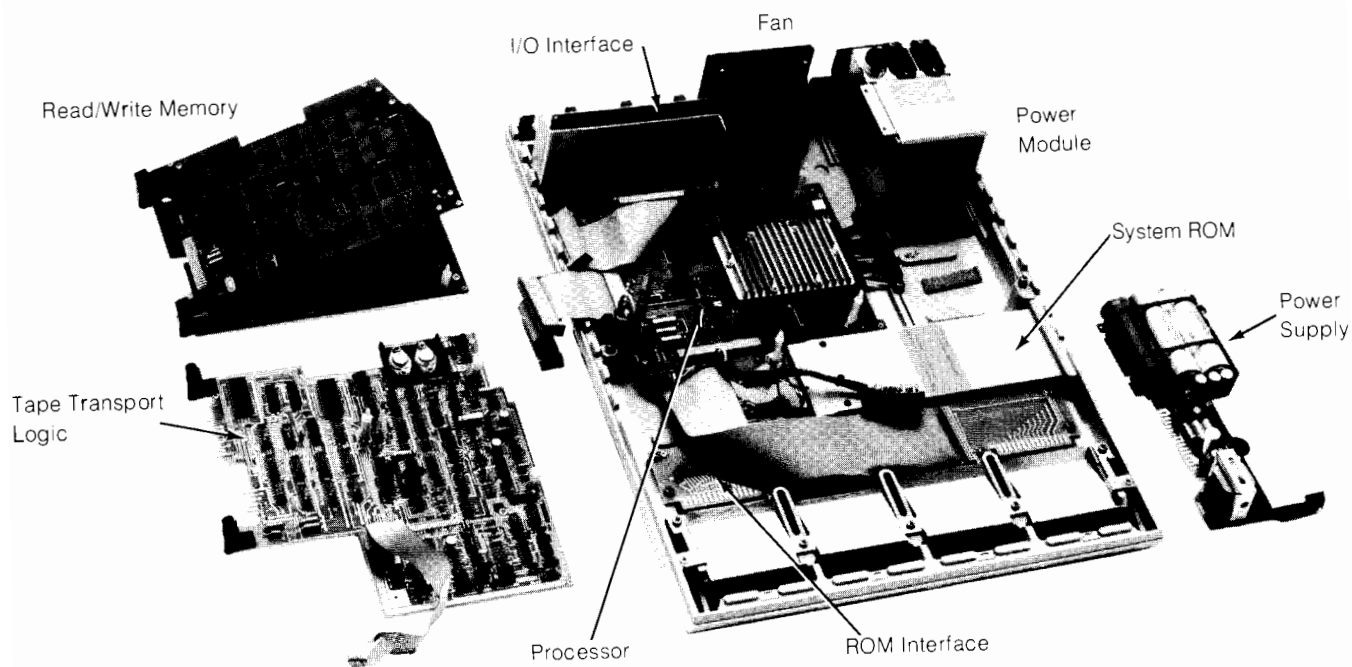
Figure 2-15B   9825A Base Assemblies

Computer
Museum

Read/Write Memory Assembly

A 9825A/B will have either one or two read/write memory assemblies. Computers having only the standard read/write memory assembly will have a dummy board assembly in the top position.

The assemblies are mounted on hinges so that they can be rotated upward while the system is operating. Each assembly is held in place by three white nylon spacer/retainers. These must be released in order to either remove the assembly or rotate it. This is done by using the printer paper spindle, which has a hole in the end of it for this purpose. Press it down over the protruding tip of the retainer as shown in Figure 2-16 while lifting up on the assembly.
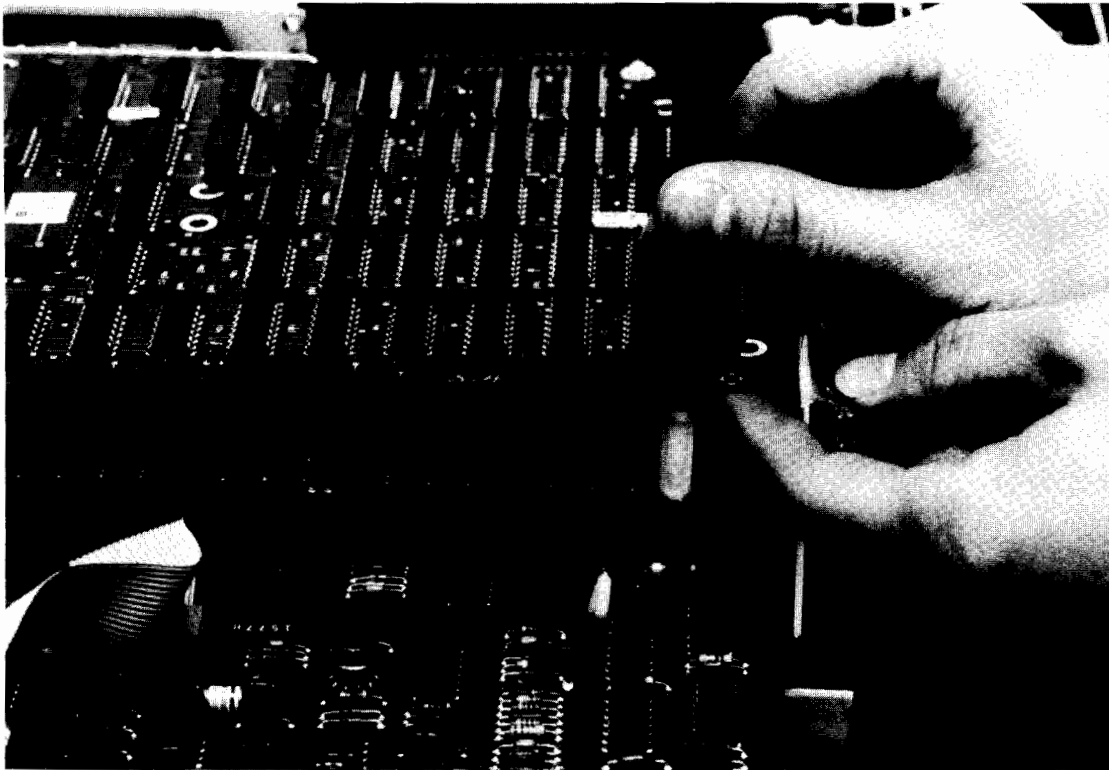
Figure 2-16   Using the Paper Spindle

The top read/write memory assembly must be removed before the one underneath it can be removed.

To remove a memory assembly:

1. Remove the memory cable(s).

2. Rotate the assembly upward to an angle of approximately 45 degrees as shown in Figure 2-17.

3. Slide it forward about 10 mm until the hinges disengage.

Earlier versions of the computer had hinges that disengaged at 90 degrees of rotation instead of the current 45 degree hinges.
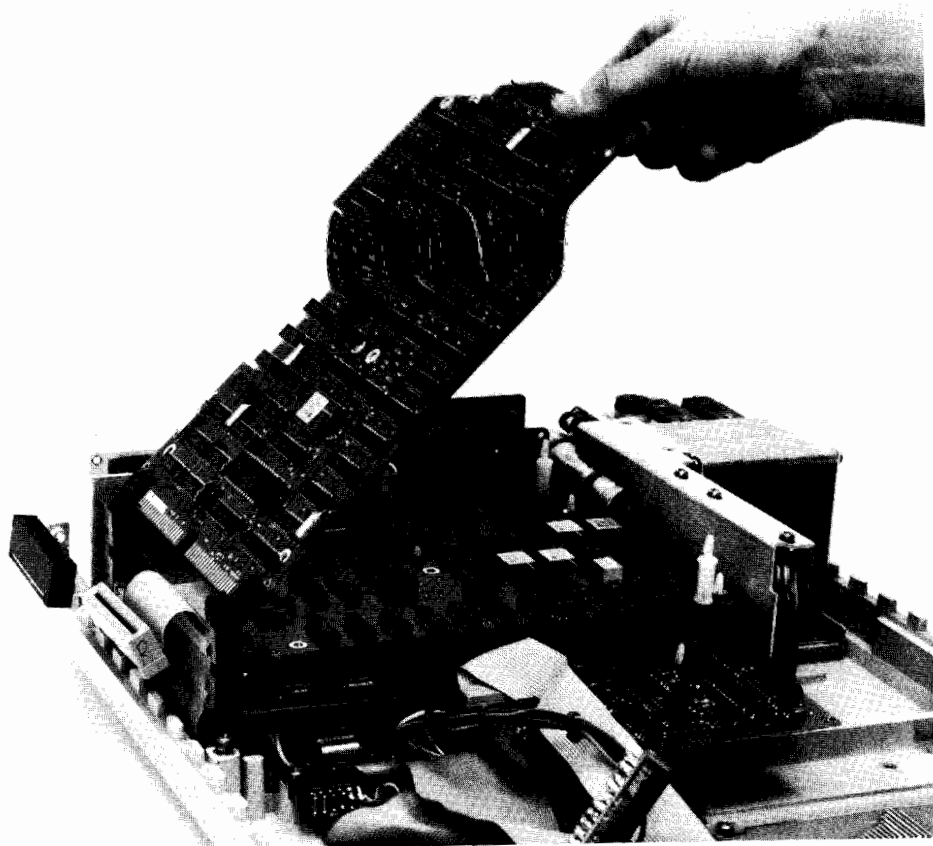
Figure 2-17   Removing a Read/Write Memory Assembly

Tape Transport Logic Assembly

After the bezel assembly is moved out of the way, the tape transport logic assembly can be rotated. It is held in place by three spacer/retainers that must be released before rotation. The memory assemblies must be removed before removing the tape transport logic assembly.

To remove the tape transport logic assembly:

1. Remove the power cable, the I/O cable and the ribbon cable at the tape transport.
2. Rotate the assembly 45 degrees and remove.
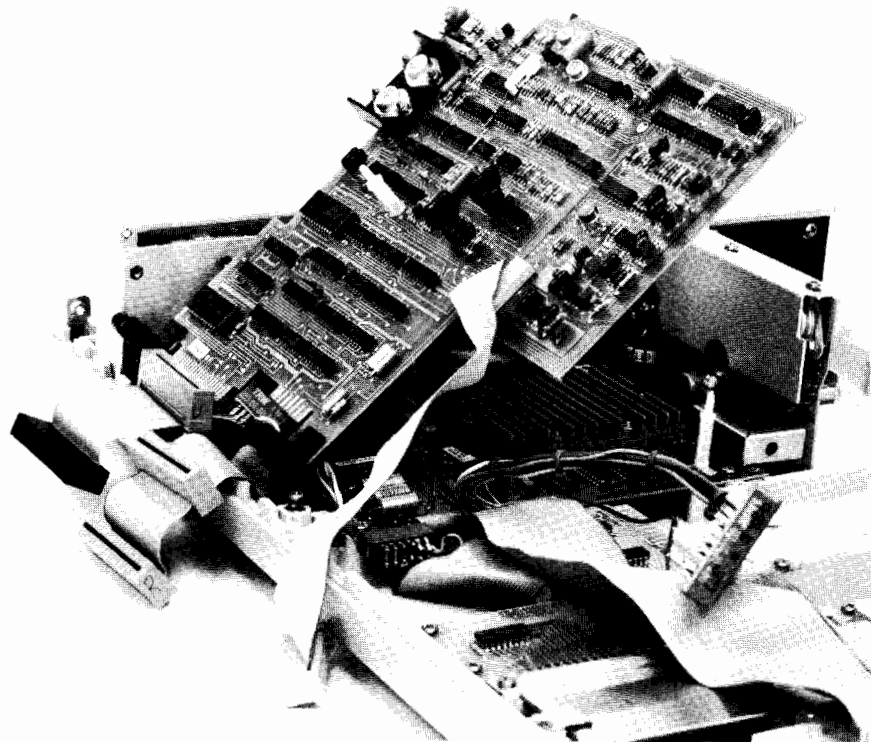
Figure 2-18 Removing the Tape Transport Logic Assembly

Power Supply Assembly

The power supply can be removed only after the tape transport logic assembly has been removed or rotated out of the way. To remove the power supply assembly, remove the two screws which attach the power supply heat sink to the power module.

The three round head screws holding the two pieces of the heat sink together should only be removed to replace components on the assembly or to get access to the +7 volt adjustment.

Remove These
Two Screws
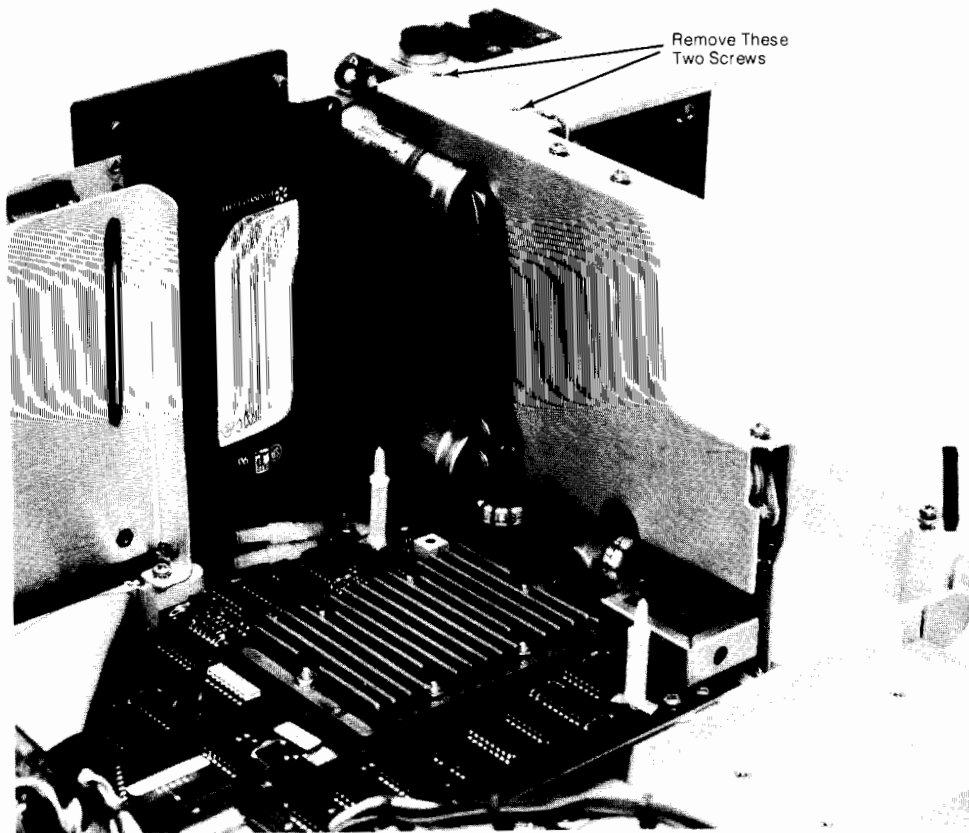
Figure 2-19   Removing the Power Supply Assembly

Processor Assembly

The power supply should be removed before the processor assembly is removed.

To remove the processor assembly:

1. Remove the memory cable, the I/O cable and the power cable.

2. Disconnect the ground jumper coming from the ROM Interface.

3. Remove the four screws attaching the assembly to the base.

4. Keep the processor assembly insulator on the base.

Figure 2-20 shows the extractor tool in position for removing the I/O cable.
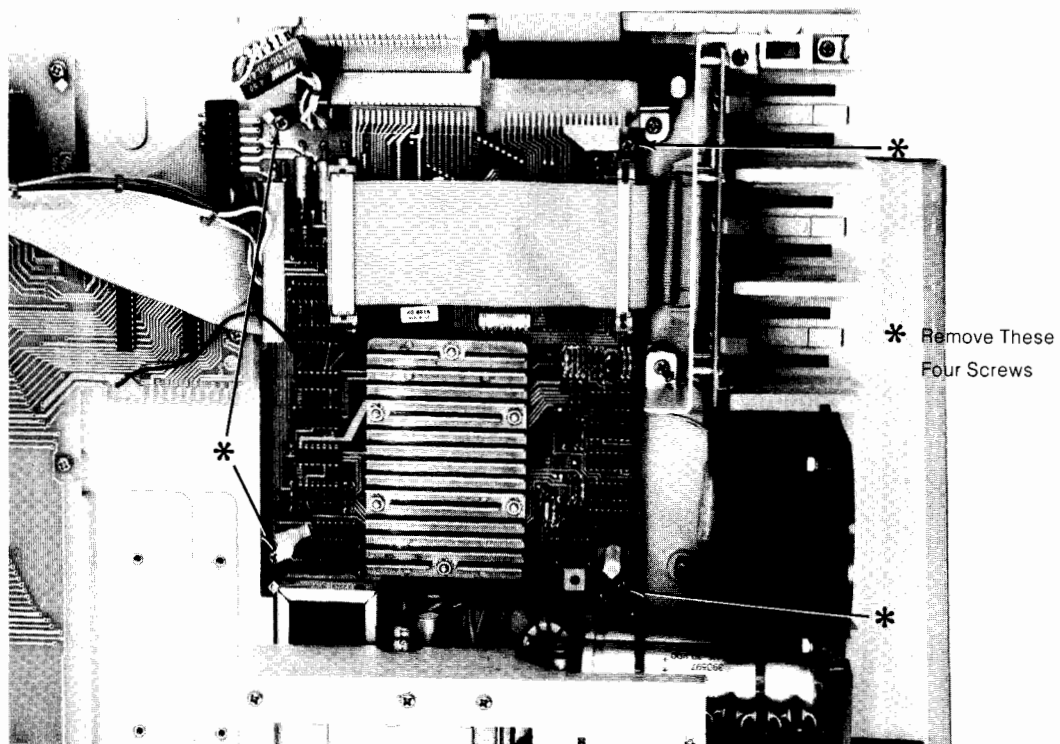
Figure 2-20 Removing the Processor Assembly

I/O Interface Assembly

The screws holding the I/O Interface bracket can be reached as shown in Figure 2-21 without removing any other assembly. The tape transport logic assembly must be rotated up to give access to the I/O cable. If there is not enough slack in the I/O cable to use the extractor tool, the processor assembly must be removed.

