Integral Personal Computer
Service Manual

HEWLETT PACKARD

Integral Personal Computer Service Manual

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Product Information

1.1 Introduction

This chapter provides an overview of the Integral Personal Computer.

The Integral PC is a fully integrated system that contains a built-in disc drive and printer. It is designed for ease of operation and flexibility. The computer is capable of multi-tasking. It provides extensive I/O (input/output) and interfacing capabilities.

1.2 Description

The computer is based upon a 16-bit CPU (central processing unit) and contains 512K-bytes of internal RAM (random-access memory). The computer reserves address space for up to 1M-byte of internal ROM (read-only memory), all contained in a plug-in ROM assembly.

> **Note:** Current production units are equipped with a plug-in ROM assembly that has room for two ROM PCAs. The operating system ROM PCA is standard. It contains the HP-UX System V operating system (address space is reserved for up to 512K-bytes of operating system ROM). An option ROM PCA, containing up to 512K-bytes of optional ROM (for languages and application programs), may be added to the plug-in ROM assembly.
>
> Early production units are equipped with a plug-in ROM assembly containing the HP-UX System III operating system on two ROM PCAs. This assembly cannot be expanded. It cannot be serviced to the component level.

The following devices are integral parts of the computer:

- A 3½-inch micro-floppy disc drive.
- A 255 by 512 pixel electroluminescent display. (The display can be configured for up to 31 lines with up to 85 characters per line.)
- A 90-key detachable keyboard.
- An HP-IB (IEEE-488) interface.
- A thermal inkjet printer.
- A real-time clock.
- A speaker.
- An external I/O bus with two I/O ports for interfaces and memory modules.

The I/O capabilities of the computer can be expanded by adding up to two HP 82904A Bus Expanders to the system. Each bus expander provides five ports, but requires one of the computer I/O ports, giving a maximum of 10 I/O ports.

The computer has three major printed-circuit assemblies (PCAs): the logic A PCA, the logic B PCA, and the power supply PCA.

The logic A PCA contains the CPU, RAM, MMU (memory-management unit), and keyboard controller. The plug-in ROM assembly plugs into the ROM receptacle on the logic A PCA.

The logic B PCA contains the clock, the speaker, the HP-IB interface, the power supply for the print head, and the control circuitry for the disc drive, display, and printer.

The power supply provides +5V, +12V, −12V, +15V, and +18V outputs.

The major system assemblies and I/O devices are identified in figures 1-1, 1-2, and 1-3.

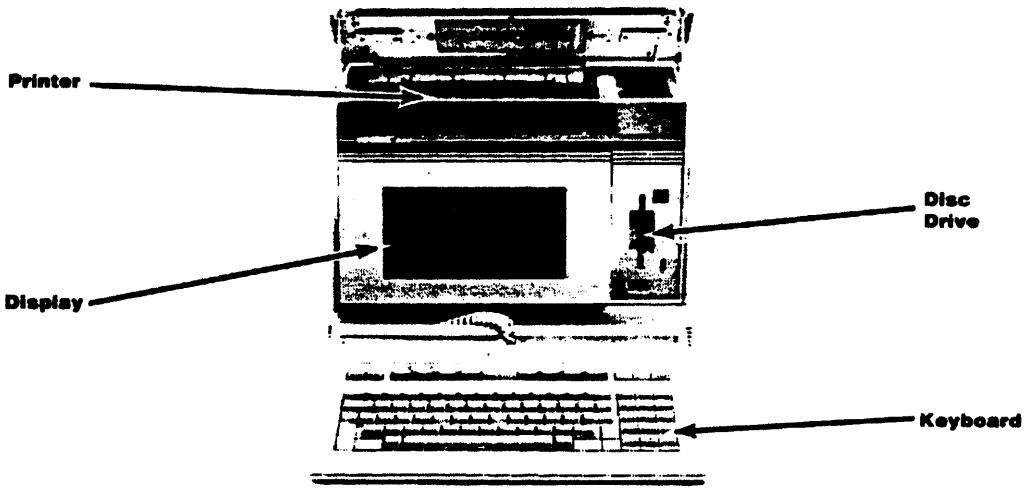


Figure 1-1. Integral Personal Computer—Front View

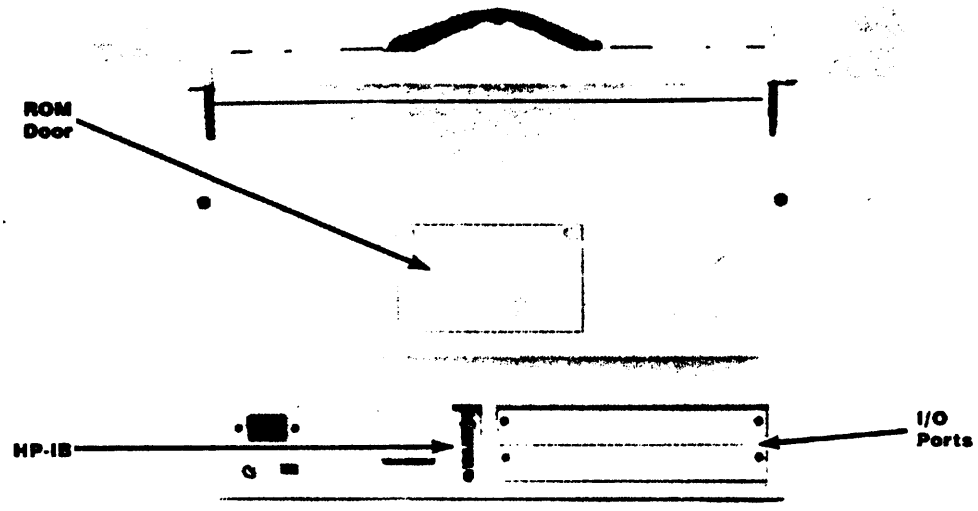


Figure 1-2. Integral Personal Computer—Rear View

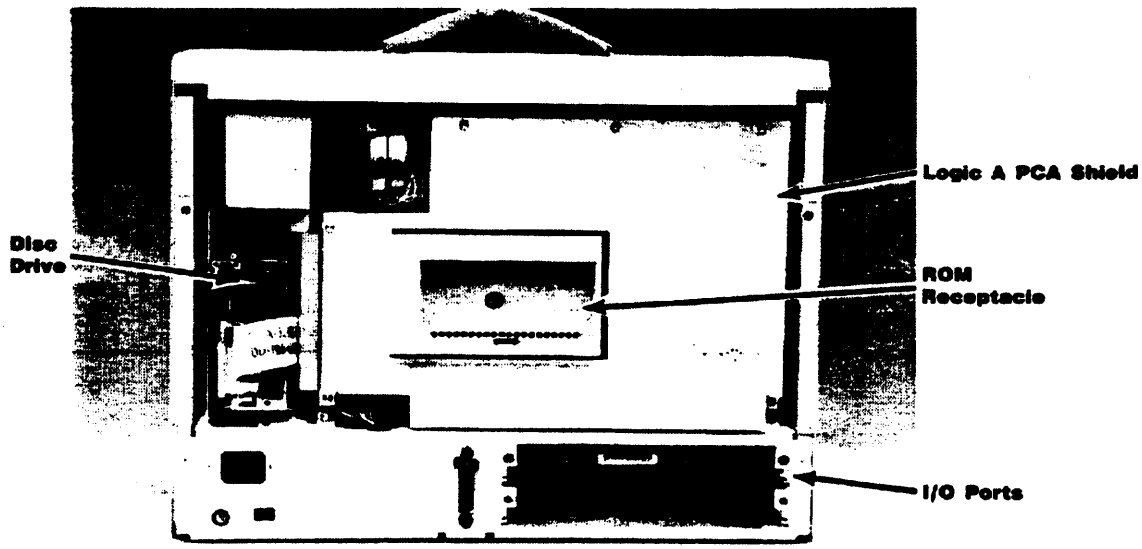


Figure 1-3. Integral Personal Computer—Internal View

1.3 Specifications

Detailed equipment specifications are shown in table 1-1.

Table 1-1. Specifications

Physical Properties ■ Width: 425 mm (16.7 inches). ■ Height: 331 mm (13.0 inches). ■ Depth: 215 mm (8.5 inches). ■ Weight: 11.5 kg (25.3 pounds).
CPU ■ 68000 microprocessor (16 bit, 8 MHz).
RAM ■ Memory mapped; four segments. ■ 512K-bytes internal RAM. ■ Up to 7M-bytes external RAM.
ROM ■ All internal ROM is contained in the plug-in ROM assembly (up to 1M-byte). This assembly has room for two ROM PCAs, each with room for up to 512K-bytes of ROM: 1) the operating system ROM PCA (which is standard), and 2) an option ROM PCA.

Table 1-2. HP Portable Plus Computer Specifications (Continued)

External I/O Bus

- Two I/O ports are provided (port A and port B).
- Maximum total power to both I/O ports: 9 watts.
- Two interfaces or memory modules may be plugged into I/O ports A and B. One can draw up to 6 watts (either port); the other, 3 watts.
- I/O capability is expandable to 10 I/O ports using two bus expanders (each has its own power supply).

Display

- 255 by 512 pixel electroluminescent display.
- Up to 85 characters by 31 lines. (Default of 80 characters by 24 lines.)
- Viewing angle: greater than 120 degrees in a horizontal plane.
- Display tilt: adjustable in 2-degree steps from 5 to 17 degrees.
- 32K-byte dedicated bit-mapped display memory.

Printer

- Thermal inkjet printer.
- 80 characters per line at 12 characters per inch (normal mode).
- Peak printing speed: 150 characters per second.
- Screen copy in 26 seconds.
- Roman8 character set.
- Four character sizes.
- Normal and bold character modes.
- Recommended paper: HP 92261M (500 single 8½-by-11-inch sheets) or HP 92261N (2500 fan-fold sheets).
- Plain paper is usable with lower print quality.

Print Head

- Life: 820,000 characters (approximately 500 pages).
- Shelf life (in shipping container): 18 months at 25°C.
- Shelf life (outside shipping container): 6 months at 25°C.

Table 1-2. HP Portable Plus Computer Specifications (Continued)

Disc Drive

- 3½-inch micro-floppy disc drive.
- Burst transfer rate: 62.5K-bytes per second.
- Encoding: Modified Frequency Modulation.
- Rotational speed: 600 revolutions per minute.
- Capacity: 709K-bytes.
- Bytes per sector: 512.
- Sectors per track: 9.
- Total tracks per surface: 80.
- Available tracks per surface: 77.
- Spare tracks per surface: 2.
- Wear track per surface: 1.
- Surfaces per disc: 2.
- Interleave factor: 1.

Disc Media

- Life: 3×10^6 passes per track.
- Read errors: 1 per 10^9 bits read.

Keyboard

- 90-key condensed ITF (Integrated Terminal Family) keyboard.
- Detachable, low profile (30 mm high).
- Adjustable tilt, 0 or 8 degrees.
- Modified HP-HIL (Hewlett-Packard Human Interface Link) keyboard interface with two HP-HIL connectors.

Speaker

- Frequency range: 100 to 5000 Hz.

Real-Time Clock

- Accuracy: maximum error, 120 seconds per month; typical, 30 seconds per month.
- Battery life: minimum expected, 6 years; typical, 12 years.

HP-IB Interface

- Maximum transfer rate: 135K-bytes per second (software limitations may reduce the rate).
- Conforms to IEEE-488 interface standard.

Table 1-2. HP Portable Plus Computer Specifications (Continued)

Environmental Limits

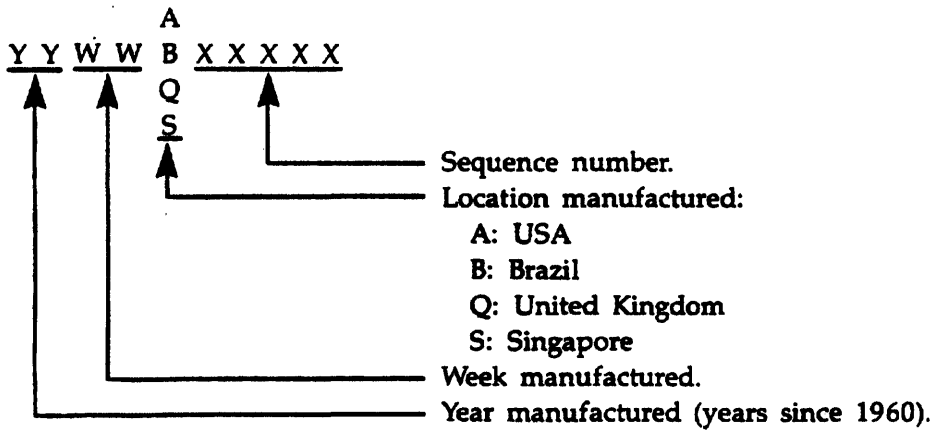
- Computer: Operating temperature: 0° to 40°C (32° to 104°F).
  Storage temperature: −40° to 75°C (−40° to 167°F).
  Operating humidity: 5% to 95% RH at 40°C (104°F).
  Non-operating humidity: 90% RH at 65°C (149°F).
  Operating altitude: 0 to 4600 m (0 to 15,000 feet).
  Non-operating altitude: 0 to 15,300 m (0 to 50,000 feet).
- Disc media: Operating temperature: 10° to 40°C (50° to 104°F).
  Long-term storage temperature: 10° to 60°C (50° to 140°F).
  Transporting temperature: −40° to 60°C (−40° to 140°F).
  Humidity: 8% to 80% RH at 40°C (104°F).
- Print Head: Operating temperature: 10° to 40°C (50° to 104°F).
  Storage temperature: −20° to 60°C (−4° to 140°F).
  Humidity: 5% to 80% RH at 40°C (104°F).

Power Requirements

- **Voltage:** 87 to 127 Vac (115 Vac line).
  195 to 264 Vac (230 Vac line).
- **Frequency:** 47.5 to 66 Hz.
- **Power:** 88W.

1.4 Serial Number Information

The serial number of the computer is used for identification and the determination of warranty status. It is located on the safety label near the power cord receptacle. Its format is described below.



Chapter 2
Site Preparation and Requirements

There are no special site preparation requirements for the Integral PC.

Chapter 3
Installation and Configuration

3.1 Introduction

The Integral Personal Computer is a self-contained computer system, complete with printer and display. Therefore, setting up the unit requires little time and is very simple. This chapter tells you how to set up the computer for use or in preparation for troubleshooting.

3.2 Preparation

CAUTION

Be sure the computer is set for the line voltage that you are using. Check the selector switch on the back panel near the power cable. Failure to do this can result in improper operation and/or possible damage to the computer.

1. Place the computer on a table with the back panel facing toward you.
2. Make sure that the line voltage switch on the back of the computer is set to the correct voltage (115 or 230 Vac).
3. Make sure that a good fuse of the proper rating is installed in the fuse receptacle on the back panel. A computer operating on 115 Vac requires a 1.5A fuse. A computer operating on 230 Vac requires an 800-mA fuse.
4. Turn the computer around, so that the front now faces you.
5. Press the buttons on the two latches on the top cover and slide them toward the carrying handle.
6. Lift up on the cover. It will swing up on its hinges.
7. Push the cover away from you. It will swing down along the back of the case. *Make sure the keyboard doesn't fall out (don't open the printer lid until you remove the keyboard).*
8. Lift the keyboard up and out of the front of the case, and place it on the table in front of the computer.
9. Plug the keyboard cable into either of the two HP-HIL jacks.
10. Plug an ac power cable into the receptacle on the back of the computer and into an ac outlet.
11. Install paper in the printer as follows: Open the printer lid. Pull the paper bail forward. Push the paper down into the slot between the printer mechanism and the case. Continue pushing the paper until it comes out in the front of the printer mechanism. Adjust the top of the first page to a position just above the bail arm, engage the sprocket pins in the paper holes, then lower the bail arm.

    For best results, use the recommended ThinkJet paper (refer to table 1-1).

12. Install the printhead in the printer carriage as follows: Press down on the latch lever to open the printhead carrier. Position the printhead in the carrier, then raise the latch lever to lock it in position.

CAUTION

Be sure to remove the printhead cartridge before shipping the unit. It is possible for the ink to leak out of the cartridge while in transit, especially in an unpressurized aircraft cargo compartment. A leak may result in damage to the computer.

Chapter 4
Preventive Maintenance

The Integral PC does not require any preventive maintenance. However, the following practices should be observed to avoid damage to the unit and to obtain best results:

- Remove the printhead (ink cartridge) whenever shipping or storing the unit. This prevents possible damage caused by ink leaking out of the cartridge. This is particularly important when the unit is to be shipped in an unpressurized aircraft cargo compartment.
- Always insert the shipping disc (HP part number 1535-4881) in the disc drive before shipping the computer. This prevents possible damage to the disc drive.
- Avoid leaving the unit on continuously for an extended period while not in use. This prevents unnecessary wear on the electroluminescent display.
- Use care when cleaning the exterior of the unit, especially the display screen, to prevent scratching. The display screen is made of clear plastic, and it is easily scratched or damaged. Use a clean, damp, soft cloth to clean the display screen and plastic case. You can dampen the cloth with a warm, mild soap solution if necessary. *Do not use petroleum distillates, acetone, methyl ethyl ketone, or other strong cleaners.*
- If an I/O port is not being used for an extended period, replace the I/O port cover to protect the unit.

Chapter 5
Functional Description

5.1 Introduction

This chapter describes the major components of the Integral Personal Computer. The block diagram of figure 5-1 shows how the components of the computer are connected together and identifies the major printed circuit assemblies (PCAs).

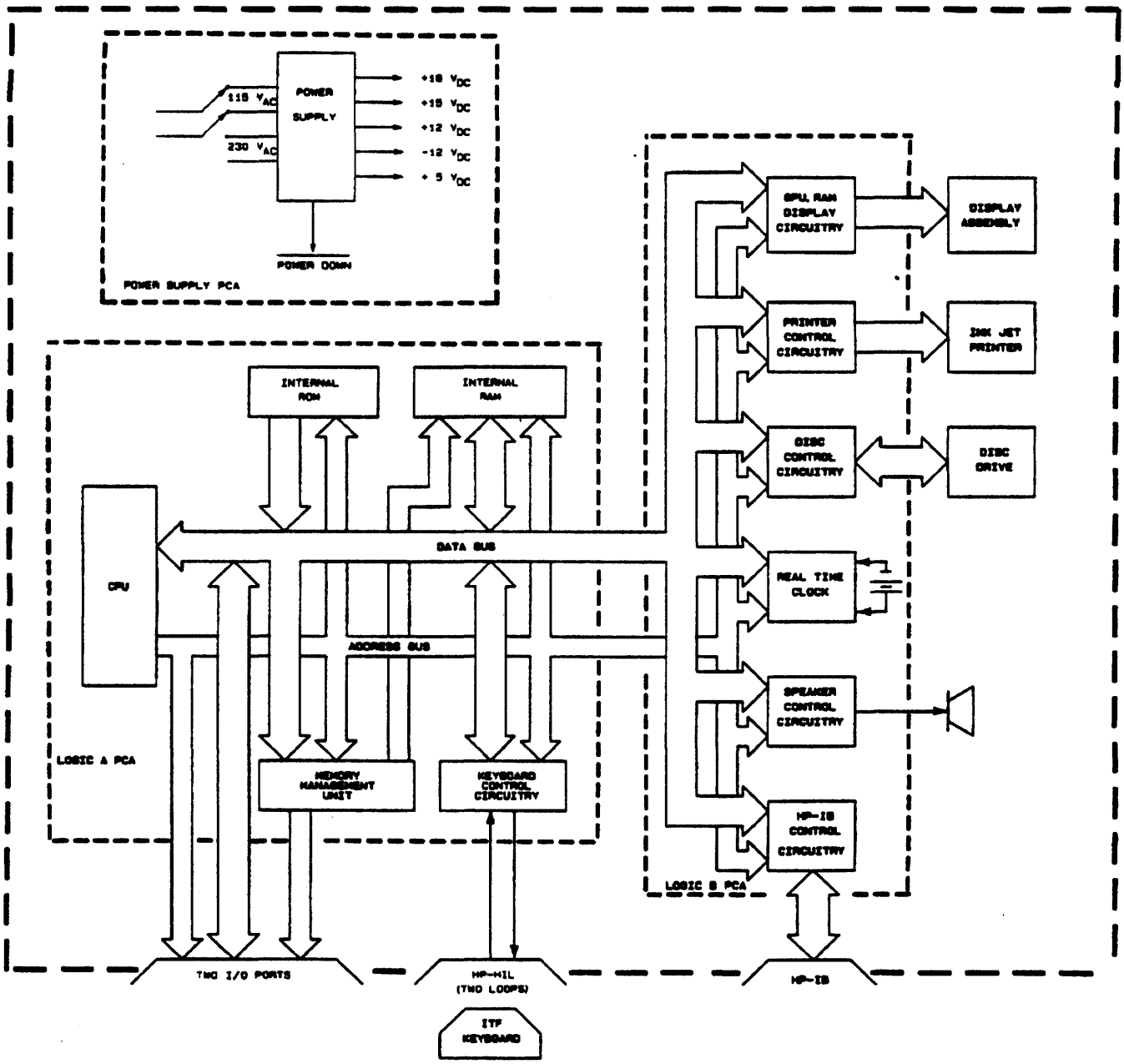


Figure 5-1. Integral PC Block Diagram

The *logic A PCA* contains the computing electronics of the Integral PC, including the CPU (central processing unit), RAM (random-access memory), and MMU (memory-management unit). The keyboard controller and external I/O (input/output) logic circuitry are also located on the logic A PCA. The internal ROM (read-only memory) is contained in the *plug-in ROM assembly*, which plugs directly into the ROM receptacle on the logic A PCA.

The plug-in ROM assembly has room for two ROM PCAs: The *operating system ROM PCA* has four ROM ICs containing the HP-UX System V operating system. The *option ROM PCA*, if present, contains optional ROM-based software.

> **Note:** If the computer is equipped with the earlier System III operating system, the plug-in ROM assembly has two PCAs containing the operating system. No optional ROM can be added to this assembly. The assembly cannot be serviced to the component level. It can only be exchanged.

The *logic B PCA* contains the control circuitry for the display, printer, disc drive, and speaker. The speaker itself, the RTC (real-time clock), and the HP-IB (IEEE-488) interface are also located on the logic B PCA.

The *I/O backplane PCA* provides two I/O connectors (one each for I/O ports A and B) and contains no logic circuitry.

The *display assembly* consists of an electroluminescent display panel, a display PCA, and the necessary mounting hardware. The display assembly is a *tuned circuit*. It cannot be serviced in the field. If the display assembly is bad, replace it.

The *power supply* provides voltages to the circuits of the computer as shown in table 5-1.

Table 5-1. Voltage Requirements

Assembly	+5V	+12V	−12V	+15V	+18V
Logic A PCA	X	X	X		
Logic B PCA	X	X			
Disc Drive	X	X			
Display	X				X
Printer Mechanism				X	
Keyboard		X			
External I/O Bus	X	X	X		
Fan				X	

The rest of this chapter describes the individual components of the Integral PC.

5.2 CPU

The CPU, IC U7 on the logic A PCA, is a 68000 HMOS (high-density metal-oxide semiconductor) microprocessor. The external clock frequency is 8 MHz.

It performs the following functions:

- Controls circuit operations via the control bus according to programs stored in RAM and ROM.
- Directs the transfer of data on the physical address and data buses.
- Responds to interrupts from both internal and external I/O.

The processor provides a 16M-byte addressing range that is divided among the internal and external ROM, the internal and external RAM, and the internal and external I/O as shown in table 5-2.

> **Note:** "Internal" refers to those components that are built into the system, including the ROM assembly that plugs into the logic A PCA. "External" refers to those components that may be plugged into the external I/O ports.

Table 5-2. Physical Address Map

Address Range (Hexadecimal)	Use
000000–07FFFF	Internal ROM (operating system PCA): 512K-bytes
080000–0FFFFF	Internal ROM (option ROM PCA): 512K-bytes
100000–4FFFFF	External ROM modules: 4M-bytes
500000–5FFFFF	Reserved: 1M-byte
600000–6FFFFF	Internal I/O: 1M-byte
700000–7FFFFF	External I/O: 1M-byte
800000–EFFFFF	External RAM modules: 7M-bytes
F00000–F7FFFF	Internal RAM: 512K-bytes
F80000–FFFFFF	Reserved: 512K-bytes

5.3 Interrupts

The CPU provides seven priority levels for hardware interrupts. The levels are encoded by U60 on the logic A PCA. The levels have been allocated as shown in table 5-3.

Table 5-3. Interrupt Allocations

Interrupt Level		Interrupt Source
(High priority)	7	Soft reset from keyboard (non-maskable)
	6	Real-time clock or NBIR3 (external I/O)
	5	Disc Drive or NBIR2 (external I/O)
	4	GPU* or NBIR1 (external I/O)
	3	HP-IB, printer, or NBIR0 (external I/O)
	2	HP-HIL devices (e.g. keyboard, mouse)
(Low priority)	1	Real-time clock

* The graphics processing unit in the display interface.

The external I/O interrupt lines, NBIR0 through NBIR3, can be asserted by an interface plugged into an external I/O port.

5.4 RAM

The computer contains 512K-bytes of internal RAM arranged in a 256K by 16-bit configuration (ICs U20 through U35 on the logic A PCA). In addition, a 7M-byte block of RAM address space is available for external RAM modules. The RAM portion of the physical address space is shown in table 5-2.

5.5 ROM

The CPU allocates address space for up to 1M-byte of internal ROM (located in the plug-in ROM assembly). In addition, a 4M-byte block of address space is reserved for external ROM modules. (External ROM modules would plug into the external I/O ports. None are currently available.) The ROM portion of the physical address space is shown in table 5-2.

5.5.1 The Plug-In ROM Assembly

All internal ROM is contained in the plug-in ROM assembly, which plugs into the ROM receptacle on the logic A PCA. The HP-UX System V plug-in ROM assembly has room for two PCAs: the operating system ROM PCA and the option ROM PCA. A 512K-byte block of ROM address space is reserved for the operating system ROM PCA, and a 512K-byte block is reserved for the option ROM PCA. Both PCAs can be serviced.

> **Note:** The HP-UX System III plug-in ROM assembly has two PCAs containing the operating system. It cannot be serviced to the component level.

5.5.2 The ROM Bus

The CPU communicates with the internal ROM by means of the ROM bus. The bus is divided into three parts: the physical address bus, the data bus, and the control signals. The ROM bus connects the CPU to the plug-in ROM assembly by means of the ROM receptacle. Refer to table 10-2 for the ROM receptacle pin assignments.

The ROM Physical Address Bus (A1 Through A17). The 17-bit unidirectional physical address bus is driven by the CPU. The 17 physical address bits correspond directly to logical address bits A1 through A17 in the CPU. A0 is a bit that distinguishes the upper byte from the lower byte in a 16-bit word. It is internal to the CPU and does not appear on the address bus.

The ROM Data Bus (D0 Through D15). The 16-bit bidirectional three-state data bus provides the general-purpose data path for the system. It can accept data in either word (16-bit) or byte (8-bit) length. The upper byte of the data bus includes D8 through D15; the lower byte includes D0 through D7. The upper and lower bytes of a word are always enabled during an internal ROM access.

The ROM Control Signals. The ROM control signals include four ROM-select signals and $\overline{\text{RDTACK}}$.

The ROM-select signals are decoded by IC U19 on the logic A PCA. Each of these signals ($\overline{\text{ROM0}}$, $\overline{\text{ROM1}}$, $\overline{\text{ROM2}}$, and $\overline{\text{ROM3}}$) selects a 256K-byte block of ROM address space in the plug-in ROM assembly. Table 5-4 shows the address range enabled by each ROM-select signal.

Table 5-4. ROM-Select Address Ranges

ROM-Select Signal	Address Range
$\overline{\text{ROM0}}$	000000-03FFFF
$\overline{\text{ROM1}}$	040000-07FFFF
$\overline{\text{ROM2}}$	080000-0BFFFF
$\overline{\text{ROM3}}$	0C0000-0FFFFF

$\overline{\text{RDTACK}}$ is the ROM data transfer acknowledge signal. This signal (by going low) indicates that the data transfer portion of a bus cycle is completed. When the mainframe recognizes $\overline{\text{RDTACK}}$ during a read cycle, data is latched and the bus cycle is terminated.

5.6 MMU

The MMU (Memory-Management Unit) consists of a 4 by 12-bit register file (ICs U55 through U57) and a 12-bit full adder (ICs U47 through U49), all mounted on the logic A PCA. Its function is to perform address mapping.

5.6.1 Address Mapping

Mapping is performed during RAM operations only; that is, when the most significant bit of the physical address (PA23) is high.

During a RAM access, the contents of one of the registers in the register file is added to logical address bits A11 through A22 of the CPU, forming the physical address. Since logical address bits A1 through A10 are unmapped, the minimum segment size is 2K-bytes (1K-words). The adder is enabled only during a RAM access; therefore, mapping can be performed only within the RAM address space.

The register used for the mapping function is selected by the FC1 and FC2 (function code) bits from the CPU.

The MMU is a write-only device that powers up into an unknown state. It must be initialized before any RAM accesses are attempted.

5.6.2 Physical Address Bit 23

Physical address bit 23 (PA23) distinguishes mapped RAM accesses from unmapped ROM or I/O accesses. It is high during a RAM access and low during a ROM or I/O access.

PA23 is derived (by IC U43 on the logic A PCA) from the CPU logical address bit A23 and function code bit FC2.

5.7 Internal I/O

Internal I/O devices are those devices that are built into the computer system. The keyboard control circuitry and MMU are located on the logic A PCA. The real-time clock, HP-IB interface, and speaker are located on the logic B PCA, along with the control circuitry for the disc drive, display, and printer.

5.7.1 Internal I/O Addressing

The internal I/O physical address map is shown in table 5-5. Each device is allocated a 64K-byte block of address space.

Table 5-5. Internal I/O Physical Address Map

Address Range (Hexadecimal)	Port Number	Use
600000–60FFFF	0	MMU
610000–61FFFF	1	Disc Drive
620000–62FFFF	2	Display
630000–63FFFF	3	HP-IB
640000–64FFFF	4	Real-Time Clock
650000–65FFFF	5	Printer
660000–66FFFF	6	Keyboard
670000–67FFFF	7	Speaker
680000–68FFFF	8	Reserved
690000–69FFFF	9	Reserved
6A0000–6AFFFF	10	Reserved
6B0000–6BFFFF	11	Reserved
6C0000–6CFFFF	12	Reserved
6D0000–6DFFFF	13	Reserved
6E0000–6EFFFF	14	Reserved
6F0000–6FFFFF	15	Reserved

5.7.2 The Logic A to Logic B Bus

The logic A to logic B bus provides the communication path between the two logic boards. The bus can be divided into three parts: the physical address bus, the data bus, and the control signals. Table 10-3 gives the connector pin assignments for the logic A to logic B bus.