To remove the I/O Interface assembly:

1. Remove the two screws holding the bracket to the base. The screw nearest the fan assembly has a lug with a ground wire.
2. Remove the I/O cable using the extractor tool.
3. Remove the six screws holding the assembly to the bracket.
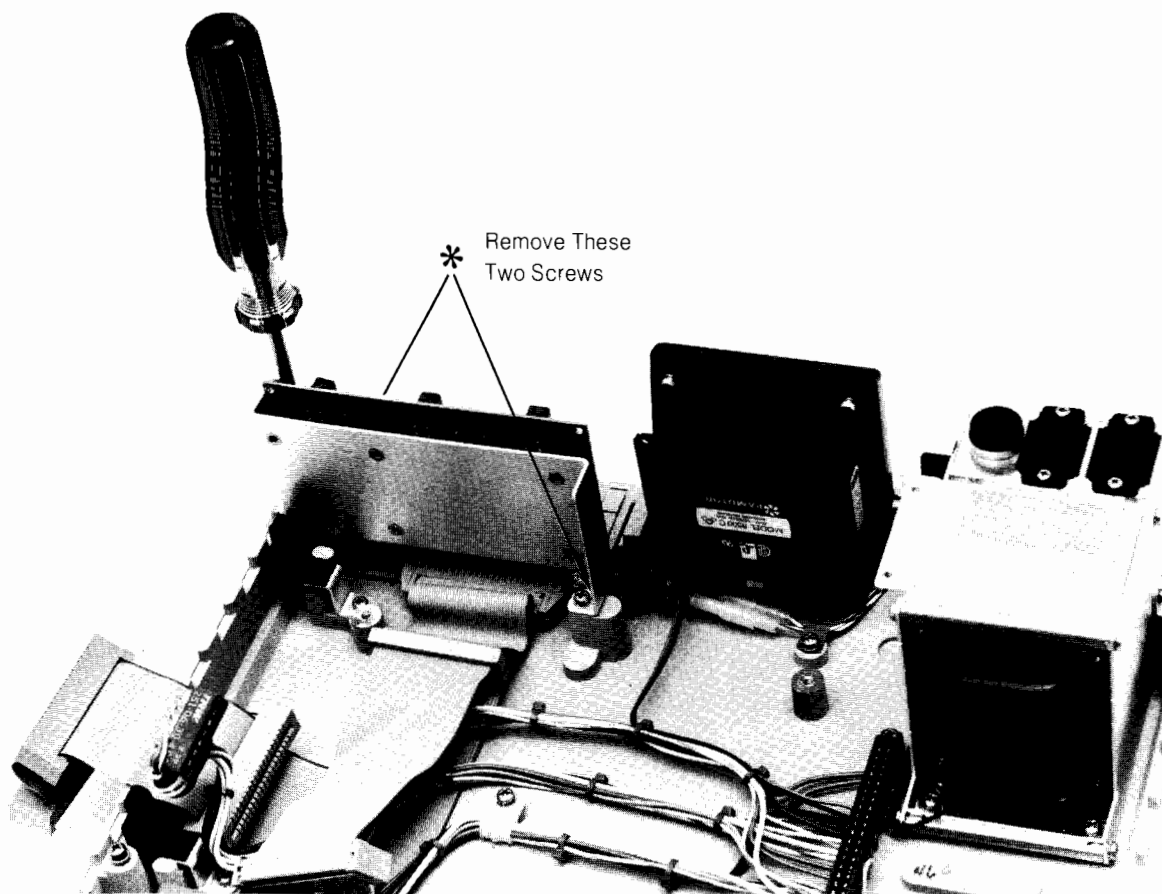
Figure 2-21   Removing the I/O Interface Assembly

CAUTION

BEFORE TIGHTENING THE TWO BRACKET SCREWS, BE SURE THAT THE ASSEMBLY IS IN ITS SLOT IN THE BASE. IF IT IS NOT, TIGHTENING THE SCREWS WILL TWIST THE BRACKET AND CAUSE MISALIGNMENT OF THE I/O INTERFACE CONNECTORS.

ROM Interface Assembly

The ROM Interface can be removed after removing the bezel and rotating the tape transport logic assembly out of the way. No other assemblies need to be removed.

To remove the ROM Interface assembly:

1. Option ROMs should have already been removed to remove the bezel.

2. Remove the system ROM (9825A only).

3. Disconnect the memory cable.

4. Disconnect the ground jumper to the processor assembly.

5. Remove the nine screws that attach the assembly to the base.
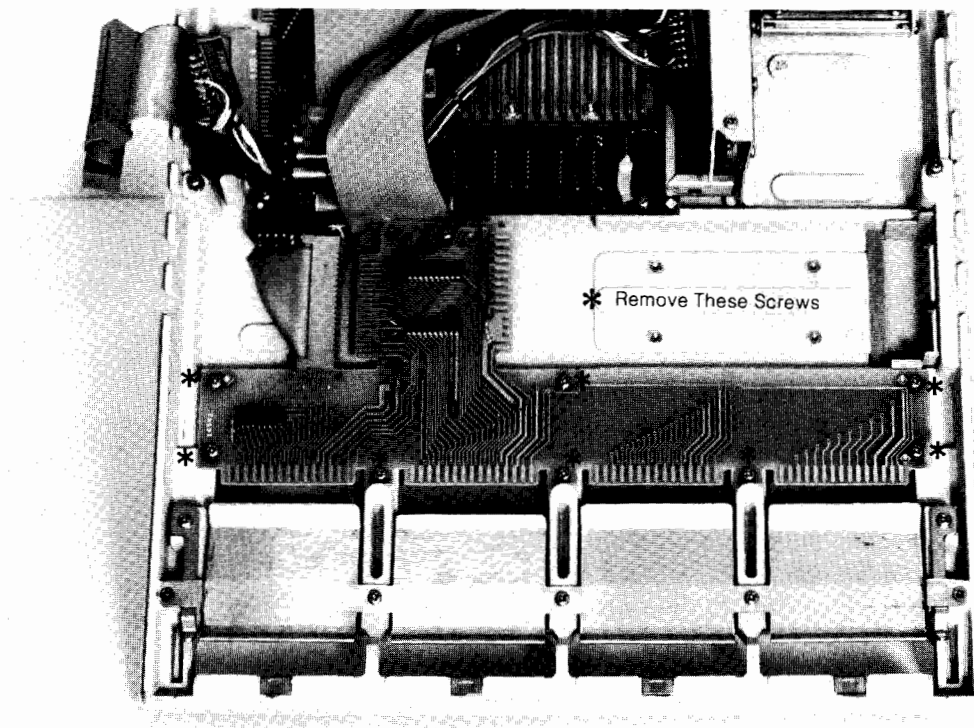
Figure 2-22 Removing the ROM Interface Assembly

Power Module Assembly

The power module contains the high frequency line filter, the power switch, the line voltage switches, the fuse, and the power transformer. To replace the power module the power supply must be removed.

WARNING

REMOVE THE AC POWER CORD BEFORE REPLACING THE POWER MODULE ASSEMBLY. FAILURE TO DO SO IS A SAFETY HAZARD, WHICH COULD RESULT IN INJURY OR DEATH.

To remove the power module:

1. Disconnect the wires going to the fan.

2. Remove the four screws that attach the power module to the base. Note that the screw nearest the power supply connector has a black wire on a ground lug.
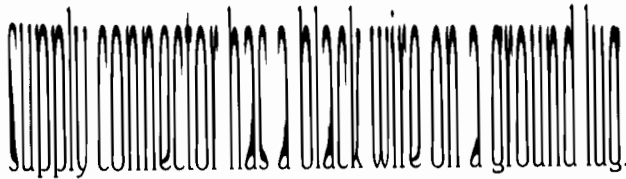
3. Remove the two screws that attach the power supply connector to the base.

4. Unsolder the red wire on pins 3 and C of the power supply connector.

5. Unsolder the red wire on pins 5 and E.

6. Unsolder the black wire on pins 6 and F (9825A only).
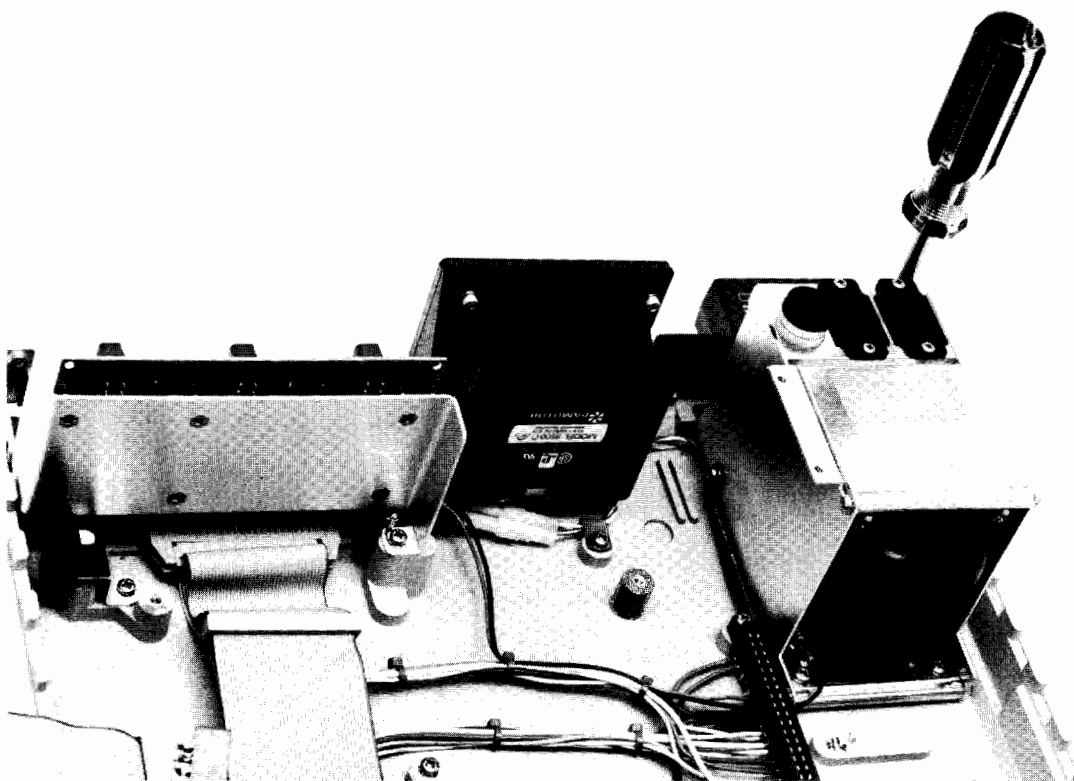
Figure 2-23   Removing the Power Module Assembly

Fan Assembly

The processor assembly and the power supply must be removed before the fan can be removed.

WARNING

REMOVE THE AC POWER CORD BEFORE REPLACING THE FAN AS-
SEMBLY. FAILURE TO DO SO COULD CONSTITUTE A SAFETY
HAZARD, WHICH COULD RESULT IN INJURY OR DEATH.

To remove the fan assembly:

1. Remove the clamp holding the fan wires to the base.

2. Disconnect the fan wires by using needle-nose pliers to spread the sides of the female connector until the male connector slides out.

3. Use a 7/64 inch hexagonal (Allen) wrench to remove the four screws. The bottom screw nearest the I/O Interface assembly has a lug with a green wire.

Cable Assemblies

The processor assembly must be removed to replace any of the three cable assemblies. The memory assembly and the tape transport logic assembly only need to be swung to the side and do not need to be removed.

When installing the cables the memory cable is on the bottom, closest to the base. The I/O cable is in the middle, and the power distribution cable is on top.

Removing the Power Distribution Cable

Each wire in the power distribution cable is supposed to have enough slack to allow it to be repaired once. So if it breaks off at a connector, there should be about one centimetre extra available for repair so that the entire cable assembly does not need to be replaced. Of course if the same wire breaks again, or if there is no slack to effect a repair, the replacement must be made.

To replace the power distribution cable:

1. Disconnect the ground lug from the power module screw.

2. Disconnect the ground lug from the fan screw.

3. Disconnect the ground lug from the I/O bracket screw.

4. Remove the screws that fasten the power supply connector to the base.

5. Unsolder the red wires from the power module. These are on pins 3 and C, 5 and E.

6. Unsolder the black wire from the power module that is on pins 6 and F (9825A only).
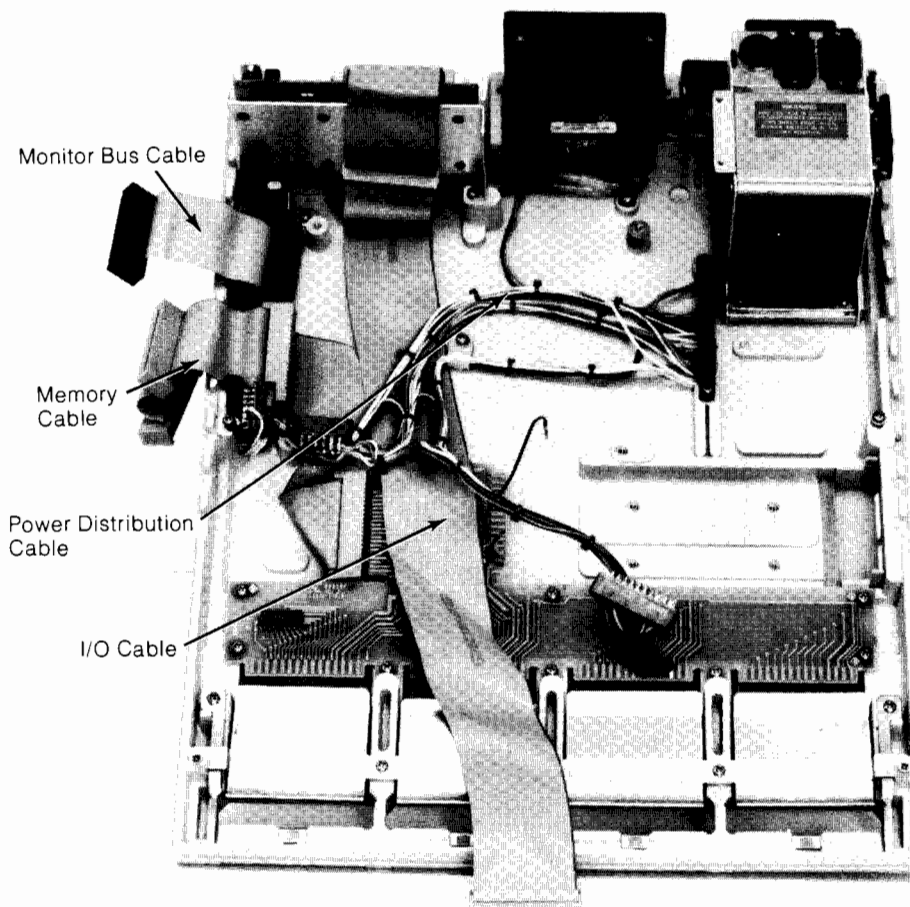
Figure 2-24   Cable Assemblies

Notes

Chapter 3

Adjustments

Tools Required

The following tools are necessary for performing adjustments on the computer:

HP Part Number	Description
8710-0033	Alignment Tool, Non-conductive
98240-67901	Print Head Alignment Fixture
8710-0693	Print Head Alignment Tools
8720-0002	1/4 inch Nut Driver
HP 3476A	Voltmeter (or Equivalent)
	1/16 in. Hexagonal Wrench

Power Supply

Before any of the computer's circuits can be expected to function correctly the power supply voltages must be within their tolerances. Table 3-1 gives the power supply's nominal output voltage, the upper and lower limits of each voltage, and the maximum current capability of each.

Table 3-1   Power Supply Voltages

Nominal Voltage	Lower Limit	Upper Limit	Maximum Current	Adjustment
+RAW	+21.0	+25.0		none
+12	+11.95	+12.05	3 A	R11
+7	+6.9	+7.1	1 A	none (A & B), R6 (C,D,&E)
+5	+4.9	+5.15		none
−5	−5.20	−4.80	0.2 A	none
−12	−12.5	−11.5	1 A	none
−RAW	−26.0	−22.0		none
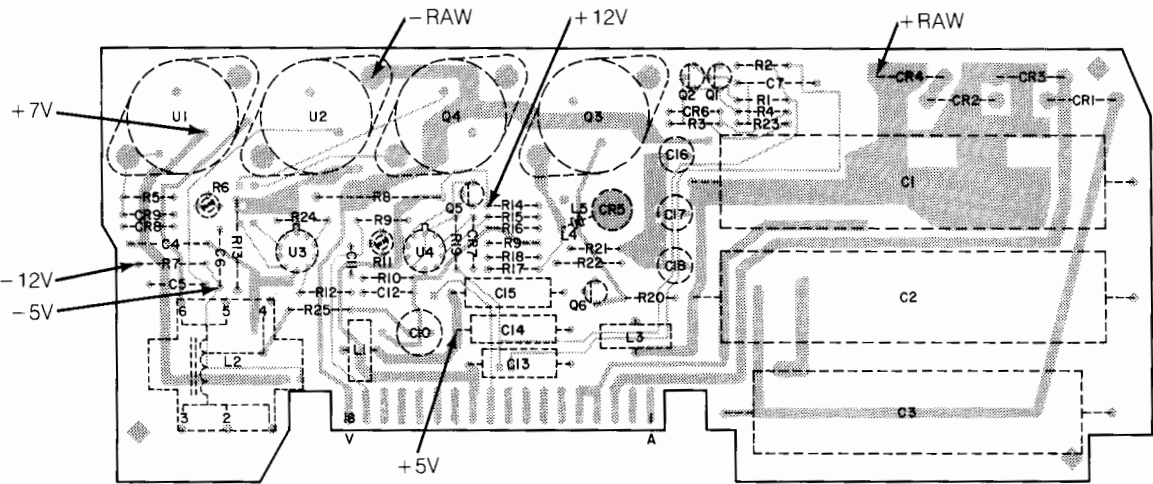
Figure 3-1   Voltage Test Points

Power supply test points are marked on the back of the power supply assembly as shown in Figure 3-1. Voltage should be tested with all assemblies connected and the computer positioned as in Figure 2-5. Ground potential can be obtained on the transformer sheet-metal enclosure or the power supply heat sink. Figure 3-2 shows how the +12 volt adjustment can be reached. Revision C of the power supply assembly introduced an adjustment for the +7 volt supply. The power supply heat sink must be removed to perform this adjustment.

Figure 3-2   Adjusting the +12 Volt Supply

Adjusting the +12 volt supply affects the +7 volt and the +5 volt supplies. Only after the +12 volt supply is within its limits should the +7 volt and the +5 volt supplies be checked. The voltages that are not adjustable must be within their limits when the computer is in the reset condition:

- No option ROMs installed.

- No I/O devices plugged in.

- No printer or tape transport operations being done.

- Minimum display.

System Clock

CAUTION

THE CLOCK FREQUENCY IS SET AT THE FACTORY; IT IS NOT NOR-
MALLY ADJUSTED IN THE FIELD. IT IS NOT TO BE ADJUSTED INDIS-
CRIMINATELY. IF THE CLOCK FREQUENCY EXCEEDS ITS TOLER-
ANCE, ERRATIC OPERATION PRODUCING RANDOM ERRORS COULD
RESULT.

Checking Clock Frequency

Once the power supply voltages are known to be good, the system's clock can be checked.

A quick check of the clock frequency can be made by running the following program:

```
0: dsp I; wait 10780; beep; jmp (I+10→I)=60
1: beep; wait 100; beep; dsp "DONE"; end
```

This program will produce a beep every ten seconds if the clock frequency is 6 MHz. The double beep should occur between 59 and 61 seconds after starting the program if the clock is in tolerance. Note that this is just a quick check; it should not replace the following procedure.

Adjusting Clock Frequency

There is a test point labeled "φ1" on the processor assembly near the fan. Using a frequency counter with a gate time greater than 250 milliseconds, measure the frequency at this point, and adjust the potentiometer as shown in Figure 3-3. The clock frequency must be 6.0 MHz plus or minus 0.1 MHz.

Figure 3-3　Adjusting the Clock Frequency

Printer Adjustments

The sixteen character thermal printer has several adjustments that can be made in the field. Adjustments made to the printer mechanism require a Print Head Alignment Fixture (98240-67901), which is part of the 9825A/B Product Support Package.

Paper Advance Adjustment

This adjustment should be made only if the printed character height is other than 3 mm ± 0.5 mm.

1. Loosen the lock nut on the adjustment screw with a ¼ inch nut driver.
2. Set the fixture switch to "RUN".
3. Turn the adjustment screw clockwise until the printer stops advancing.
4. Turn the adjustment screw counterclockwise until the individual dots in a vertical line are distinctly separated. This should give a character height of 3 mm for a seven dot high character.
5. Turn the adjustment screw another ¾ of a turn counterclockwise. This is to cancel the effects that tightening the lock nut has upon screw.
6. Tighten the lock nut. The character height should be 3 mm. If it is not, loosen the lock nut and make the adjustment that is necessary.
7. When the lock nut is tightened and the character height is correct, seal the lock nut with some glue or paint to prevent it from vibrating loose.

Printer Intensity

The printer intensity adjustment is on the KDP assembly as shown in Figure 3-4. The printer characters should be clear and well defined, but not too dark. The print head must be aligned before making this adjustment.
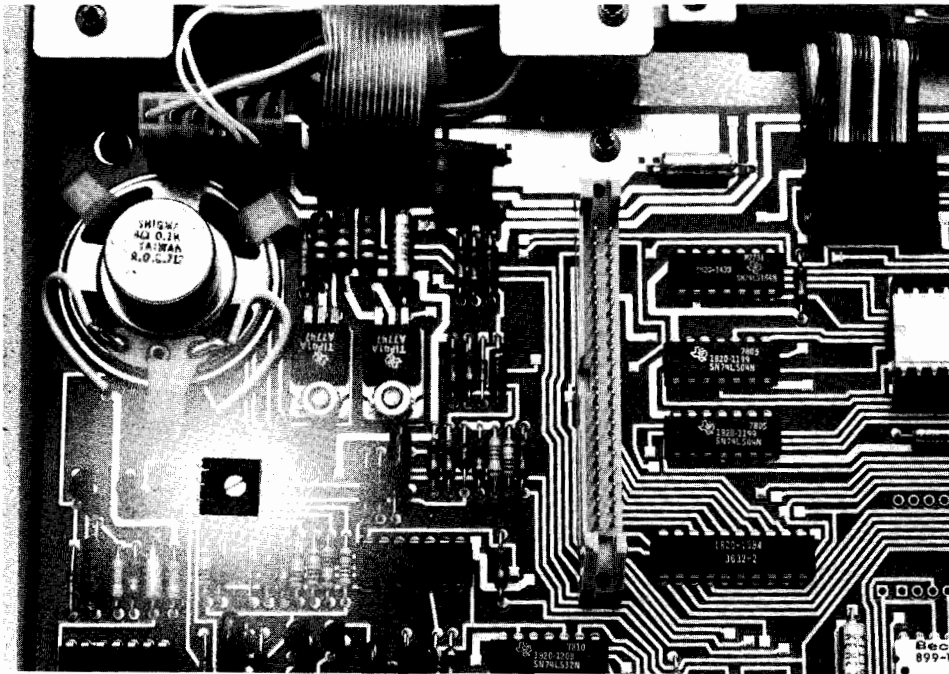
Figure 3-4   Printer Intensity Adjustment

The following program will print a row of characters while the adjustment is made.

```
0: prt "ZZZZZZZZZZZZZ"; jmp 0
```

Print Head Alignment

Uniform character intensity is a function of the print head alignment. To align the print head, the printer must be removed from the bezel assembly, the paper well and its sheet metal bracket must be removed from the printer assembly, and the printer must be set up as shown in Figure 3-5. To align the print head:

1. Connect the printer cables to the connectors on the Print Head Alignment fixture. The thermistor connector is not used.

2. Disconnect the power distribution cable from the KDP assembly and connect it to this fixture.

3. Turn computer power on.

4. Loosen the print head set screws with a 1/16 hexagonal wrench to allow the print head to move slightly.

5. Set the switch on the fixture to ''RUN''.

6. Ensure that the thermistor clip is not binding.

7. Using the alignment tools (HP part number 8710-0693) as shown in Figure 3-6, move the print head up or down to get the best overall print quality.

8. Tighten the set screws to 4300 gram-centimetres (60 inch-ounces).
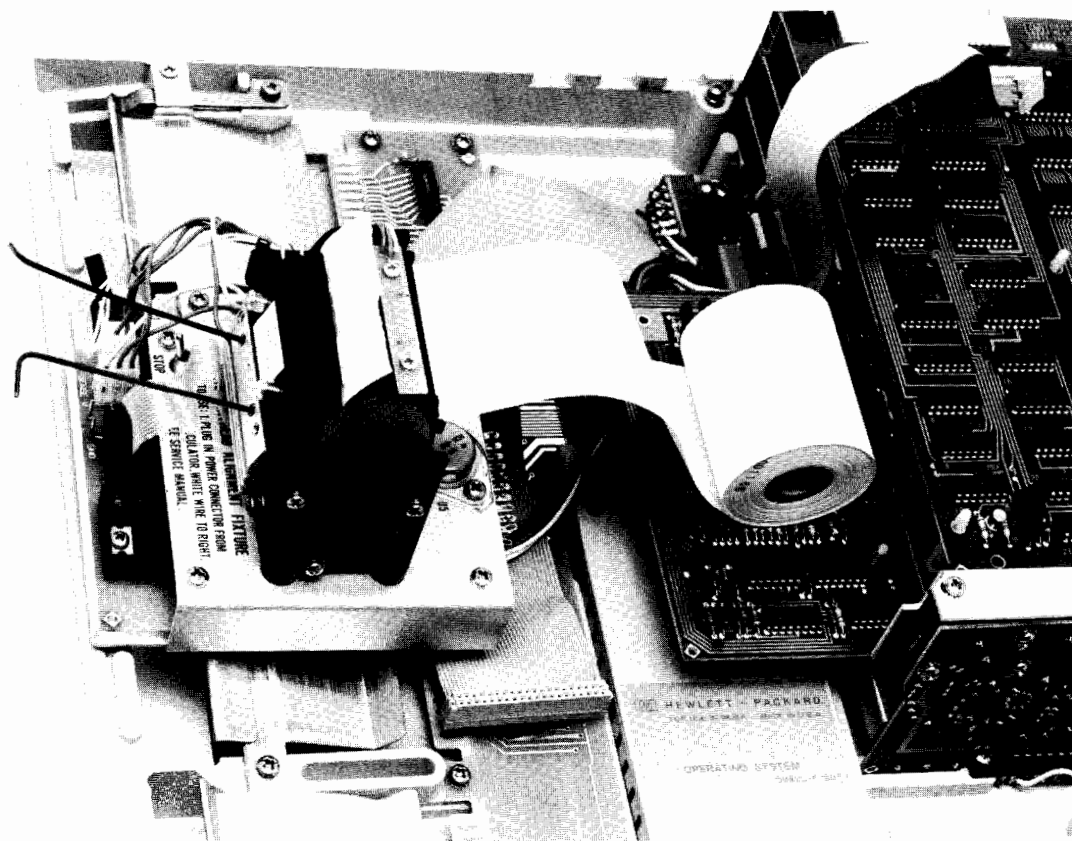
Figure 3-5   Print Head Alignment Setup

Thermistor Clip

Alignment Tools

Paper Advance
Adjustment

Set Screws

Computer
Museum
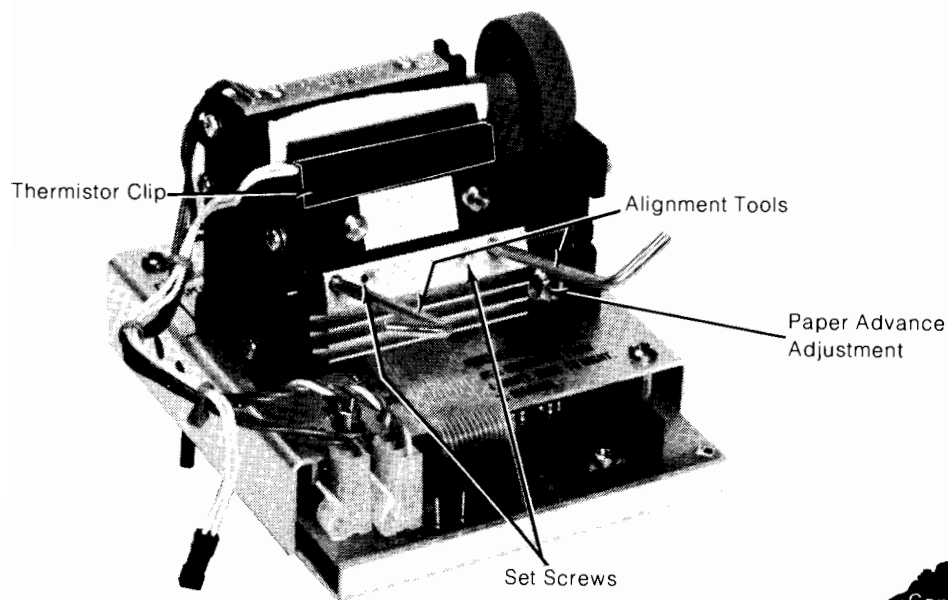
Figure 3-6 Print Head Alignment

Intensity   Speed

Run Stop
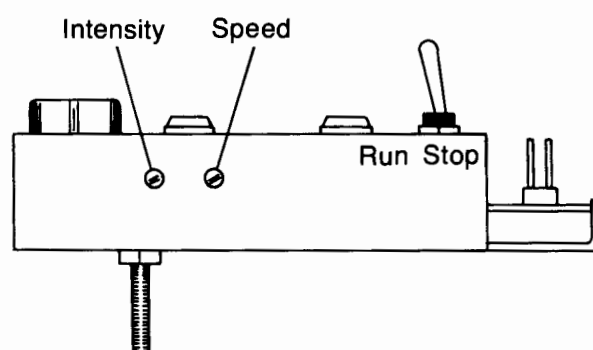
Figure 3-7 Alignment Fixture Adjustments

9825 Switches and Jumpers

Processor Switches

The processor assembly used in the 9825B is the same as the one used in the 9825A with minor modifications. The memory size switches on the processor assembly are only used for the 9825A. The processor assembly switches have no effect on the 9825B and can be in any position.

9825B Memory Assembly (A24) Switches

There are two switches on the A24 memory assembly used to select various read/write and read only memory combinations (see Figure 3-8).

Selects 9862
Plotter ROM

Selects 9872
Plotter ROM

Front of
Computer

- 32,160 Bytes of Read/Write Memory Available
- General I/O ROM
- Plotter ROM

- 22,918 Bytes of Read/Write Memory Available
- General I/O ROM
- Extended I/O ROM
- Plotter ROM
- Advanced Programming ROM
- String ROM

If the Option 201 Memory Assembly is Installed:

- 61,610 Bytes of Read/Write Memory Available
- General I/O ROM
- Extended I/O ROM
- Plotter ROM
- Advanced Programming ROM
- String ROM
- System Programming ROM

Figure 3-8 A24 Switches

9825A Memory Switches and Address Jumpers

A pair of switches on the 9825A processor assembly must be set to correspond to the amount of read/write memory available. Each read/write memory assembly has a shorting clip which defines the lowest address on that assembly. Table 3-2 gives the position of each shorting clip and memory switch setting for a given memory configuration.

Table 3-2 Memory Shorting Clip and Size Switch Positions

OPTION	8192 byte boards		16384 byte boards		PROCESSOR BOARD SWITCHES
	NO.	CLIP POSITION	NO.	CLIP POSITION	
Standard	1	70	0		
001	0		1	60-70	
002	1	50	1	60-70	
003	0		1 1	60-70 40-50	
Not Recommended[1]	1 1	70 60	0 0		

[1] HP policy does not allow buying assemblies back from a customer who updates his computer. So if the customer wanted to update this computer to 23228 bytes, he would then have an unuseable 8192 byte memory assembly remaining. It is suggested that the customer update to 23228 bytes in one step if he intends to update at all. Therefore this configuration is not recommended to anyone who may further update their computer.
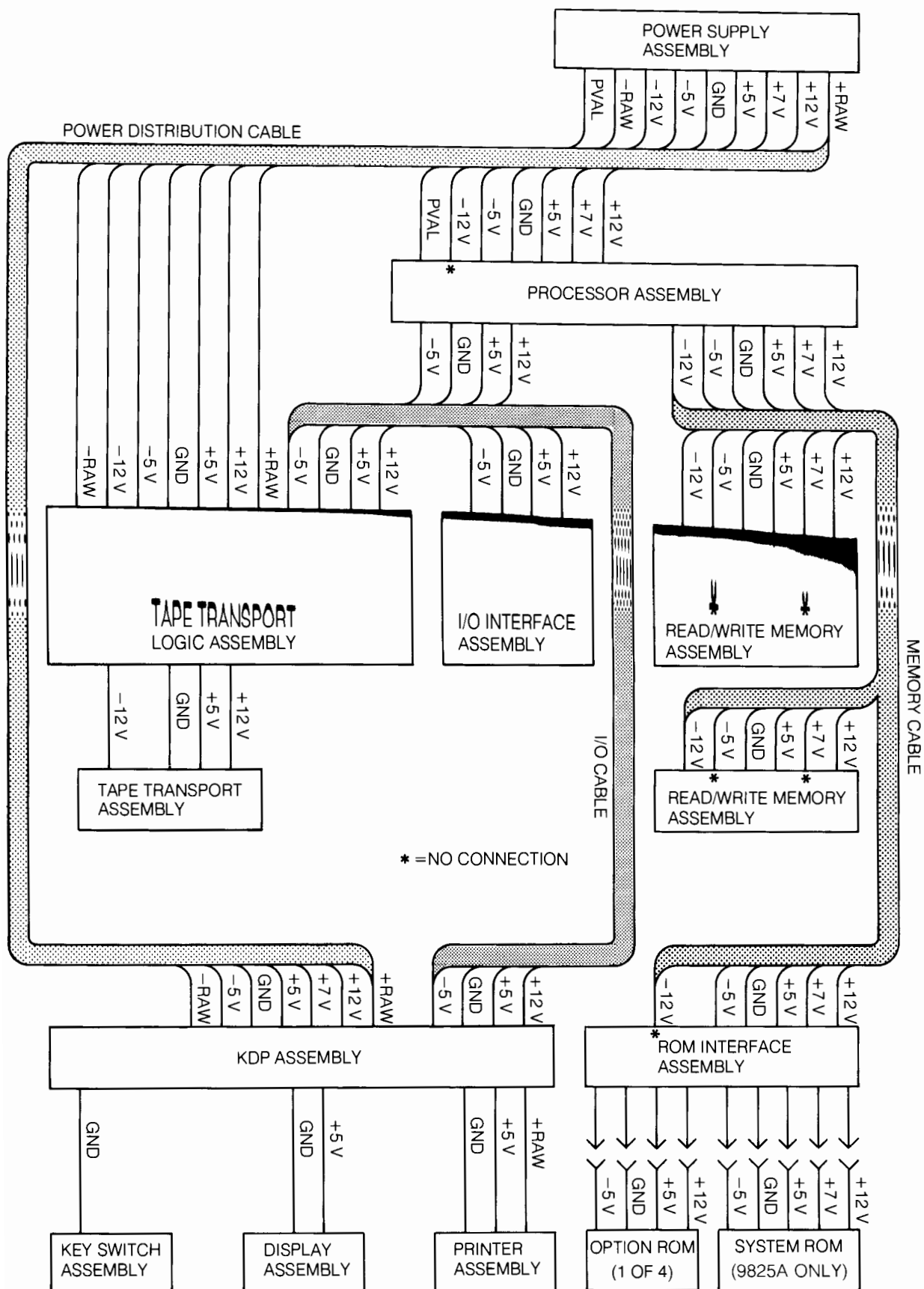
Figure 4-1   Power Distribution

Chapter 4
Theory of Operation

This chapter will give an overview of how the various major sections of the computer work. Detailed circuit analysis of the entire computer is not within the scope of this manual.

Power Supply

The power supply furnishes the voltages required by the various assemblies. A power distribution chart is in Figure 4−1.

Positive and Negative Raw Voltage

The output of the transformer goes through a full wave bridge rectifier; the resulting voltages are filtered and distributed throughout the computer. They are referred to as plus and minus raw voltage, or +20 V and −20 V. The actual voltage figure depends on the primary AC input voltage, and on the power supply load. It can range from +18 to +26 volts, and from −18 to −26 volts.

Negative Voltages: −12 V and −5 V

The negative raw voltage is regulated to −12 volts at a maximum of 1 amp by a voltage regulator mounted on the heat sink. This −12 volts is used as the input to a −5 volt regulator consisting of a breakdown diode and a dropping resistor. The −5 volts goes to the processor and the KDP assemblies. Each memory assembly generates its own −5 volts from a −12 volt input.

Positive Voltages: +12 V and +7 V

Positive raw voltage is regulated to +12 volts by a regulator which drives a pass transistor. The voltage at the emitter of the pass transistor is approximately +12 volts. This +12 volts is sensed at the power supply connector (there is a wire between pin M and pin U), and fed back to the negative input of the regulator. The +12 volt adjustment is in this feedback circuit.