The Logic A-B Physical Address Bus (IBA1 Through IBA5). This is a unidirectional five-bit bus driven by IC U6 on the logic A PCA. The five physical address bits correspond directly to the A1 through A5 logical address bits in the CPU. IBA5 is the most significant bit of the address.

The Logic A-B Data Bus (IBD0 Through IBD7). This is a bidirectional eight-bit bus driven by IC U5 on the logic A PCA. IBD7 is the most significant bit of the bus.

The Logic A-B Control Signals. These signals include: $\overline{RD}$, $\overline{WR}$, $\overline{SPKWR}$, $\overline{HPIB}$, $\overline{RTC}$, $\overline{RESET}$, $\overline{PRNT}$, $\overline{DISP}$, $\overline{DISC}$, PWRDN, $\overline{IR1}$, and $\overline{IR3}$ through $\overline{IR6}$. All of these signals, except PWRDN, are active low.

The read ($\overline{RD}$) and write ($\overline{WR}$) signals define the data bus transfer as a read cycle or a write cycle. If $\overline{RD}$ is low, the transfer is a read cycle. If $\overline{WR}$ is low, the transfer is a write cycle. Only one of these two signals can be low at a time.

The device-select signals ($\overline{SPKWR}$, $\overline{HPIB}$, $\overline{RTC}$, $\overline{PRNT}$, $\overline{DISP}$, and $\overline{DISC}$) correspond to the six internal I/O devices on the logic B PCA. They are generated by ICs U3, U13, and U10 on the logic A PCA, and are described in table 5-6.

Table 5-6. Internal I/O Device-Select Signals

Signal Name	Description
$\overline{SPKWR}$	Speaker (qualified by $\overline{WR}$)
$\overline{HPIB}$	HP-IB
$\overline{RTC}$	Real-time clock
$\overline{PRNT}$	Printer
$\overline{DISP}$	Display
$\overline{DISC}$	Disc Drive

Each device-select signal corresponds to a 64K-byte block of address space as shown in table 5-5.

The $\overline{\text{RESET}}$ signal is driven low for at least 100 ms after the power is turned on. $\overline{\text{RESET}}$ also goes low a minimum of 100 ms starting at least 1 ms before system power is lost. The $\overline{\text{RESET}}$ signal is driven low for 15.5 μs in response to a RESET instruction.

The PWRDN (power down) signal originates as $\overline{\text{PWRDN}}$ on the power supply PCA ($\overline{\text{PWRDN}}$ is buffered and inverted). The PWRDN signal holds the $\overline{\text{RESET}}$ output low for at least 100 ms when the power is turned on. The PWRDN signal provides an early warning to the computer of loss of power.

The interrupt request signals ($\overline{\text{IR1}}$ and $\overline{\text{IR3}}$ through $\overline{\text{IR6}}$) are used by the internal I/O devices to request interrupts at five different levels. Refer to section 5.3 for the interrupt assignments.

5.8 External I/O

An external I/O device is an interface or memory module plugged into one of the two ports in the I/O backplane of the computer or into a bus expander port. These devices are linked to the CPU by the external I/O bus.

5.8.1 External I/O Addressing

The external I/O physical address map is shown in table 5-7. Each device is allocated a 64K-byte block of address space.

Table 5-7. External I/O Physical Address Map

Address Range (Hexadecimal)	Port Number	Use
700000–70FFFF	16	Mainframe Port A
710000–71FFFF	17	Mainframe Port B
720000–72FFFF	18	Bus Expander Port A1
730000–73FFFF	19	Bus Expander Port A2
740000–74FFFF	20	Bus Expander Port A3
750000–75FFFF	21	Bus Expander Port A4
760000–76FFFF	22	Bus Expander Port A5
770000–77FFFF	23	Reserved
780000–78FFFF	24	Reserved
790000–79FFFF	25	Reserved
7A0000–7AFFFF	26	Bus Expander Port B1
7B0000–7BFFFF	27	Bus Expander Port B2
7C0000–7CFFFF	28	Bus Expander Port B3
7D0000–7DFFFF	29	Bus Expander Port B4
7E0000–7EFFFF	30	Bus Expander Port B5
7F0000–7FFFFF	31	Reserved

Note: Memory modules are initially addressed using the appropriate port address. However, once configured, they are addressed outside the "port selected" address space. Table 5-2 shows the address space reserved for external memory modules.

Figure 5-2 shows the locations of the I/O ports for the Integral PC and two HP 82904A Bus Expanders.

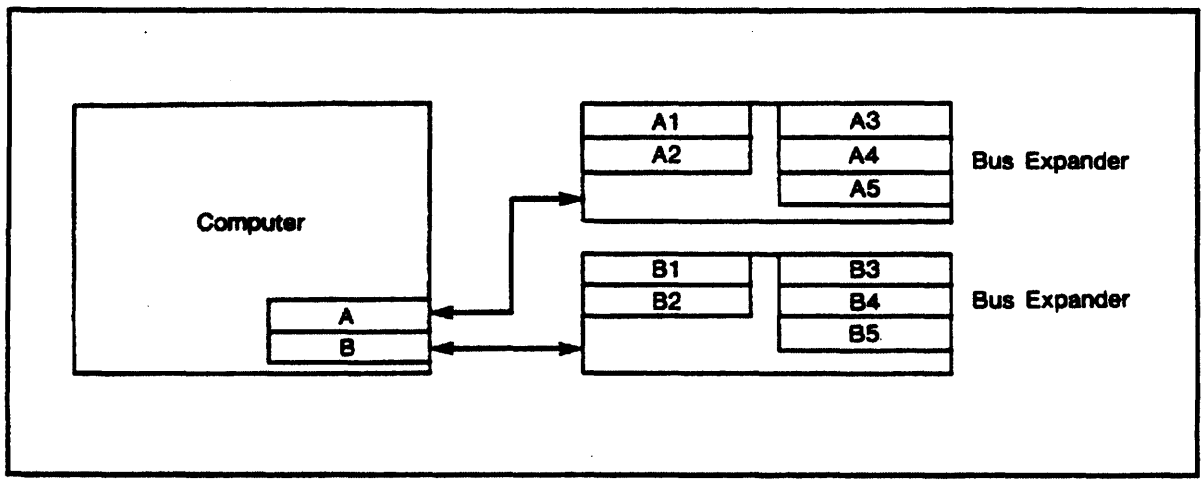


Figure 5-2. I/O Port Locations

5.8.2 The External I/O Bus

The external I/O bus provides the link between the CPU and the external I/O devices plugged into the I/O backplane. The bus can be divided into three parts: the physical address bus, the data bus, and the control signals.

The External I/O Physical Address Bus (BA1 Through BA23). This bus is 23 bits wide and is latched by ICs U44, U45, and U46 on the logic A PCA. BA23 is the most significant bit. The least significant bit (A0), which distinguishes the upper byte from the lower byte in a 16-bit word, is not present on the bus. In its place two signals, NBUD and NBLD, are provided. They specify whether the upper byte, lower byte, or both bytes of the addressed word are involved in a cycle.

The External I/O Data Bus (BD0 Through BD15). This is a 16-bit bidirectional bus driven by ICs U53 and U54 on the logic A PCA. The upper (even) byte of the bus consists of BD8 through BD15. The lower (odd) byte of the bus consists of BD0 through BD7.

The External I/O Control signals. These signals include: BR/NW, NBUD, NBLD, NPS0, NPS1, NBAS, NBIMA, NBDTACK, NBRESET, NBIR0 through NBIR3, NBDMARQ, GRIN, and GROUT. Except for GRIN and GROUT, all of these signals are active low.

BR/NW is the read/not write signal. This signal, when high, indicates a read cycle; when low, it indicates a write cycle on the data bus.

NBUD and NBLD are the upper and lower data byte signals. If NBUD is low, an upper byte transfer on the data bus is indicated. If NBLD is low, a lower byte transfer is indicated. If both signals are low, a 16-bit word transfer is indicated.

NPS0 and NPS1 are the port select signals for ports A and B, respectively. The NPS0 or NPS1 signal indicates to a card that it is being accessed within its "port selected" address space. The signal, when low, indicates that BA1 through BA23, BR/NW, NBUD, and NBLD are valid for the selected port.

NBAS is the address strobe signal. This signal, when low, indicates that BA1 through BA23 and BR/NW are valid. The address strobe signal is used by memory modules since they must be accessed outside the "port selected" address space for the I/O port.

NBIMA is the "I'm addressed" signal. A memory module uses this signal to indicate (by a low signal) that it has been previously allocated the address specified by the current bus cycle.

NBDTACK is the data transfer acknowledge signal. This signal (by going low) indicates that the data transfer portion of a bus cycle is completed. When the mainframe recognizes NBDTACK during a read cycle, data is latched and the bus cycle is terminated. When NBDTACK is recognized during a write cycle, data is removed from the bus and the cycle is terminated.

NBRESET is the reset signal. This signal goes low for at least 100 ms when the power is turned on. It also goes low for at least 100 ms starting a minimum of 1 ms before the power goes off. The NBRESET signal goes low for 15.5 μs in response to the RESET instruction.

NBIR0, NBIR1, NBIR2, and NBIR3 are the interrupt request signals. Interfaces assert these lines low to request asynchronous interrupts at different interrupt levels. External interrupt request levels NBIR0 through NBIR3 correspond to internal interrupt request levels IR3 through IR6, respectively.

NBDMARQ is the direct memory access request signal. The Integral PC does not support direct memory access. The NBDMARQ pins on the port A and port B connectors are wired together to facilitate bus expander testing.

GRIN and GROUT are not used by the Integral PC. In the I/O port connectors the GRIN pins are tied low, and the GROUT pins are left open.

5.8.3 The I/O Backplane

The I/O backplane assembly provides the link between external I/O devices and the external I/O bus. It consists of the I/O backplane PCA and a guide assembly to hold interfaces and memory modules. The I/O backplane PCA has two connectors, one for port A and one for port B.

The I/O backplane assembly can support a total power requirement of 9 watts for both ports. An individual port can support a 6-watt power requirement. Thus, up to one 6-watt interface and one 3-watt interface (or memory module) may be installed.

> **Note:** You can expand the I/O capability of the Integral PC to 10 ports by using two bus expanders as shown in figure 5-2. Each bus expander has its own power supply.

Each I/O port supports the Level 0 Subset of the P-bus (the Personal Computer Group compatible bus) with the exception that the I/O backplane connectors provide the outer two rows of pins only (row A and row C). Refer to table 10-4 for the connector pin assignments.

5.9 Display

The Integral PC uses a 255 by 512-pixel electroluminescent panel display. The *display controller* is located on the logic B PCA. The electroluminescent panel and its associated driver circuitry are located in the *display assembly*. Figure 5-3 is the display block diagram.

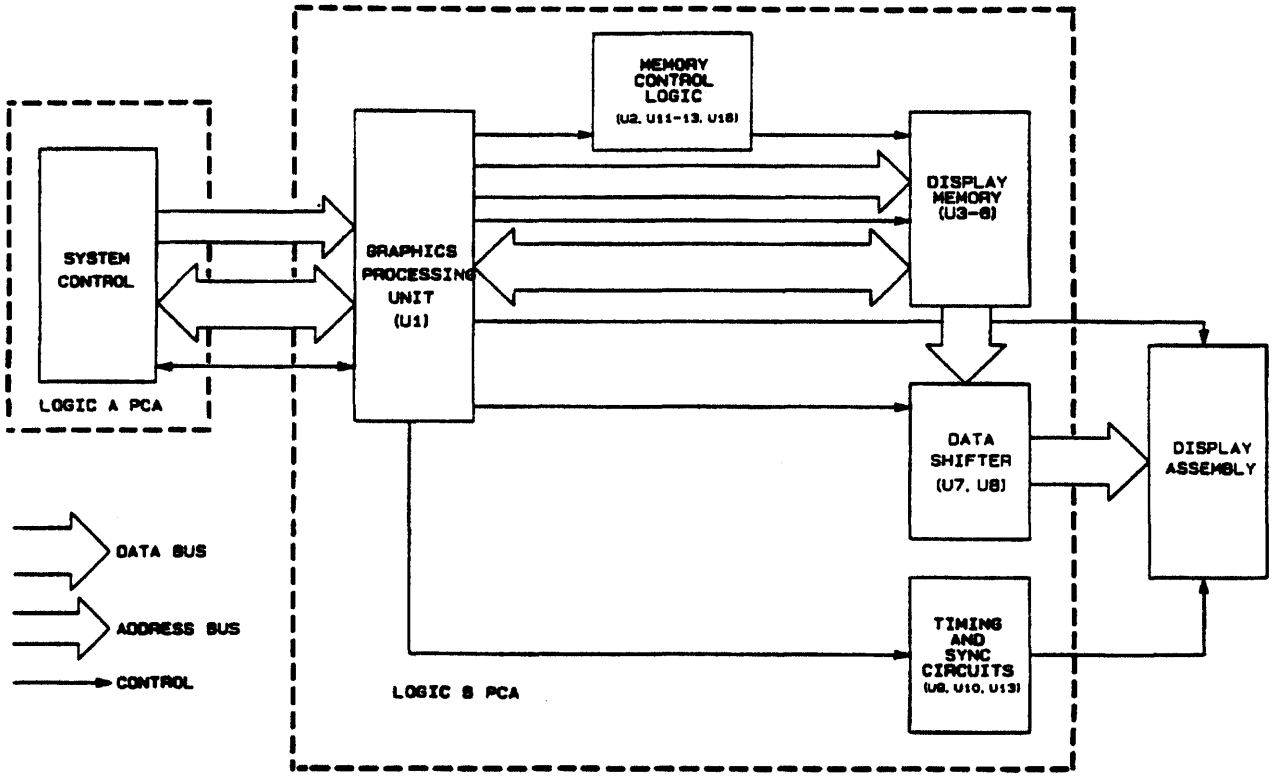


Figure 5-3. Display Block Diagram

5.9.1 The Display Controller

The display controller consists of the following components:

- The GPU (graphics processing unit) microprocessor. This microprocessor (IC U1 on the logic B PCA) is specially designed as a display controller.
- The display memory. This is a 32K-byte memory organized as a 16K by 16-bit bank of dynamic RAM (ICs U3 through U6 on the logic B PCA).
- The control logic for the display memory (ICs U2, U11, U12, U13, and U16 on the logic B PCA).
- The data shifter (ICs U7 and U8 on the logic B PCA), which consists of two 8-bit shift registers that convert the outgoing data to serial form.
- The timing circuit (ICs U9, U10, and U13 on the logic B PCA), which synchronizes the output of data to the display assembly.

The display controller outputs data to the display assembly. It performs a complete *display refresh cycle* 60 times a second in order to keep the image visible on the display screen. The display refresh process is accomplished using *line-at-a-time scanning.* In this process, which differs from the dot-at-a-time raster scan process used in CRT monitors, an entire 512-pixel display line is activated at one time.

The GPU controls the storing of data in display memory, and the reading of data for output to the display assembly. The GPU also controls the timing and sync (synchronization) circuits, which output the sync signals to control the display assembly.

The display memory stores data in a bit-mapped format. For each point on the display screen there is a corresponding bit in the display memory. If the bit in the display memory is a "1", the corresponding point on the screen will be lit; if the bit is a "0", the point will be dark.

The GPU performs display memory cycles continuously, but only every other cycle is a display refresh cycle. The GPU uses the alternate memory cycles to modify and manage the contents of the display memory.

The GPU performs the refresh process by reading sequential locations in display memory and sending the information stored in those locations to the display assembly. However, the GPU transfers the data to the data shifter one 16-bit word at a time. The data shifter consists of two 8-bit shift registers, one for the odd bits and one for the even bits of each word. When these shift registers are fully loaded, they send the data in serial form two bits at a time (odd and even bits) to the display assembly.

At the display assembly the incoming bits are entered into two 256-bit shift registers. When the shift registers are full, the 512 data bits are latched, and the display drivers are activated for the entire line. Thus, the desired pixels in the selected line are turned on. This process is repeated until each of the 255 lines have been written. The refresh process then begins again at the top of the screen.

> **Note:** The System III operating system provides a display timeout feature. If a unit is equipped with System III, its display normally times out after 15 minutes of unattended operation. (The display comes back on when you press any key.) You can disable the timeout feature with the `disp_time_off` command on the Utilities disc. *The System V operating system does not implement the display timeout feature.*

5.9.2 The Display Assembly

The display assembly consists of a 512-pixel by 255-line electroluminescent panel and the associated driver circuitry and mounting hardware. The display assembly is a *tuned assembly.* It cannot be serviced in the field. If this assembly is faulty, replace it.

5.10 Keyboard

The detachable keyboard is a compressed ITF (Integrated Terminal Family) keyboard. It contains 90 keys, including cursor keys, edit keys, a numeric pad, and eight function keys. Autorepeat and n-key rollover functions are provided.

Localized keyboards are available for several languages. Refer to table 10-1 for a list of these keyboards and their identification codes.

An HP-HIL (Hewlett-Packard Human Interface Link) keyboard interface, IC U58 on the logic A PCA, controls the keyboard. The keyboard plugs into either one of the two HP-HIL jacks on the front panel (lower left) of the computer.

The number of HP-HIL devices (for example, a keyboard and mouse) that can connected to the computer depends upon the power drawn by the individual devices. (The Integral PC keyboard draws 100 mA.) *The total power drawn by all HP-HIL devices connected to the two jacks must not exceed 600 mA.* The HP-HIL controller can configure up to seven devices if they do not exceed the power rating.

5.11 Disc Drive and Controller

The Integral PC includes a double-sided 3½-inch microfloppy disc drive. The disc control circuitry includes a Western Digital 2797 floppy disc controller IC (U18 on the logic B PCA) and associated logic circuitry. Figure 5-4 is a block diagram of the disc drive and controller.

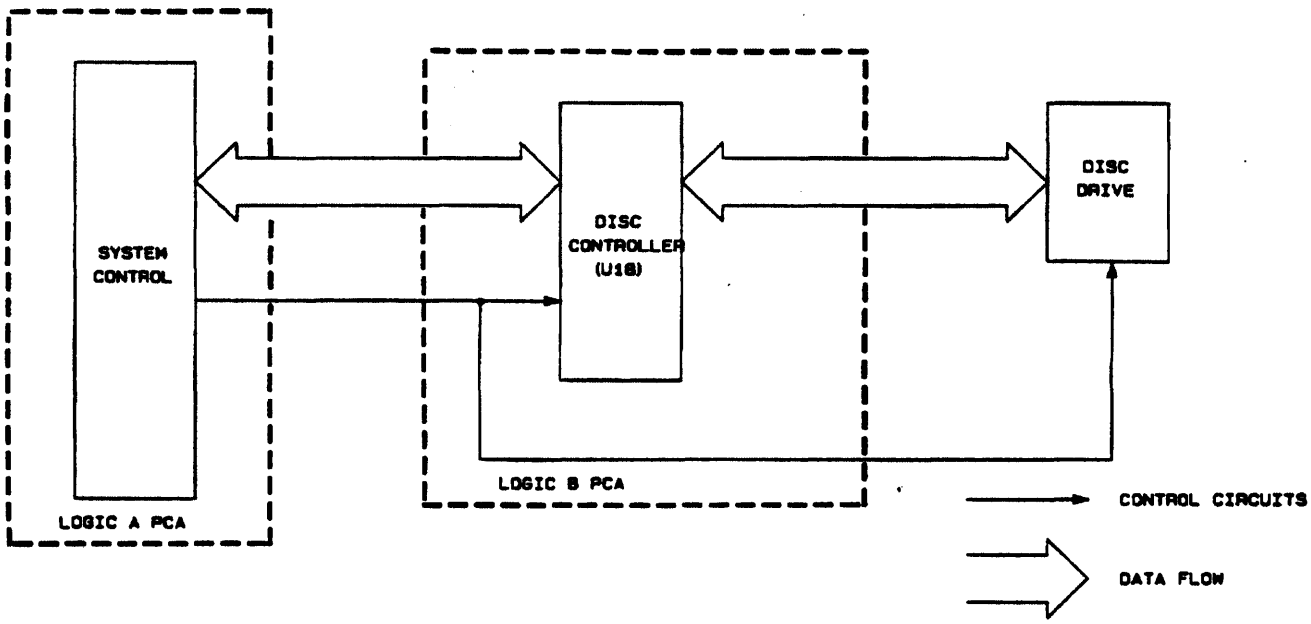


Figure 5-4. Disc Drive Block Diagram

The disc drive routine resides in operating system ROM. It contains a software loop to control data transfer.

The disc drive uses double-density recording in accordance with the Hewlett-Packard MFM (modified frequency modulation) format.

Each disc drive assembly consists of a drive mechanism, a read/write head, a head-positioning mechanism, the control interlocks, and a PCA containing the electronic components. The read and write circuits, the head-position control circuit, and the read, write, and erase enable circuits are all located on the disc drive PCA.

The disc drive motor operates only during a disc access.

5.12 Printer

The Integral PC includes an 80-column dot matrix inkjet printer that uses a disposable printhead. (The printer is a modified ThinkJet HP-IL printer.) Figure 5-5 is the printer block diagram.

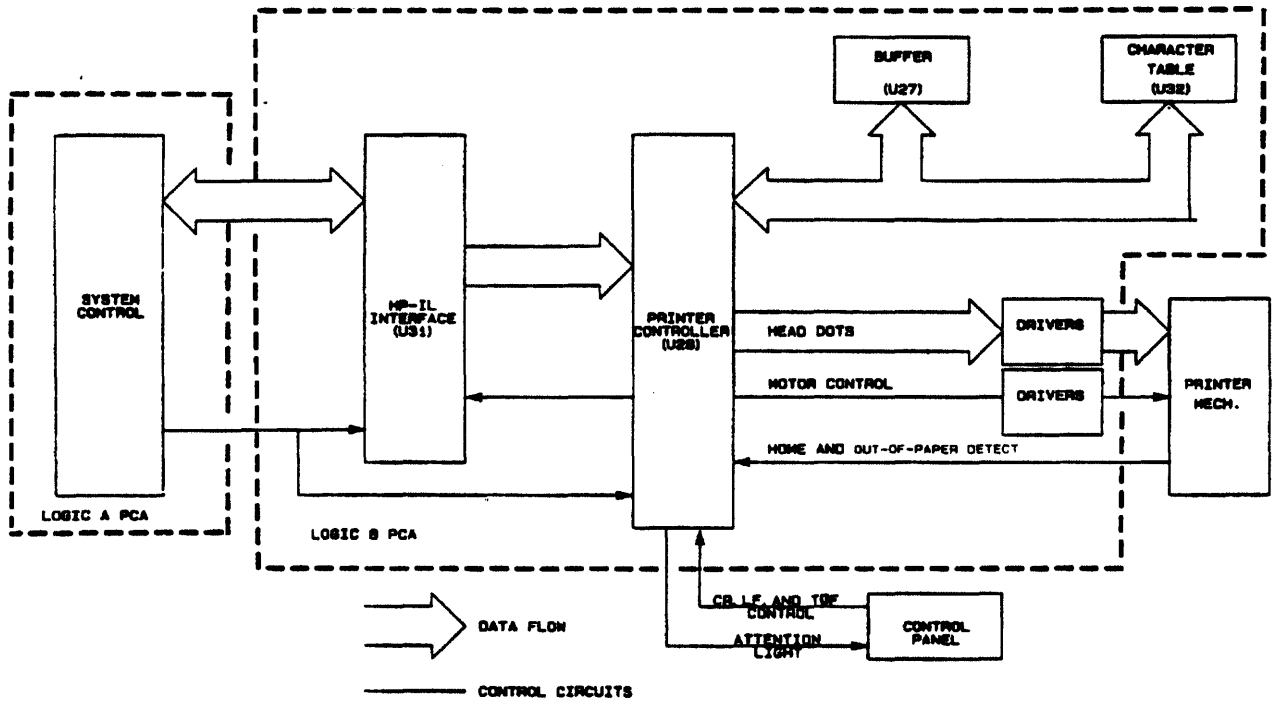


Figure 5-5. Printer Block Diagram

The printer uses an HP-IL interface (U31 on the logic B PCA) to communicate with the computer. It has a custom-designed controller IC (U28 on the logic B PCA), a 1K-byte RAM IC (U27 on the logic B PCA), and a 16K-byte ROM IC (U32 on the logic B PCA).* The 1K-byte RAM IC buffers at least one line of 12 by 640 dot graphics. The 16K-byte ROM IC contains the character font table.

The control panel includes a form-feed key, a line-feed key, and a continue-operation key that is used to set the top-of-form position and to recover from errors. The panel includes an attention light (the yellow LED) that comes on continuously to indicate an out-of-paper condition and blinks to indicate an error condition.

The printer provides printing and non-printing self tests to identify failures.

5.13 Real-Time Clock

The real-time clock (located on the logic B PCA) keeps time continuously, even while the computer is turned off. The clock also provides the timing for the operating system.

* The printer ROM IC is localized for some languages. Currently the standard version is used for all languages except Arabic, Hebrew, and Japanese.

The clock controller (IC U44 on the logic B PCA) is a National Semiconductor NS58167A IC that counts from 1/10,000 second to months. It contains two interrupt outputs. The $\overline{\text{STANDBY INT}}$ output interrupts at interrupt level 6 when the clock count matches a predetermined value (user programmable). The INT output interrupts at interrupt level 1 either when a predetermined value is matched or at a predetermined periodic interval (also user programmable).

The 32.768-kHz oscillator (Y1 on the logic B PCA) can be fine tuned by adjusting the variable capacitor (C43 on the logic B PCA) connected to pin 10 of the controller IC.

The oscillator is connected to an LM 358 operational amplifier (U40 on the logic B PCA). The operational amplifier is wired in voltage-follower configuration to buffer the clock signal. The buffered clock signal is available at test point TP1 for measurement with a frequency counter.

The standby lithium battery (BT1 on the logic B PCA) maintains clock operation while the computer is turned off. The battery has a six-year minimum expected life (12 years typical).

Each of the controller address and control lines is connected to ground through a 22-kΩ resistor (R38 on the logic B PCA). This prevents the inputs from floating into their linear operating regions when the computer is turned off, reducing the drain on the standby battery.

5.14 Speaker

The speaker (LS1 on the logic B PCA) allows the user to generate tones in the range 100 Hz to 5000 Hz.

The speaker controller (IC U39 on the logic B PCA) is a National Semiconductor COP 452 frequency generator/counter. The controller outputs a square wave, the frequency and number of pulses of which are programmable.

5.15 HP-IB Interface

The computer contains an HP-IB (Hewlett-Packard Interface Bus) interface that is compatible with the IEEE-488 standard. It is the primary means for interfacing the computer to peripherals such as plotters, external printers, and external disc drives. The HP-IB interface is also often used for data acquisition and controller applications.

The interface circuit includes two bus transceivers: an SN 75160A (IC U42) and an SN 75162A (IC U43). It also includes a 9914 talker/listener/controller IC (IC U41). An ALS00 quad-NAND IC (IC U26) provides for the decoding of the controller-enable signal. All of these components are located on the logic B PCA.

Jumper W1 defines whether the interface is to be system controller of the HP-IB or not. It is factory set in the system controller position since the interface is most often used in this mode.

All bus configuration is done by the operating system at initialization or by the application program. Therefore, no switches are required for this purpose.

5.16 Power Supply

The Integral PC power supply is an off-line switcher. It is located on a separate printed-circuit assembly. Figure 5-6 is a block diagram of this circuit.

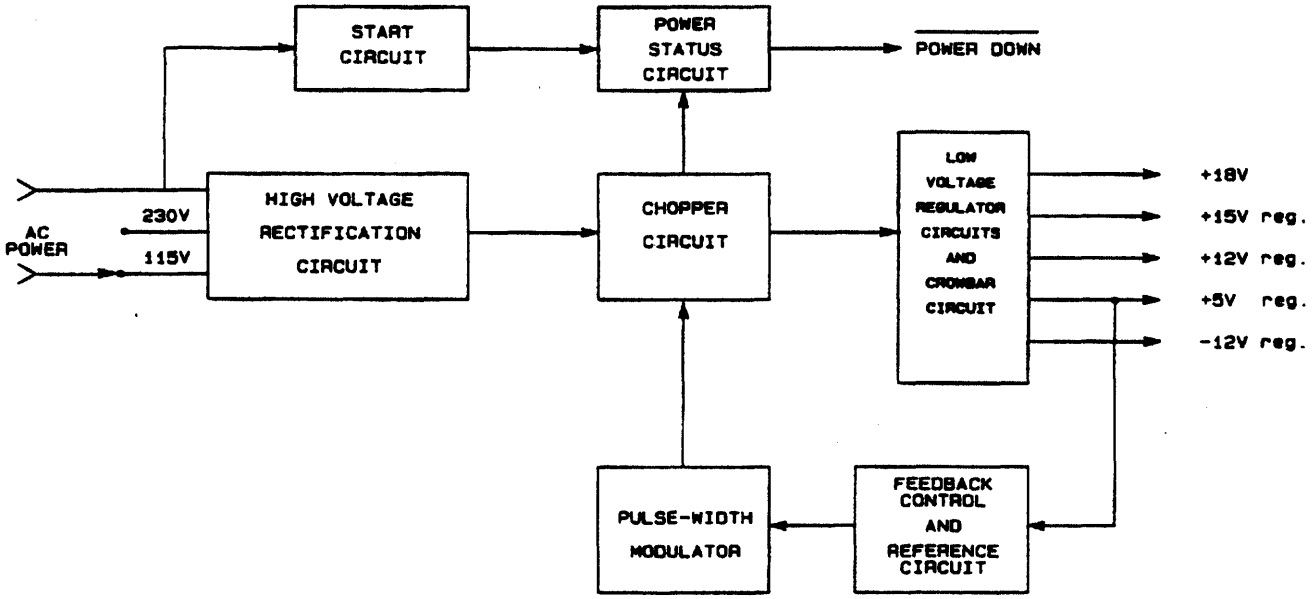


Figure 5-6. Power Supply Block Diagram

The power supply provides five direct-current outputs. The +5V, +12V, +15V, and −12V outputs are regulated, and the +18V output is not regulated. Table 5-1 shows which components of the computer use these voltages.