The +12 volt supply has over-current protection in the form of a 0.2 ohm fusible resistor in the emitter circuit of the pass transistor. Current in excess of 3 amps will start to shut off the regulator IC, thereby lowering the +12 volts.

The +7 volt regulator is powered by the +12 volt supply. It is a fixed +5 volt regulator in a TO-3 case. The reference of this regulator is raised 2 volts above ground, and thus provides +7 volts at a maximum of 1 amp. Revision C of the power supply changed the circuit to provide an adjustment for the +7 volt value.

The +5 Volt Supply

+5 volts is supplied by a variable frequency switching regulator. This means that the frequency will increase as the output current increases. It is not current limited, but there is short circuit protection. If the +5 volt output drops to zero volts as the result of a short circuit inside the computer, Q5 will turn on, clamping the voltage at U4 pin 9 below +1 volt. This prevents the Q3 switching transistor from turning on. The computer must be turned off to recover from this condition, even after the short circuit has been removed.

+12 volts is used to power U4, the +5 volt regulator. It is also used to provide the reference voltage, so if a failure occurs on the +12 volt line, +5 volts will be shut off.

Power Valid

It takes a certain amount of time for the power supplies to assume their prescribed value after power is initially turned on. This waiting period is defined by the signal called Power Valid (PVAL).

A capacitor (C7) is shorted by Q1 until the +Raw voltage exceeds approximately 14 volts. At that time Q1 turns off and PVAL increases to +5 volts as C7 is charged through R2. It passes through the TTL threshold of +1.4 volts after about 85 milliseconds, which is ample time for the power supplies and the system clock to settle to their final values.

Processor

The processor assembly controls all activity in the computer. The most prominent component on it is the micro-processor; the rest of the circuitry is for generating the system clock and for generating and buffering system control signals.

System Clock

A voltage controlled oscillator generates a 12 MHz square wave. This 12 MHz is frequency modulated ± 4 percent to reduce the energy radiated at any one particular frequency in this range. The actual modulating frequency is of no concern, but the amount of frequency deviation is. Excessive modulation could cause the system clock to exceed the frequency specifications of some devices. The 12 MHz is adjustable as described in Chapter 3; the frequency modulation is not adjustable.

The 12 MHz is divided to give a nearly symmetric 6 MHz square wave. It then is delayed and gated to give a 6 MHz, two phase, non-overlapping clock switching between 0 and 12 volts. Non-overlapping means that one phase is below 0.8 volts a minimum of 5 nanoseconds before the other phase rises above 0.8 volts.

Power Valid

As mentioned in the power supply section, the PVAL signal stays below 1.4 volts for about 85 milliseconds, keeping Power On Pulse (POP) low. When POP goes high, the processor does its first memory cycle, an instruction fetch from address 000040s. The system firmware responds, and the computer goes through its initialization procedure.

The Processor

The micro-processor used in the 9825 is an HP-developed NMOS device. The processor actually consists of three LSI chips mounted on a ceramic substrate. The binary processor chip (BPC) controls all computer activity, fetching instructions from ROM and directing their execution. The extended math chip (EMC) executes the more complex mathematical instructions. The input/output chip (IOC) handles data exchanges via the I/O port as the BPC directs it.

There are two sixteen-bit bidirectional buses that carry information into and out of the processor. Each bus has two eight-bit inverting bidirectional interface buffer chips (BIBs) on the processor substrate. They are powered by +7 volts and convert the bus data from NMOS levels on the BPC (or IOC) side to TTL levels on the bus side.

The IDA Bus

The processor communicates with memory, both ROM and read/write memory, over the IDA bus. This sixteen-bit bidirectional bus carries instructions, data, and addresses, hence the acronym IDA. Information on this bus is negative true, TTL level logic. The status of the control lines determines when the IDA bus information contains instruction address, instruction, data address, data, or nothing significant.

The I/O Bus

Data between the IOC and peripheral devices is carried over the I/O bus. Like the IDA bus, the I/O bus is a sixteen-bit bidirectional bus buffered on the processor substrate by two BIBs. As on the IDA bus, information on the I/O bus is negative true, TTL level logic. Control signals generated by the IOC distinguish the direction of the data, when it is valid, and what peripheral device is involved in the exchange. The tape transport, the keyboard, the display, and the printer are all considered I/O devices and so are connected to the I/O bus.

9825A Memory

The processor can address 2^{15} words of memory. Memory addresses are given in octal notation, so valid addresses range from 00000_8 to 77777_8. Addresses 00000_8 through 00037_8 are assigned to the processor; of these only 00000_8 through 00027_8 actually exist. System ROM occupies addresses 00040_8 through 27777_8; option ROMs can occupy addresses 30000_8 through 47777_8.

As Figure 4-2 shows, read/write memory starts at address 77777_8 and the various options fill the memory area downward toward ROM area. You can see there is a conflict in the 40000_8 to 47777_8 range. If a computer has 32K bytes of read/write memory it cannot use the Strings, Extended I/O, or Advanced Programming option ROM. Conversely, a computer using any or all of these ROMs cannot operate with two 16K byte read/write assemblies. A conflict on the IDA bus occurs, which could result in damage to the computer. This conflict cannot be eliminated by using the switches on the processor assembly to mask off part of the read/write memory. The memory map also show that addresses 76550_8 through 77777_8 are base page read/write memory. This block of memory is not available to the user; it is "stolen" by the system for temporary storage. The variables kept there are used by the system firmware for its internal operations.
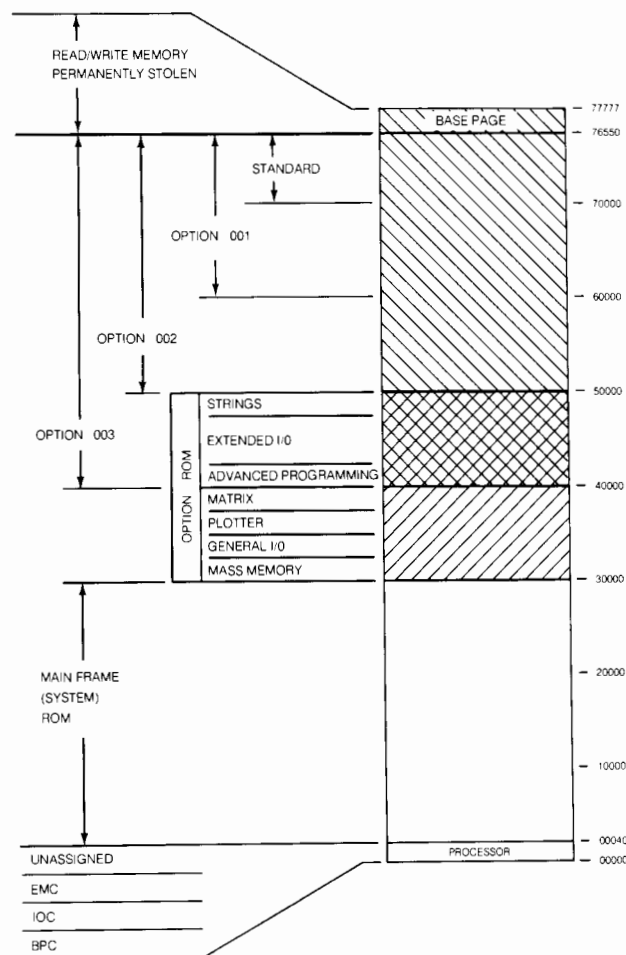
Figure 4-2   9825A Memory Map

Read Only Memory

ROM data is either from System ROM or Option ROM. Both are plugged into the ROM Interface assembly. On the ROM Interface assembly are 2.2K pullup resistors for the IDA bus, and two BIBs, each in a 20 pin package.

The ROMs used in the 9825A are HP manufactured, 1024 by 16 bit, mask programmable ROMs. The ROMs are normally in a "standby" mode for low power consumption. Each ROM has an address recognition circuit on the ROM assembly. When a ROM's address is recognized, this circuit applies +12 volts only to its ROM, supplying it with enough power to drive the BIBs.

Read/Write Memory

The read/write memory assemblies come in two sizes: 8192 bytes and 16384 bytes. Each is composed of a number of 4096 by 1 bit dynamic RAMs. The 8192 byte assemblies have 16 RAM chips, the 16384 assemblies have 32 RAM chips. The rest of the circuitry on the assembly controls the refreshing of the RAMs, byte operations, write enabling, and address recognition.

The entire contents of each RAM must be refreshed every 2 milliseconds. It takes 64 refresh cycles to accomplish this, each cycle refreshing 64 memory cells. There is a six-bit binary counter that determines which of the 64 rows is to be refreshed. The output of this counter drives RAM address lines A0 through A5. A read-of-memory cycle is simulated by the refresh circuit, which causes the RAM to refresh that particular row.

The time between refresh cycles is determined by a one-shot on the memory assembly. The 8192 byte assembly refreshes one row on all 16 RAMs every 29 microseconds. The 16384 byte assembly, with twice as many RAMs, also refreshes 16 of them at a time, one refresh every 15 microseconds. However, it refreshes the other 16 RAMs 15 microseconds later, before incrementing the six-bit row counter.

Refresh cycles and memory cycles on the same read/write assembly are mutually exclusive. If one is occurring when the other tries to start, the cycle that is in progress is allowed to finish before the other cycle starts. Also, a refresh cycle happening on one memory assembly has no effect on a memory cycle involving any other memory assembly.

9825B Memory

The 9825B memory consists of read/write and read only memory. The various memory configurations change the amount of read/write memory available and also change the accessibility of internal option ROMs. Here is a description of the various memory configurations.

Standard Memory (A24)

The standard 9825B has one memory assembly (A24). This assembly contains sixteen, 16k-bit RAMs, providing 32,160, eight-bit bytes. It also holds all the system language ROMs and the internal option ROMs. The ROMs used in the 9825B are 2048 by 16 bit, mask programmable ROMs. The ROMs are normally in a "standby" mode for low power consumption. Each ROM has an address recognition circuit on the ROM assembly. When a ROM's address is recognized, this circuit applies +12 volts only to its ROM, supplying it with enough power to drive the BIBs.

The A24 assembly can exist in two major configurations. As a 32k-byte read/write memory assembly, read/write memory occupies memory addresses 40000_8 to 77777_8. This leaves ROM from address 40_8 to 37777_8. In this configuration, ROMs which occupy addresses 40000_8 to 47777_8 are disabled, namely strings, extended I/O and advanced programming. As a 24k-byte read/write memory assembly, read/write memory occupies memory addresses 50000_8 to 77777_8, leaving room for all the ROMs up to address 47777_8. Another A24 switch allows selection between the 9862 and 9872 plotter ROMs.

9825B Option 201   Standard 9825B
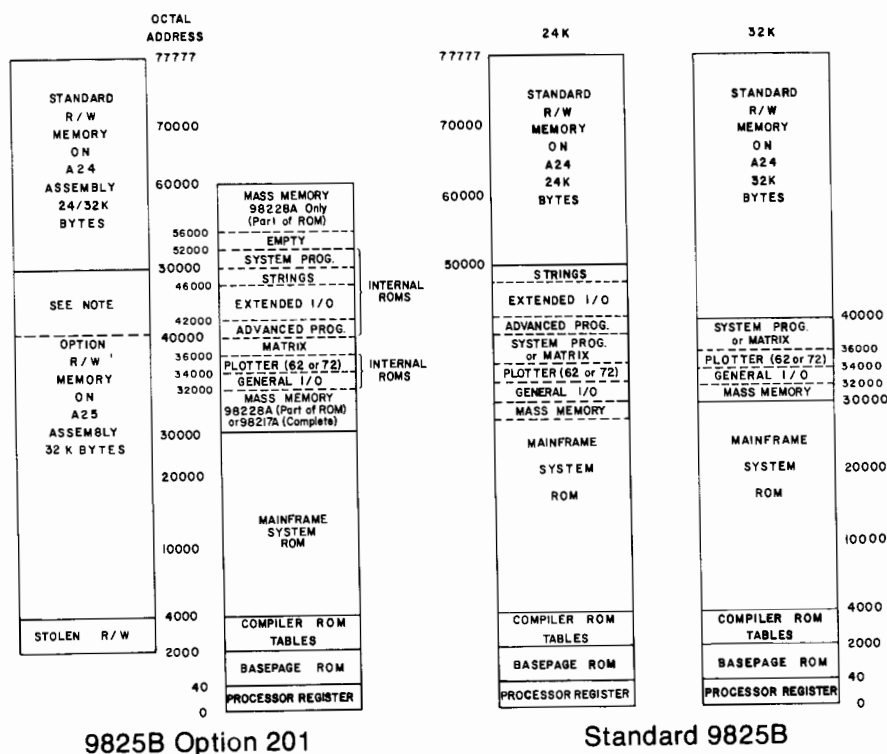
NOTE: This RAM is on A24 assembly, but is enabled only when A25 assembly is present.

Figure 4-3   9825B Memory Maps

Option 201 Memory (A25)

The addition of the option memory assembly, A25, adds 29,510 bytes of memory to the 9825B to make it a 9825T. This assembly contains sixteen, 16k-bit RAMs and a state machine. This state machine is connected to the processor's Monitor Bus. The state machine determines whether a particular memory cycle will reference RAM or ROM. With this capability, the read/write memory can be expanded to occupy the same address locations as the read only memory. The A25 read/write memory actually occupies the same address space as the read only memory on the A24 assembly.

The A25 state machine knows the following information about each memory cycle:

- Whether the memory cycle is an instruction fetch, address fetch, data fetch or I/O cycle.

- Whether the memory cycle is a read or a write.

- The address of the memory reference.

- The address and class of the currently executing instruction.

- Whether the instruction accesses RAM or ROM.

The state machine asynchronously switches between RAM and ROM after the monitor bus becomes stable and before the memory cycle starts. The time required for the state machine to make a decision is less than 50 nanoseconds. The state machine contains a bit map with one bit used to specify whether the address references RAM or ROM. A ROM disable signal is then used to disable ROMs during a read/write cycle and to enable ROMs during a ROM cycle.

The monitor bus provides the state machine with the necessary signals to determine the type of memory access about to take place. The monitor bus signals are:

SYNC	Indicates instruction fetch cycle.
BG	Indicates processor cycle.
EBG	Indicates a monitor cycle.
SMC	Indicates valid data on memory bus.

The state machine monitors the following signals from the IDA bus:

R/W	Indicates a read or write is taking place.
Address	Indicates the address of the current memory cycle.
Instruction	Indicates the class of instruction.
Clocks	For state machine clocking.

Input∕Output

The computer's I∕O operations involve either internal or external devices. The processor can handle up to sixteen I∕O devices, but the two internal I∕O devices, i.e. the tape transport and the KDP chip, leave only fourteen that can be handled through the I∕O slots.

How the I∕O Works

I∕O data exchanges are done by using four pseudo-registers: R4, R5, R6, and R7. These addresses, 00004_8 through 00007_8, are in the IOC's address range, and it responds as if they were actually on the IOC. These registers, however, do not exist on the processor. A read or write operation involving any of these four registers results in an I∕O cycle, either in or out. So there must be some kind of registers in the I∕O device to respond to these addresses. Convention has designated their use as follows:

- R4:   Primary data both in and out.

- R5:   Primary control and status. Control is for output from the processor and status for input to the

processor.
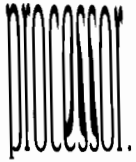
- R6:   Secondary data both in and out.

- R7:   Secondary control and status.

Some peripheral devices do not have hardware to respond to all these addresses, since secondary channels are not always necessary.

Peripheral Address Lines
The IOC drives four lines, PA0 through PA3, that determine which peripheral device is being addressed. Circuitry on each peripheral device establishes its unique address identity, and allows it to respond only to that address. The select code is usually selected by a switch on the interface cable. Conflicts will occur if two devices are assigned the same select code. Even if the devices are similar, subtle timing differences can cause errors.

Interrupt Priority

There are two levels of interrupt priority. Devices with select codes 0 through 7 are assigned low priority, and select codes 8 through 15 are assigned high priority. The select code of a particular I/O device is of no concern until another device competes for the processor's attention.

An I/O device requests service by generating an interrupt request. There are two interrupt request lines, IRH, and IRL; one is for high level devices, one for low level. To request service, an I/O device will pull one or the other low depending on the device's select code.

When the processor sees an interrupt request, it stops what it is doing and branches to an interrupt service routine. If the request came from a low priority device, that interrupt service routine can in turn be interrupted by a high priority device. However, the interrupt service routine of a high priority device cannot be interrupted by a request from another high priority device, not even by a device with a higher select code! So if several devices request service while a high priority device is being serviced, they have to wait until the service routine is finished. Then the processor will do a poll and service the device with the highest select code. Only then is the individual select code important, and that is because the processor services whichever interrupting device has the highest select code.

By now someone has probably asked "What about DMA? Where does it fit in with interrupt priorities?" Direct Memory Access (DMA) operations are not the same as interrupts, even though the data is transferred over the I/O bus. Different mechanisms in the IOC control DMA operations. There is only one priority level for DMA, and it has priority over system firmware, including interrupts of any level.

The only way a DMA operation interferes with interrupt service routines is by stealing the IDA bus for its memory cycles. These DMA initiated memory cycles are interleaved with firmware-initiated memory cycles at a rate controlled by the DMA device.

The KDP

The KDP Chip

The KDP chip responds to select code 0. It handles inputs from the keyboard, outputs to the LED display, and outputs to the printer. Information is transferred using the lower eight bits of the I/O bus (IOD 0 through IOD 7).

The chip is powered by +12 volts, +5 volts, and −5 volts from the power supply. The 6 MHz, phase 1 signal from the processor assembly is divided down to form a two phase, non-overlapping 1.5 MHz clock exclusively for the KDP chip.

The Keyboard

All of the key switches except the RESET, the SHIFT LOCK, and the two SHIFT switches are scanned by the keyboard scanning circuit.

The output of a seven-bit counter in the KDP chip is shifted serially to a shift register every 85 microseconds. The four least significant bits drive a four-to-sixteen decoder which sets one of its outputs low. The three most significant bits drive an eight-to-one data selector. If its output is high the KDP chip increments its counter and starts the cycle again.

If the output is low, the key switch represented by the counter has been pressed. The count is stopped and an appropriate de-bounce time follows. If the key is still down at the end of this delay, an interrupt request is issued. When the processor services this interrupt with a read of R4, the KDP chip will set the output of the key counter onto the IOD bus.