The following paragraphs describe the operation of the power supply. Refer to the schematic diagram in figure 12-11 to identify the components.

The 115 or 230 Vac line voltage is rectified by diode CR36 and applied to transformer T1. Transistor Q3 chops the voltage at a frequency of 45 kHz. The appropriate voltages appear across the secondary windings of T1 and are rectified and regulated as required.

The pulse-width modulator (IC U4) controls the frequency at which the input to T1 is chopped. During normal operation power for modulator U4 is provided by the dc voltage developed across capacitor C13. However, since no voltage exists across C13 when the power is turned on, U4 remains turned off, and the power supply remains inoperative. To initiate operation, the start-up circuit provides power to U4.

The start-up circuit functions as follows. When the power is turned on, voltage is applied across capacitor C3 through capacitor C2 and diodes CR1 and CR2. The voltage across C3 rapidly builds up to a predetermined positive value, then transistor Q1 conducts, assisted by transistor Q2, which also conducts. The voltage across capacitor C3 is then applied across C13 and briefly provides power for U4 while the power is coming up.

Comparator U10 monitors the +5V output and feeds a signal back to modulator U4 (through optoisolator U5) to control the frequency of the chopping circuit. If the +5V output should rise to 6.2V, transistor Q8 is turned on. This shorts out the +5V output, and also shorts out the feedback signal through diodes CR27, CR28, and CR29, thereby turning off U4 and shutting down the power supply.

Comparator U2A monitors the rectified line voltage. If the power starts to shut down and falls to a certain level, U2A turns on the $\overline{\text{POWER DOWN}}$ signal and warns the rest of the system before the power is lost completely. This allows the system to perform certain functions, such as preparing the real-time clock for power shut-down.

Comparator U2B overrides U2A and maintains the $\overline{\text{POWER DOWN}}$ signal for a period of time after the power has been turned off. Resistor R15 and capacitor C8 determine the length of this time period.

Chapter 6
Removal and Replacement

6.1 Introduction

This chapter describes the procedures for removing and replacing the assemblies and components of the Integral PC. To reassemble the computer, you will generally reverse the disassembly procedure. "Reassembly notes" are included in the procedures where additional reassembly information is needed.

The directions "left," "right," "front," "back," "top," and "bottom" in these instructions refer to the computer in the upright position as seen from the front (display side).

6.2 Safety Considerations

WARNING

Life threatening voltages are present in the power supply primary circuitry whenever the line cord is plugged in, *even while the power switch is turned off.* Use extreme care whenever servicing the computer with the power supply cover removed. Electrical and mechanical failures may cause dangerous voltages to be present at points that normally are safe.

Observe the following safety guidelines when working on the computer.

- Do all possible operations with the computer turned off.
- *Never work alone.* Be familiar with the location of power switches in your service area and what they control.
- In case of an accident, know where to obtain respiratory resuscitation and cardiopulmonary resuscitation (CPR).
- Keep your work area neat and free of nonessential conducting material and sharp objects. Remember that reaction to an electrical shock can cause you to strike nearby objects, possibly resulting in serious injury.
- Do not exceed the rated specifications of test instruments.
- Observe all cautions and warnings in this manual.

6.3 ESD Considerations

CAUTION

The Integral PC is susceptible to damage from electrostatic discharge (ESD), especially when the back case has been removed. Follow anti-static procedures when working on the computer. Serious damage to the computer may otherwise occur.

Observe the the following anti-static guidelines when working on the Integral PC:

- Use a static-safe workstation. At a repair bench, this may consist of a grounded anti-static work surface (an anti-static mat), a grounded wrist strap, a grounded soldering iron, and an ionized air blower directed over the workstation. At an on-site location, this may consist of a folding anti-static mat, a grounded cable, and a wrist strap. Keep all insulators (such as coffee cups, paperwork, or packing material) far away from static-sensitive devices. They are notorious static generators.
- Keep all assemblies and components in their conductive packages until needed. When the part is needed, unpack it only at a static-safe workstation and only while you are grounded. If you must set the part somewhere, place it only on the conductive mat.
- Handle PC boards by the edges. *Do not touch any component, trace, or connector.*
- Keep your clothing away from static-sensitive parts, even when using heel and wrist straps. The static charge on clothing often is not bled away.
- Do not use erasers to clean contacts (they generate lots of static and also tend to rub off the gold).
- Connect the chassis of the instrument you are working on to the grounded mat so that it will remain grounded even when you remove the power cord for service. The ground jumper should have a 1-MΩ resistor built into it to protect you in case of a ground fault in the instrument.

WARNING

An anti-static wrist strap should have a 1-MΩ series resistor built into the ground jumper to protect you against an electrical shock through the wrist strap. Use of an unapproved wrist strap could result in a potentially fatal electric shock.

6.4 Required Tools

Table 6-1 lists the tools that you will need to disassemble and reassemble the computer.

Table 6-1. Required Tools

Part Number	Description
8710-1426	Torx kit
8710-1284	T-10 angle driver
8710-1220	5.5-mm nut driver
8710-0797	9/32-in. nut driver
8730-0008	Screwdriver, flat-blade
8710-1107	Pliers, needlenose

6.5 Removing the Back Case

To gain access to the assemblies and wiring inside the computer, do the following:

1. Open the computer by pressing the buttons and then sliding the two latches on the lid inwards towards the handle; lift the lid up, and swing it back on its rockers. Be careful that the keyboard assembly doesn't fall out. Remove the keyboard assembly.

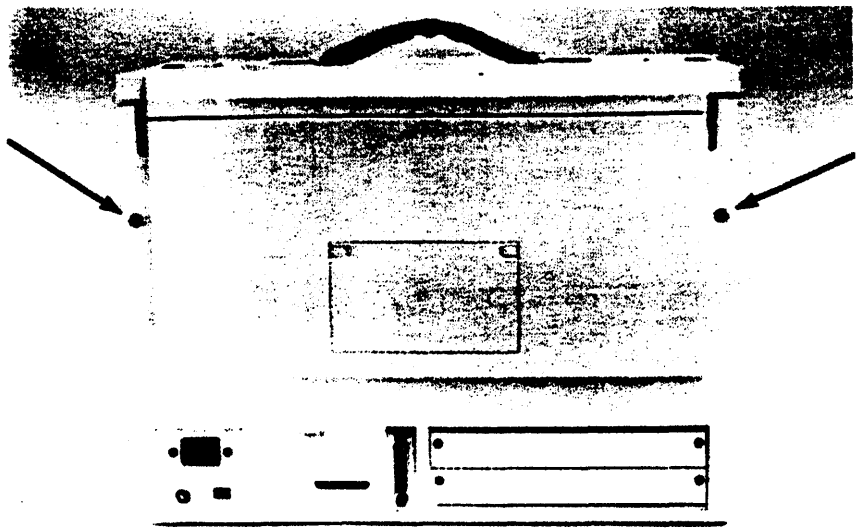


Figure 6-1. Back Case Screws

2. Swing the lid back up on top. Using a T-20 Torx driver, remove the screws on the sides of the back case. Tip the computer toward its front, disengage the back case from the top of the computer, then lower the back case to release its bottom lip. Remove the back case from the computer.

6.6 Removing the Lid

To remove the lid assembly:

1. Open the computer by pressing the buttons and then sliding the two latches on the lid inwards towards the handle; lift the lid up, and swing it back on its rockers. Be careful that the keyboard assembly doesn't fall out. Remove the keyboard assembly.
2. Swing the lid back up on top. Tilt the lid up so that you have access to the rocker pins on which the lid bail pivots.

3. Using needlenose pliers or a small screwdriver, remove the E-rings from the two small rocker pins (see figure 6-2). *Be careful not to drop the E-rings inside the case.*
4. Disengage the bail arm from the pins and lift off the lid. Remove the spring washers from the rocker pins to prevent loss.

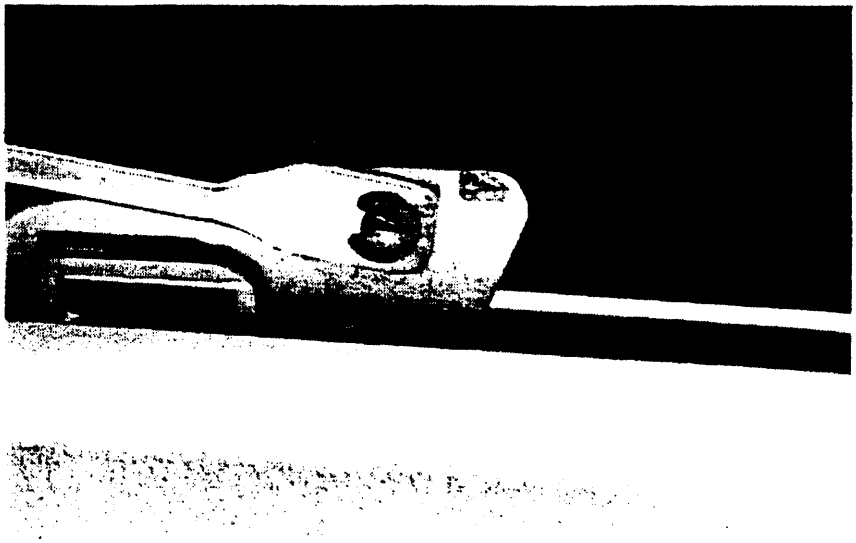


Figure 6-2. Computer-Lid Rocker

If you need to disassemble the lid, see figure 9-6.

6.7 Removing the Logic A PCA

To remove the logic A PCA, follow these steps:

1. Remove the plug-in ROM assembly if one is installed (refer to section 6.16.1).
2. Remove the back case (refer to section 6.5). Unsnap the white button on the clear ESD shield in the upper right-hand corner (see figure 6-3).

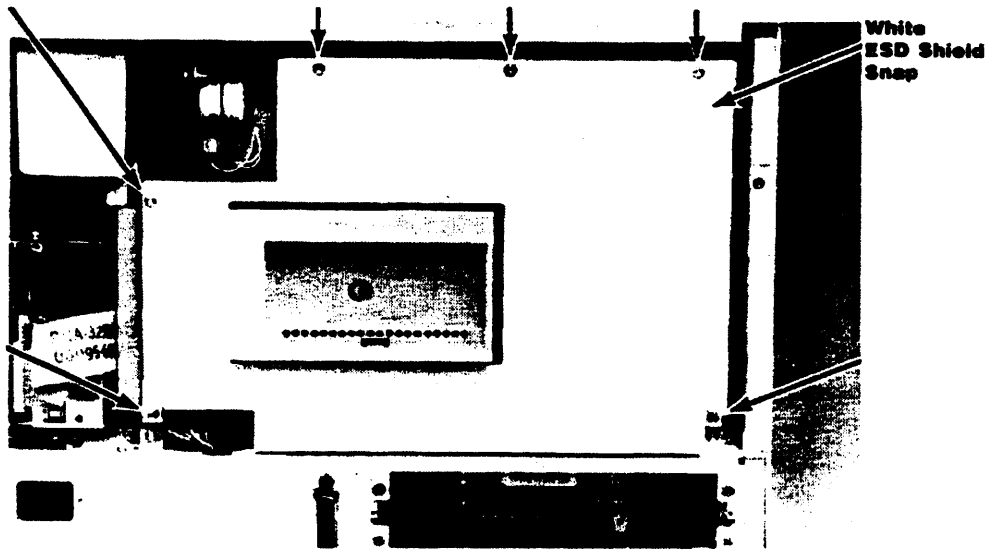


Figure 6-3. Logic A Shield Screws

3. Remove the six shield screws and the logic A shield (see figure 6-3).
4. Remove the five PCA mounting screws (see figure 6-4).

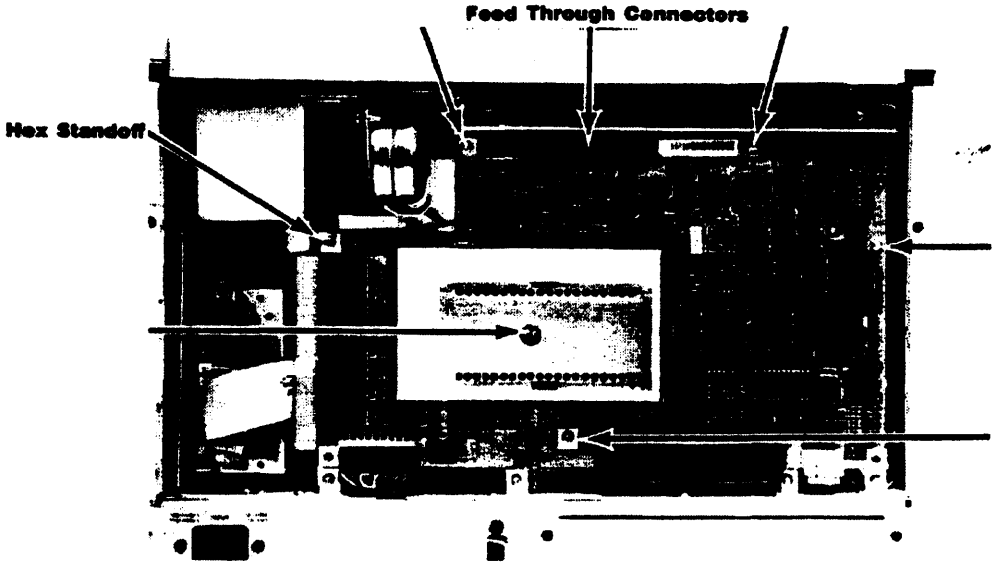


Figure 6-4. Logic A PCA Mounting Screws and Feed-Through Connector

5. Use a 5.5-mm nutdriver to remove the hex standoff (figure 6-4). The PCA is now held in place by the pins in the feed-through connectors.
6. Grasping the PCA at each side near the top, gently pull it out. Be careful not to bend the pins on the feed-through connectors.
7. Disconnect all cables from the bottom of the PCA. (Note that the large I/O cable connector has a locking lever on each side.)
8. Remove the plastic insulator sheet.

Note: If necessary, you can remove the ROM guide by disengaging, one at a time, the two tabs that are inserted in the slots in the PCA. Do not install the ROM assembly with the ROM guide removed. If you do, you will not be able the remove the ROM assembly.

Reassembly Notes: To replace the logic A PCA, follow these steps:

1. Insert both feed-through connectors in the logic B PCA (if they are not already there).

CAUTION

Make sure that you do not interchange the power-cable connectors to the logic A and logic B PCAs. The logic B power-cable connector is the one from which the disc-drive extension cable extends (see figure 6-32). If you interchange the logic A and logic B power-cable connectors, serious damage to the power supply or the logic PCAs will result.

2. Connect the three cables to the bottom of the logic A PCA.

3. While holding the logic A PCA with one hand, place the insulator sheet on the PCA mounting panel behind the PCA. *Make sure the holes line up properly.*
4. Carefully align the logic A PCA over the feed-through connectors and press the PCA into place. *Press as close to the connector as possible.*
5. Replace the top two PCA mounting screws first to hold the insulator sheet and PCA in place, then replace the other screws and the hex standoff.
6. Reinstall the logic A shield, snap the white ESD shield button in place, then reassemble the unit.

6.8 Removing the Logic B PCA

To remove the logic B PCA, follow these steps:

1. Remove the back case (refer to section 6.5). Unsnap the white button on the clear ESD shield in the upper right-hand corner (see figure 6-3).
2. Remove the six screws holding the logic A shield (see figure 6-3) and remove the shield. (Leave the logic A PCA in place.)
3. Remove the six screws holding the PCA mounting panel (see figure 6-5).

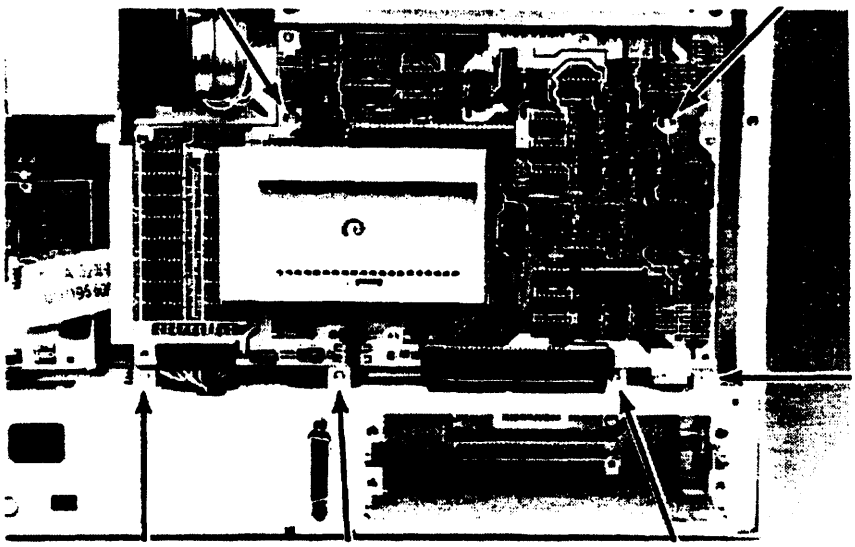


Figure 6-5. PCA Mounting-Panel Screws

4. Tilt the panel down and toward you (unhook the cable clip from the printer-mechanism cables). Support the panel to prevent any strain on the cables.
5. Disconnect the fan cable and the printer flex cable from the logic B PCA.

6. There are four printer-mechanism cables that pass through the grommeted hole in the shield (see figure 6-6). Disconnect these cables from the logic B PCA, but don't remove them from the grommeted hole.

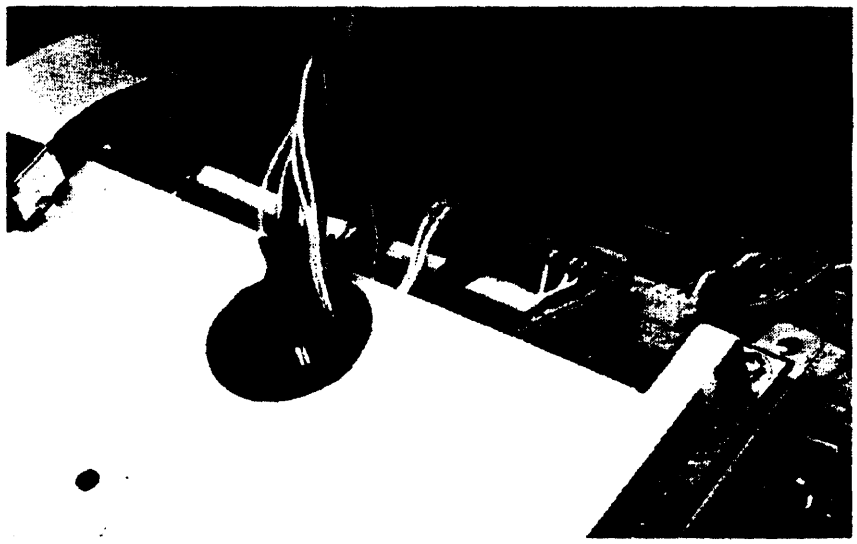


Figure 6-6. Grommeted Hole in Logic B Shield

7. Remove the four shield screws (labeled "B" in figure 6-7). Lift up the shield and disconnect the display flex cable from the logic B PCA.

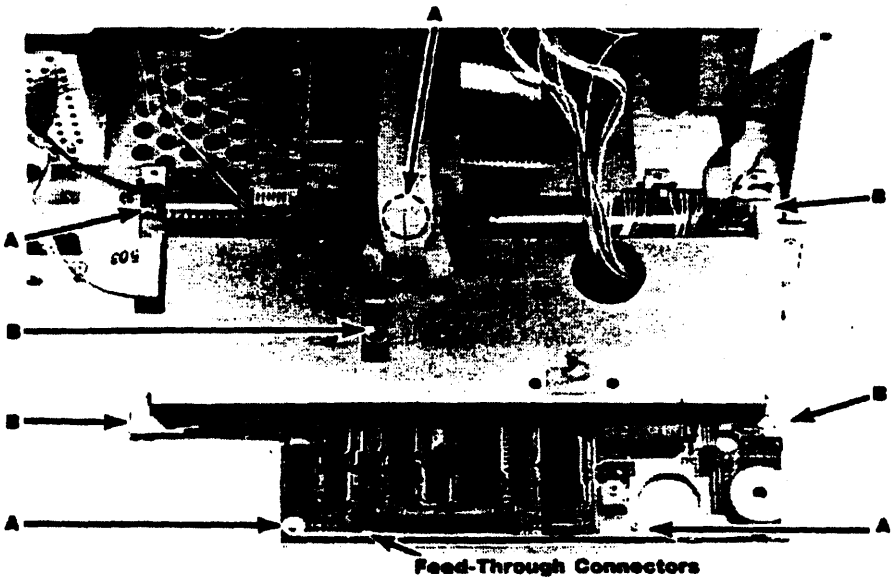


Figure 6-7. Logic B PCA Screws and Feed-Through Connectors.

8. Support the shield up and out of the way by refastening the cable clip to the printer-mechanism cables.

9. Disconnect the remaining cables from the logic B PCA (the disc drive flex cable, power cable, printer switch-panel cable, and HP-IB ribbon cable).

   Note: If the logic A PCA is still installed, its cables will hold the PCA mounting-panel assembly in place. If the logic A PCA has been removed (or if you disconnect its cables), you can remove the PCA mounting-panel assembly and lay it on a bench.

10. Remove the four remaining screws that hold the logic B PCA (labeled "A" in figure 6-7).
11. The feed-through connectors now are all that hold the PCA. Grasp the PCA as near to the connectors as possible and gently pull the PCA loose. Be careful not to bend the pins on the feed-through connectors.
12. Remove the plastic insulator sheet.

Reassembly Notes: Make sure the plastic insulator sheet is positioned properly relative to the screw holes in the PCA mounting panel. Insert the feed-through connectors into the logic A PCA, align the logic B PCA over the pins, then press the PCA into place. *Press as close to the connectors as possible.* Secure the PCA with its mounting screws (labeled "A" in figure 6-7) before you reconnect any cables.

CAUTION

Make sure that you do not interchange the power-cable connectors to the logic A and logic B PCAs. The logic B power-cable connector is the one from which the disc-drive extension cable extends (see figure 6-32). If you interchange the logic A and logic B power-cable connectors, serious damage to the power supply or the logic PCAs will result.

Connect the display flex cable to the PCA before you reinstall the shield on the PCA. Figure 6-8 shows the proper orientation.

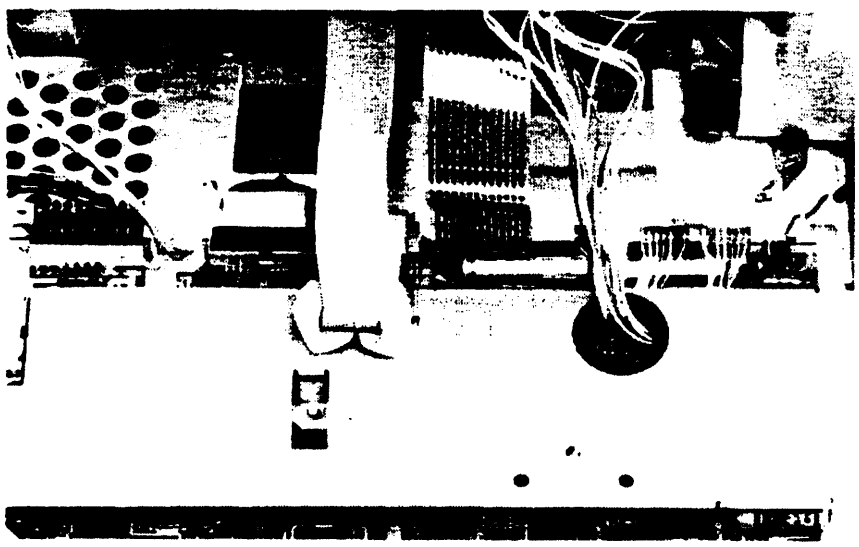


Figure 6-8. Display Cable Orientation

When you reconnect the four printer-mechanism connectors to the logic B PCA, make sure that the printer cables are properly oriented. *The connectors are keyed. Install them as shown in figure 6-6.*

Be sure that the printer cables are pulled tightly through the grommeted hole in the shield. The wires as they come out of the connectors in the open space below the shield must lie flat on the PCA so as not to interfere with the fan (see figure 6-6).

Make sure that all cable connectors have been reinstalled before you reassemble the unit.

> **Note:** The printer ROM IC (U32 on the logic B PCA) is localized for some languages. It is socketed for easy removal. Currently the standard version is used for all languages except Arabic, Hebrew, and Japanese. The standard printer ROM is supplied on *all* replacement logic B PCAs. If you are replacing the logic B PCA on a unit localized for Arabic, Hebrew, or Japanese, remove the localized printer ROM from the defective PCA and install it in the replacement PCA. Install the standard printer ROM in the PCA to be exchanged. If the printer ROM needs to be replaced, use the correct part number for the localized unit (refer to table 9-12).

6.9 The Printer Assembly

The printer assembly is a modified HP-IL version of the ThinkJet printer. Before you service the printer mechanism, remove it from the computer.

6.9.1 Removing the Printer

To remove the printer assembly, follow these steps:

1. Open the computer by pressing the buttons and then sliding the two latches on the lid inwards towards the handle; lift the lid up, and swing it back on its rockers. Be careful that the keyboard assembly doesn't fall out. Remove the keyboard assembly.
2. Open the printer cover. Remove the cover as follows: bend the middle of the hinged edge outward slightly, then disengage the hinge pins. (See figure 6-9.)

Figure 6-9. Removing the Printer Cover

3. Remove the back case of the computer (refer to section 6.5). Unsnap the white button on the clear ESD shield in the upper right-hand corner (see figure 6-3).
4. Remove the six screws holding the logic A shield (see figure 6-3) and remove the shield. (Leave the logic A PCA in place.)
5. Remove the six screws holding the PCA mounting panel (see figure 6-5).
6. Tilt the panel down and toward you (unhook the cable clip from the printer-mechanism cables). Support the panel to prevent any strain on the cables.
7. Disconnect the four printer-mechanism cables from the logic B PCA.
8. Remove the four screws that hold the logic B shield (labeled "B" in figure 6-7). Lift up the shield and disconnect the display flex cable from the logic B PCA and display assembly.
9. Holding the shield in one hand, pass each of the four printer-mechanism cable connectors back through the grommeted hole.
10. Once the shield is free, set it aside.
11. Disconnect the printer flex cable and the printer switch-panel cable from the logic B PCA.

CAUTION

Be very careful when removing the printer switch panel not to tear the plastic ESD shield attached to the panel and to the 5.5-mm hex standoff.

12. Remove the 5.5-mm hex standoff and washer, and carefully remove the ESD shield from the standoff. (See figure 6-10.)

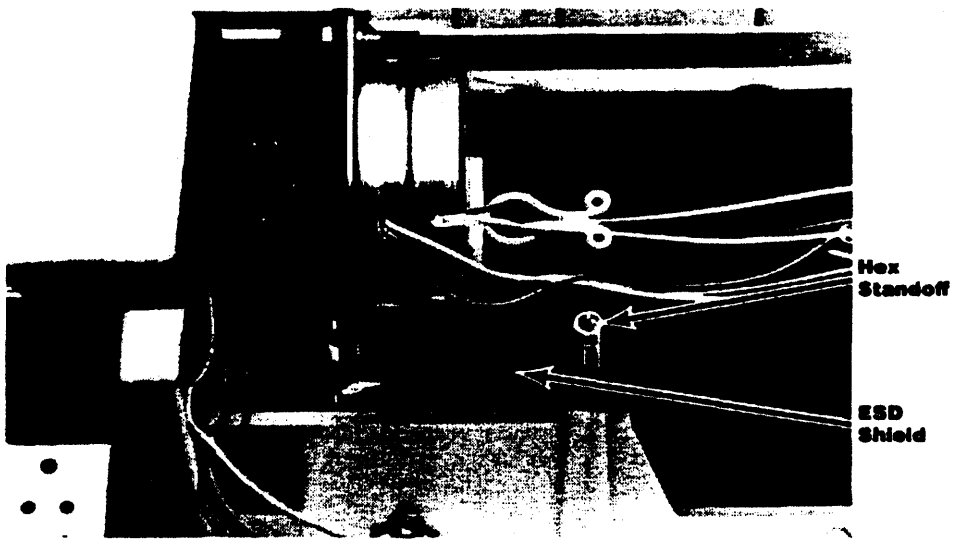


Figure 6-10. ESD Shield

13. Remove the printer switch panel as follows. Remove the screw shown in figure 6-11, move the front of the panel slightly to the right to clear the screw post, then lift the panel up and out.

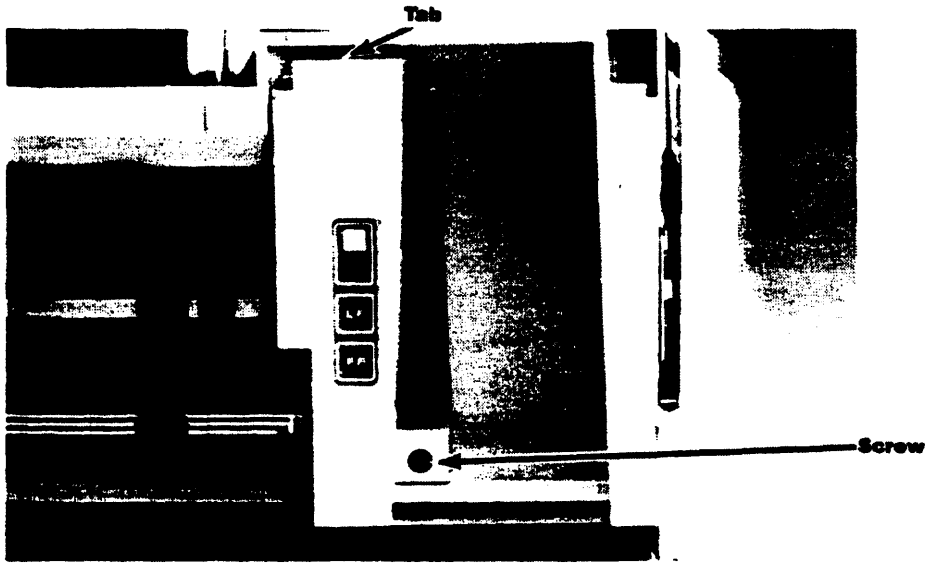


Figure 6-11. Printer Switch Panel

14. Remove the two screws in the bottom of the printer assembly and the screw in the rear right-hand corner of the assembly near the switch-panel tab slot. See figure 6-12. (You may have to move the printhead out of the way to remove one of the screws.)