Other Key Switches

The RESET key switch and the SHIFT and SHIFT LOCK key switches are sensed in a different fashion than the rest of the keyboard switches. The RESET key switch will, when pressed, initiate a pulse that sets the POP signal on the processor assembly low. This stops all processor activity for the duration of the pulse: about 150 microseconds. When POP goes high again, the processor initiates an instruction fetch from address 000408 just as at turn-on.

The SHIFT keys are sensed at the same time as each key count. The presence or absence of a SHIFT key determines the polarity of IOD 7 when R4 is read. The seven bits of the key counter comprise IOD 0 through IOD 6.

The Display

The single line LED display consists of eight display chips, each chip consisting of four characters in a 5 wide by 7 high array of LEDs. Each character has a seven-bit serial input shift register to store column data for the duration of the display period. The character shift registers are cascaded from right to left, so the right hand character is the one most recently shifted in.

The data for the display's 32 characters is stored in the KDP chip. It is written into the KDP chip by a write into R4. 224 data bits are shifted into the display's shift register from the KDP; this is data for only one seven-dot column for each of the 32 characters. The LEDs for the appropriate column are then enabled for 1.36 milliseconds. Subsequent display cycles shift in data for column two, display it, and so on for column 3, 4, and 5. The entire display is scanned in this fashion 128 times a second, since each display of all five columns lasts about 7.8 milliseconds.

The Printer

The sixteen character thermal printer is also controlled by the KDP chip. Data for the printer is written into the KDP chip using a write to R6. Although the General I/O Programming Manual says that the printer responds to select code 16, this only applies to programming applications. It is a pseudo-select code used to differentiate between output operations to the display and output operations to the printer. The firmware translates the select code to 0 and outputs the data to R6.

The first thing done in a print cycle is a paper advance. The printer paper is advanced one dot height. Print information for the 1st, 5th, 9th, and 13th characters is serially shifted to the print head by the KDP chip. The burn select turns on the thin-film print resistors in the print head for an adjustable time between 2 and 5.46 milliseconds. A 2 millisecond cooling off time follows, then print information for the 2nd, 6th, 10th and 14th characters is shifted to the print head and burned. When the top row of all sixteen characters has been burned in this manner, the paper is advanced one row and the second row is burned. When all seven rows have been printed in this fashion, the paper is advanced twice. This gives a row of characters seven dots high separated by a three dot high unprinted space.

The paper advance circuit applies −Raw voltage to the advance solenoid. A current sensing resistor shuts off the drive transistor when solenoid current exceeds 1 amp. A reverse voltage suppressor limits voltage generated by the collapsing field to about +1 volt when the paper is being advanced, and to the +Raw voltage after the advance signal has been turned off. The printer is allowed 7.5 milliseconds to advance the distance of one dot height. One complete row of printed characters takes 333 milliseconds to complete.

The Beep

An audible tone is controlled by the KDP chip. A 667 nanosecond pulse is sent to a CMOS one-shot, which gates a free running oscillator. The resulting signal is amplified and used to drive a small speaker on the KDP assembly.

The Tape Transport

The tape transport logic assembly acts as a data interface between the processor and the magnetic tape, and also controls the cartridge drive motor. It responds to select code 1.

Digital information is stored on the tape using a delta distance encoding scheme. The distance between flux transitions on the tape determines whether the written data is "1" or "0". The "1" distance is approximately 1.75 times longer than the "0" distance. The magnetic polarity is irrelevant, only the distance is important. Since the tape is driven at a constant speed, the time elapsed between flux transitions is measured.

Writing to the Tape

Data to be written on the tape is sent to the tape transport logic assembly in bit serial form over IOD 0. It is latched on the assembly by a write to R4 operation. A voltage comparator configured as a free-running multivibrator determines the time between flux transitions. The latched bit-serial data controls a FET switch that determines whether the period of the oscillator is long or short. Each positive transition of the oscillator output initiates a 4 microsecond pulse which causes a flux transition, latches the next data bit, and sets the read/write flag to request the following bit.

Reading from the Tape

Reading data from the tape is more complex than writing it. Variations in timing and tape speed from system to system must be accounted for. To allow for these variations the circuit detects the ratio of the "1" time to the "0" time, not the actual elapsed time. So the first thing that has to be done when reading a particular tape is to establish the duration of a "0" time on that tape. Tape protocol dictates that a gap will be followed immediately by twelve flux transitions with the "0" spacing. These are used to establish a reference for the data which follows on the tape.

A flux transition from the tape triggers a one microsecond one-shot which triggers a four microsecond one-shot. The latter is used to zero a ramp generator. The output of the ramp generator starts to go positive as soon as the four microsecond one-shot expires. At the next flux transition the one microsecond one-shot causes a FET switch to charge a capacitor on a sample-and-hold circuit. This capacitor is charged by the voltage output of the ramp generator. The output of this sample-and-hold voltage follower is used to keep a reference capacitor charged to an average value. Thus the voltage on the reference capacitor is updated at each flux transition. Its voltage is kept at a value somewhere between the final ramp voltage for a "0" time and the final ramp voltage for a "1" time.

The voltage on the reference capacitor is used as the negative input of a comparator; the attenuated output of the ramp generator is used as the positive input. The one microsecond pulse at the next flux transition latches the comparator output so that it can be read by the processor with a read of R4 instruction.

Flux Transition Detection

The analog signal from the read head is pre-amplified on the tape transport analog assembly to give an output of .300 volts peak-to-peak. On the tape transport logic assembly it is filtered by a low-pass filter with a bandwidth gain of 6.7. A threshold detector detects when the filter output exceeds a certain percentage of its nominal peak value. The signals FST and MOD determine whether the percentage is 45%, used for write verification and gap detection; 30%, used for high speed gap search; or 10%, used for slow speed reading.

Once the threshold voltage is exceeded, a zero crossing detector and the flux transition latch are enabled. When the differentiated output of the filter crosses zero volts the latch is clocked and the output, FTR, goes high. When the filter output drops below the threshold voltage, the FTR latch is cleared, setting FTR low.

Controlling the Tape Speed

Control and status signals are transferred through R5. Most of them pertain to controlling movement of the transport motor.

An analog reference voltage is generated from the three digital signals GO, FST, and REV. This voltage drives a ramp generator to control the slew rate; this limits the acceleration of the transport motor. The steady state output of this circuit is a forcing function, or reference voltage, of either 0 volts, ±2 volts, or ±7 volts.

This voltage is sensed by a comparator circuit. If it indicates a tape speed greater than 2 inches per second in either direction it turns on the amber LED on the tape transport assembly. If it indicates a tape speed of less than 2 inches per second the power amplifier input is grounded, keeping the motor from creeping. The input to the power amplifier is also grounded during turn-on, preventing the tape from moving while power is applied.

The output of the tachometer is either 23 kHz at a slow tape speed of 22 inches per second, or 94 kHz at a fast tape speed of 90 inches per second. This signal goes to a 2.2 microsecond one-shot which triggers on both the rising and the falling edge of its input. This doubles the tachometer frequency. The signal is filtered and amplified ±3 times, as determined by the polarity of the forcing function. The resultant signal is combined with the forcing function at a summing junction; it is then amplified and used to drive the power amplifier.

The power amplifier is a complementary symmetry power amplifier. If one of the power darlingtons fail, both should be replaced. Drive voltage and motor current are monitored; if either is excessive, the drive voltage is removed and a failure signal, SFL, is sent to the processor.

Verify the problem!
Review all bug reports to eliminate known system problems.

Is it obviously a hardware problem?

Yes / No/Don't Know

Store the program that exhibits the problem onto a tape cartridge for future use.

Work with the system programmer to minimize the software that will exhibit the problem.

Is the problem associated with a peripheral device?

Yes/Don't Know / No

Remove all peripherals that don't affect the problem.

Is there more than one peripheral remaining?

More than one. / One

PROBABLE CAUSE
More than one device using the same select code.
Processor Assembly
Read/Write Memory Assembly
I/O Cable
I/O Interface Assembly
Option ROM Assembly

Remove the peripheral.

Do all the System Tests pass?

No / Yes

Replace the indicated assembly.

Consult the Service Manual for the peripheral involved.

Do all the System Tests pass?

No / Yes

Consult your local Service Representative.

Replace the indicated assembly.

Figure 5-1   Flow Chart 1

Chapter 5

Troubleshooting

This chapter describes how to isolate a problem to an individual assembly. By using the flow charts, a given set of symptoms and test results will guide you to a list of probable causes. This list shows, in order of likelihood, which assembly's failure is going to produce the symptoms you have. Thus the top listed assembly is usually the cause of your problem. In a long list, the bottom assembly is not a likely cause; still, an obscure failure on this assembly could be the problem.

This flow chart will not diagnose the cause of every possible problem. No troubleshooting guide can do that. The troubleshooting flow chart does show simple procedures that can be done before using the System Test Tape or the Extended Test Package. In the long run, training and experience will guide you to the cause of the problem faster than the flow chart.

The first task is to make certain that the system is malfunctioning. Review the bug reports, which should be filed in another section of this binder, to make sure that your problem is not connected with any of them.

If a modification of a known good program is causing the problem, make sure that the new program is stored before proceeding with System tests. The program modifications could be causing the problem, or a failure could have occurred while the programmer was at work. In either case the system must be proven to be good before any program de-bugging can proceed. The System Test Cartridge should be used to do this. It will catch about 90% of all hard failures. The System Test Booklet that is shipped with the computer describes the tests which are on the cartridge and how to use them.

Problems that involve peripheral devices can be difficult to find. Some computer problems are exhibited only by peripherals, and some problems with peripherals look like computer problems. As with software related problems, the computer mainframe should be proven good before investigating the peripherals involved. The only parts of the computer system that are not checked by mainframe tests are the I/O backplane, and the part of the I/O cable that connects to it.

```
                                    ┌─────┐
                                    │  2  │
                                    └──┬──┘
                                       │
                                       ▼
                              ╱───────────────╲        Yes          ┌─────┐
                             ⟨   Is the fan on?  ⟩───────────────────│  3  │
                              ╲───────────────╱                     └─────┘
                                       │
                                      No
                                       │
                         ┌─────────────────────────────┐
                         │ Verify that the line voltage │
                         │ selector switch positions    │
                         │ correspond to the actual     │
                         │ line voltage.                │
                         └─────────────────────────────┘
                                       │
                                       ▼
                              ╱───────────────╲        Yes
                             ⟨  Is the fuse good? ⟩──────────────────────────┐
                              ╲───────────────╱                             │
                                       │                                     ▼
                                      No                          ╱──────────────────╲      No
                                       │                         ⟨  Are all the Power   ⟩──────────┐
                         ┌─────────────────────┐                 ⟨  Supply voltages within⟩          │
                         │   Replace the fuse.  │                 ⟨     tolerance?        ⟩          │
                         └─────────────────────┘                  ╲──────────────────╱             │
                                       │                                     │                       ▼
                                       ▼                                    Yes          ┌──────────────────────────────┐
   No             ╱───────────────╲                          ┌────────────────────┐       │      PROBABLE CAUSE          │
 ┌───────────────⟨   Does the new   ⟩                         │   PROBABLE CAUSE   │       ├──────────────────────────────┤
 │               ⟨   fuse blow?     ⟩                         ├────────────────────┤       │ Power not applied to power   │
 │                ╲───────────────╱                          │ Power Module Assembly│     │ cord.                        │
 │                        │                                   │ Fan Assembly        │      │ Power Module Assembly        │
 │                       Yes                                  └────────────────────┘       │ Faulty power cord.           │
 │       ┌──────────────────────────────────┐                                            └──────────────────────────────┘
 │       │ Replace the fuse again.            │
 │       │ Remove the power supply assembly.  │
 │       │ Verify that there is no short      │
 │       │  circuit between the transformer   │
 │       │  secondary wires and ground.       │
 │       └──────────────────────────────────┘
 │                        │
 │                        ▼
 │               ╱───────────────╲        No
 │              ⟨   Does the new   ⟩───────────────────┐
 │              ⟨   fuse blow?     ⟩                    │
 │               ╲───────────────╱                     │
 │                        │                             ▼
 │                       Yes              ┌────────────────────────────────┐
 │       ┌────────────────────┐           │        PROBABLE CAUSE          │
 │       │   PROBABLE CAUSE   │           ├────────────────────────────────┤
 │       ├────────────────────┤           │ Power Supply Assembly          │
 │       │ Power Module Assembly│         │ Power Distribution Cable       │
 │       │ Fan Assembly        │          │ Power Supply output shorted    │
 │       └────────────────────┘           │  together or to ground.        │
 │                                         │ Check the KDP Assembly, or the │
 └─────────────────────────────────────   │  Tape Transport Logic Assembly.│
                                          └────────────────────────────────┘
```

Figure 5-2   Flow Chart 2

Use this page if the computer shows that line voltage is not getting to it. The surest way of determining that line voltage is being applied is to see if the fan is running. The fan is powered by 120 volts AC which comes from the power module. This voltage is irrespective of the line voltage selector switch settings.

The line voltage selector switches must be set correctly. There should be no reason to ever change them, since a user will generally have only one voltage available; but you cannot overlook the remote possibility that they were accidently changed.

If a replacement fuse blows when power is applied, there is probably a power supply related problem in the computer. Review the Service Notes to familiarize yourself with any precautions that should be taken when disassembling the computer or running it when it is disassembled. Removing the power supply will help to verify that the power module and the fan are good.

Positive or negative raw voltage being shorted to ground would cause the fuse to blow. Replacing the power supply without finding the cause of the short circuit could damage the new supply if the short is on another assembly. Therefore the short must be found and removed before turning power on again.
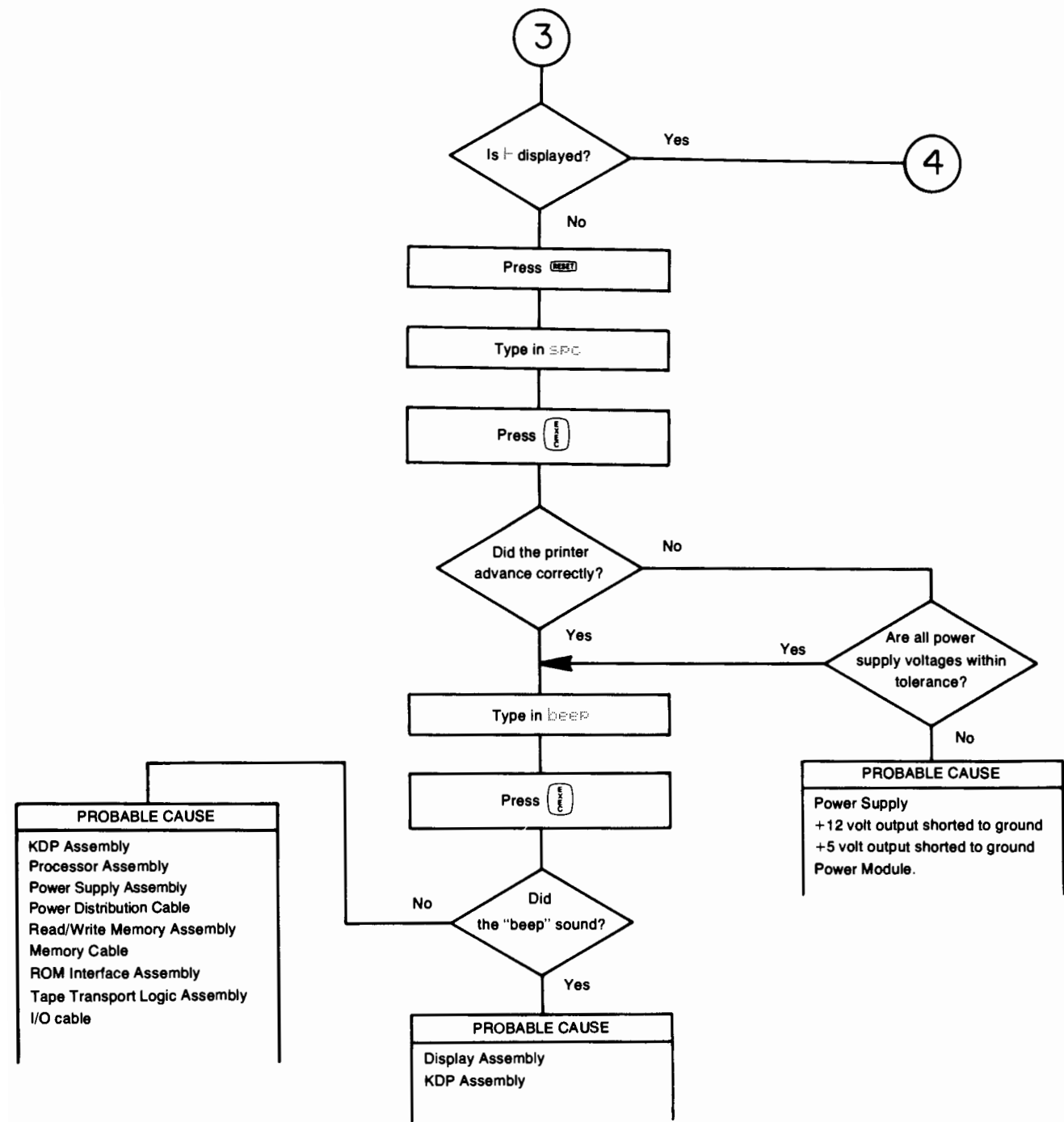
Figure 5-3 Flow Chart 3

Once power can be applied to the computer, a lot of things have to happen correctly before the ⊢ appears on the display. The most important is that the power supply voltages must be good. Most of them could fail, or even be shorted to ground, without blowing the fuse. One operation that involves all voltages is a printer operation. If it works, the power supply is probably good, and most of the system is working. If the printer does not increment, check the value of the power supply voltages.

Power supply components can be damaged if the power supply output is shorted to ground. The source of the short must be found and removed before you install and turn on a new power supply.

If the printer works, the next simplest check that can be done from the keyboard is to see if the 'beep' works. If it does, the problem is probably isolated to the display circuitry. If it doesn't beep, the problem could be almost anywhere in the system. The computer is probably failing to initialize correctly, and the system is 'hanging up'.

This part of the troublesh

most difficult to find. If

System Test Tape or the

Before inserting a tape

cartridge drive unit are b

The other is for detectir

working, the tape will be

④

Type in SPC

Does the display show SPC? — No →

PROBABLE CAUSE
Display Assembly
KDP Assembly
I/O Cable
Processor Assembly
System ROM
ROM Interface Assembly
Memory Cable

Yes ↓

Press [EXEC]

← No — **Did the printer advance correctly?**

PROBABLE CAUSE
Printer Assembly
KDP Assembly
I/O Cable
Processor Assembly
System ROM
ROM Interface Assembly
Memory Cable

Yes ↓

Examine the tape cartridge slot to be sure that both lamps are on.