15. Lift the printer assembly out of the unit being careful not to damage any of the cables.

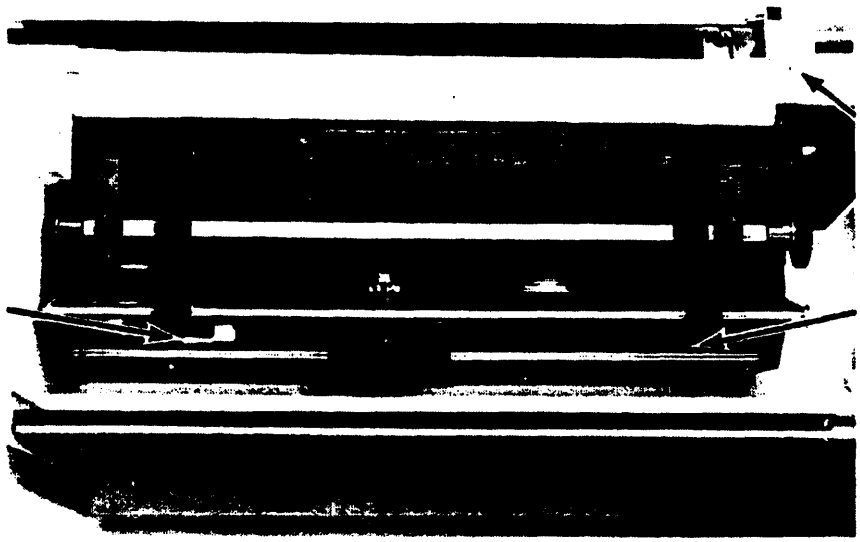


Figure 6-12. Printer Mounting Screws

Reassembly Notes: Make sure the tab on the ESD shield is back in place before reinstalling the printer switch panel. The shield wraps up in a circular fashion around the bottom of the panel. Make sure the dull side of the shield is toward the outside and faces the 5.5-mm standoff (see figure 6-10).

To replace the printer switch panel, orient it properly, insert the tab into the slot at an angle, and drop the panel into place. Install the screw (see figure 6-11).

6.9.2 Servicing the Printer

Use the procedures that follow to adjust the printer mechanism and to replace its subassemblies.

Before performing any of these procedures, you must remove the printer assembly from the computer as described in section 6.9.1.

Adjusting the Bail Arm. Adjust the bail arm correctly to allow the pinch rollers to apply pressure equally to the paper. If the pressures are unequal, the paper will skew as it moves through the mechanism.

1. Apply downward pressure on the left side of the bail-arm assembly while lifting the right side of the bail. See figure 6-13. The right pinch roller should lift a short distance (⅛ to ¼ inch) off the grit wheel before meeting heavy resistance.
   - If there is no "play" in the right side, apply more pressure until the right side of the shaft loosens up.
   - If there is too much play, and the right bail arm easily goes backward and hits the stop on the print frame, the screw on the left end of the bail shaft is too loose. Tighten it until the play is correct.

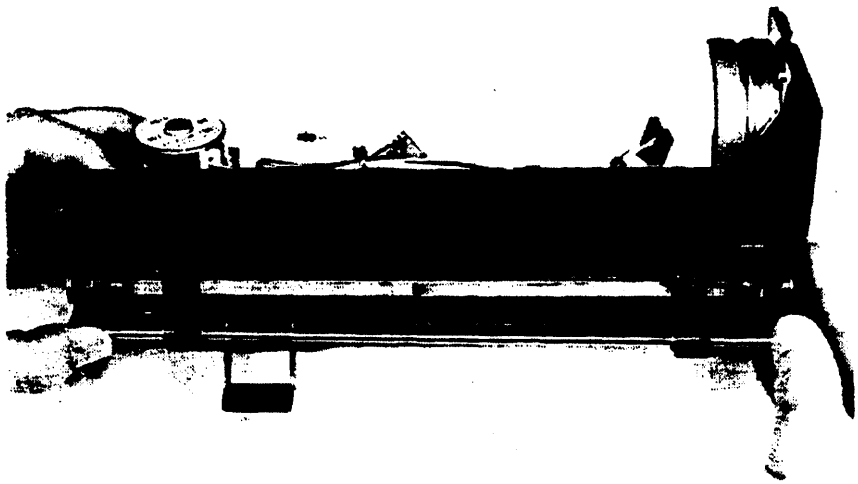


Figure 6-13. Bail-Arm Adjustment—Right Side

2. Once the right side is adjusted properly, apply downward pressure on the right side of the bail arm assembly and lift the left side of the bail. See figure 6-14. The left pinch roller should have the same amount of play. If not, use the techniques outlined in step 1 to make the proper adjustment.

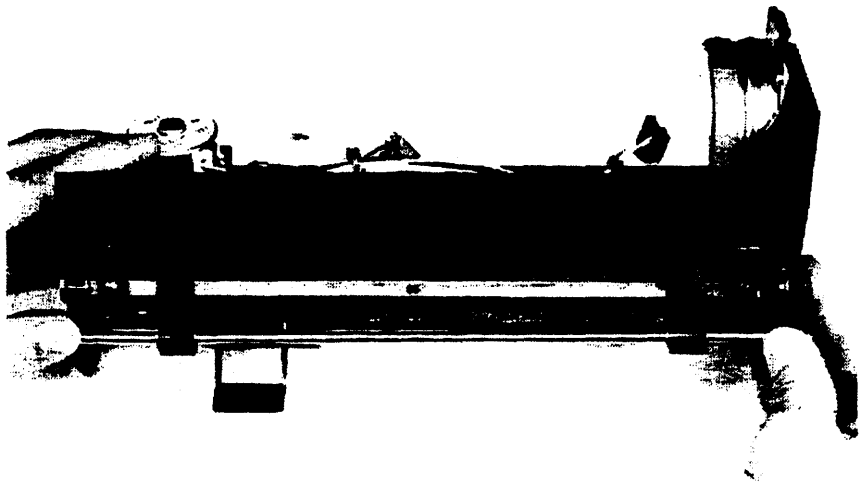


Figure 6-14. Bail-Arm Adjustment—Left Side

3. After both sides are set correctly, rotate the platen shaft to ensure that both pinch rollers are driven by the grit wheels.

Grit Wheel and Pin Wheel Replacement. To remove the grit wheels or pin wheels, follow these steps:

1. Remove the E-rings from both ends of the platen shaft.
2. Remove the output gear and dowel from the right side of the shaft. Be careful not to lose the dowel when the gear is removed.
3. Remove both sleeve bearings by pulling straight out from the sides.
4. Lift the shaft free and remove the wheels.

To reassemble the platten shaft, proceed as follows:

1. When installing the platen shaft, place both grit wheels on the shaft and temporarily set the shaft in the mechanism with the dowel hole positioned on the right side. Position the wheels so they fit between the flanges on the platen frame. See figure 6-15.

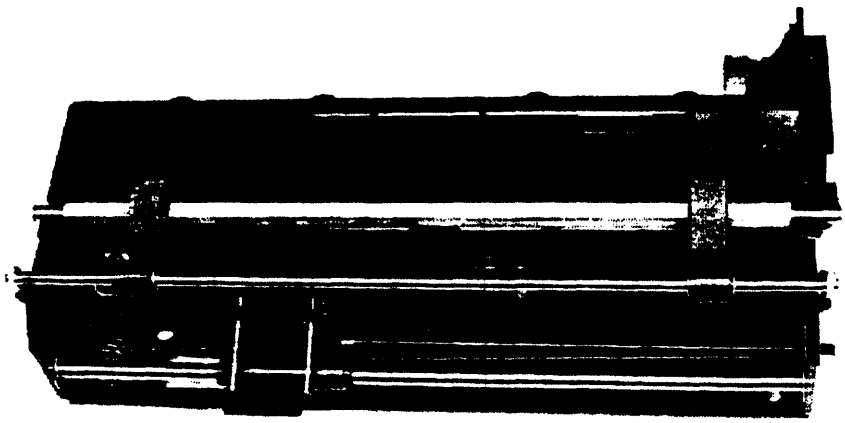


Figure 6-15. Grit-Wheel Installation

2. Install the pin wheels on each side of the shaft. Ensure that the pins are positioned on the shaft in alignment with each other. See figures 6-16a and 6-16b.

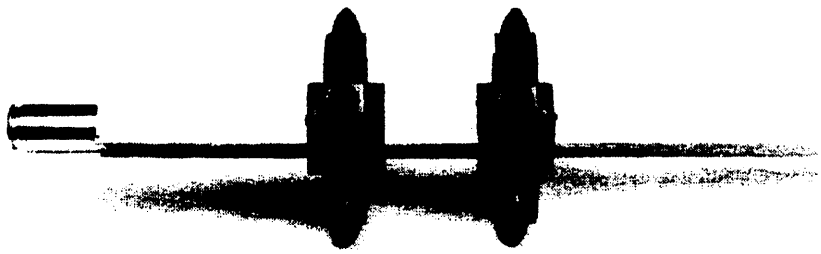


Figure 6-16a. Pin Wheel Replacement—Correct Alignment

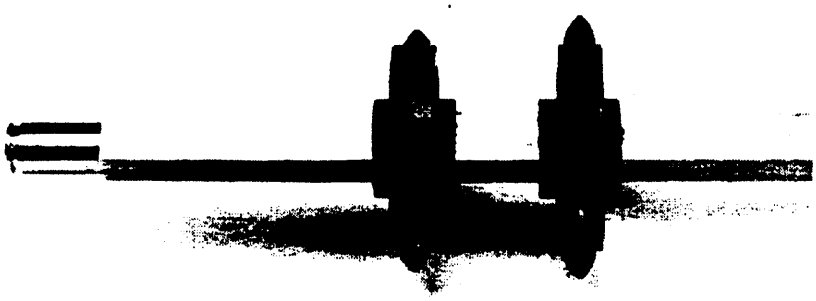


Figure 6-16b. Pin Wheel Replacement—Incorrect Alignment

3. Place the guides over each pin wheel, and set the left guide into its slotted position on the platen frame. Seat the guides firmly into place. See figure 6-17.

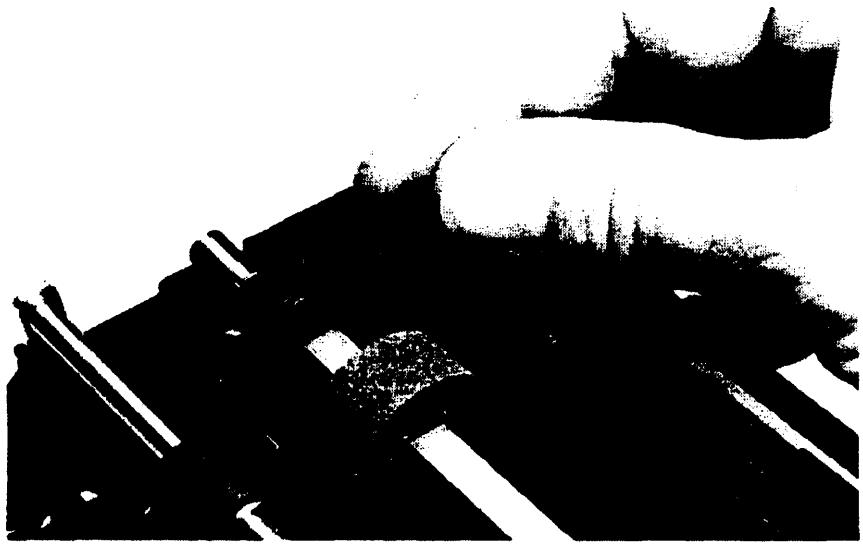


Figure 6-17. Pin Wheel Guide Replacement

4. Install the sleeve bearings by pushing them onto the shaft with the shaft resting in place.
5. Rotate the shaft so that the dowel hole is horizontal and insert the dowel.
6. Install the output gear so that its recessed areas fit over the dowel.
7. Install the two E-rings on the ends of the shaft.

Carriage-Assembly Replacement. To replace the carriage assembly, follow these steps:

1. Lower the printhead carriage latch and remove the printhead.
2. Move the carriage to the full left position and remove the T7 screw that secures the cable to the carriage. The screw can be accessed through the bottom cutout in the mechanism frame. See figure 6-18.

CAUTION

Use care to keep the two cable ends attached to the screw. The retaining washer will help secure these parts together after they have been removed from the carriage. If you fail to do this, the cable could unwind and force the replacement of the print-structure assembly.

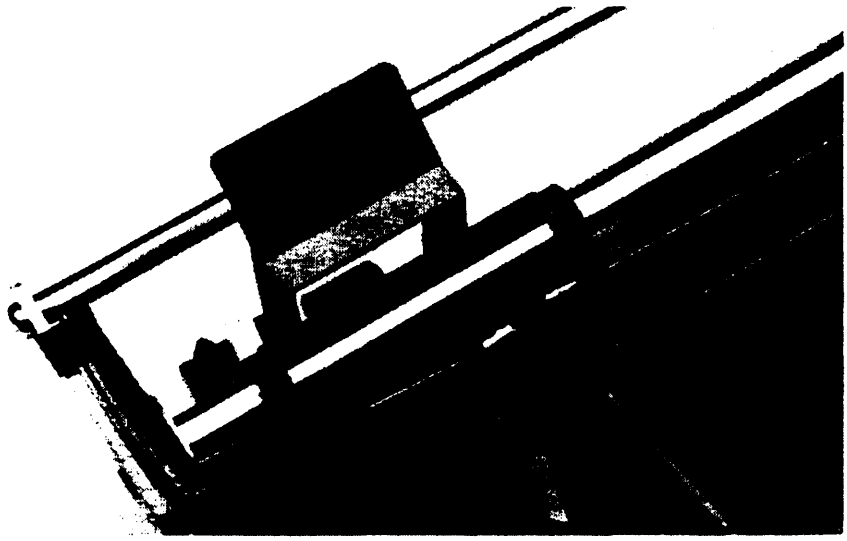


Figure 6-18. Carriage-Screw Removal

3. Use needlenose pliers to remove the rectangular clip holding the printhead flex cable in the bottom of the mechanism.
4. Remove the two E-rings from the ends of the carriage shaft. Remove the shaft and carriage assembly. Feed the flex cable through the slot in the bottom of the mechanism as you do so.

Pinch-Roller Replacement. To replace the pinch roller, follow these steps:

1. Remove the screw on the left end of the bail shaft.
2. Remove the left E-ring and slide the left pinch roller off the shaft. If the right pinch roller requires replacement, remove the next two E-rings and slide the right pinch roller off the left end of the shaft.

Note: After you replace the pinch rollers, E-rings, and the screw, ensure that the rollers spin freely on the shaft. Adjust the pinch rollers for equal presure on the paper (refer to "Adjusting the Bail Arm").

Bail-Assembly Replacement. To remove the bail assembly, follow these steps:

1. Lift the right-hand bail spring to the outward position, pinch the legs together, and lift it out. Repeat with the left-hand bail spring. See figure 6-19.

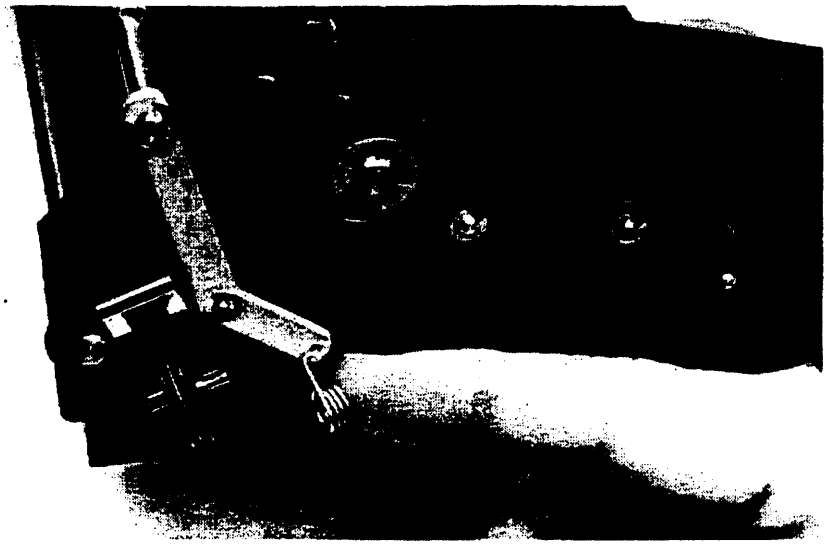


Figure 6-19. Bail-Arm Removal—Spring in Outward Position

2. Remove the T10 screw on the left end of the bail shaft.
3. Remove the E-ring on the right end of the bail shaft. Be careful not to lose the dowel when removing the shaft from the bail arm.
4. Remove the two bail arms by removing the two E-rings.

To install the bail assembly, follow these steps:

1. When reassembling the bail assembly, be sure to note the left-and right-hand characteristics of the bail arms. See figure 6-20.

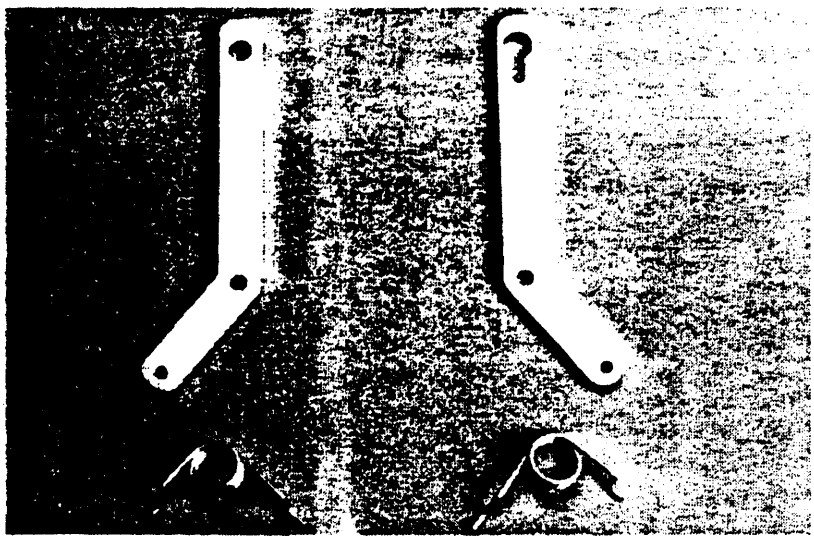


Figure 6-20. Bail-Arm and Spring Identification

2. When you reinstall the right-hand bail arm, refer to figure 6-21 for the proper placement of the arm and spring. The left-hand bail arm is positioned in a similar manner.

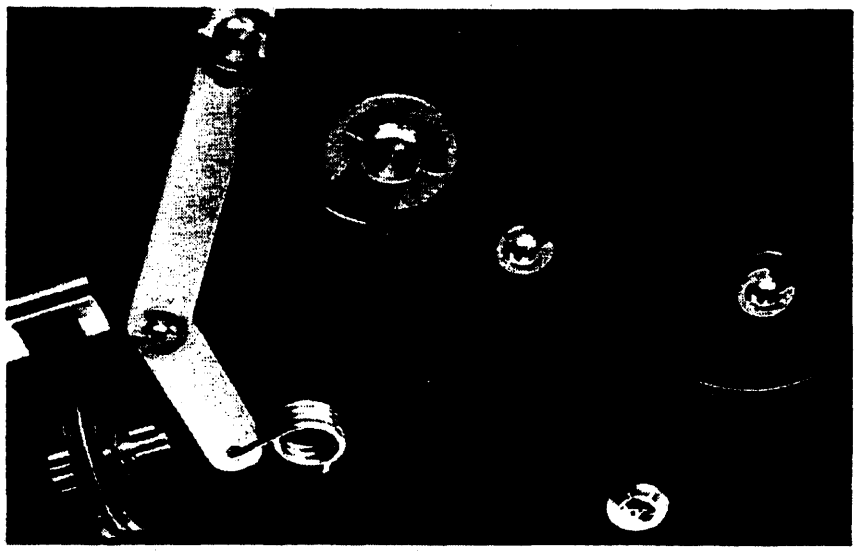


Figure 6-21. Right Bail-Arm and Spring

3. To install the right-hand spring, place the short side of the spring in the bail-arm hole and the longer side in the printer frame hole. If the two legs are properly seated, the spring can be pushed down easily to its normal position flat against the frame. If it does not position easily, the legs are not set in properly. See figure 6-21.
4. Install the left spring in the same manner as the right spring.
5. To insert the bail shaft into the right bail arm, position the shaft so that the dowel hole is horizontal. Place the dowel in the shaft, and position the shaft into the right bail arm. Apply enough pressure on the shaft to hold the dowel in place; then turn the shaft so the dowel lines up with the slot in the arm. Push down on the dowel to set it in place; the shaft should then slip fully into the arm. Install the E-ring on the end of the shaft.
6. Secure the other end of the shaft to the left bail arm with the T10 screw.
7. Perform the bail-arm adjustment procedure (refer to "Adjusting the Bail Arm").

Home Switch (Opto Sensor) Replacement. To replace the home switch, follow these steps:

1. Locate the home switch shown in figure 6-22 and remove the T6 screw that fastens the switch to the mechanism frame.

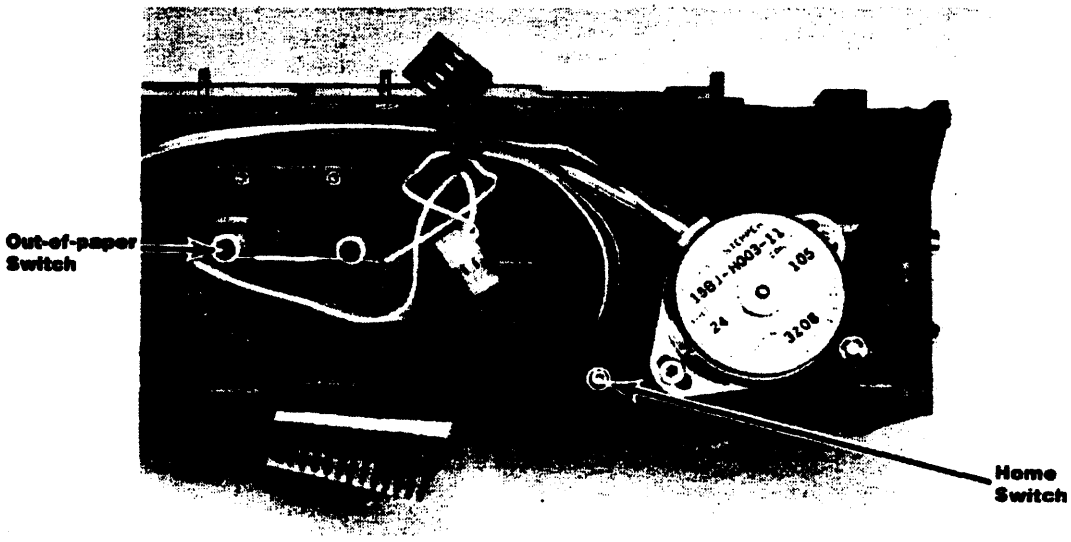


Figure 6-22. Home Switch and Out-Of-Paper Switch Locations

2. Cut the tie wrap holding the switch cable to the other cables and lift the switch out.

Out-of-Paper Switch Replacement. To replace the out-of-paper switch, follow these steps:

1. Locate the out-of-paper switch shown in figure 6-22 and loosen the two T6 screws that hold the switch on its bracket.
2. Slide the switch free of the loosened screws, cut the tie wrap holding the switch wires to the other cables, and lift the switch out.

6.10 Removing the Disc Drive

To remove the disc drive from the computer, follow these steps:

1. Remove the back case (refer to section 6.5).
2. Disconnect the four-wire power cable and the flex cable from the back of the disc drive.

3. Remove the two top screws that are located in the bottom of the cable well on top of the computer to the right of the printer. Remove the screw in the bottom rear of the bracket. See figures 6-23a and 6-23b respectively.

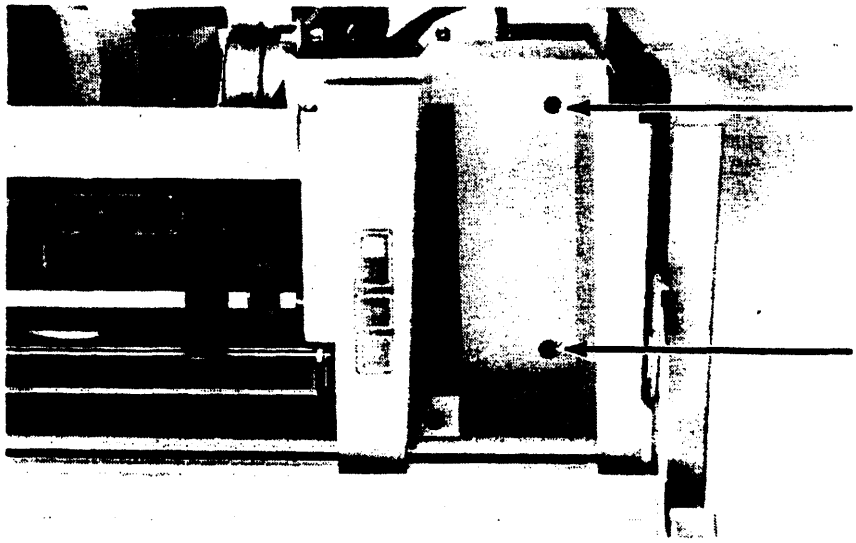


Figure 6-23a. Disc-Drive Mounting Screws—Top

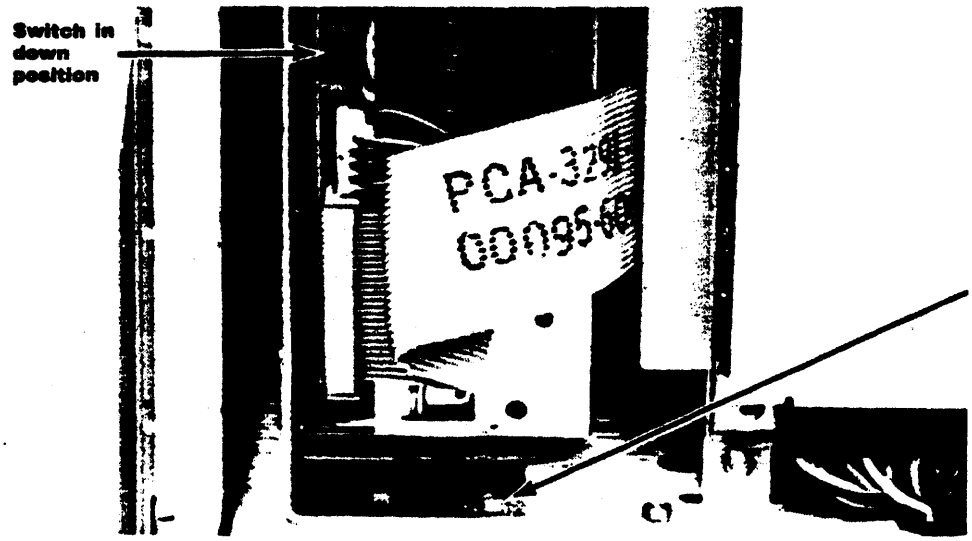


Figure 6-23b. Disc-Drive Mounting Screw—Bottom

4. Pull the disc drive and bracket out the back of the computer.
5. Remove the four screws that hold the disc drive to the bracket.

Reassembly Notes: Make sure the disc release button is in place in the bezel. (You may wish to hold it in place with a piece of masking tape.)

Replace the two top screws first. The screw hole in the bracket should then be aligned properly.

The replacement disc drive comes with a bezel mounted on it. Remove this bezel before installing the new drive. To do this loosen the two screws shown in figure 6-23c and slide the bezel off.

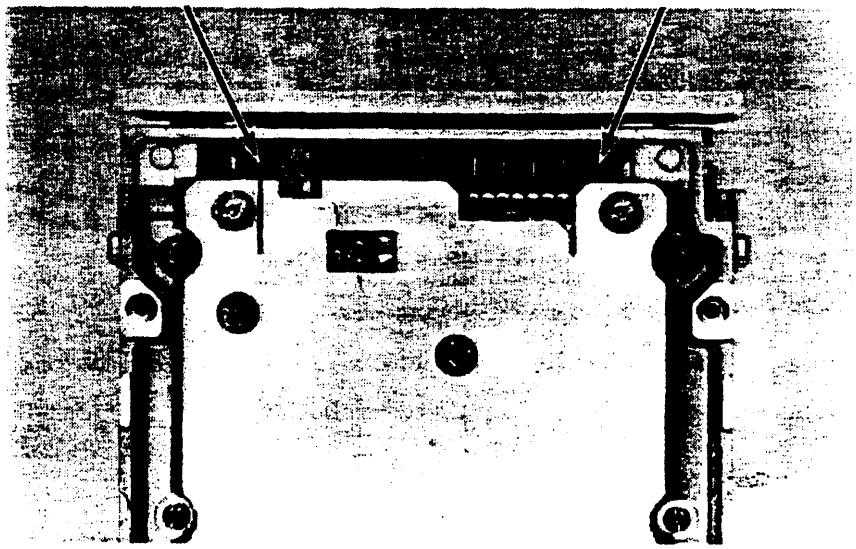


Figure 6-23c. Bezel Mounting Screws

Remove the bezel-mounting screws and retainer nuts from the new drive and transfer them to the old drive. Mount the bezel on the old drive before returning it.

Make sure that the switch on the back of the new drive is in the "down" position (see figure 6-23b).

6.11 Removing the Display Assembly

> **Note:** There are two versions of the display assembly. (Both are functionally equivalent.) The original assembly had a small PCA mounted on the back frame of the assembly. The later version does not have this PCA because the circuitry has been added to the main display assembly PCA. Do not remove this PCA from a display assembly that has it, nor transfer the PCA to a replacement display assembly that does not have it. Replace the entire display assembly with an exchange assembly. The display assembly is a *tuned assembly*. It cannot be serviced to the component level in the field.

You don't need to open the back of the computer. Just open the lid and remove the keyboard to get access to the front of the computer. Follow these steps:

1. Make sure the display assembly is in the closed position. (The edge of the display panel is flush with the edge of the disc-drive bezel.)
2. Remove the printer cover as shown in figure 6-9.

3. Insert a small flat-blade screwdriver between the disk drive bezel and the front edge of the cable well just to the right of the centerline of the bezel. It should contact the latch approximately ¾-inch below the top edge of the bezel. See the figure 6-24.

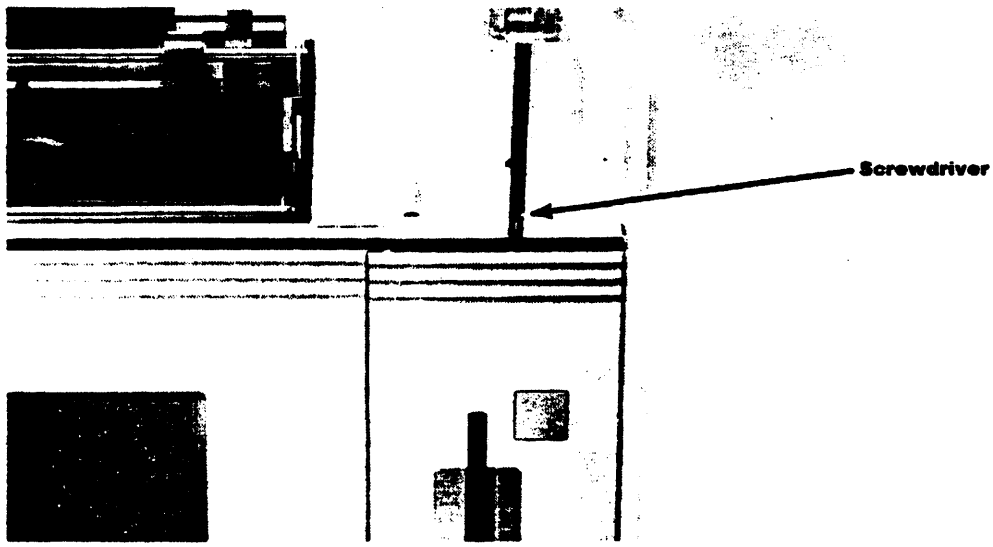


Figure 6-24. Disconnecting the Disc-Drive Bezel

4. Press down carefully with the screwdriver to disengage the latch and swing the bezel forward and off. Remove the disc eject button.
5. Close the computer lid and latch it, then lay the computer flat on its back.

CAUTION

If you proceed beyond this point with the computer in the upright position, the display-panel assembly may fall out and be damaged.

6. Remove the two screws holding the pivot clamp directly above the disc drive and remove the clamp. See figure 6-25.

Figure 6-25. The Pivot Clamp and Dashpot Bracket

7. Remove the screw that holds the dashpot bracket. See figure 6-25.

   Note: The dashpot should be removed as a unit. Do not allow the dashpot plunger to come out of the tube. Otherwise, dirt may get into the dashpot and cause it to malfunction.

8. The display latch is located below the disc drive. Disengage the latch spring, then disengage the latch from the display-panel assembly by pushing it to the right.
9. Lift up the right-hand edge of the display assembly (along with the dashpot bracket and the dashpot), disengage the left-hand pivot from the frame, and lift the display assembly up.
10. Disconnect the display flex cable.
11. Lift the display assembly out of the computer.

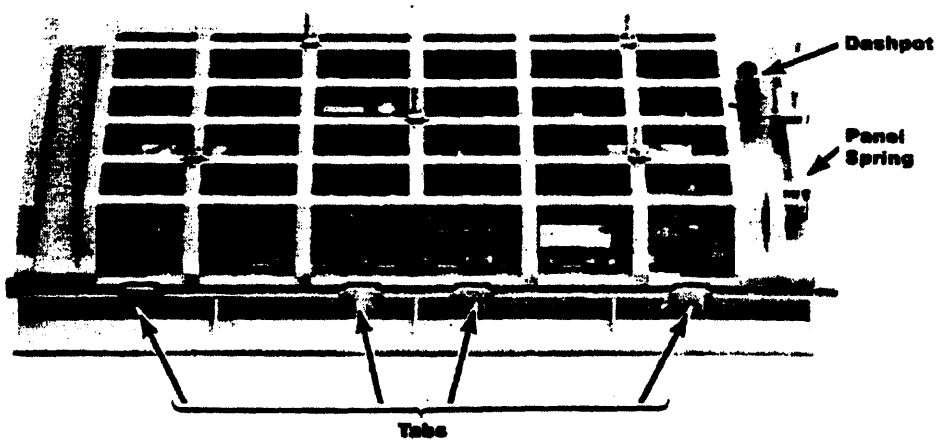


Figure 6-26. Display-Bezel Tabs and Panel Spring

12. Using a flat-blade screwdriver, gently disengage the four tabs along the top of the bezel starting at either end. Press on the bezel as you go to keep the tabs disengaged. See figures 6-26 and 6-27.

Figure 6-27. Disengaging the Display-Bezel Tabs

13. Disengage the bottom of the bezel from the display.
14. Remove the panel spring from the display assembly and transfer it to the new assembly.

Reassembly Notes: To install the display assembly, follow these steps:

1. Insert the bottom edge of the display into the display bezel so the four clips on the bottom of the frame engage the bezel. Then press on the top of the display bezel until it snaps into place with the four tabs on the bezel holding the display.

   Before replacing the display assembly, see figures 6-26, 6-28a, and 6-28b, and identify the following:

   - The panel spring.
   - The dashpot.
   - The slot.
   - The dashpot bracket.
   - The rubber spacer.

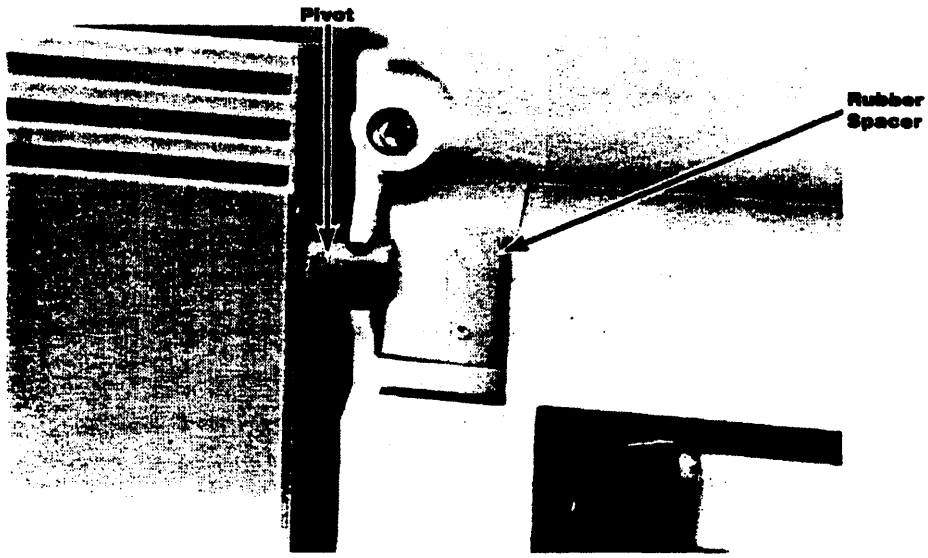


Figure 6-28a. Display-Assembly Details—Front

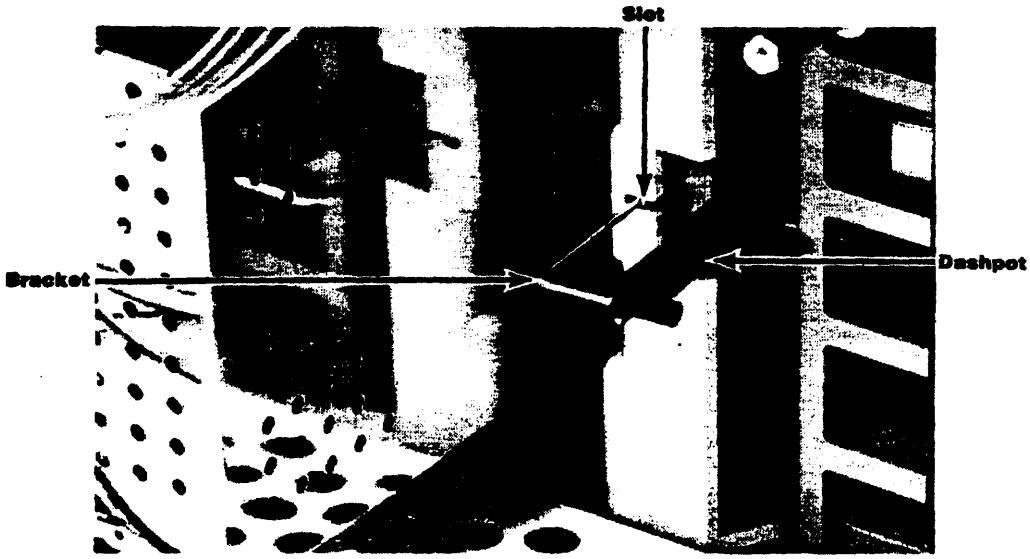


Figure 6-28b. Display-Assembly Details—Back

2. Lay the computer flat on its back.
3. Position the display latch all the way to the right. (You may wish to hold it in place with a piece of masking tape.)
4. Remove the rubber spacer.
5. Connect the flex cable.
6. While holding the bottom of the display assembly up, insert the left-hand pivot into its hole in the frame. Position the dashpot bracket in line with the slot in the frame, then lower the right side of the display assembly so that the right-hand pivot rests in its pivot position and the dashpot bracket extends through the slot. Now lower the bottom edge of the display assembly so that the assembly is lying flat in place in the frame. The panel spring should have folded down between the display assembly and the frame. If it didn't, reach in with your finger and push it down.
7. Insert the rubber spacer (if not present), its arrow pointing up, into its hole in the frame to the right of the right-hand display pivot. The rubber spacer should cover half of the pivot. See figure 6-28a.
8. Install the pivot clamp.
9. Install the dashpot-bracket screw.
10. Reset the spring force on the display latch by putting the free end of the spring back into its slot.
11. Stand the computer upright and install the disc-drive bezel. Press it until it snaps into place.
12. To test the dashpot, press the display latch to the right. If the dashpot is mounted properly, the display assembly will swing up quickly at first and then more slowly.

6.12 The Base Assembly

The base assembly forms the metal substructure of the computer. It includes the I/O backplane assembly, HP-IB ribbon-cable assembly, and power supply.

6.12.1 Removing the Base Assembly

Before you can work on the I/O backplane assembly, HP-IB ribbon-cable assembly, or power supply, you must remove the base assembly from the computer. Follow these steps:

1. Remove the back case (refer to section 6.5). Unsnap the white button on the clear ESD shield in the upper right-hand corner (see figure 6-3).
2. Remove the disc drive assembly (refer to section 6.10, steps 1 through 4).
3. Close the computer lid (if present) and latch it.

   Note: If you intend to remove either the left-side-support assembly (the fan housing) or the right-side-support assembly, you must remove the lid assembly (refer to section 6.6) before you proceed. Otherwise, latch the lid assembly in the closed position.

4. Remove both I/O port covers.
5. Remove the 5.5-mm grounding nut accessible through the hole in the I/O PCA (see figure 6-29a).

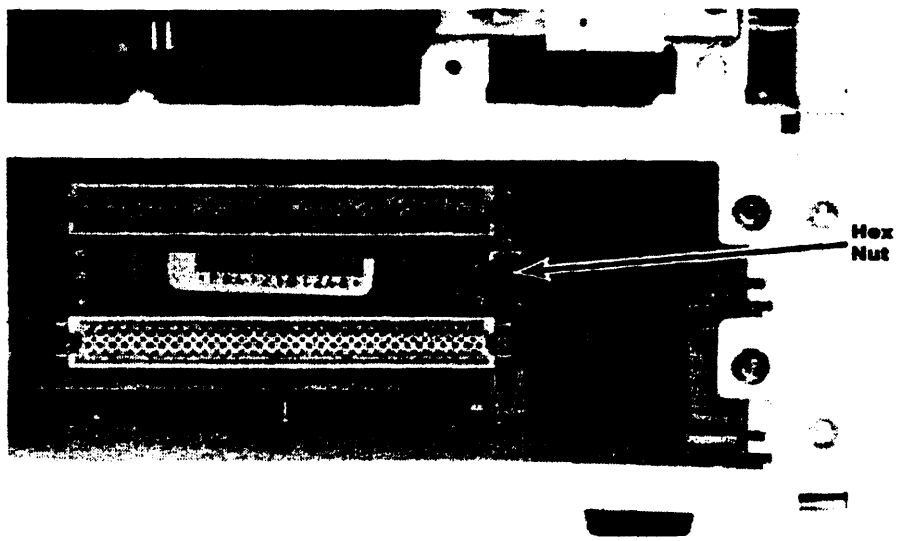


Figure 6-29a. Grounding Nut

6. Remove the six screws holding the logic A shield (see figure 6-3) and remove the shield. (Leave the logic A PCA in place.)
7. Remove the six screws holding the PCA mounting panel (see figure 6-5).
8. Tilt the panel down and toward you (unhook the cable clip from the printer-mechanism cables). Support the panel to prevent any strain on the cables.

9. Disconnect the following from the logic B PCA: the fan cable, the power cable, and the HP-IB ribbon cable. (The power cable and HP-IB ribbon cable extend down into the base assembly.)
10. Make sure that the computer lid (if present) is latched. Tilt the PCA mounting panel back up and, holding the panel in place, tilt the computer onto its front face.
11. Holding the PCA mounting panel securely, disconnect all three cables from the logic A PCA: the keyboard flex cable, I/O flex cable, and power cable.
12. Set the PCA mounting panel assembly in a secure location on top of the computer case as shown in figure 6-29b.

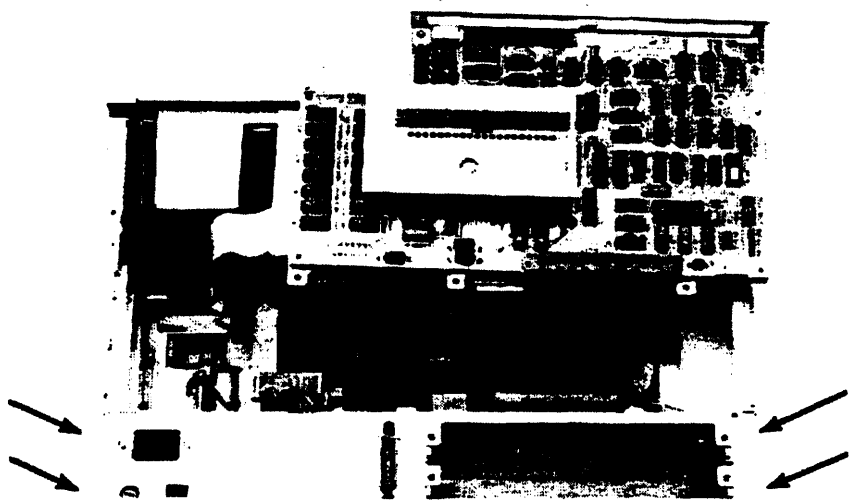


Figure 6-29b. Base Assembly Mounting Screws

13. Remove the four flat-head screws that hold the base assembly to the side supports (see figure 6-29b).
14. Lift the base assembly out of the computer.
15. The base assembly should now appear as shown in figure 6-30a. Remove the eight screws and six nuts holding the cover to the base assembly.

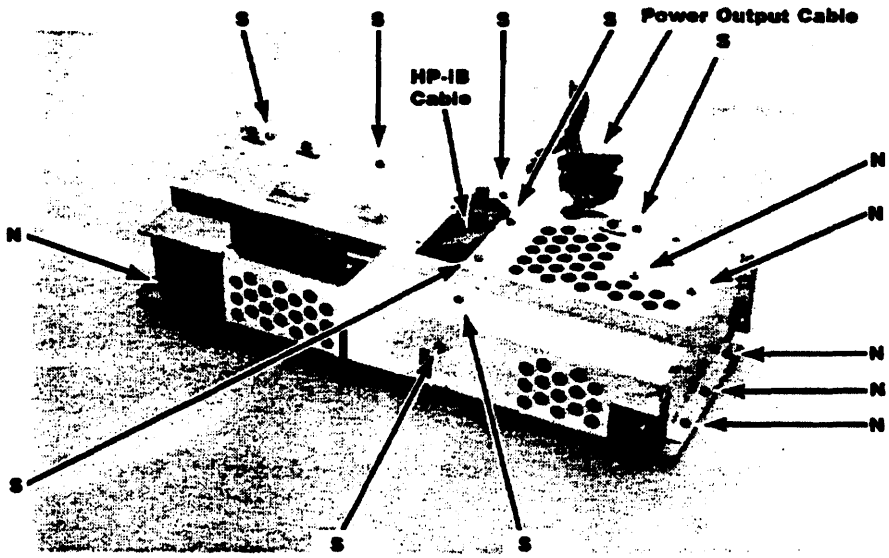


Figure 6-30a. Base Assembly Cover Screws and Nuts

16. Press the HP-IB ribbon-cable connector down through the grommeted hole. Remove the cover from the base assembly being careful not to damage the external I/O flex cable. The base assembly should now appear as shown in figure 6-30b.

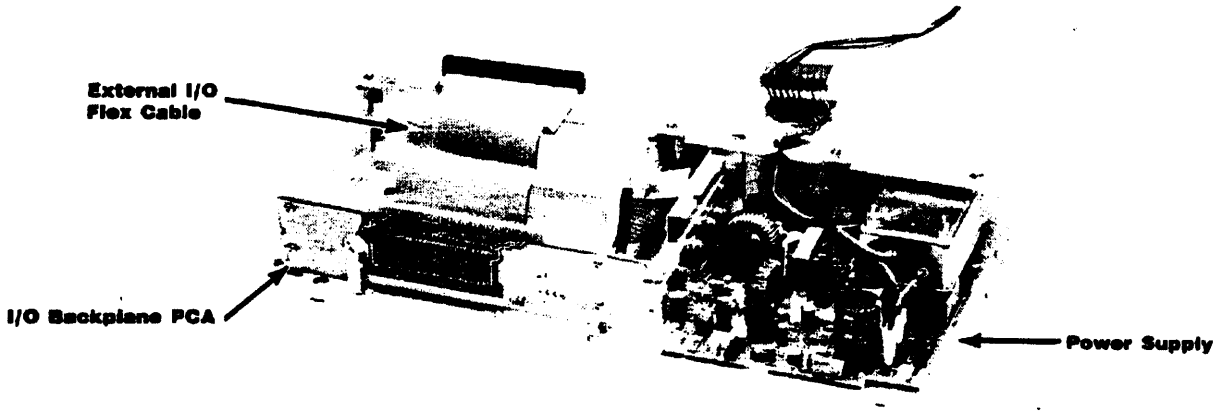


Figure 6-30b. Base Assembly With Cover Removed

17. You can now remove the I/O backplane PCA, the HP-IB ribbon-cable assembly, and the power supply as described below.

Reassembly Notes: When installing the cover on the base assembly, install it as shown in figure 6-30c with the two left sections of the cover tucked behind the lip of the base assembly. *The idea is to make electrical contact between the cover and base, so don't bend the front section of the cover.* Just gently press the cover behind the lip as you install it. By making electrical contact between the cover and base, electromagnetic interference (EMI) problems are reduced.

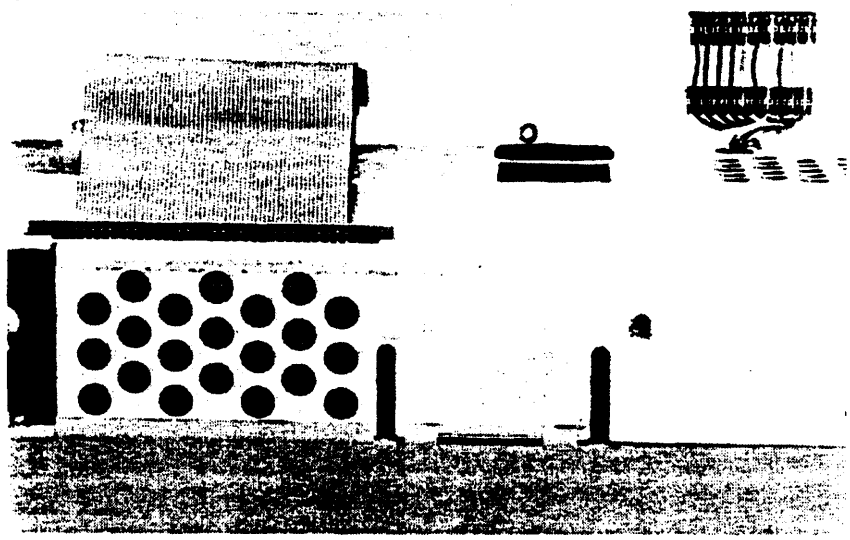


Figure 6-30c. Reinstalling the Base-Assembly Cover

CAUTION

Make sure that you do not interchange the power-cable connectors to the logic A and logic B PCAs. The logic B power-cable connector is the one from which the disc-drive extension cable extends (see figure 6-32). If you interchange the logic A and logic B power-cable connectors, serious damage to the power supply or the logic PCAs will result.

6.12.2 Removing the I/O Backplane PCA

Before you can remove the I/O backplane PCA, you must remove the base assembly from the computer and remove its cover as described in section 6.12.1. Once you have done this, follow these steps:

1. Remove the four screws holding the I/O backplane PCA to the base assembly.
2. Pull the PCA back to release it from the two plastic pins, then slide the PCA upwards. (Leave the I/O ground bracket in place.)
3. If further disassembly of the I/O chassis is needed, see figure 9-4.

6.12.3 Removing the HP-IB Ribbon-Cable Assembly

Before you can remove the HP-IB ribbon-cable assembly, you must remove the base assembly from the computer and remove its cover as described in section 6.12.1. Once you have done this, follow these steps:

1. Using a 9/32-inch nut driver, remove the two hex standoffs from either side of the HP-IB back-panel connector.
2. Carefully remove the HP-IB ribbon-cable assembly from the base assembly. See figure 9-4 for further details.

6.12.4 Removing the Power-Supply Assembly

Before you can remove the power-supply assembly, you must remove the base assembly from the computer as described in section 6.12.1. Once you have done this, remove the power-supply assembly as described below.

WARNING

Capacitors C4 and C5 will remain charged for an hour or more after the power is turned off. You should short the leads on each of these capacitors to avoid a possible shock hazard.

1. Remove the power cord if you have not already done so. Short capacitors C4 and C5 to ground.
2. The ac line filter is shown in figure 6-31a. Disconnect the line filter ground wire from the chassis.

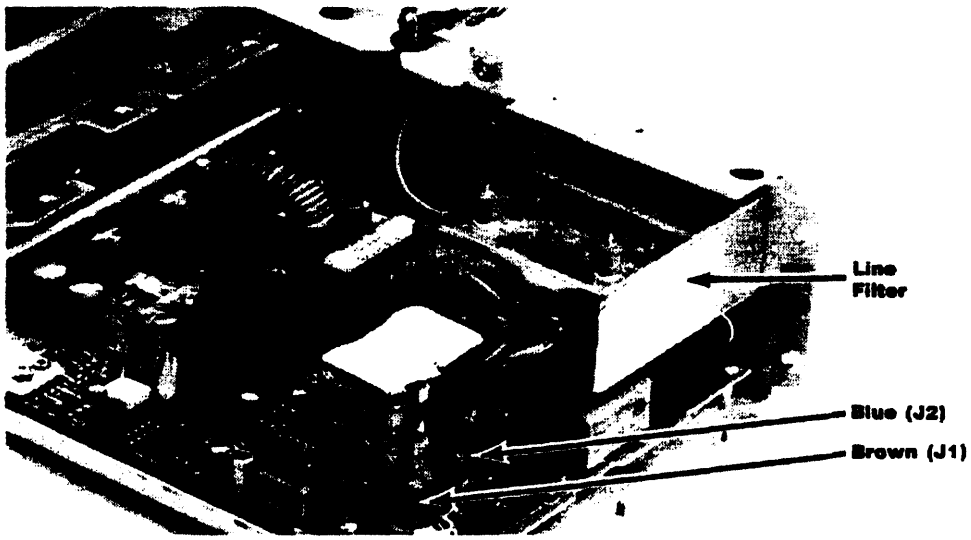


Figure 6-31a. Power-Supply Assembly Showing AC Line Filter

3. Remove the two screws that hold the ac line filter to the back panel of the base assembly, being careful not to drop the filter onto the PCA. Set the filter in a secure location on top of the power supply. (It is not necessary to disconnect the line filter from the power supply PCA.)
4. Disconnect the output connector from the power-supply assembly.
5. Remove the six screws holding the power-supply assembly (see figure 6-31b).

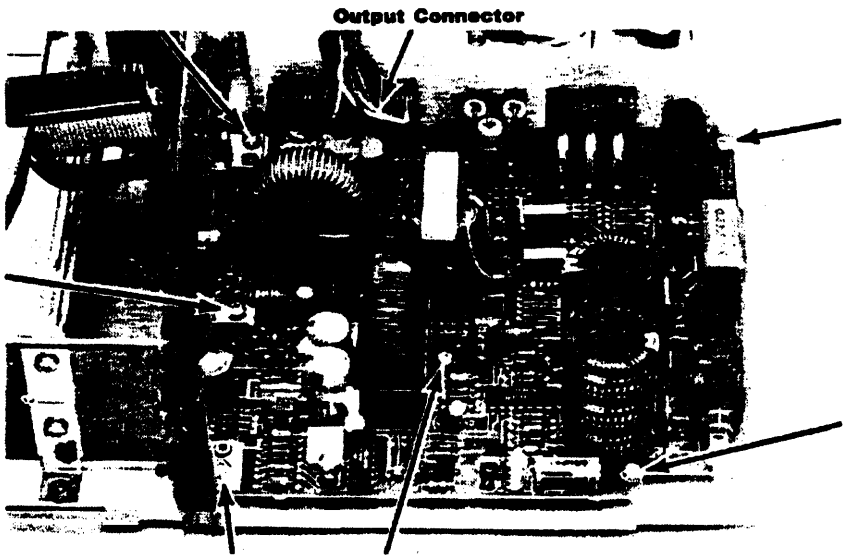


Figure 6-31b. Power-Supply Assembly Showing Mounting Screws

6. Remove the power-supply assembly and line filter as a unit.

CAUTION

Remove the line filter leads from the power supply PCA only if necessary, and use care when doing so. The line filter connectors fit very tightly on the PCA, and it is easy to damage the PCA when removing them.

Leave the ac line filter connected to the power supply PCA unless you must replace the line filter or the power supply PCA. If you must disconnect the line filter, remove its leads from connectors J1 and J2 on the power supply PCA (see figure 6-31a).

Reassembly Notes: Make sure the transparent plastic sheet is positioned properly relative to the screw holes in the bottom of the power-supply assembly.

WARNING

Do not reverse the brown and blue line-filter leads when replacing the line filter. They must be connected as shown in figure 6-31a. If these leads are reversed, there will be no fuse protection.

If the plastic coating on the two large capacitors (C4 and C5) is scratched, replace the capacitors. Otherwise a shock hazard will result.

Note that the mounting screw next to the large capacitor (C4) has no star washer. This prevents possible damage to the coating on C4. Make sure that you use the washerless screw here when reinstalling the power supply.

CAUTION

Make sure that you do not interchange the power-cable connectors to the logic A and logic B PCAs. The logic B power-cable connector is the one from which the disc-drive extension cable extends (see figure 6-32). If you interchange the logic A and logic B power-cable connectors, serious damage to the power supply or the logic PCAs will result.

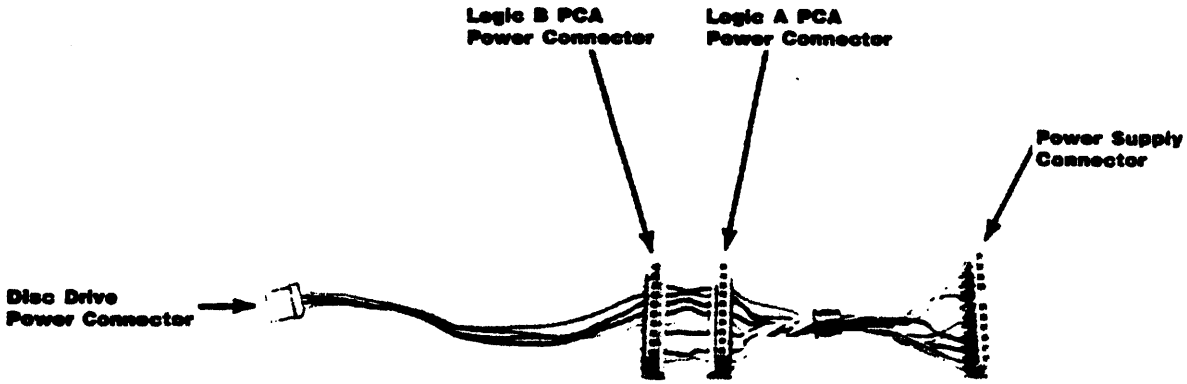


Figure 6-32. Power-Cable Harness

6.13 Removing the Fan

The fan is part of the left-side-support assembly. To replace the fan you must replace this assembly. Follow these steps:

1. Remove the lid assembly (refer to section 6.6).
2. Remove the base assembly (refer to section 6.12.1, steps 1 through 14).
3. Remove the three screws (designated H4, H5, and H6 in figure 9-1) that hold the left-side-support assembly to the front case.
4. Set the logic PCA mounting-panel assembly out of the way, then slide the left-side-support assembly out from the front case assembly.

Reassembly Note: The paper door cushions are located behind the left- and right-side-support assemblies (see figure 9-1). When you remove either side-support assembly the corresponding paper door cushion tends to fall out of position. Before you reinstall a side-support assembly, make sure that the paper door cushion is in place.

6.14 Removing the Keyboard Connector Assembly

To remove the keyboard connector assembly, follow these steps:

1. Remove the base assembly (refer to section 6.12.1, steps 1 through 14).
2. Remove the two screws shown in figure 6-33 and lift out the PCA.