Are they both on? — No →

PROBABLE CAUSE
Tape Transport Assembly
Tape Transport Logic Assembly
Memory Cable

Yes ↓

← No — **Will a tape cartridge rewind properly?**

PROBABLE CAUSE
Tape Transport Assembly
Tape Transport Logic Assembly
Processor Assembly
I/O Cable

Yes ↓

Write
Store

<

Install
Test

Consu
Packa
nece:

<

Consu
Repr

Figure 5-4 Flow Chart 4

looting flowchart covers a system that is 'almost working'. Problems in this area are the
a computer passes all the tests on this page you should be able to run tests from the
Test ROM.

cartridge into a computer, check to be sure that the two incandescent bulbs in the
)oth on. One is for the tachometer wheel, which is necessary to regulate motor speed.
g the holes in the magnetic tape which mark the ends of the tape. If that bulb is not
:come de-spooled.

a simple program.
it, list it, and run it.

Does it   No
operate correctly?

Yes

```
                              PROBABLE CAUSE
                       Read/Write Memory Assembly
the Test ROM and the   Processor Assembly
RAM.                   System ROM
```

ilt the Extended Testing
ige Manual and conduct all
isary tests.

Do all   No
system tests pass?

Yes

ilt your local Service   Replace the indicated assembly.
esentative.

Figure 5-5   9825B Block Diagram

ROM Disable

A24 Memory Assembly

Data Out Bus

| 32k Bytes Read/Write Memory | System Language ROM | Internal Option ROM |

Address Bus

A25 Memory Assembly

Address Bus

32k Byte Read/Write Memory

Data Out

Block Controller

Block Status

Block Control

| Address Latch | Memory Controller | Output Multiplexer | Instruction Decode |

IDA Bus

IDA Bus

Monitor Bus

ROM Interface A

IRH, IRL, DMAR, FLG, STS

PA 0-3, IC 1, IC 2, INT, DOUT, IOSB

I/O Bus

KDP Assembly

Print Intensity

Tape Transport Logic Assembly

Control Circuits

Control Circuits

Read/Write Circuits

KDP Chip

| Key Code Counter | Key Switch Detector | 32 x 8 Register | 128 x 35 ROM | 16 x 8 Register |

| Key Switch Assembly | Display Assembly | Printer Assembly |

Reset

Power Supply

+12V Adj.

+7V Adj.

+RAW
+12V
+7V
+5V
−5V
−12V
−RAW
PVAL

Memory
Controller

Address
Latch

Processor Assembly

Hybrid Microprocessor

BPC

EMC

IOC

STM, WRIT, BYTE

STM ROM

PIRBC

Clock

Freq.
Adj.

POP

DOUT

INIT

PVAL

9825-J-75013

Figure 5-5. 9825A Block Diagram

ASSEMBLY

REFRESH
CIRCUIT

DATA
SELECTOR

8192/16384
x 16
READ/WRITE
MEMORY

ADDRESS
LATCH

SS
NITION
ING

BUS

READ/WRITE MEMORY ASSEMBLY

REFRESH
CIRCUIT

DATA
SELECTOR

8192/16384
x 16
READ/WRITE
MEMORY

READ/
WRITE
MEMORY
CONTROL

ADDRESS
LATCH

ADDRESS
RECOGNITION
SHORTING
CLIP

SYSTEM

ROM INTERFA

$\overline{IRH}, \overline{IRL}, \overline{DMAR}, FLG, \overline{STS}$

PA 0-3, $\overline{IC1}, IC2, INT, \overline{DOUT}, \overline{IOSB}$

I/O BUS

KDP ASSEMBLY

PRINT
INTENSITY

CONTROL
CIRCUITS

TAPE
TRANSPORT
LOGIC
ASSEMBLY

CONTROL
CIRCUITS

READ/
WRITE
CIRCUITS

KDP CHIP

KEY
CODE
COUNTER

KEY
SWITCH
DETECTOR

32x8
REGISTER

128x35
ROM

16x8
REGISTER

KEY SWITCH
ASSEMBLY

RESET

DISPLAY
ASSEMBLY

PRINTER
ASSEMBLY

POWER SUPPLY

+12 V ADJ.

+7 V ADJ.

+RAW
+12 V
+7 V
+5 V
-5 V
-12 V
-RAW
PVAL

READ/WRITE MEMORY

READ/
WRITE
MEMORY
CONTROL

ADDRE
RECOG
SHORT
CLIP

PROCESSOR ASSEMBLY

HYBRID MICROPROCESSOR

IDA

BPC

$\overline{STM}$
$\overline{WRIT}$
$\overline{BYTE}$
$\overline{MEB}$
$\overline{STM\ ROM}$
$\overline{MFRBC}$
$\overline{PIRBC}$
$\overline{SOB}$

CLOCK

FREQ.
ADJ.

EMC

IOC

$\overline{POP}$

$\overline{DOUT}$

$\overline{INIT}$

PVAL

9825-J-65042

Chapter 6

Replaceable Parts

This chapter gives information for replacing lost or damaged parts. It includes:

- Indented material list for the computer.

- Power supply schematic diagrams.

- Power supply component designators.

- Power supply material list.

- Printer alignment fixture schematic diagram.

- Printer alignment fixture component designator.

- Printer alignment fixture material list.

The first table is an indented material list. Its first column, headed "Assembly Level", indicates which parts are sub-assemblies of other parts. They are indented by decimal points, as well as being numerically ordered, for ease in recognizing associated sub-assemblies. A person ordering an assembly will get, as part of that assembly, whatever lower level sub-assemblies immediately follow it on the list. In ordering an assembly listed at a level 1, all succeeding level 2 and level 3 items will be included, down to the next item at level 1. In ordering a level 2 item, all succeeding level 3 items will be included, until the next level 2 or level 1 item is encountered. For example, the Processor Assembly (09825-66517) contains four level 2 sub-assemblies. One of these, the Hybrid Microprocessor (09825-67907) has a level 3 component, the Microprocessor Heat Sink (0050-0631). So people ordering a Processor Assembly (09825-66517) will receive:

- Processor Assembly (09825-66516).

- Hybrid Microprocessor (09825-67907) with its Heat Sink (0050-0631).

- Microprocessor Gasket Assembly (09825-67908).

- Two Nylon Snap-In Spacers (0380-0632).

They will not receive the white cable shield (4040-1032) that goes under the Processor Assembly, nor will they receive the four screws (2360-0115) that attach the assembly to the base because they are at the same assembly level as the Processor Assembly.

Table 6-1. 9825 Replaceable Parts

Assembly Level	Reference Designator	C.D.	*hp* Part No.	TQ	Description
					Assemblies on the Base
1	A11	7	09825-66511	1	9825A Processor Assembly
.2		6	09825-66510	1	9825A Processor Assembly (without Hybrid Microprocessor)
1	A17	3	09825-66517	1	9825B Processor Assembly
.2		2	09825-66516	1	9825B Processor Assembly (without Hybrid Microprocessor)
.2		7	09825-67907	1	Hybrid Microprocessor
..3		0	0050-0631	1	Microprocessor Heat Sink
.2		8	09825-67908	1	Microprocessor Gasket Assembly
.2		0	0380-0632	2	1.0 inch Nylon Snap-In Spacer
1		0	4040-1032	1	Cable Shield
1		4	2360-0115	4	#6-32 Pan Head Mach. Screw 0.312 long
1	A61	7	09825-66561	1	Tape Transport Logic Assembly
.2		9	09825-61604	1	Tape Transport Control Cable
.2		9	2110-0002	1	Fuse-2.0 Amps NB
.2		8	0380-0630	3	0.75 inch Nylon Snap-In Spacer
.2		4	2360-0115	3	#6-32 Pan Head Mach. Screw 0.312 long
.2		7	5040-7721	2	Full Hinge
1	A12	8	09825-66512	1	ROM Interface Assembly
1		0	0380-0632	1	1.0 inch Nylon Snap-In Spacer
1		2	09835-04704	1	ROM Interface Assembly Insulator
1		7	09825-61610	1	Ground Cable-Single Conductor
1		7	2360-0332	9	#6-32 Pan Head Mach. Screw 0.312 long (patch-lock)
1	A51	5	09825-66551	1	Power Supply Assembly
1		0	09825-01106	1	Power Supply Heat Sink
1		4	2360-0115	3	#6-32 Pan Head Mach. Screw 0.312 long
1		7	2360-0316	2	#6-32 100° Flat Head Mach. Screw 0.250 long
1	A71	9	09825-66571	1	I/O Interface Assembly
1		0	09825-01213	1	I/O Assembly Support Bracket
1		7	2360-0332	6	#6-32 Pan Head Mach. Screw 0.312 long (patch lock)
1		4	2360-0115	2	#6-32 Pan Head Mach. Screw 0.312 long
1		5	09825-67905	1	System ROM Drawer
.2	A13	9	09825-66513	1	System ROM Assembly (9825A only)
.2		4	5040-8156	1	Plastic Case-Top Piece
.2		5	5040-8157	1	Plastic Case-Bottom Piece
.2		0	0624-0311	6	#4-20 82° Flat Head Tapping Screw .500 long
.2		0	7120-5875	1	System ROM Label
1		6	09825-61601	1	I/O Cable Assembly
1		7	09825-61602	1	Memory Cable Assembly
1		6	09825-67914	1	Transformer Enclosure Assembly
.2		8	09825-61603	1	Power Distribution Cable Assembly
..3		7	1251-0334	1	P.C. Edge Connector (2x18)
..3		4	1251-2262	1	P.C. Edge Connector (2x10)
..3		3	1251-2500	2	P.C. Edge Connector (2x6)
..3		4	0360-1610	3	#6 Solder Lug
.2		0	2110-0003	1	Fuse-3 Amps NB
.2		3	2110-0543	1	Fuse Holder
.2		5	2110-0545	1	Fuse Holder-Cap
.2		1	3101-2298	2	Slide Switch
.2		4	5040-8289	1	EMI Filter Housing
.2		3	09825-67911	1	Power Switch Assembly
1		6	2360-0315	2	#6-32 Pan Head Mach. Screw 0.500 long
1		2	2360-0197	4	#6-32 Pan Head Mach. Screw 0.375 long
1		1	09825-67200	1	Fan with Connector
1		9	4208-0110	1	Foam Dust Filter
1		4	5040-8362	1	Fan Bracket
1		1	3030-0003	4	#6-32 Socket Head Cap Screw 0.375 long
1		4	2190-0918	4	#6 Helical Lock Washer

Table 6-1. 9825 Replaceable Parts (cont'd)

Assembly Level	Reference Designator	C.D.	hp Part No.	TQ	Description
					Other Components on the Base
1		9	09825-64434	1	Base
1		3	0403-0106	5	Rubber Foot
1		4	2360-0115	5	#6-32 Pan Head Mach. Screw 0.312 long
1		6	09825-01201	1	Right Hand Shell Bracket
1		4	2360-0115	1	#6-32 Pan Head Mach. Screw 0.312 long
1		0	09825-01205	1	Left Hand Shell Bracket
1		4	2360-0115	1	#6-32 Pan Head Mach. Screw 0.312 long
1		1	09825-01206	2	Hinge Bracket
1		4	2360-0115	2	#6-32 Pan Head Mach. Screw 0.312 long
1		7	5040-7721	2	Full Hinge
1		0	1460-1431	1	Bezel Spring-Left
1		7	2360-0332	1	#6-32 Pan Head Mach. Screw 0.312 long (patch-lock)
1		5	1460-1436	1	Bezel Spring-Right
1		7	2360-0332	1	#6-32 Pan Head Mach. Screw 0.312 long (patch-lock)
1		2	1600-0859	1	ROM Guide Spring
1		4	2360-0115	3	#6-32 Pan Head Mach. Screw 0.312 long
1		6	2360-0316	2	#6-32 100° Flat Head Mach. Screw 0.250 long
1		3	5040-8155	4	Option ROM Door
1		5	1460-1626	4	Option ROM Door Spring
1		6	1600-0514	4	Option ROM Door Clip
1		2	5040-8287	1	Power Switch Bezel
1		3	0624-0314	2	#4-20 Pan Head Tapping Screw 0.375 long
1		9	2360-0368	4	#6-32 Pan Head Mach. Screw .375 long (with flat washer)
					Assemblies on the Bezel
1	A33	3	09825-66533	1	KDP Assembly (with KDP Chip)
.2		3	1818-2508	1	KDP Chip
.2		5	9160-0246	1	Speaker
1		1	09835-04703	1	KDP Assembly Insulator
1		4	2200-0521	9	#4-40 Pan Head Mach. Screw 0.250 long (patch lock)
1	A41	3	09825-66541	1	Single line LED Display Assembly
1		8	09825-21102	1	Display Heat Sink
1		4	8120-2725	1	14 Cond. Ribbon Cable Assembly
1		8	1990-0553	8	Four Character LED Display IC
1		1	0340-0835	1	Display Assembly Insulator
1		8	2200-0521	3	#4-40 Pan Head Mach. Screw 0.250 long (patch-lock)
1		6	2200-0769	4	#4-40 Pan Head Mach. Screw 0.375 long (patch-lock)
1		0	09815-67902	1	Tape Transport Assembly
2		1	2140-0457	2	Incandescent Lamp
2		6	3101-1980	2	Micro Switch
1		1	09825-01214	1	Tape Transport Mounting Bracket
1		8	1600-0524	1	Left Hand Bezel Mounting Foot
1		4	2200-0105	2	#4-40 Pan Head Mach. Screw 0.312 long (with star washer)
1		6	3050-0105	2	#4 Flat Washer 0.281 Diameter
1		5	0400-0203	2	Grommet
1		3	0624-0281	2	#4-24 Pan Head Tapping Screw .500 long
1		6	3050-0105	2	#4 Flat Washer 0.281 Diameter
1		8	2200-0521	3	#4-40 Pan Head Mach. Screw .250 long
1		5	1990-0534	1	LED, Yellow (Run light)

Table 6-1. 9825 Replaceable Parts (cont'd)

Assembly Level	Reference Designator	C.D.	*hp* Part No.	TQ	Description
					Other Components on the Bezel
1		3	09825-64412	1	9825A Bezel
1		7	09825-64432	1	9825B Bezel
1		1	5040-8187	1	Eject Button
1		6	09825-64415	1	9825A Display Insert
1		7	09825-64416	1	9825B Display Insert
1		3	5040-7727	1	Printer Tear Bar-Clear Plastic
1		8	5040-7813	1	Display Window-Red Plastic
					Miscellaneous Items and Consumables
1		5	09825-67913	1	Shell Assembly
1		2	5041-1403	3	Door for I/O Slot
1		8	9222-0495	1	Dust Cover
1		1	8120-1378	1	AC Power Cable
1		0	2110-0003	1	Fuse-3 Amps NB
1		8	2110-0043	1	Fuse-1.5 Amps NB
1		4	2110-0544	1	Fuse Holder Cap (European)
1		2	09825-10000	1	Utility Pack
.2		3	09825-10001	1	Users Guide
.2		7	9282-0563	1	Software Binder
1		0	09825-90200	1	Operating and Programming Manual
1		3	09825-90012	1	Quick Reference Guide
1			09825-87901	1	Manual Kit
2		0	09825-90200	1	Operating and Programming Reference
2			09825-90210	1	I/O Control Reference
2			09825-90060	1	Interfacing Concepts Guide
2		3	09825-90012	1	Quick Reference
2			9282-0885	2	9825 Documentation Binder
1		7	09825-90015	1	Error Booklet
1		4	09825-90038	1	System Test Package
.2		2	09825-90036	1	System Test Cartridge
.2		3	09825-90037	1	System Test Booklet
1		1	7120-4802	5	Special Function Key Overlay
1		5	8500-1251	1	Mag Tape Head Cleaner
1		2	9270-0480	1	Thermal Printer Paper (Box of 6 rolls)

Table 6-1. 9825 Replaceable Parts (cont'd)