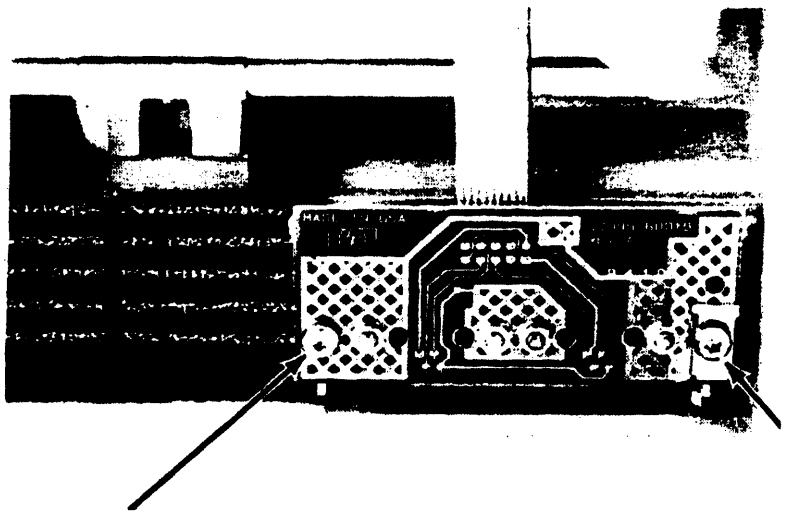


Figure 6-33. Keyboard Connector Assembly

6.15 The Keyboard

The keyboard consists of the *keyboard case*, the *keyboard cable*, and the *keyboard assembly*. The keyboard assembly is an exchange assembly that contains all of the mechanical and electronic parts of the keyboard mounted on a printed circuit board. Most keyboard problems can be corrected by replacing either the keyboard assembly or the keyboard cable.

6.15.1 Removing the Keyboard Assembly

To remove the keyboard assembly, follow these steps:

1. Carefully pry up and remove the four rubber pads from the bottom of the keyboard.
2. Remove the four bottom screws. See figure 6-34.

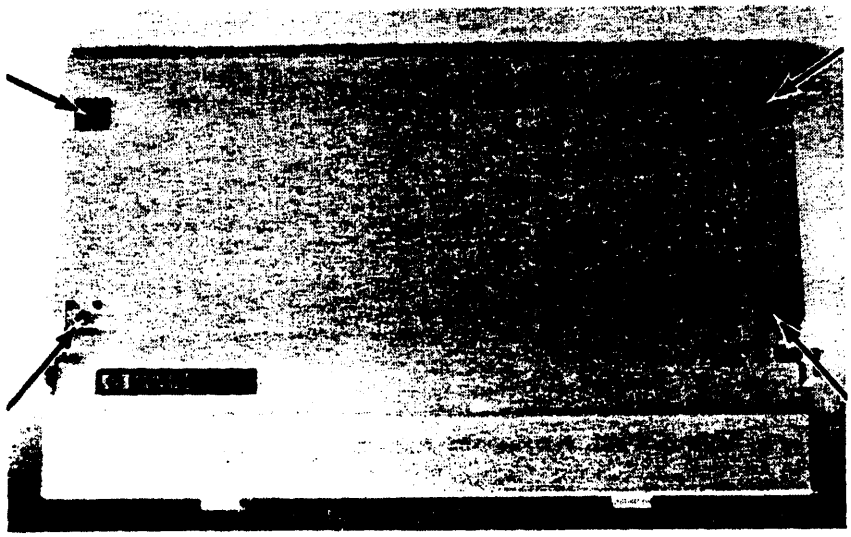


Figure 6-34. Keyboard Bottom Screws

3. Remove the two top screws. See figure 6-35.

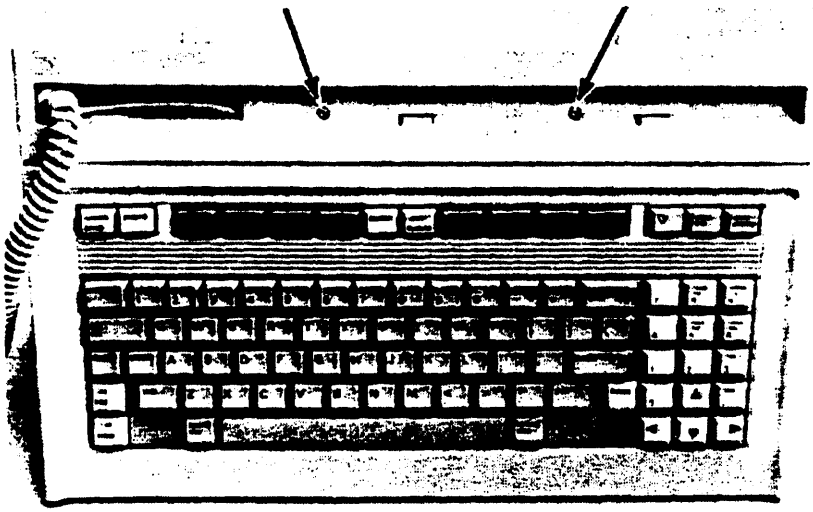


Figure 6-35. Keyboard Top Screws

4. Lift off the top case and turn it over.

5. Remove the two keyboard assembly mounting screws. See figure 6-36.

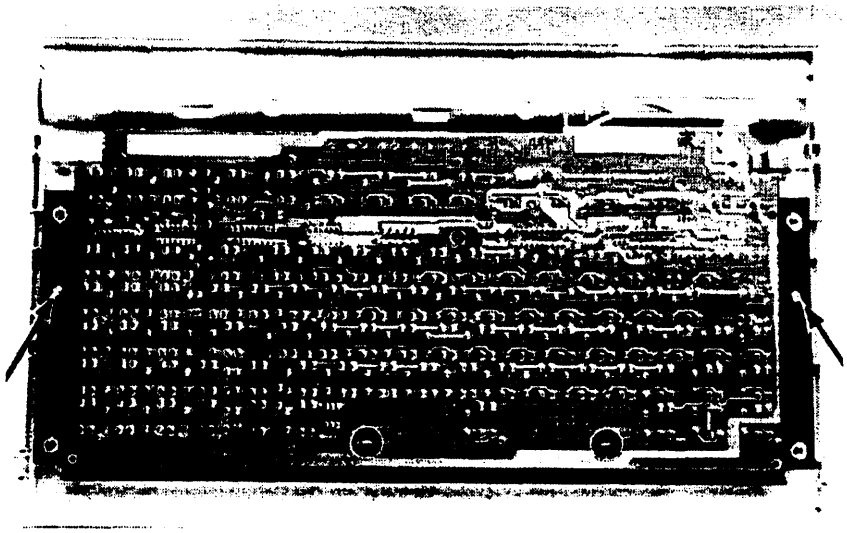


Figure 6-36. Keyboard Assembly—Mounting Screws

6. There is a ferrite cylinder on the keyboard cable located between the keyboard assembly and the top case. The cylinder is held in place with double-sided foam tape. Pry the cylinder loose from the case and keyboard assembly with a small flat-bladed screwdriver. Lift up the keyboard assembly and turn it over.
7. Carefully unplug the cable connector. See figure 6-37.

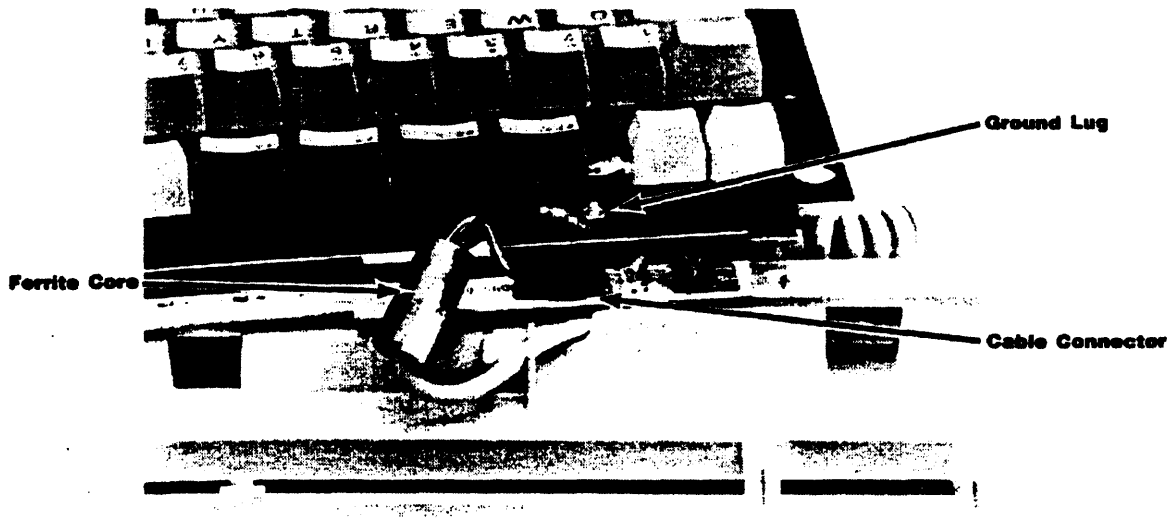


Figure 6-37. Keyboard Assembly—Cable Connector and Ground Lug

8. Disconnect the ground lug. See figure 6-37.
9. Pull the connecting cable (with its ferrite cylinder) out through the slot in the top case.

The cable and keyboard assembly are now separated and can be replaced individually.

Reassembly Notes: Install the keyboard cable exactly as shown in figure 6-37.

Place the ferrite cylinder in its original position. You don't need to replace the double-sided foam tape. The foam padding will hold the cylinder in place.

6.15.2 Replacing the Keyboard Legs

To replace a keyboard leg, proceed as follows:

1. Open the keyboard case as described in section 6.15.1, steps 1 through 4.
2. Install the legs as shown in figures 6-38a and 6-38b.

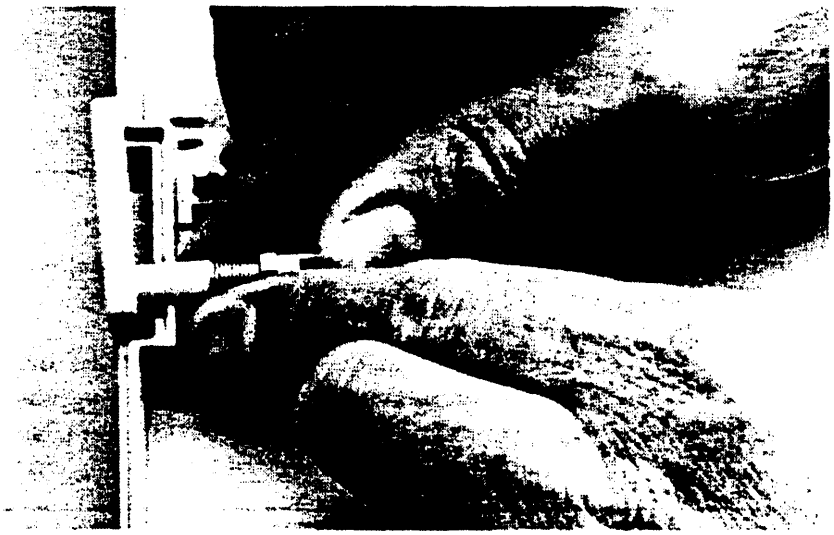


Figure 6-38a. Installing a Keyboard Leg

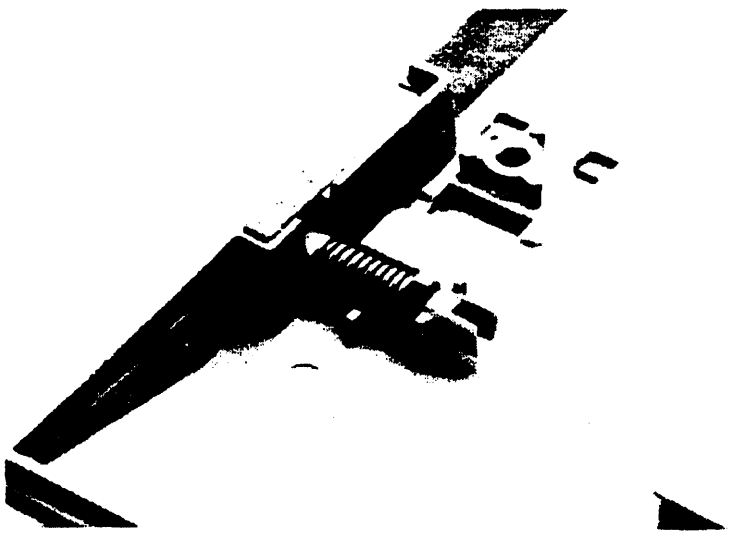


Figure 6-38b. Keyboard Leg in Closed Position

6.16 The ROM Assembly

There are two operating system plug-in ROM assemblies that may be installed in the Integral PC:

- If the computer has the HP-UX System III operating system (Release 1.0.0), it will have the System III plug-in ROM assembly (part number 00095-60006). This assembly cannot be taken apart or serviced. If the assembly fails the ROM test, replace it.
- If the computer has the HP-UX System V operating system (Release 5.0 or higher), it will have a plug-in ROM assembly that can be taken apart and repaired. The current versions are the HP 82991A ROM Assembly and the HP 82995A ROM Assembly. The assemblies have room for two PCAs: the operating system ROM PCA and the option ROM PCA (which may or may not be present).

6.16.1 Removing the ROM Assembly

To remove the plug-in ROM assembly, follow the procedure below.

CAUTION

Before installing or removing the plug-in ROM assembly, turn off the computer. Otherwise serious damage to the unit may occur.

Use care when you install or remove the plug-in ROM assembly. Be sure that the assembly is right-side up (there are two guides on the bottom of the assembly) and that it is aligned properly before you try to insert it. The ROM connecting pins in the ROM receptacle are very easily damaged.

1. Turn off the computer.
2. Remove the ROM compartment door in the middle of the back of the computer by pushing the tabs at the top of the door toward the center.

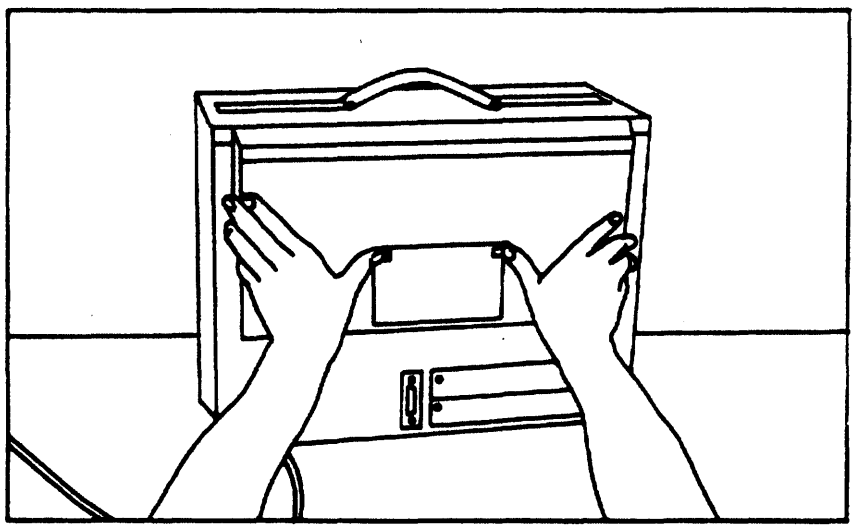


Figure 6-39. Unlocking the ROM Door

3. Remove the protective label that covers the ROM assembly (if present). *The protective label is needed only for the System III ROM assembly. The label is normally not present if the computer has the System V ROM assembly. When you are reinstalling a System V ROM assembly, you don't need the label.*
4. If the computer has the System III ROM assembly, go to step 5. If it has the System V ROM assembly, go to step 7.
5. **System III ROM Removal.** To unlock the ROM assembly, slide the metal tabs on each side toward the center of the assembly.

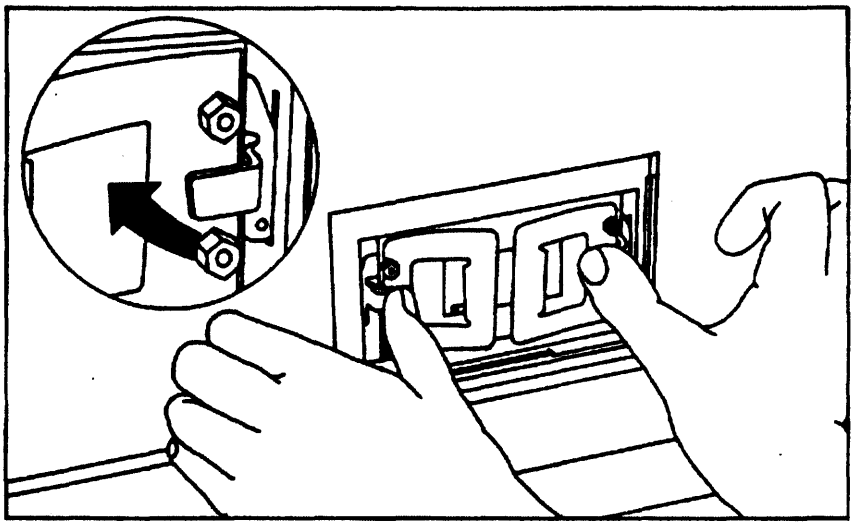


Figure 6-40a. Unlocking System III ROM Assembly

6. Using the clear handles, carefully pull the ROM assembly out. Note that the bottom of the assembly is keyed.

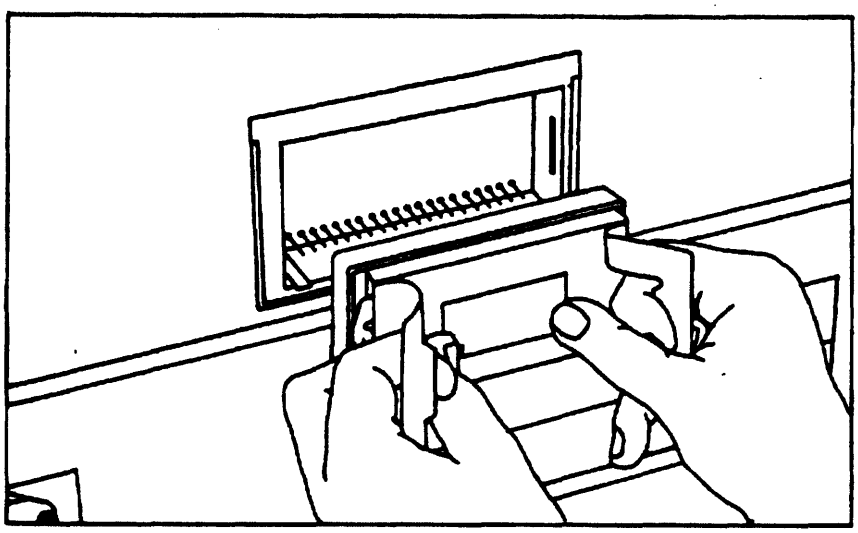


Figure 6-40b. Removing System III ROM Assembly

7. **System V ROM Removal.** To unlock the ROM assembly, pull out the two black handles. Holding onto the black handles, carefully pull the assembly out. Note that the bottom of the assembly is keyed.

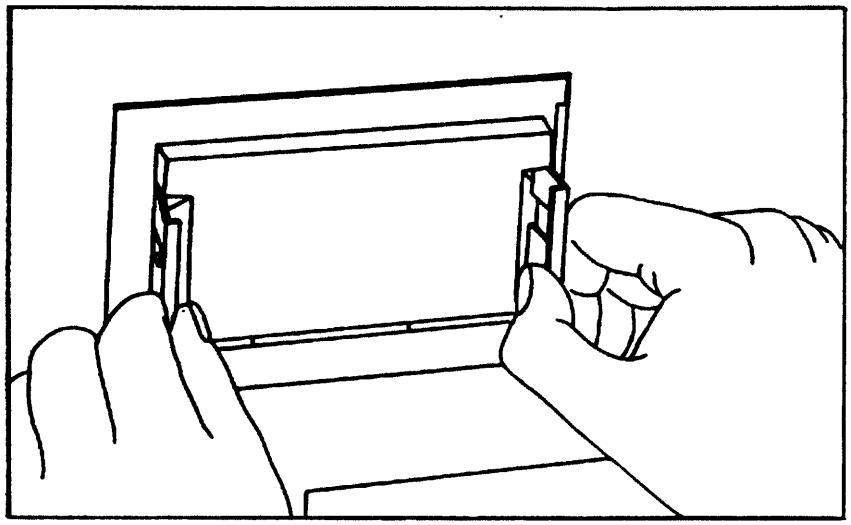


Figure 6-41. Removing the System V ROM Assembly

Reassembly Note: To reinstall the ROM assembly in the computer, make sure that the assembly is right-side up (the bottom of the assembly is keyed), then carefully plug it into the computer. *Be careful not to bend the connector pins.* Lock the ROM assembly in place, then reinstall the ROM door on the back panel of the computer.

6.16.2 Disassembling the System V ROM Assembly

To disassemble the System V ROM Assembly, follow these steps:

1. Remove the ROM assembly from the computer (refer to section 6.16.1).
2. A tab at each corner of the bottom of the ROM case holds the cover on. To release the cover, depress each tab in turn with a small flat-bladed screwdriver while pulling on the cover (see figure 6-42). Once the four tabs are released, remove the cover (making sure the black handles are out).

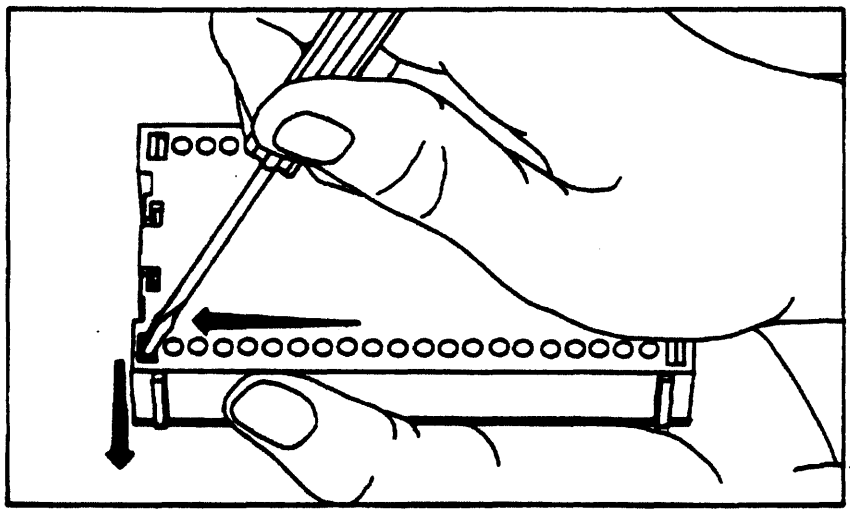


Figure 6-42. Removing the ROM Assembly Cover

3. There may be either one or two ROM PCAs in the plug-in ROM assembly. The operating system PCA is at the bottom, and the option ROM PCA (if present) is on top. The operating system ROM PCA is the larger of the two. Remove the PCAs from the assembly, handling them by the edges to avoid possible ESD damage.
4. If both PCAs are present, separate them by gently pulling them apart. They are held together by opposing connectors at each end. Note that the PCAs can be connected together in only one way.

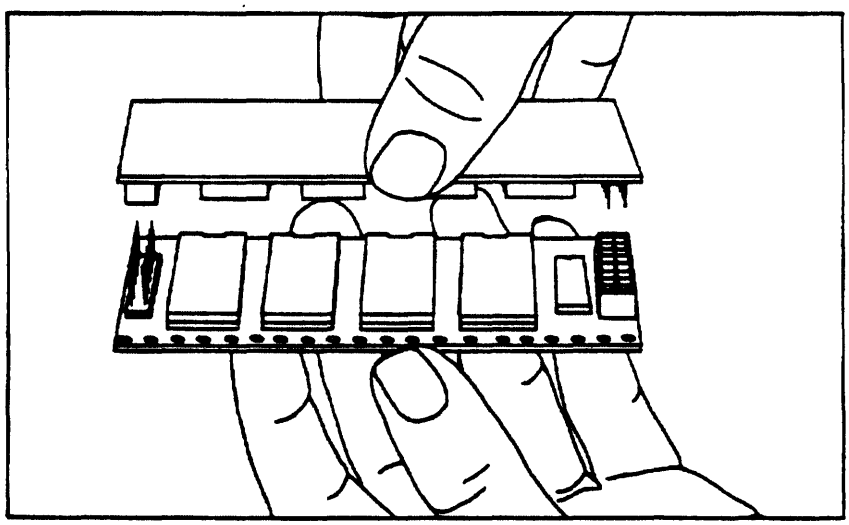


Figure 6-43. Separating the ROM PCAs

5. Once you have serviced the ROM PCAs, put them back together (if both are present). Note that the end connector pins may not go all the way into the receptacles.
6. Put the connected PCAs back into the ROM assembly with the operating system PCA on the bottom. That's the only way they will fit in the container. The operating system PCA is slightly larger and has rows of holes across the top and bottom. Position the reference hole (with a square around it) as shown in figure 6-44.

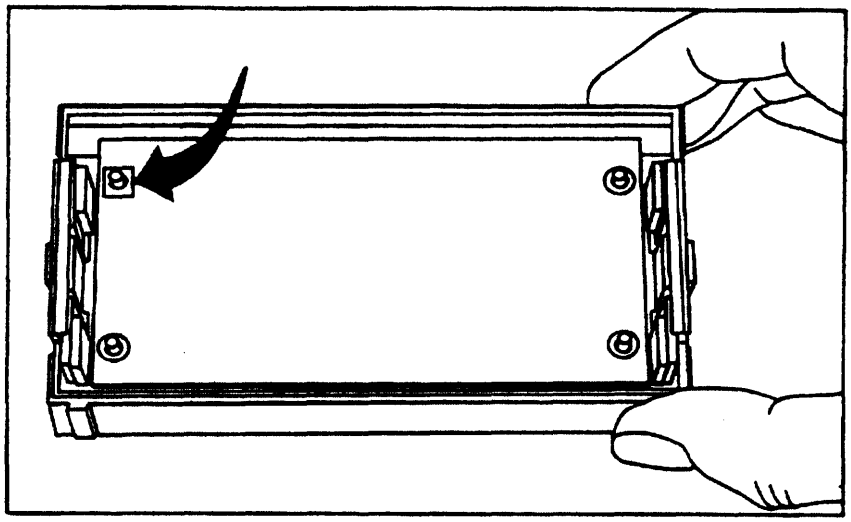


Figure 6-44. Reinstalled PCAs

7. Pull the black handles out (if you have not already done so), then snap on the assembly cover. Note that the keys on the cover and base must match.

6.16.3 Replacing the ROM Connector Pins

If a ROM connector pin in the ROM receptacle on the logic A PCA becomes bent or broken, it should be replaced. Follow these steps:

1. Remove the ROM assembly if one is installed (refer to section 6.16.1).
2. Remove the computer back case (refer to section 6.5).
3. Remove the logic A PCA (refer to section 6.7).
4. Release the plastic ROM guide by disengaging one at a time the two tabs that are inserted in the slots in the logic A PCA (use a flat bladed screwdriver). Press outwards from the inside of the ROM guide. Remove the ROM guide, but be careful not to bend the ROM connector pins. (If a bent pin prevents you from removing the guide, cut off the damaged pin.)

CAUTION

Do not install the plug-in ROM assembly if you have removed the guide assembly from the ROM receptacle on the logic A PCA. If you do, you may not be able to remove the ROM assembly.

5. Desolder and remove all damaged pins. It is easiest to replace two adjacent pins at a time, so you may need to remove one or more good pins as well.
6. Replacement pins are supplied as a strip connected by a rail. Simply cut the rail to remove a pair of pins, insert them in the PCA, and solder them in place as close to the proper alignment as possible. *Do not break the rail off until you have finished aligning the pins.*
7. Once soldered, apply the soldering iron to the solder again and, as the solder remelts, clamp the pins to the adjacent good pins with needle-nose pliers to get the proper alignment. (See figure 6-45.)

8. Remove the soldering iron and hold in place until the solder sets.
9. Once you are satisfied with the alignment of the pins, break off the rail to expose the tips of the new pins.

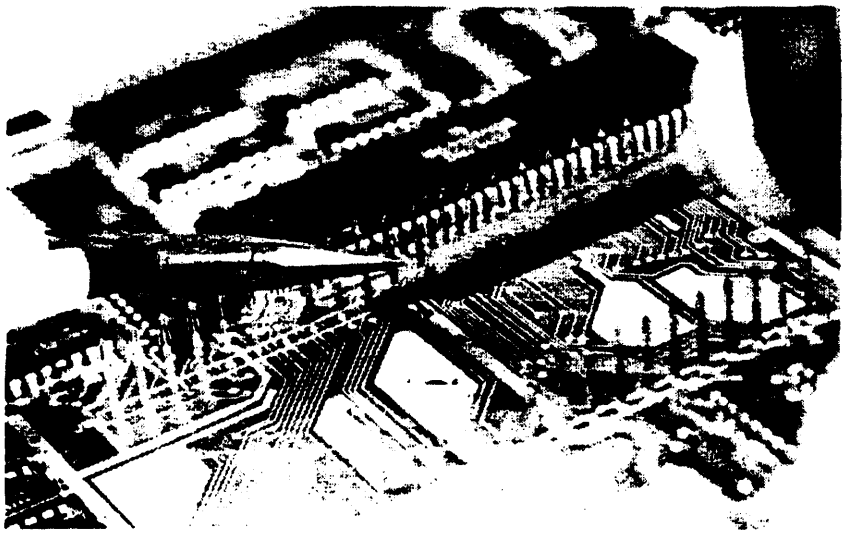


Figure 6-45. Aligning the Pins

Chapter 7
Adjustments

The Integral PC does not require any special adjustments. All electronic adjustments are performed, if needed, as part of the troubleshooting procedures given in chapter 8. Printer-mechanism adjustments are covered in chapter 6.

Chapter 8
Troubleshooting and Diagnostics

8.1 Introduction

This chapter presents the troubleshooting procedures that you will use to test and repair the Integral PC. These procedures allow you to repair all failures at the assembly level and many failures at the component level. The procedures can be used to service an Integral PC with either the HP-UX System III or the HP-UX System V operating system.

Troubleshooting is often begun by the customer, who has two diagnostic tools available: the turn-on self tests (provided by the operating system), and the customer diagnostic disc (provided with the computer). The owner's documentation tells the customer how to use these tests. The customer may comment on the results of these tests.

The troubleshooting procedures that you will use are based on additional, more extensive diagnostic tools. There are three diagnostic tools that you will use to troubleshoot the Integral PC:

- **Turn-On Self Tests.** The operating system provides diagnostic tests that automatically check the ROM and RAM when the computer is turned on.
- **Service ROM Tests.** The service ROM replaces the operating system ROM assembly in the ROM receptacle. The service ROM contains diagnostics that test most of the circuitry of the computer. When you turn on the computer with the service ROM installed, the *sequence test* is run automatically. Once the sequence test is completed, a function key menu appears. You can run an individual diagnostic test by pressing the desired function key.
- **Service Diagnostic Disc Tests.** In order to test the plug-in ROM assembly, the external I/O ports, and the built-in HP-IB interface, you will need to run the tests on the service diagnostic disc (HP part number 00095-60969). This disc can be used with either the System III or System V operating system ROM.

For assembly-level repair, the diagnostic tests indicate a bad assembly. All failures can be repaired by replacing an assembly.

For component-level repair, the diagnostic tests indicate a bad component. However, the diagnostic tests support component-level repair for only certain selected components.

In addition to the diagnostic tests, there are optional procedures that allow you to do selected component-level repair of various assemblies.

8.2 Description of Diagnostics

The following paragraphs describe the diagnostic tests contained in the operating system ROM, the service ROM, and the service diagnostic disc.

8.2.1 Turn-On Self Tests

The operating system ROM provides self tests that run automatically whenever the computer is turned on with the operating system ROM installed. However, these self tests do not display any messages unless an error occurs. In this case an appropriate error message is displayed at the bottom of the copyright window. The following self tests are executed at turn on:

- **The ROM Check-Sum Test.** The operating system ROM has a check sum stored in its last four bytes. This test adds all of the bytes in the ROM (except for the last four bytes) and compares the sum with the check sum.
- **Optional ROM Check-Sum Test.** This test checks to see if an optional ROM PCA is present. If one is found, a check-sum test is performed.
- **RAM Test.** This test checks the internal RAM and any external RAM modules found.

The self tests simply indicate that a problem exists. To diagnose the problem further, use the service ROM and the service diagnostic disc as described in section 8.5.

8.2.2 Service ROM Diagnostic Tests

The service ROM contains most of the diagnostic tests that you will need to troubleshoot the computer.

The Service ROM Sequence Test. When you turn on the computer with the service ROM installed, the service ROM *sequence test* runs automatically. The sequence test includes all of the following tests:

- **Internal RAM Test.** This test checks all RAM locations for address and data uniqueness. If an internal RAM error occurs, an error message will identify the RAM IC to replace (refer to section 8.2.4), the sequence test will stop, and no more tests can be run.
- **MMU Test.** This test checks all functions of the MMU (memory management unit). If an MMU error occurs, the error message is displayed, the sequence test will stop, and no more tests can be run.
- **Short Keyboard Test.** This test checks to see if a keyboard is plugged into one of the keyboard jacks and, if so, tests the keyboard. If no keyboard is connected to either jack, an error message is displayed.
- **Display/GPU Test.** This test checks the display RAM and GPU, then presents a series of test patterns. These test patterns can be used to spot display faults.
- **Floppy Disc Test.** This test checks the operation of the floppy disc drive. You must install a blank, formatted disc in the drive before this test is run. If you do not, an error message will be displayed. *Note that any data or programs on this disc will be lost.*
- **RTC Test.** This test checks the real-time clock.
- **External RAM Test.** This test searches for an external RAM module, then checks the operation of the module and, indirectly, the I/O port in which it is installed. The test reports the number of K-bytes of RAM contained in the module, then runs a module diagnostic test and reports whether the module passed or failed the test.

  In testing the computer, this test is used to check the data and address lines of each I/O port. The test is run with a known-good RAM module installed first in port A, then in port B, before the power is turned on. *Always turn off the power before installing or removing a module in an I/O port.* If an error message occurs, it indicates a failure of the I/O bus or a portion of the logic circuitry since the RAM module is known to be good.

- **Speaker Test.** This test checks the speaker by outputting an ascending musical scale. If you do not hear the notes, the speaker (or its associated circuitry) is bad.
- **Short HP-IB Test.** This test checks the built-in HP-IB interface.
- **Short Printer Test.** This test checks the printer control circuitry and prints three lines. If the test is passed, the printer will output the results of all tests in the sequence.

During the sequence test messages are displayed and printed to indicate which tests have been passed or failed. Once the display/GPU test is done, you can halt the sequence test if desired by pressing any key.

When the sequence test is completed, a function key menu appears. You can repeat any individual test by pressing the appropriate function key. In addition, there is a function key that allows you to repeat the entire sequence test, and there are function keys for three *extended tests* (refer to "Service ROM Extended Tests" below).

Continuous Mode. You can run each of the tests in continuous mode (except the complete keyboard test, described below). Press the (Shift) key and the appropriate function key. The test will run and repeat continuously. You can exit any test (except the complete keyboard test) by pressing (ESC).

Service ROM Extended Tests. The service ROM provides three extended tests: the *printer test*, the *complete keyboard test*, and *continuous HP-IB test*.

> **Note:** The printer test and the complete keyboard test must be run to completely evaluate the computer. The continuous HP-IB test is used for component-level HP-IB troubleshooting if the short HP-IB test or the service diagnostic disc HP-IB test indicates an HP-IB failure.

- **Printer Test.** This test prints a page using various character sets and print pitches that you can analyze for consistency and uniformity.

  You can also run this test with the operating system installed by pressing and holding the LF (line-feed) button while you turn on the power, then releasing the button.

- **Complete Keyboard Test.** This test checks both HP-HIL loops. The test searches for a keyboard, tests the loop to which the keyboard is connected, then gives you 10 seconds to unplug the keyboard and connect it to the other loop. At the end of this period, the other loop is tested.

  After both loops have passed the test, a representation of the keyboard is displayed. You can then test each key. When you press a key, its outline changes to black if the key is good. Pressing the same key repeatedly toggles the key outline from amber to black and back again. Blacken all keys to complete the test. (You can execute this test easily by running your finger quickly along each row of keys.) After all keys have been blackened, the display will flash and the speaker will beep. While the keyboard outline is displayed, you can exit the test if desired by pressing (CTRL)(C).

- **Continuous HP-IB Test.** This test, like the other continuous tests, is started by pressing the (Shift) key and the function key at the same time. However, this test (unlike the short HP-IB test) outputs alternate highs and lows to certain pins in the built-in HP-IB connector. You can check the output using an oscilloscope or logic probe.

8.2.3 Service Diagnostic Disc Tests

The service diagnostic disc (HP part number 00095-60969) provides the following tests:

- **ROM Test.** For the HP-UX System III ROM assembly, a check-sum test is performed and a message indicates whether the ROM assembly passed or failed the test.

  For the HP-UX System V ROM assembly, a check-sum test is performed and a message indicates whether the ROM assembly passed or failed. If the ROM assembly failed the overall test, a check-sum test is done *individually* for each ROM IC on the operating system PCA. If the ROM assembly contains an option ROM PCA, each ROM on that PCA is also tested. If a ROM IC on either PCA fails the test, an error message identifies it.

- **I/O Diagnostic Tests.** You can test an I/O interface by pressing the appropriate function key. Refer to the *Integral PC Interface and Memory Module Assembly-Level Service Manual* for the troubleshooting procedures.

- **Bus Expander Test.** You can also use the service diagnostic disc to test the HP 82904A Bus Expander. Refer to the *HP 82904A Bus Expander Service Manual.*

The procedures in this chapter use the ROM test plus two of the I/O diagnostic tests: the *serial interface test* and the *HP-IB interface test.*

The serial interface test performs a functional check of an HP 82919A Serial Interface installed in one of the I/O ports and, indirectly, of the I/O port itself. In this manual the test is used with a known-good serial interface to test the interrupt lines for port A and port B. To complete this test, the serial interface must be installed in the computer, and a 82919-60903 Serial Test Connector must be installed in the interface before the computer is turned on.

The HP-IB test performs a complete functional check of the built-in HP-IB of the Integral PC and of an external HP-IB interface plugged into an I/O port. In this manual the test is used to check the built-in HP-IB using a known-good HP 82998A HP-IB Interface. To perform the test you need to do the following before you turn on the computer: install the I/O port extender (00095-60902) in an external I/O port, install the HP 82998A HP-IB Interface in the port extender, and connect the the interface to the built-in HP-IB with an HP 82977A/B HP-IB Cable.

> **Note:** The current service diagnostic disc (HP part number 00095-60969) can be used to test an Integral PC equipped with either the HP-UX System III or System V operating system. The earlier I/O diagnostic disc (HP part number 00095-60942) cannot be used with System V.

8.2.4 Error Number Interpretation

The service ROM and service diagnostic disc return two kinds of error messages:

- Error messages that describe the problem (for example: `*** ERROR - The external RAM failed`).
- Error numbers (for example, `*** ERROR - 120`).

If an error message gives a number, it will be a three-digit number identifying an integrated circuit to be replaced. The first digit identifies the printed circuit assembly on which the IC is located:

- 1 indicates the logic A PCA.
- 2 indicates the logic B PCA.
- 3 indicates the operating system ROM PCA (System V only).
- 4 indicates the option ROM PCA (System V only).

The operating system ROM PCA and the option ROM PCA (if present) are located in the System V plug-in ROM assembly.

The last two digits in the three-digit error number identify the specific IC that is defective. For example, `*** ERROR - 120` means that U20 on the logic A PCA is defective, while `*** ERROR - 201` means that U1 on the logic B PCA is defective. The ROM test on the service diagnostic disc returns errors like `*** ERROR - 304` (U4 on the operating system ROM PCA is defective).

8.3 Safety Considerations

To insure safety while you disassemble the computer you should disconnect the power cord (refer to chapter 6). However, you will need to reconnect the power in order to troubleshoot the computer. Observe the following precautions:

- There are *life threatening voltages* present in the primary circuitry of the power supply at all times when the line cord is connected, *even though the power switch is off.* Use extreme care whenever you troubleshoot the computer with the power supply cover removed.
- Use only an isolated or battery-powered voltmeter when testing the power supply primary circuit.

You should also observe the ESD (electrostatic discharge) precautions given in chapter 6.

8.4 Required Tools and Equipment

Table 8-1 lists the tools and test equipment that you will need to troubleshoot and repair the computer.

Table 8-1. Required Tools

Part Number	Description
8710-1426	Torx kit
8710-1284	T-10 angle driver
8710-1220	5.5-mm nut driver
8710-0797	9/32-in. nut driver
00095-60901	Power supply test tool
00095-60007	Harness, power-cable
00095-60925	Service ROM
00095-60969	Service diagnostic disc

Table 8-1. Required Tools (Continued)

Part Number	Description
HP 82916A/25A/27A	Memory module (1M byte/256K byte/512K byte), only one needed.
HP 82919A	Serial interface
82919-60903	Serial test connector
HP 82998A	HP-IB interface
HP 82977A/B	HP-IB cable
00095-60902	I/O port extender
HP 3469B*	Multimeter, or equivalent
	Oscilloscope
	Logic probe
	Frequency counter (preferably six significant digits)
	Soldering iron
	Desoldering tool

* The HP 5005A Signature Multimeter is recommended. You can use this instrument in place of the multimeter, logic probe, and frequency counter listed above.

8.5 Main Diagnostic Procedure

To check out a unit prior to repair, follow the problem analysis steps in section 8.5.1, then do the turn-on self tests (section 8.5.2), the service ROM tests (section 8.5.3), and the service diagnostic disc tests (section 8.5.4). Once you have identified the problem, repair the computer using the repair procedures in section 8.6, then verify the repair by repeating the appropriate tests. (For a good unit, you'll proceed through the entire main sequence without branching to any of the repair procedures.)

Once you have repaired the computer and verified the repair, perform a complete functional verification of the computer following the procedure in section 8.5.5.

CAUTION

Whenever you open up the computer, wear a grounded wrist strap and work at a bench that is electrostatically protected. Refer to "ESD Considerations" in chapter 6. Many components are highly susceptible to damage by electrostatic discharge.

Figure 8-1 provides an overview of the Integral PC troubleshooting procedure:

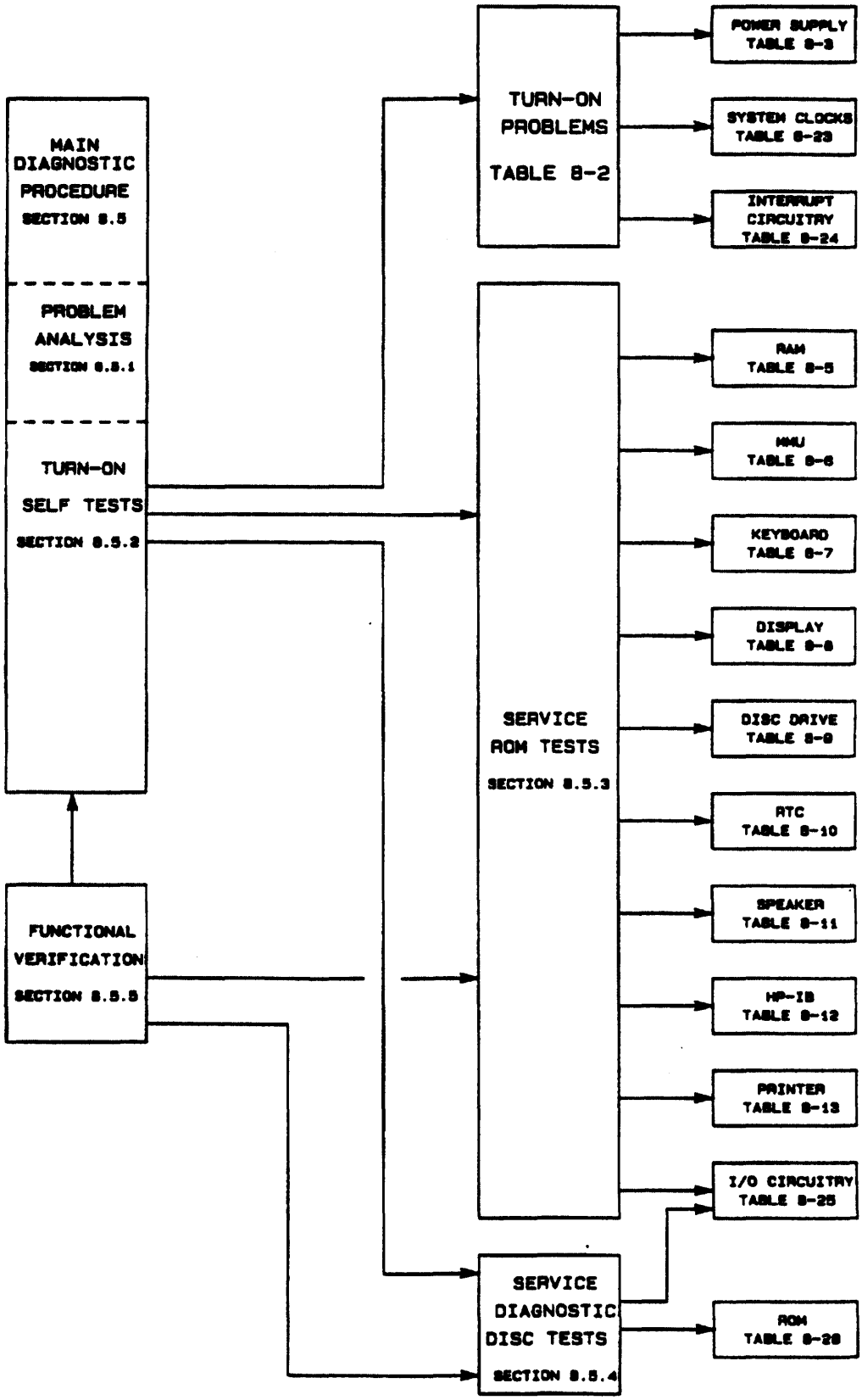


Figure 8-1. Troubleshooting Overview

8.5.1 Problem Analysis

1. **Read Comments.** Determine the customer's concern, if possible. Frequently the customer includes with the computer a message describing the problem.
   - If the message indicates a problem with a particular section of the computer, you may need to test only that section. However, you should do a complete verification of the computer after you have repaired it.
   - If the message indicates a problem with a *peripheral* (rather than with the computer itself), test the Integral PC I/O circuitry and the corresponding interface. You also need to test the peripheral (refer to its service manual).
2. **Observe Symptoms.** If possible, try to observe the trouble by duplicating the situation described. Determine how the observed or reported behavior differs from the proper behavior. (Also take note of functions that work properly.) You may want to run the tests of the customer diagnostic disc to verify a reported error condition.
3. **Separate Problems.** Separate the symptoms into distinct problems. Use the troubleshooting procedure below to correct one problem at a time, starting with the more critical system functions.
4. **Consider Causes.** Consider possible causes for each problem. Keep them in mind as you perform the troubleshooting procedure.

8.5.2 Turn-On Self Tests

Prepare the computer as described in chapter 3, then turn on the power. The normal power-on sequence is as follows:

- The disc drive light blinks.
- The yellow attention LED on the printer switch panel blinks twice.
- The display lights up.
- The printhead sweeps twice and stops at the home position.
- The "copyright window" appears at the bottom of the display after several seconds.

The turn-on self tests run automatically whenever the power is turned on with the operating system installed. An error message will be displayed in the copyright window if any self test is failed. If the copyright window shows no error messages, all of the self tests were passed.

If the computer does not appear to come on when you turn on the power (if you see no display activity within 20 seconds), follow the procedure given in table 8-2, "Turn-On Problems."

> **Note:** An interface or memory module installed in an external I/O port may prevent the computer from turning on. If the customer has sent any interfaces or memory modules with the unit, try the turn-on self test first with them installed. If the computer doesn't turn on correctly, remove the interfaces or modules one at a time (always turn off the power before removal), repeating the turn-on test after each removal. If the computer turns on correctly, troubleshoot the interface or memory module that you have just removed.

8.5.3 Service ROM Tests

Now run the service ROM tests as follows:

CAUTION

Before installing or removing the service ROM assembly, turn off the computer. Otherwise serious damage to the unit may occur.

Use care when you install or remove the ROM assembly. Be sure that the assembly is right-side up (there are two guides on the bottom of the assembly) and that it is aligned properly before you try to insert it. The ROM connecting pins in the ROM receptacle are very easily damaged.

1. **Preparation.** Turn off the computer and disconnect it from the power.
2. Remove the ROM door from the back of the computer, remove the operating system ROM assembly, and install the service ROM assembly.
3. Remove the customer's interfaces and memory modules, and install a *known-good* RAM module in port A.
4. Reconnect the power to the computer.
5. Insert a *formatted* floppy disc into the disc drive. Do not use a disc that contains useful data. *Any data on the disc will be destroyed during the test.*
6. **Sequence Test.** Turn on the computer. After power up, the service ROM sequence test runs automatically. This test checks the following circuits:
   - Internal RAM.
   - MMU (memory management unit).
   - Keyboard (short test).
   - Display/GPU. (If there is a GPU failure, the speaker will output a *descending* musical scale.) Watch the series of patterns to check for display problems.
   - Floppy disc drive.
   - RTC (real-time clock).
   - External RAM. (Since the RAM module is known to be good, this test indicates whether the port A I/O bus data and address lines are good.)
   - Speaker. An *ascending* musical scale is output to verify speaker operation.
   - Internal HP-IB (short test).
   - Printer (short test).

   Refer to section 8.2.2 for a description of these tests. An appropriate message will be displayed after each test is passed. If a test is failed, an error message will be displayed. After the internal RAM, MMU, keyboard, and display/GPU tests are done, you can halt the sequence test by pressing any key.

7. When the sequence test is completed or halted, the following function key menu is displayed. (The data displayed at the top of the screen will be different if an error occurs or the test is halted.)

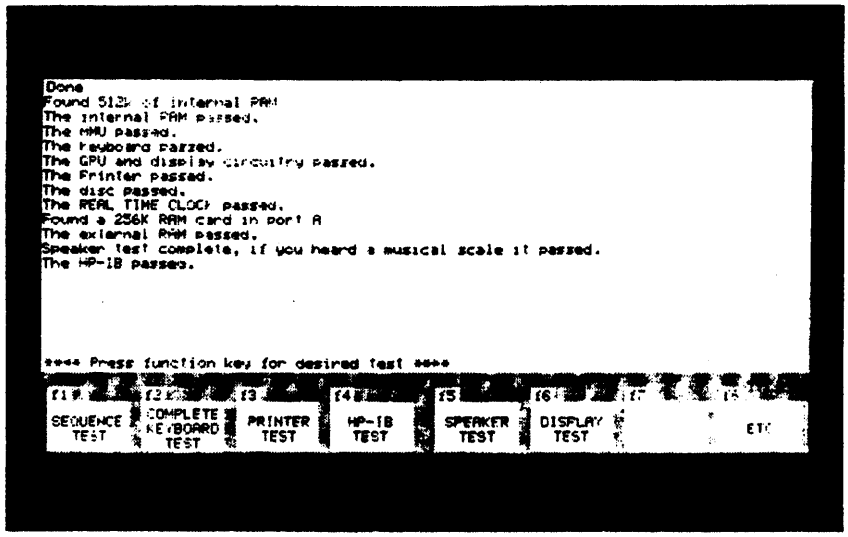


Figure 8-2. Function Key Menu

8. If any test gives you an error message, repeat that test. You can repeat an individual test or restart the sequence test by pressing the appropriate function key. Press the ETC (f8) key to switch to the second menu:

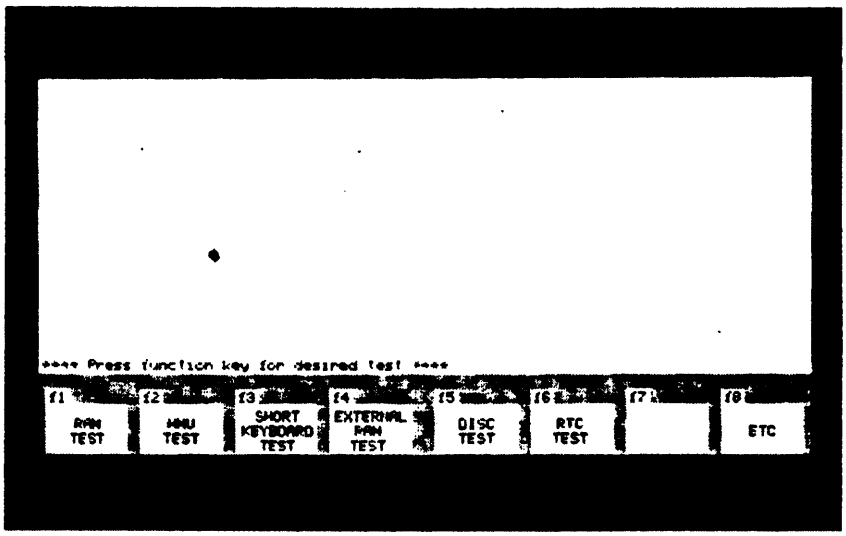


Figure 8-3. Second Function Key Menu

9. **Complete Keyboard Test.** Press COMPLETE KEYBOARD TEST (f2 on the first menu) to run this test. The test will locate the keyboard, identify the loop on which it was found, then prompt you to move the keyboard plug to the other jack. When the keyboard outline is displayed, press each key until the whole outline is blackened. (Each key will toggle between amber and black when pressed repeatedly.) Note any key that does not work.

10. **Printer Test.** Press [PRINTER TEST] ([f3] on the first menu) to run this test. The test checks the printer control circuitry, then causes the printer to print a one-page test pattern. Inspect the test pattern for any printer problems.

    After the printer test is completed, check the operation of the line-feed (LF), form-feed (FF), and top-of-form (the white button) switches on the printer switch panel. Refer to table 8-14 (steps 7, 11, and 13) for the procedure.

11. **RAM Test (Port B).** Turn the computer off. Remove the RAM module from port A and install it in port B. Turn the computer back on. The sequence test will begin. Press any key to stop the sequence after the display test is done. Press [ETC] ([f8]), then press [EXTERNAL RAM TEST] ([f4]) to test the data and address lines of I/O port B.

    Note: If an external RAM error is indicated for either I/O port, troubleshoot the I/O circuitry as described in table 8-25.

12. Take the appropriate action according to the results of the tests:

    - If any service ROM test returns an error message, repair the computer following the appropriate service procedure in section 8.6. Table 10-6 lists the error messages generated by the service ROM, and gives the table number of the appropriate service procedure for each. *After you have repaired the computer, verify its operation following the steps in section 8.5.5, "Functional Verification."*
    - If the service ROM tests have all been passed, perform the service diagnostic disc tests in the following section.

8.5.4 Service Diagnostic Disc Tests

You can use the service diagnostic disc (HP part number 00095-60969) to diagnose an Integral PC equipped with either HP-UX System III or HP-UX System V. To determine which operating system the computer has, turn on the computer. The release number of the operating system will appear in the copyright window: `HP-UX RO/ Release 1.0.0` indicates System III, and `HP-UX RO/ Release 5.0` indicates System V.

Note: If the computer will not turn on, refer to section 6.16 to identify the ROM assembly.

To run the service diagnostic disc tests, follow these steps:

1. **Preparation.** Turn off the computer. Remove the RAM module and install a *known good* HP 82919A Serial Interface in I/O port A. Insert the serial interface test connector (HP part number 82919-60903) in the interface.
2. Insert the service diagnostic disc and turn on the computer. Wait until the P.A.M. window appears, select the "Service" program (use the cursor-control keys if necessary), press [Start] ([f1]), then press [Cont] ([f1]).
3. **ROM Test.** Press [ETC] ([f8]). The second function key menu will be displayed. Press [ROM] ([f7]) to run the ROM test.

4. If the computer has HP-UX System III installed, the ROM test indicates only whether the entire ROM assembly passed or failed the check-sum test. If a ROM failure is indicated for the System III ROM assembly, replace it.

   If the computer has HP-UX System V installed, the ROM test will check each ROM IC on the operating system ROM PCA and on the option ROM PCA (if one is present). If there is a ROM failure, an error message will identify the failed ROM IC. Repair the assembly as described in table 8-26.

   If the ROM test is passed, press Cont (f8) to return to the menu.

5. **Serial Interface Test.** To test the port A interrupt lines, run the serial interface test (be sure to use a known-good serial interface). Press Esc (f8) to return to the first menu, then press Serial (f2) to start the test.

6. Normally, the following series of messages will be displayed:

```
Serial card found in port A
The serial card passed
Continuous loop mode
Number of passes: xx
```

   The test will repeat continuously until either the power is turned off or a failure occurs. If an error message is displayed, troubleshoot the I/O circuitry following the procedure in table 8-25. If no error message appears after two passes, go on to step 7.

7. Remove the service diagnostic disc and turn off the computer.

8. Remove the serial interface from port A and install it in port B.

9. Reinsert the disc and turn on the computer. Wait until the P.A.M. window appears, select the "Service" program, press Start (f1), then press Cont (f1).

10. Repeat the serial interface test (steps 5 and 6 above) for port B.

11. Remove the disc and turn off the computer.

12. Remove the serial interface from port B. Install a *known-good* HP 82998A HP-IB Interface using the port extender so that you will have access to the switches on the PCA. Put the jumper in the *system controller* position and set the switches as follows: S1=1, S2=0, S3=1, S4=0, and S5=1. Connect the external HP-IB to the built-in HP-IB using an HP 82977A/B HP-IB cable.

13. Reinsert the disc and turn on the computer. Wait until the P.A.M. window appears, select the "Service" program, press Start (f1), then press Cont (f1).

14. **HP-IB Test.** Now run the HP-IB test to check the built-in HP-IB. Press the HP-IB (f7) key to start the test. As the test runs, the program will prompt you to move the system controller/non-system controller jumper, and to change switch settings. In each case, do as asked, then press Return. The test will continue cycling until an error occurs or the power is turned off. Remove the disc and turn off the computer after two passes if no error message appears.

Note: If you suspect a problem with the external HP-IB interface (for example, a failed switch or jumper), troubleshoot the interface (refer to the *Integral Personal Computer Interface and Memory Module Assembly-Level Service Manual*).

15. If an HP-IB problem is indicated, troubleshoot the built-in HP-IB following the procedures in table 8-12.

If no trouble with the computer is found by the turn-on self tests, the service ROM tests, or the service diagnostic disc tests, look again at the customer's comments.

- If the customer has indicated a problem with a peripheral, test the peripheral and the interface used to connect it. (Refer to the peripheral service manual and the *Integral PC Interface and Memory Module Assembly-Level Service Manual*).
- If the customer has indicated an external RAM problem, test the RAM module (refer to the *Integral PC Interface and Memory Module Assembly-Level Service Manual*).
- If the customer has indicated a problem that may be intermittent, try letting the unit run for a while, then repeat the tests. It may be helpful to run the applicable test in continuous mode. You may also want to try heating the circuitry with a heat gun and cooling it with freon.

8.5.5 Functional Verification

Once you have repaired the computer and you have verified the repair, you should perform a complete functional verification of the computer.

> **Note:** If you have disassembled the computer so that the logic B PCA is accessible, it is a good idea to check the voltage of the real-time clock battery (BT1 on the logic B PCA) before reassembling the computer. This step is optional (refer to table 8-10).

Reassemble the computer, then perform the verification as follows:

1. Run the turn-on self tests in section 8.5.2.
2. Run the service ROM tests in section 8.5.3.
3. Run the service diagnostic disc tests in section 8.5.4.

8.6 Troubleshooting and Repair

The following tables describe the procedures for troubleshooting and repairing specific sections of the computer. Perform the diagnostic tests in section 8.5 to determine which section of the computer is not working correctly, then go to the appropriate table in this section. Tables 10-5, 10-6, and 10-7 list the error messages that you may encounter, and identify the corresponding repair tables.

Table 8-2. Turn-On Problems

If the computer does not appear to come on when you turn on the power (if you see no display activity within 20 seconds), follow the turn-on analysis procedure in this table. Make sure that the computer is set to the correct line voltage and is connected to an active electrical outlet.

The procedure assumes that no interfaces or memory modules are installed in the external I/O ports. An interface can cause interrupt problems that may prevent the computer from turning on. If you find that the computer will not turn on with an interface installed, but operates normally without the interface, troubleshoot the interface.

Note: The following procedure assumes that (initially) the operating system ROM is installed in the computer.