Assembly Level	Reference Designator	C.D.	*hp* Part No.	TQ	Description
					9825A Standard Memory
1	A22	0	09825-66522	1	8K-Byte Read/Write Memory Assembly
.2		4	5020-8330	1	Shorting Clip
1		7	5040-7721	2	Full Hinge
1		8	0380-0630	2	0.75 inch Nylon Snap-In Spacer
1		4	2360-0115	2	#6-32 Pan Head Mach. Screw 0.312 long
1		6	09825-67906	1	Dummy Read/Write Memory Assembly
.2		5	5040-7787	2	Half Hinge
					9825A Option 001
1	A23	1	09825-66523	1	16K-Byte Read/Memory Assembly
.2		4	5020-8330	1	Shorting Clip
1		7	5040-7721	2	Full Hinge
1		8	0380-0630	2	0.75 inch Nylon Snap-In Spacer
1		4	2360-0115	2	#6-32 Pan Head Mach. Screw 0.312 long
1		6	09825-67906	1	Dummy Read/Write Memory Assembly
.2		5	5040-7787	2	Half Hinge
					9825A Option 002
1	A23	1	09825-66523	1	16K-Byte Read/Write Memory Assembly
.2		4	5020-8330	1	Shorting Clip
1		7	5040-7721	2	Full Hinge
1		8	0380-0630	3	0.75 inch Nylon Snap-In Spacer
1		4	2360-0115	3	#6-32 Pan Head Mach. Screw 0.312 long
1	A22	0	09825-66522	1	8K-Byte Read/Write Memory Assembly
.2		4	5020-8330	1	Shorting Clip
1		5	5040-7787	2	Half Hinge
					9825A Option 003
1	A23	1	09825-66523	2	16K-Byte Read/Write Memory Assembly
.2		4	5020-8330	2	Shorting Clip
1		7	5040-7721	2	Full Hinge
1		8	0380-0630	3	0.75 inch Nylon Snap-In Spacer
1		4	2360-0115	3	#6-32 Pan Head Mach. Screw 0.312 long
1		5	5040-7787	2	Half Hinge
					9825B Standard Memory
1	A24	2	09825-66524	1	24k/32k-Byte RAM & ROM Assembly
1		7	5040-7721	2	Full Hinge
1		8	0380-0630	2	0.75 inch Nylon Snap-In Spacer
1		4	2360-0115	2	#6-32 Pan Head Mach. Screw 0.312 long
			3101-2363	1	Memory Size Switch
1		6	09825-67906	1	Dummy Read/Write Memory Assembly
.2		5	5040-7787	2	Half Hinge
					9825B Option 201 Memory
1	A25	3	09825-66525	1	32k-Byte RAM Assembly
1		7	5040-7721	2	Full Hinge
1		8	0380-0630	2	0.75 inch Nylon Snap-In Spacer
1		4	2360-0115	2	#6-32 Pan Head Mach. Screw 0.312 long
1		7	8120-3130		Skoal Cable
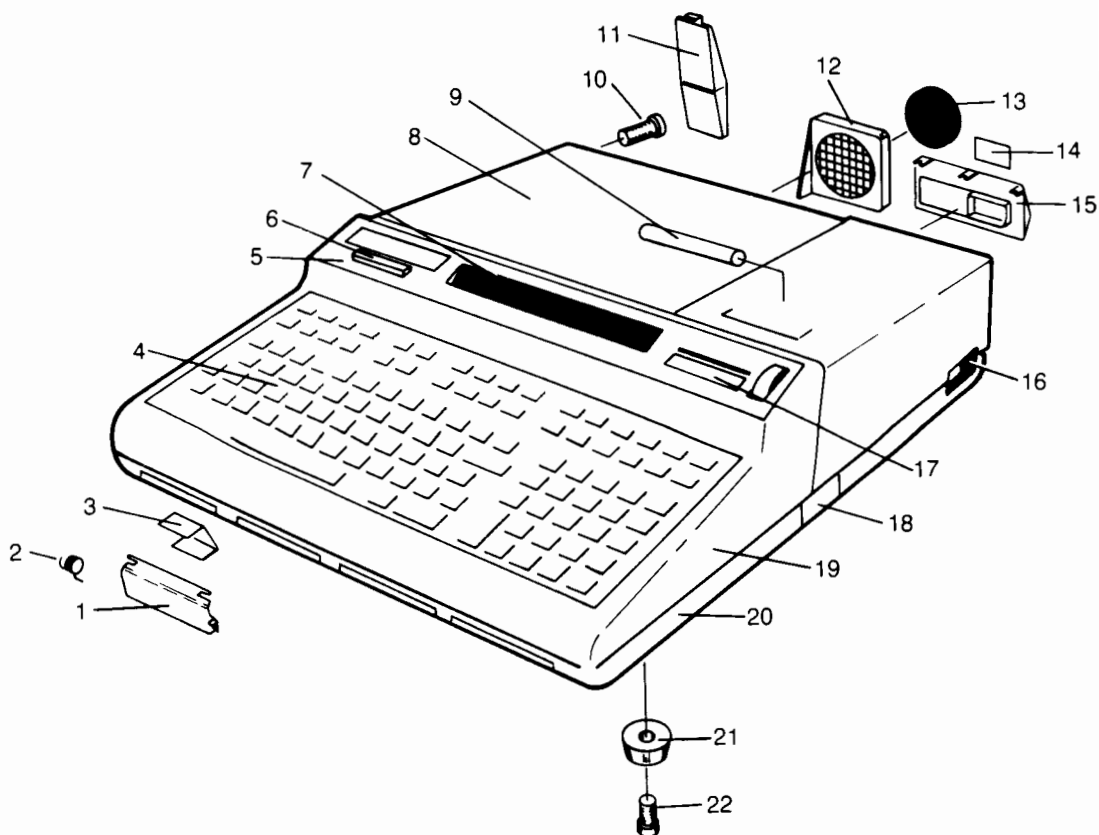
Figure 6-1. Case Replacement Parts

Case Replacement Parts

Assembly Level	Reference Designator	C.D.	*hp* Part No.	TQ	Description
					Case Replaceable Parts
	1	3	5040-8155	4	Option ROM Door
	2	5	1460-1626	4	Option ROM Door Spring
	3	6	1600-0514	4	Option ROM Door Clip
	4	2	09825-68025	1	9825B Keyswitch Assembly
	5	6	09825-64415	1	9825A Display Insert
	5	7	09825-64416	1	9825B Display Insert
	6	1	5040-8187	1	Eject Button
	7	8	5040-7813	1	Display Window
	8	5	09825-67913	1	Shell Assembly
	9	9	09815-20602	1	Printer Paper Spindle
	10	9	2360-0368	2	#6-32 Pan Head Mach. Screw 0.375 long
	11	2	5041-1403	3	I/O Slot Door
	12	4	5040-8362	1	Fan Bracket
	13	9	4208-0110	1	Foam Dust Filter
	14	9	7120-6450	1	Filter Housing Label
	15	4	5040-8289	1	EMI Filter Housing
	16	2	5040-8287	1	Power Switch Bezel
	17	3	5040-7727	1	Printer Tear Bar
	18	5	09825-67905	1	9825A System ROM Drawer
	18		4040-1697	1	9825B System ROM Plug
	19	3	09825-64412	1	9825A Bezel
	19	7	09825-64432	1	9825B Bezel
	20	2	09825-64411	1	9825A Base
	20	9	09825-64434	1	9825B Base
	21	3	0403-0106	5	Rubber Foot
	22	4	2360-0115	5	#6-32 Pan Head Mach. Screw 0.312 long
					Keyswitches
			3101-2390		All Keys except Store, Cont, Exec, Space
			3101-0468		For Store, Cont, Exec
			3101-0469		Space Bar
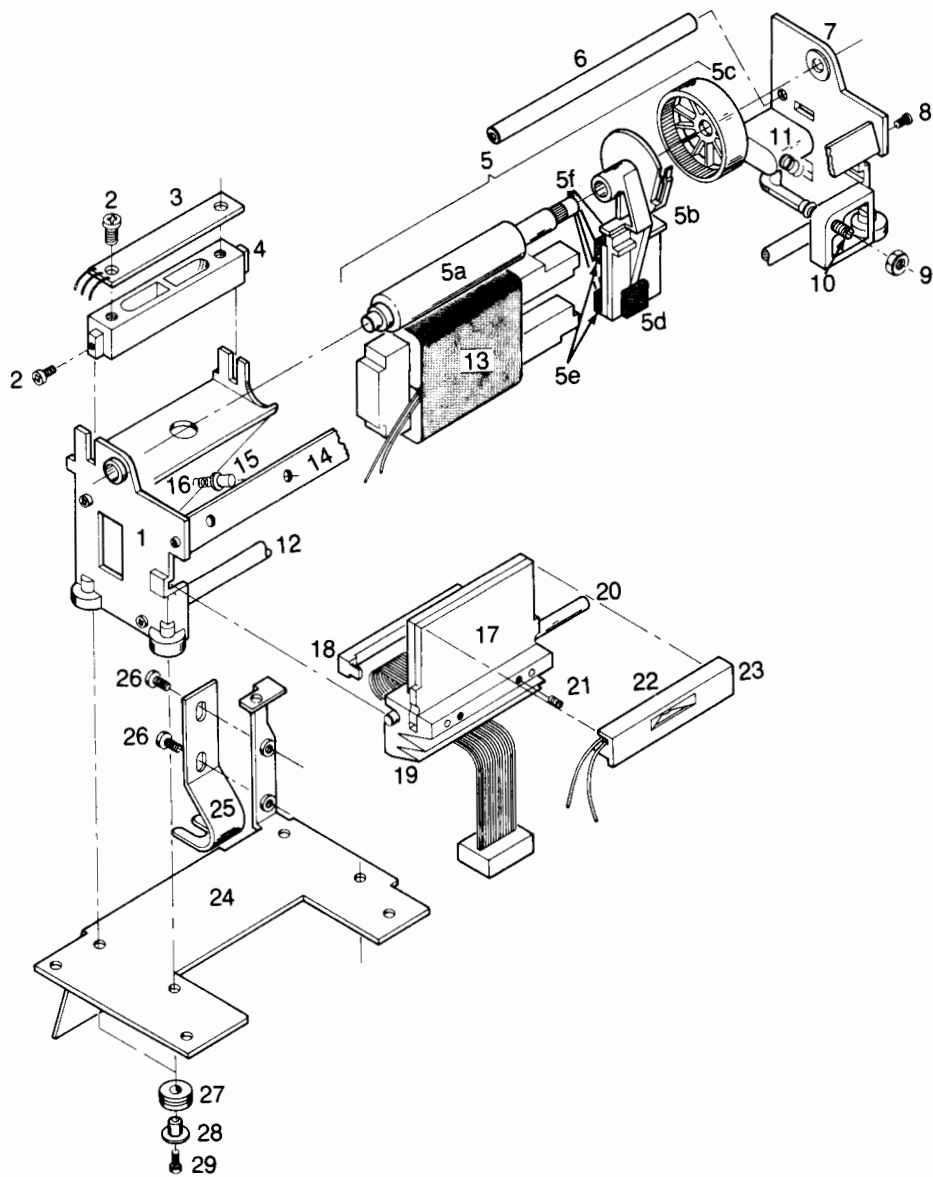
Figure 6-2. Printer Exploded View

Assembly Level	Reference Designator	C.D.	*hp* Part No.	TQ	Description
1			**09835-67940**	**1**	**Sixteen Character Thermal Printer Assembly**
.2	1	5	5041-1448	1	Left Hand Side Plate
.2	2	3	0624-0314	4	#4-20 Pan Head Tapping Screw .375 long
.2	3	4	5061-0752	1	Paper Switch Assembly
.2	4	3	5040-7800	1	Paper Guide
.2	5	3	5061-0751	1	Platen Sub-Assembly
..3	5a	0	1530-1771	1	Platen
..3	5b	5	5061-0761	1	Rotor Sub-Assembly
..3	5c	2	5040-8188	1	Thumbwheel
..3	5d	1	4208-0097	1	Rubber Pad
..3	5e	0	4208-0096	1	Foam Pad
..3	5f	5	0403-0330	4	Rubber Bumper Foot (under foam pad)
.2	6	8	1531-0026	1	Tie Rod (Modified)
.2	7	4	5040-7744	1	Right Hand Side Plate
.2	8	0	2200-0143	6	#4-40 Pan Head Mach. Screw 0.375 long
.2		5	3050-0716	6	#5 Flat Washer 0.253 O.D.
.2		8	2190-0003	6	#4 Helical Lock Washer
.2	9	7	2420-0003	1	#6-32 Hexagonal Nut
.2	10	2	0570-0566	1	Stop Screw
.2	11	8	1460-0697	1	Spring
.2	12	7	1530-1827	1	Tie Rod
.2	13	1	5061-4214	1	Transformer-Stator
.2	14	6	5021-0203	1	Spring Bracket
.2	15	7	5021-0212	2	Spring Holder
.2	16	9	1460-0565	2	Spring
.2	17	7	1813-0051	1	Print Head Assembly
..3	18	6	5040-7366	1	Strain Relief Clamp
.2	19	1	1205-0301	1	Heat Sink
.2	20	9	1460-0698	1	Support Rod
.2	21	4	3030-0353	2	#6-32 Set Screw 0.188 long
.2	22	8	09825-61611	1	Thermistor
.2	23	5	5040-7927	1	Thermistor Clip
1	24	4	09825-01209	1	Printer Mounting Bracket
1	25	7	09825-01210	1	Right Hand Bezel Mounting Foot
.2	26	8	2200-0521	2	#4-40 Pan Head Mach. Screw 0.250 long (patch-lock)
1	27	2	0400-0193	4	Grommet
1	28	8	0380-0599	4	Headed Spacer 0.237 long
1	29	4	2200-0147	4	#4-40 Pan Head Mach. Screw 0.500 long
1		8	2190-0003	4	#4 Helical Lock Washer
1		8	5040-8192	1	Printer Bucket
1		4	2200-0105	2	#4-40 Pan Head Mach. Screw 0.312 long (with star washer)
1		6	3050-0105	2	#4 Flat Washer 0.281 Diameter
1		8	2200-0521	4	#4-40 Pan Head Mach. Screw 0.250 long (patch-lock)

COMPONENT SIDE

A51
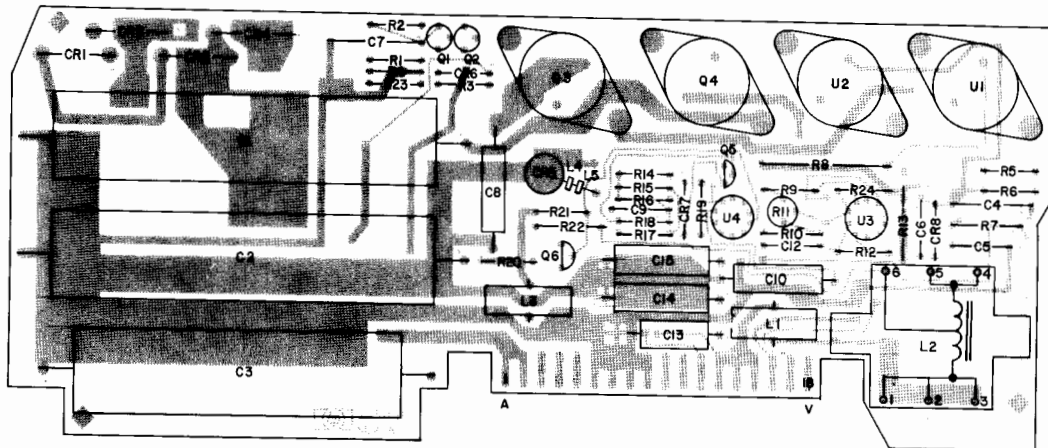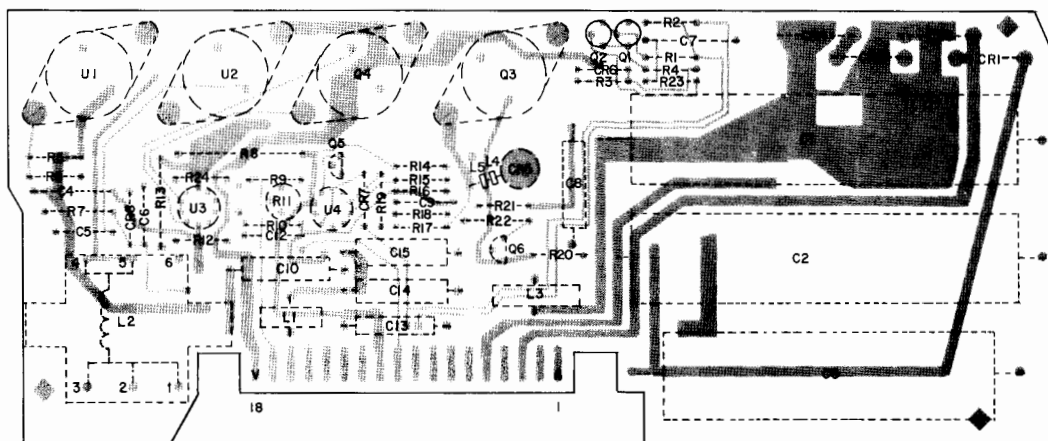
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CIRCUIT SIDE

A51

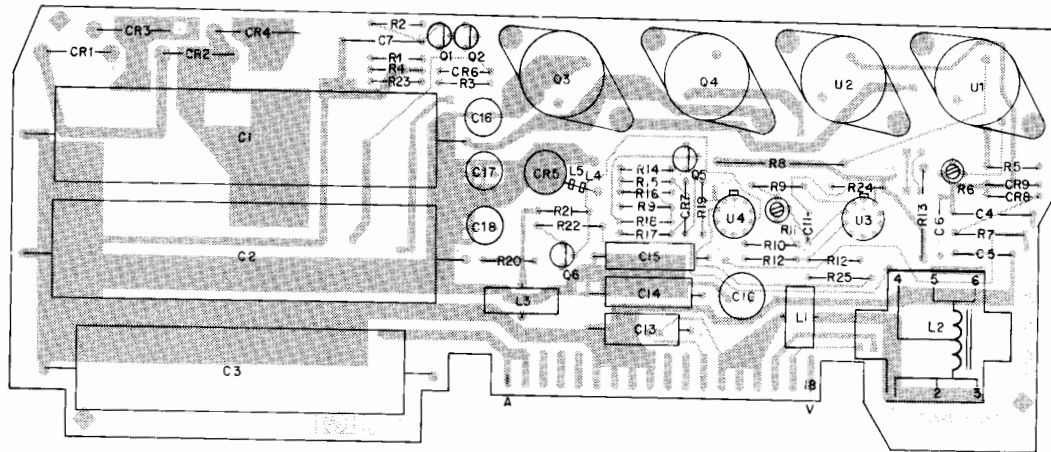-hp- Part No. 09825-66551   Rev A & B

Figure 6-3.   Power Supply (Rev. A & B) Schematic Diagram
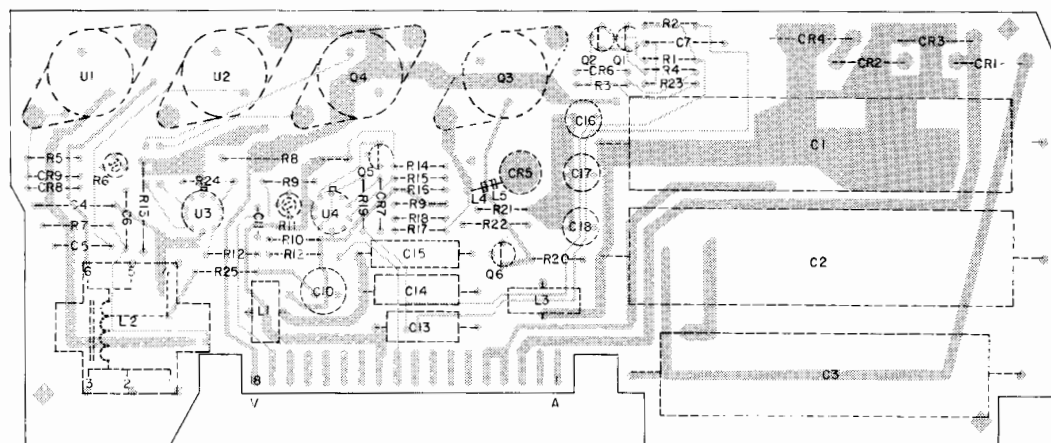
COMPONENT SIDE

A51

-hp- Part No. 09825-66551   Rev C & D

CIRCUIT SIDE

A51

-hp- Part No. 09825-66551   Rev C & D

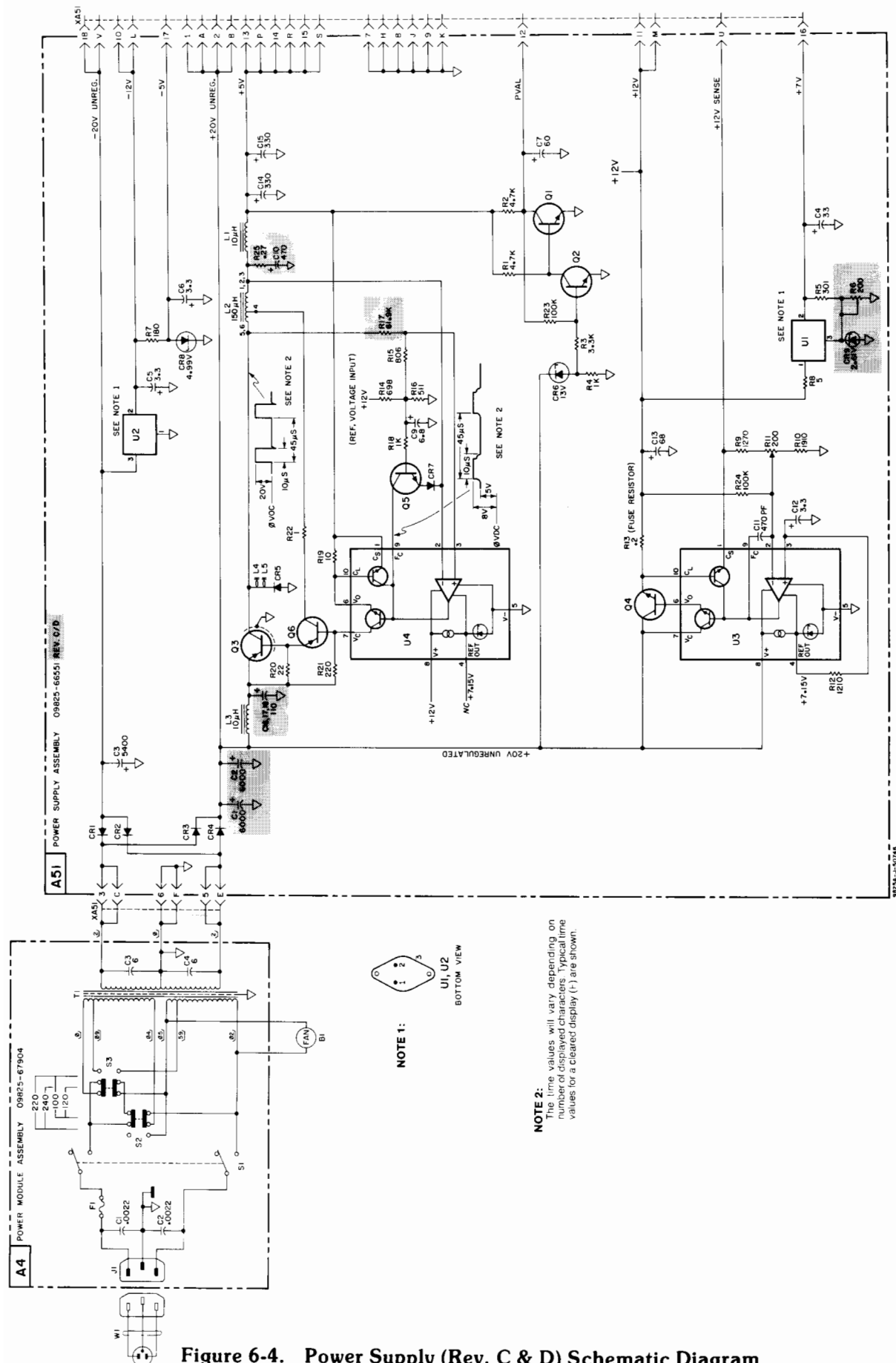**Figure 6-4. Power Supply (Rev. C & D) Schematic Diagram**

Table 6-2. Power Supply Replaceable Parts

Revision	Reference Designator	C.D.	*hp* Part No.	TQ	Description
	A51	5	09825-66551	1	Power Supply Assembly
A,B	C1,C2	5	0180-2405	2	CAP: Fxd 6400μF 25V
C,D,E		6	0180-0583	2	CAP: Fxd 6000μF 30V
	C3	4	0180-0408	1	CAP: Fxd 5400μF 25V
	C4	7	0180-0229	1	CAP: Fxd 33μF 10V
	C5,C6,C12	6	0180-0210	3	CAP: Fxd 3.3μF 15V
	C7	9	0180-0106	1	CAP: Fxd 60μF 6V
A,B	C8	8	0180-2614	1	CAP: Fxd 100μF 30V
	C9	2	0180-1701	1	CAP: Fxd 6.8μF 6V
A,B	C10	6	0180-2208	1	CAP: Fxd 200μF 10V
C,D,E		4	0180-2751	1	CAP: Fxd 470μF 12V
	C11	4	0150-0071	1	CAP: Fxd 400pF 1000V
	C13	3	0180-1835	1	CAP: Fxd 68μF 15V
	C14,C15	7	0180-1714	2	CAP: Fxd 330μF 6V
C,D,E	C16,C17,C18	8	0180-2771	3	CAP: Fxd 110μF 30V
	CR1-CR4	3	1901-0662	4	DIODE: 100V 6A Power Rectifier
A-D	CR5	1	1901-0511	1	DIODE: 1N3889R Power Switching
E		0	1901-0833	1	DIODE: 1N6096 Power Schottky
	CR6	0	1902-3190	1	DIODE: Breakdown 13V @ 7.5mA
	CR7	1	1901-0040	1	DIODE: 30V .05A
	CR8	1	1902-3092	1	DIODE: Breakdown 4.99V @ 50mA
C,D,E	CR9	6	1902-0126	1	DIODE: Breakdown 2.61V @ 20mA
	L1,L3	7	9100-3462	2	INDUCTOR: 10μH
	L2	7	9100-3488	1	INDUCTOR: Tapped Choke 150μH
A-D	L4,L5	3	9100-0894	2	INDUCTOR: Ferrite Bead
	Q1	4	1854-0094	1	TRANSISTOR: NPN 2N3646
	Q2,Q5	7	1854-0071	2	TRANSISTOR: NPN SPS5103
	Q3	5	1853-0310	1	TRANSISTOR: PNP 2N4398
	Q4	7	1854-0063	1	TRANSISTOR: NPN 2N3055
	Q6	3	1853-0045	1	TRANSISTOR: PNP 2N4036
	R1,R2	2	0683-4725	2	RES: Fxd 4.7KΩ 5%
	R3	6	0683-3325	1	RES: Fxd 3.3KΩ 5%
	R4,R18	9	0683-1025	2	RES: Fxd 1.0KΩ 5%
	R5	1	0757-0410	1	RES: Fxd 301Ω 1%
A,B	R6	5	0757-0399	1	RES: Fxd 82.5Ω 1%
C,D,E		3	2100-2061	1	RES: Var 200Ω 10% 1 turn
	R7	1	0686-1815	1	RES: Fxd 180Ω 5%
	R8	8	0812-0047	1	RES: Fxd 5Ω 5% 5 Watts
	R9	7	0698-4422	1	RES: Fxd 1.27KΩ 1%
	R10	7	0698-4430	1	RES: Fxd 1.91KΩ 1%
	R11	3	2100-2061	1	RES: Var 200Ω 10% 1 turn
	R12	5	0757-0274	1	RES: Fxd 1.21KΩ 1%
	R13	7	0811-3414	1	RES: Fxd 0.2Ω 5% 2 Watts
	R14	4	0698-4461	1	RES: Fxd 698Ω 1%
	R15	7	0698-3557	1	RES: Fxd 806Ω 1%

Table 6-2. Power Supply Replaceable Parts (cont'd)

Revision	Reference Designator	C.D.	*hp* Part No.	TQ	Description
A-D E	R16 R17	7 1 3	0757-0416 0757-0270 0757-0462	1 1 1	RES: Fxd 511Ω 1% RES: Fxd 249KΩ 1% RES: Fxd 75KΩ 1%
	R19 R20	5 9	0683-1005 0683-2205	1 1	RES: Fxd 10Ω 5% RES: Fxd 22Ω 5%
C,D,E	R21 R22 R23,R24 R25	1 8 3 1	0683-2215 0811-3069 0683-1045 0812-0040	1 1 2 1	RES: Fxd 220Ω 5% RES: Fxd 1Ω 5% 0.5 Watts RES: Fxd 100KΩ 5% RES: Fxd 0.27Ω 5% 0.5 Watts
	U1 U2 U3,U4	1 1 6	1820-0430 1826-0123 1820-0196	1 1 2	IC: Fxd +5 Volt Regulator TO-3 case IC: Fxd -12 Volt Regulator TO-3 case IC: Voltage Regulator 723 type TO-100 case
		7 0 3	09825-64101 0340-0503 1200-0080	1 4 1	INSULATOR: Q3 INSULATOR: Q3,Q4,U1,U2 INSULATOR: CR5
		7 0	1205-0050 09825-01106	1 1	HEAT SINK: U3 HEAT SINK: Q3,Q4,U1,U2
		9 2 4	2190-0004 2200-0111 2200-0147	2 1 1	#4 Internal Tooth Lock Washer #4-40 Pan Head Mach. Screw 0.500 long (with lock washer) #4-40 Pan Head Mach. Screw 0.500 long
		2 2 9 7	2190-0007 2360-0121 2360-0201 2420-0003	6 3 3 3	#6 Internal Tooth Lock Washer #6-32 Pan Head Mach. Screw 0.500 long (with lock washer) #6-32 Pan Head Mach. Screw 0.500 long #6 Hex Nut
		8 3	2190-0011 2740-0001	1 1	#10 Internal Tooth Lock Washer #10 Hex Nut
		7	2360-0332	3	#6-32 Pan Head Mach. Screw 0.312 long (patch-lock)
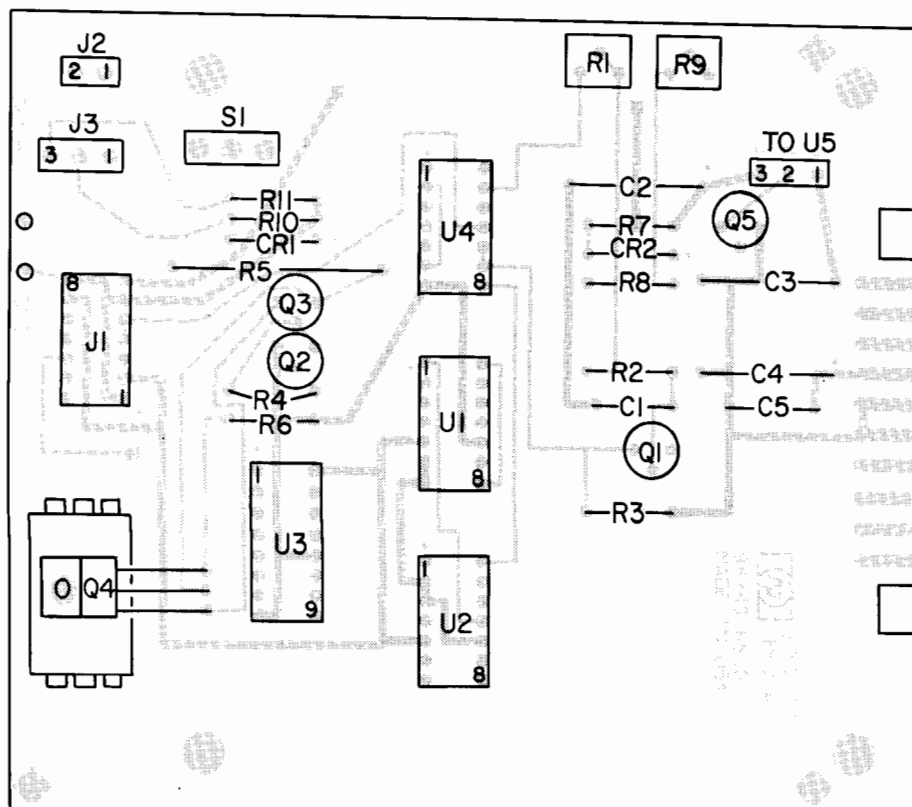
COMPONENT SIDE

A1

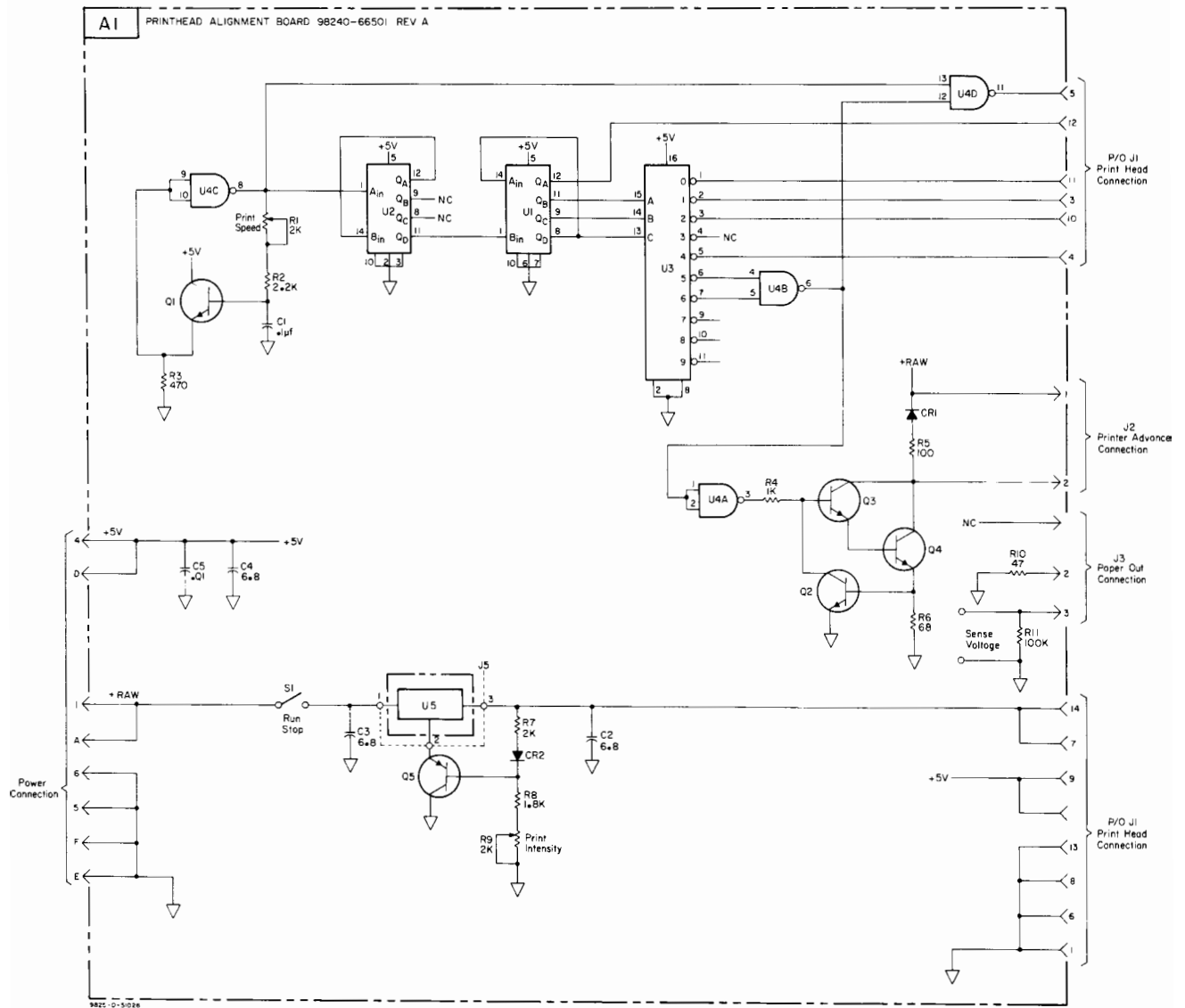-hp- Part No. 98240-66501   Rev A

Figure 6-5. Print Head Alignment Fixture Schematic Diagram

Table 6-3. Print Head Alignment Fixture Replaceable Parts

Assembly Level	Reference Designator	C.D.	*hp* Part No.	TQ	Description
	A1	5	**98240-66501**	1	**Printer Alignment Fixture**
	C1	1	0160-3047	1	CAPACITOR: Fxd 0.1µF 25V
	C2,C3,C4	1	0180-0116	3	CAPACITOR: Fxd 6.8µF 35V
	C5	9	0160-3847	1	CAPACITOR: Fxd 0.01µF 25V
	CR1	5	1901-0028	1	DIODE: 400V 0.75A
	CR2	1	1901-0040	1	DIODE: 30V 0.05
	J1	5	1200-0503	1	CONNECTOR: 14 Pin DIP Socket
	J2	7	1251-4245	1	CONNECTOR: 2 Pin
	J3	8	1251-4246	1	CONNECTOR: 3 Pin
	Q1,Q2,Q3	7	1854-0071	3	TRANSISTOR: NPN: SPS 5103
	Q4	2	1854-0456	1	TRANSISTOR: NPN: TIP 41A
	Q5	4	1853-0020	1	TRANSISTOR: PNP: SPS 3609
	R1,R9	1	2100-3273	2	RESISTOR: Var 2K 10% 1 Turn
	R2	3	0683-2225	1	RESISTOR: Fxd 2.2KΩ 5%
	R3	0	0683-4715	1	RESISTOR: Fxd 470Ω 5%
	R4	9	0683-1025	1	RESISTOR: Fxd 1.0KΩ 5%
	R5	3	0812-0018	1	RESISTOR: Fxd 100Ω 3% 5 Watts
	R6	6	0811-3413	1	RESISTOR: Fxd 0.68Ω 5% 0.5 Watt
	R7	1	0683-2025	1	RESISTOR: Fxd 2.0KΩ 5%
	R8	7	0683-1825	1	RESISTOR: Fxd 1.8KΩ 5%
	R10	8	0683-4705	1	RESISTOR: Fxd 47Ω 5%
	R11	3	0683-1045	1	RESISTOR: Fxd 100KΩ 5%
	S1	1	3101-1258		SPDT Toggle Switch
	U1	7	1820-0056		IC: 7492N
	U2	8	1820-0099		IC: 7493N
	U3	9	1820-0214		IC: 7442N
	U4	9	1820-1056		IC: 74132N
	U5	1	1826-0181		Voltage Regulator: Fxd 5 Volts
		5	98240-01101		Top Cover
		6	98240-01102		Base
		6	1200-0041		Transistor Socket-TO3
		2	0400-0193		Grommet

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