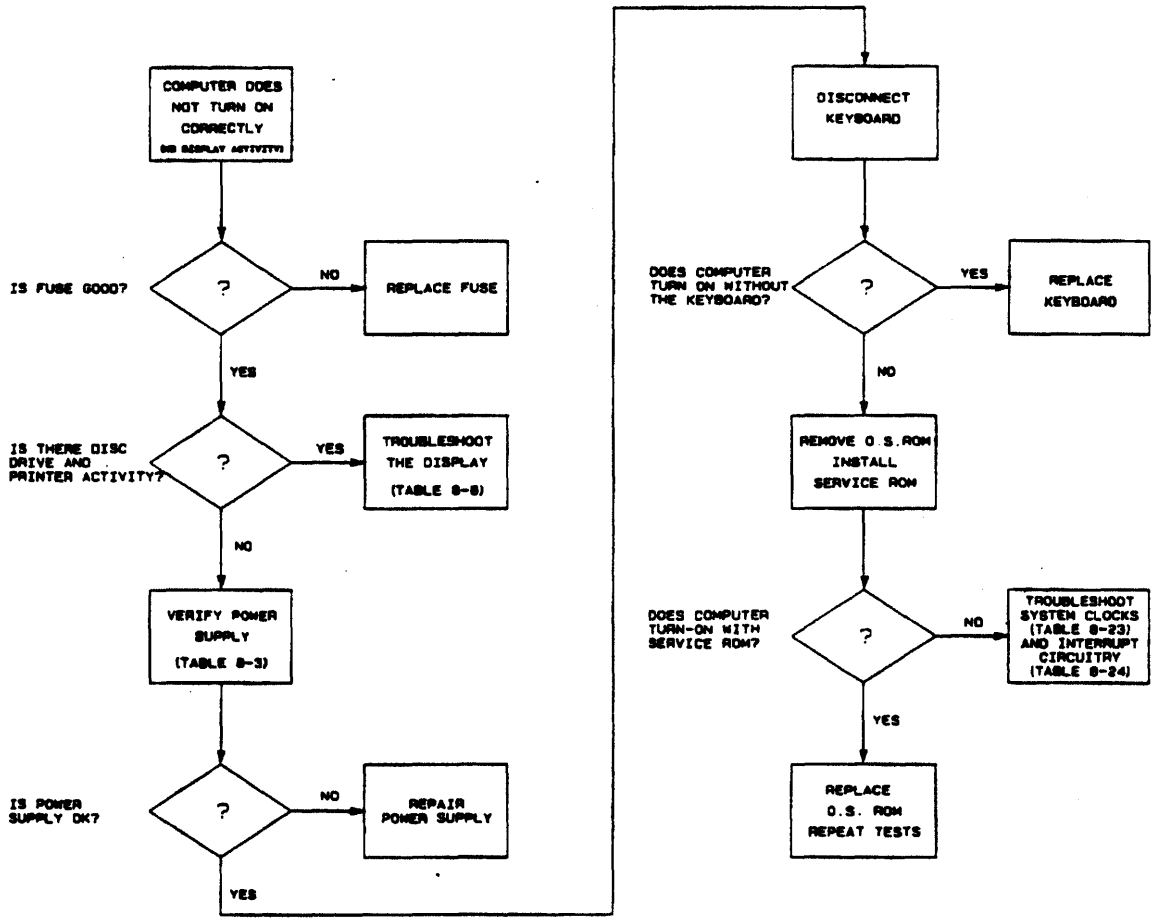


Figure 8-4. Turn-On Analysis Flow Chart

Table 8-2. Turn-On Problems (Continued)

Step	Response
1. Turn off the computer and check the fuse.	If the fuse is bad, replace it, then go to step 2. If the fuse is good, go on to step 2.
2. Turn on the computer.	If there is no display activity, but the disc drive light blinks and the printer goes through its homing cycle, a display problem is probable. Troubleshoot the display following the procedure in table 8-8. **Note:** If the display shows only a blank raster pattern, there may be a ROM problem. See step 5. If there is no power-up activity at all (no display, printer, or disc drive activity), or if the fuse blows, go on to step 3.
3. Verify power supply operation as described in table 8-3.	If the power supply is not working correctly, repair it, then proceed with the diagnostic tests in section 8.5. If the power supply is working correctly, go on to step 4.
4. Turn off the computer, disconnect the keyboard, then repeat the turn-on tests.	If the computer now turns on correctly, the keyboard is probably causing an interrupt problem. (The power-up cycle takes more time without the keyboard.) Replace the keyboard assembly, then proceed with the diagnostic tests of section 8.5. If the computer still does not power up correctly, turn off the power, reconnect the keyboard, and go on to step 5.
5. Turn off the computer. Remove the operating system ROM assembly and install the service ROM assembly. Turn on the computer.	If the computer does not turn on with the service ROM installed, troubleshoot the system clocks (table 8-23), then look for interrupt problems (table 8-24). If the service ROM sequence test runs normally and displays messages, the operating system ROM may be bad: ■ If the original ROM assembly contains HP-UX System III (Release 1.0.0), replace the ROM assembly. ■ If the original ROM assembly contains HP-UX System V (Release 5.0), remove the option ROM PCA (if present) and repeat the turn-on test. If the computer turns on correctly with just the operating system ROM PCA installed, replace the option ROM PCA. If the operating system ROM alone prevents the computer from turning on, replace the operating system ROM PCA.

Table 8-3. Power-Supply Verification

If the computer does not turn on, use the procedure of table 8-2 to eliminate the possible causes. If the power supply appears to be at fault, use this procedure to verify its operation.

WARNING

Life-threatening voltages are present in the power supply when the ac power cord is plugged in. *The primary circuitry is live even when the power switch is turned off.* Use extreme caution when you are servicing the power supply.

All voltage measurements made on the primary side of the power-supply circuit must be made with an isolated or battery-powered test instrument. If you fail to observe this precaution, the equipment may be damaged, and you may be exposed to shock hazard, since the primary circuit is not isolated from the ac power line.

Step	Response
1. Turn the power switch off. Check that the power supply voltage-select switch is set at the proper voltage and that the fuse is good. Check that line voltage is present at the power outlet and that the power cord is installed correctly.	
2. If any interfaces or peripherals are connected to the computer, disconnect them. Turn on the power to verify that the turn-on problem was not caused by the external devices.	If the unit does not turn on, go to step 3. If the unit does turn on, reconnect the interfaces and peripherals one at a time until the unit does not turn on. Repair any interface or peripheral that prevents the computer from turning on (refer to the appropriate service manual).
3. Turn off the power. Remove the back case from the computer (refer to section 6.5), remove the logic A PCA shield, and lower the logic PCA mounting panel (refer to section 6.8).	
4. Disconnect the power-cable harness from the logic A PCA, the logic B PCA, and the disc drive.	

CAUTION

Be sure to plug the power-supply test tool into the logic B connector on the power-cable harness *only*. If you plug the tool into the logic A connector, serious damage to the unit may result.

Make sure that the power supply test tool does not contact the metal chassis. A short circuit may result in damage to the test tool and power supply.

Table 8-3. Power-Supply Verification (Continued)

Step	Response
5. Plug the power supply test tool into the power-cable harness *in place of the logic B PCA*. The power supply test setup should now look like figure 8-5.	

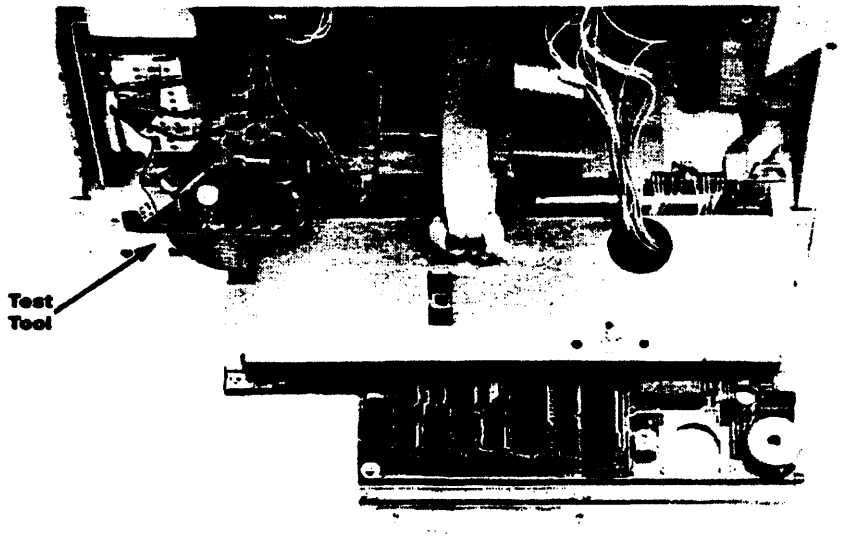


Figure 8-5. Power Supply Test Setup

6. Switch on the power.	
7. Measure the voltages on the test tool. Check each voltage against the specifications below.	If any of the voltages are not within the specified range, go to table 8-4 for repair instructions. If all of the voltages are within range, go to step 8.

Nominal Voltage	Allowable Range
+5 Vdc	4.75V to 5.25V (5.1V nominal)
+12 Vdc	11.4V to 12.6V
−12 Vdc	−11.4V to −12.6V
+15 Vdc	14.25V to 15.75V
+18 Vdc	26V to 30V under test load*
$\overline{PD}$	4.75V to 5.25V†

* The +18 Vdc output is not regulated. When the display is connected (through the logic B PCA), the voltage is typically 21 Vdc, and should be in the range 18 to 22 Vdc. Without the display load, the voltage floats to 26–30 Vdc.

† There is a delay of approximately two seconds after the power is turned on (depending on the line voltage) before the $\overline{PD}$ voltage is present.

Table 8-3. Power-Supply Verification (Continued)

Step	Resulting Action
8. If the power supply functions correctly by itself, but you still have a turn-on problem, the voltages may be affected by the other circuitry of the computer. For example, there may be a short circuit or an excessive load on a component. To isolate the problem, reconnect the circuits to the power supply following steps 9 through 16. *In each of these steps, always turn off the power before you connect or disconnect a cable, or replace a component.*	
9. Turn off the power. Reconnect the power-cable harness to the logic A PCA (leave the power supply test tool connected).	
10. Turn on the power and measure the voltages on the test tool as in step 7 above.	If the voltages are all within specification, go to step 13. If any of the voltages are out of specification, or if the fuse blows, the problem is on the logic A PCA, the keyboard assembly, the I/O backplane PCA, the keyboard-connector assembly, or the ROM assembly. Proceed with step 11.
11. Disconnect, each in turn, the following components from the logic A PCA: the keyboard, the I/O backplane PCA, and the keyboard-connector assembly. After removing each component, turn on the power and measure the voltages on the test tool as in step 7.	If the voltages are in specification after one of the components is disconnected, troubleshoot or replace that component (or its corresponding cable). If the voltages are still not within specification, or if the fuse blows, go on to step 12.

Table 8-3. Power-Supply Verification (Continued)

Step	Resulting Action
12. Remove the plug-in ROM assembly, turn on the power, and measure the voltages on the test tool as in step 7.	The display will show only a blank raster pattern without the ROM, but you can check the power supply voltages. If the voltages are still not within specification or if the fuse blows, troubleshoot or replace the logic A PCA. If the voltages are now within specification, the problem is in the plug-in ROM assembly: ■ For a System III ROM assembly, replace the whole assembly. ■ For a System V ROM assembly that contains no option ROM PCA, replace the operating system ROM PCA. ■ For a System V ROM assembly that contains an option ROM PCA, remove the option ROM PCA and turn on the computer with just the operating system ROM PCA installed. If the voltages now check good, replace the option ROM PCA. If the voltages are still bad or if the fuse blows, replace the operating system ROM PCA.
13. Reconnect the power-cable harness to the disc drive, then turn on the power. Check the voltages at the power supply test tool as in step 7 above.	If the voltages are all within specification, go to step 14. If any of the voltages are out of range, or if the fuse blows, replace the disc drive.
14. Remove the power supply test tool, reconnect the power-cable harness to the logic B PCA.	

Table 8-3. Power-Supply Verification (Continued)

Step	Resulting Action
15. Turn on the power. Measure the voltages on the power-cable harness at connector J12 on the logic B PCA.	The voltages at connector J12 are as follows (pin 1 is marked with a square indicator): Pins 1 & 2: +5 Vdc (4.75V to 5.25V) Pins 3 & 4: ground Pin 5: +12 Vdc (11.4V to 12.6V) Pin 6: +15 Vdc (14.25V to 15.75V) Pin 7: +18 Vdc (18V to 22V with the display connected)* Pin 8: no connection Pin 9: logic ground Pin 10: $\overline{PD}$ (4.75V to 5.25V after two seconds) If any of the voltages are out of specification or if the fuse blows, the problem may be in the logic B PCA, or it may be in one of the components connected to it. Proceed with step 16.
16. Disconnect, each in turn, the following components from the logic B PCA: the disc drive, the HP-IB ribbon cable, the printer (six cables), the fan, and the display. Repeat the test of step 15 after disconnecting each component.	If the voltages are in specification after one of the components is disconnected, troubleshoot or replace that component (or its corresponding cable). If any of the voltages are out of specification or the fuse blows after all of the components are disconnected, troubleshoot or replace the logic B PCA.

* Once the display is disconnected, the voltage at pin 7 will float to 26–30 Vdc.

Table 8-4. Power-Supply Repair

Use this table to repair the power supply. If more than one component is listed as a potential problem source, replace the components one at a time in the order shown. *Always turn off the power before you connect or disconnect a cable or replace a component.* After you have replaced each component, verify the power supply output voltages (step 7 of table 8-3) to see if the problem is corrected. You will find the component-location diagram in chapter 12 helpful in locating components on the PCA.

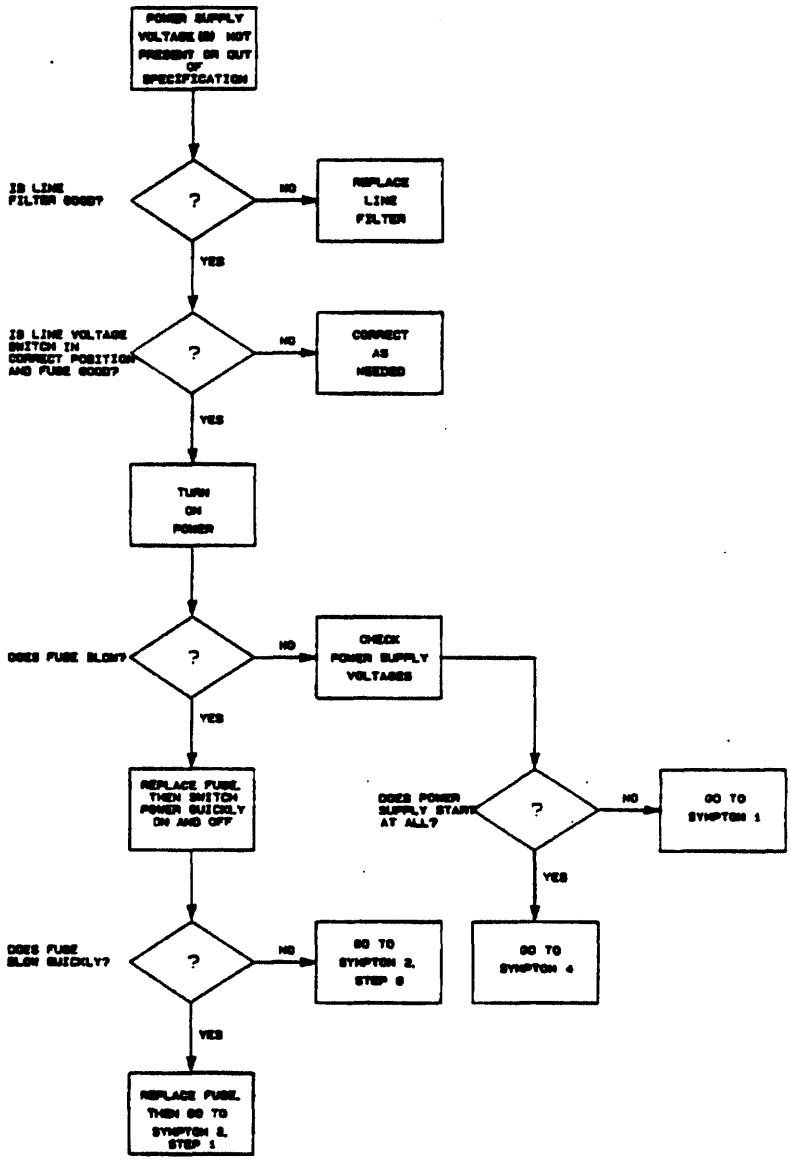


Figure 8-6. Power-Supply Repair Simplified Flow Chart

Table 8-4. Power-Supply Repair (Continued)

WARNING

Life-threatening voltages are present in the power supply when the ac power cord is plugged in. *The primary circuitry is live even when the power switch is turned off.* Use extreme caution when you are servicing the power supply.

All voltage measurements made on the primary side of the power-supply circuit must be made with an isolated or battery-powered test instrument. If you fail to observe this precaution, the equipment may be damaged, and you may be exposed to shock hazard, since the primary circuit is not isolated from the ac power line.

CAUTION

Be sure to plug the power-supply test tool into the logic B connector on the power-cable harness *only*. If you plug the tool into the logic A connector, serious damage to the unit may result.

Step	Resulting Action
1. Turn off the computer and remove the line cord.	
2. Remove the base assembly from the computer (refer to section 6.12).	
3. Remove the ac line filter and the power-supply PCA (as a unit) from the base assembly. (You don't need to disconnect the line filter from the PCA.)	
4. Visually inspect the PCA for damaged components.	
5. Check for reversed polarity electrolytic capacitors. (If the polarity is reversed, the circuit could still work for a while.)	
6. Place the line filter and power-supply on a non-conductive bench. Connect a voltmeter (set to the appropriate ac voltage scale) to J1 and J2 on the power-supply PCA.	
7. Make sure that the power switch, S1, is in the OFF (out) position.	
8. Plug a line cord into the line filter receptacle, then into an ac power outlet. Measure the voltage across J1 and J2 (the line-filter output voltage) with S1 still in the OFF position.	If the voltage is not the same as the input ac line voltage, replace the line filter. If the voltage is the same as the line voltage, unplug the power cord from the ac outlet and go on to step 9.

Table 8-4. Power-Supply Repair (Continued)

Step	Resulting Action
9. Connect a known-good power-cable harness to the power supply. Plug the power supply test tool into the *logic B PCA connector* on the power-cable harness (refer to figure 6-32). *Make sure that you do not plug the test tool into the logic A PCA connector, as serious damage will result.* The completed repair setup should be as shown in figure 8-7.	

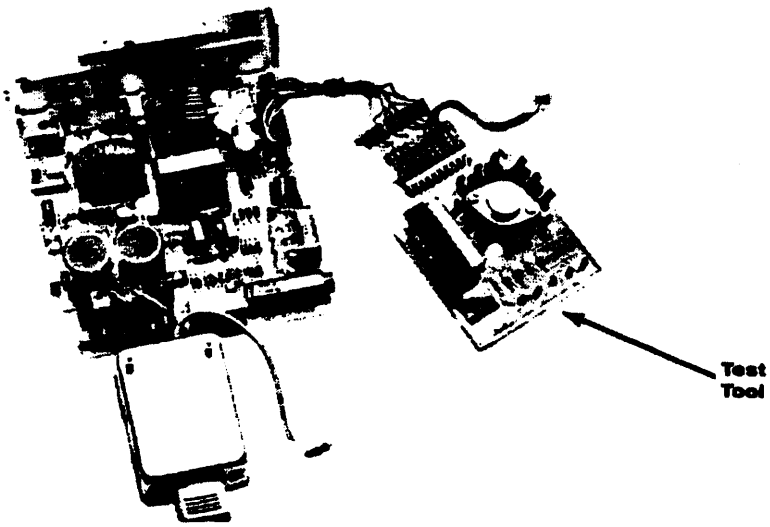


Figure 8-7. Power Supply Repair Setup

10. Check that the ac line voltage-selector switch is in the correct position and that the fuse is good. **Note:** If 230 Vac line voltage is applied with the selector switch in the 115 Vac position, the fuse will blow.	
11. Verify that the power switch (on the power supply PCA) is in the OFF (out) position.	
12. Reconnect the line cord to an ac power outlet.	

Table 8-4. Power-Supply Repair (Continued)

Step	Resulting Action
13. Switch the power on.	If the fuse blows, replace it, and go to step 14. If the fuse does not blow, go to step 15.
14. Switch the power quickly on and off.	If the fuse blows immediately, replace it, and go to symptom 2, step 1. If the fuse blows after a second or two, replace it, and go to symptom 2, step 6.
15. Check all voltages on the power supply test tool (refer to table 8-3, step 7).	If the power supply does not turn on (no voltages are present), go to symptom 1 below. If the power supply starts, but one or more voltages are not present or are out of range, go to symptom 4. If all of the voltages are now within specification, but they were not during power supply verification (step 7 of table 8-3), check the original power-cable harness for opens and shorts. Replace if necessary.
Symptom 1: *The fuse does not blow and the power supply does not turn on.*	
Step	**Resulting Action**
1. Measure the *dc high voltage* across the uncommon ends of R6 and R7. This voltage should be in the range 235 to 375 Vdc, depending on the ac line voltage.	If the dc high voltage is present and in range, go to symptom 3. If the dc high voltage is not present or is out of range, switch the power off and disconnect the power cord and receptacle from the PCA. Check the continuity of S1, S2, F1, and CR36. Replace bad parts as necessary. Check J1 and J2 for cold-solder joints; resolder as necessary.
2. Remeasure the voltage across R6 and R7.	If the dc high voltage still is not present or is out of range, replace the power supply PCA.

Table 8-4. Power-Supply Repair (Continued)

Symptom 2:

The fuse blows at turn on.

Note: All resistance measurements should be made with your meter set to the 20-kΩ scale. If your ohmmeter momentarily reads zero during a resistance measurement, you are probably charging C4 and C5 from the power supply in the ohmmeter. If you find an apparent short on a diode, reverse the ohmmeter leads and repeat the measurement to make sure you are not reading the forward resistance of the diode.

WARNING

Capacitors C4 and C5 will remain charged for an hour or more. You should short the leads on each of these capacitors to avoid exposure to shock hazard.

Step	Resulting Action
Primary Circuit:	
1. Turn the power switch off and remove the power cord.	
2. Check C4 and C5 for shorts.	Replace as required.
3. Check the continuity between R20 and the case of Q3.	If the resistance is less than 2-kΩ, replace Q3, Q4, U4, all three together, and CR36.
4. Measure the resistance across the main (outer) terminals of Q10, or across C1.	If the resistance is less than 50 ohms, replace Q10, C1.
5. If you are testing a 115 Vac computer, set the line-voltage selector switch to 230V, apply 115V, and turn on the power.	If the fuse blows when the selector switch is in the 115V position but not when it is in the 230V position, replace VR4 and VR5.
Secondary Circuit:	
6. Turn the power off and remove the power cord and the power supply test tool.	
7. Check the forward-biased resistance from the center pin of CR34 to ground (+ to −).	If the resistance is less than 100 ohms, check to see if the insulation between U7 and the heat sink is still intact. If it is not intact, replace it. If it is intact, replace CR34, VR31, U7, U8 in order; check C18, C19 for shorts.
8. Check the forward-biased resistance from the center pin of CR35 to ground (+ to −).	If the resistance is less than 100 ohms, check to see if the insulation between CR35 and the heat sink is still intact. If it is not intact, replace it. If it is intact, check C20 and C21 for shorts. Replace CR35, Q8, Q7, VR32.
9. Check the reverse-biased resistance from the anode of CR22 to ground (− to +).	If the resistance is less than 100 ohms, check CR22, VR30, U6, CR21, C16, and C17 for shorts. Replace if necessary.
10. Check CR13, CR19, CR20, and C13 for shorts. (CR13 in-circuit reversed-biased resistance: approximately 2 kΩ.) (CR19 and CR20 in-circuit reverse-biased resistance: approximately 5 kΩ.)	Replace as required. If the fuse still blows or the power supply voltages are bad, replace the power supply PCA.

Table 5-4. Power-Supply Repair (Continued)

Symptom 3:

High-voltage rectification is good, but the system does not start.

Note: All resistance measurements should be made with your meter set to the 20-kΩ scale.

Always turn off the power before moving a test lead or disconnecting anything. Leave the power supply test tool connected during all tests to provide an appropriate load.

Step	Resulting Action
1. Turn on the power and monitor the dc voltage across CR1 using an oscilloscope. *Be sure to use an isolation transformer on the oscilloscope or power supply when making this measurement.*	If the voltage builds up to about 40V and quickly discharges, the start circuit is operating. (Refer to waveforms A and B in figure 12-11, the power supply schematic.) Go to step 2. If the voltage does not build up to 40V or does not discharge quickly, the start circuit is not operating. Measure the resistance between pin 8 and pin 4 of U2 (+ to −). If the resistance is less than 4 kΩ, replace in order VR9, U2, and U4, checking the resistance after each. Check the continuity of CR1, CR2, VR3, Q1, and Q2; replace as required. If the start circuit still is not operating, replace the power supply PCA.
2. Use an oscilloscope to monitor the dc voltage at power-on between +5V and GND on the power supply test tool.	If the voltage is present briefly and then decays sharply, it is likely that the over-voltage protection circuit is being triggered. Go to step 3. If the voltage is not present, go to symptom 2, "Secondary Circuit," and do steps 7 through 10.
3. Turn R49 fully counter-clockwise. Then turn R49 clockwise while monitoring +5V with an oscilloscope.	When the output voltage exceeds 6.2V, the protective circuitry should trigger, and the voltage should fall to zero. If the protective circuitry triggers at 6.2V, go on to step 4. If the protective circuitry is triggering when the output voltage is less than 6.2V, check VR32, Q7, and Q8 for functionality. Repair as needed and go on to step 4.
4. Adjust R49 for an output voltage of +5.1V.*	If the adjustment cannot be made, replace R49 and U10. If the adjustment still cannot be made, replace the power supply PCA.

* The +5.0 Vdc power supply output should be set at +5.1 Vdc to overcome voltage drops in the power cable harness.

Table 8-4. Power-Supply Repair (Continued)

Symptom 4:

The fuse does not blow, the power supply turns on, but one or more voltages are not present or are out of range.

The procedure that you should follow depends on which voltage or voltages are missing or are out of range at the power supply test tool. Follow the appropriate procedure below, referring the the power supply schematic (figure 12-11). Refer to the power supply component-location diagram (figure 9-13) to locate components and identify pins.

Note: In each case, turn off the power before moving a test lead or disconnecting anything. Leave the power supply test tool connected during all tests to provide an appropriate load.

Step	Resulting Action
+5 Vdc is missing or out of range at the test tool:	
1. Check pins 1 and 2 of connector J3 for +5 Vdc (4.75V to 5.25V) with the power-cable harness and test tool connected.	If +5 Vdc is good at pins 1 and 2, but not at the test tool, try replacing the power-cable harness. If +5 Vdc is not present or is out of range at pins 1 and 2, check the input and output waveforms of CR35 (waveforms K and J in figure 12-11). Do the following: ■ If the input waveform is not present, replace the power supply PCA. ■ If the input is correct, but the output waveform is not, replace CR35. Check L5 for an open; replace if necessary. Go to symptom 3, step 2.
$\overline{PD}$ is missing or out of range at the test tool:	
2. Check pin 10 of connector J3 for +5 Vdc (4.75V to 5.25V).	$\overline{PD}$ should be present after a delay of about two seconds after the power is turned on (refer to waveform E in figure 12-11). If $\overline{PD}$ is good at pin 10, but not at the test tool, replace the power-cable harness.
3. Check for +5 Vdc (4.75V to 5.25V) at the common of Q6 and R38.	If +5 Vdc is present after about two seconds, but is not present at pin 10, replace the power supply PCA.
4. Check the voltage at pin 3 of U3.	The voltage should be in the range +5.5V to +6.1V after about two seconds (refer to waveform D in figure 12-11). If the waveform is good, replace Q6. If the waveform is not correct, replace in order: U3, Q5, and U2. If this does not correct the problem, replace the power supply PCA.

Table 8-4. Power-Supply Repair (Continued)

Step	Resulting Action
−12 Vdc is missing or out of range at the test tool:	
5. Check pin 8 of connector J3 for −12 Vdc (−11.4V to −12.6V).	If −12 Vdc is present at pin 8, but not at the test tool, replace the power-cable harness.
6. Check the input to U6.	If the input is good (approximately −23.4 Vdc), replace U6.
7. Check L3 for an open.	Replace if necessary.
8. Check C16 and C17 for shorts.	Replace if necessary.
9. Check the waveform at the common of T1 and CR21.	Refer to waveform F in figure 12-11. If the waveform is bad, replace the power supply PCA.
10. Check the waveform at the common of CR21 and L3.	Refer to waveform G in figure 12-11. If the waveform is bad, try replacing CR21, VR30, and CR22. If this doesn't correct the problem, replace the power supply PCA.
+18, +15, or +12 Vdc is missing or out of range at the test tool.	
11. Check pin 11 of connector J3 for +18 Vdc (26V to 30V).	If you find the voltage at pin 11, but not at the test tool, replace the power-cable harness.
12. Check to see if L4 is open.	Replace L4 if necessary.
13. Check the waveform at the common of C14 and CR34.	Refer to waveform H in figure 12-11. If the waveform is bad, replace the power supply PCA.
14. Check the waveform at the common of CR34 and L4.	Refer to waveform I in figure 12-11. If the waveform is bad, replace CR34. If this does not correct the problem, replace the power supply PCA.
15. Check pins 5 and 6 of connector J3 for +12 Vdc (11.4V to 12.6V) and +15 Vdc (14.25V to 15.75V), respectively.	If +12 Vdc is not present or is out of range at pin 5, check the input of U7 for +18 Vdc. If the input is good, replace U7. If +15 Vdc is not present or is out of range at pin 6, check the input of U8 for +18 Vdc. If the input is good, replace U8. If the problem still is not corrected, replace the power supply PCA.

Table 8-5. RAM Troubleshooting and Repair

Use the following procedure to troubleshoot and repair a RAM problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Step	Indicated Action
1. If the message `*** ERROR - The external RAM failed` appears, it indicates an external RAM failure. *However, with a known-good RAM module, an I/O problem is indicated.* Make sure that the external RAM module is good, and that it is properly inserted in the I/O port. Repeat the test with the RAM module inserted first in port A, then in port B.	If the error is still reported, connect a new I/O backplane PCA to the logic A PCA, plug the RAM module into the new PCA, and repeat the test. If the test is good, replace the I/O backplane PCA. If the problem is still not corrected, replace the logic A PCA.
2. For an internal RAM failure, the error message indicates which IC to replace. If one or two of the following messages appear, set up the computer to troubleshoot the logic A PCA (refer to table 8-27), repeat the RAM test, then replace the indicated RAM IC(s). If more than two of the messages appear, an MMU problem is probable. In such cases, replace the logic A PCA.	
`*** ERROR - 120`	Replace U20 on the logic A PCA.
`*** ERROR - 121`	Replace U21 on the logic A PCA.
`*** ERROR - 122`	Replace U22 on the logic A PCA.
`*** ERROR - 123`	Replace U23 on the logic A PCA.
`*** ERROR - 124`	Replace U24 on the logic A PCA.
`*** ERROR - 125`	Replace U25 on the logic A PCA.
`*** ERROR - 126`	Replace U26 on the logic A PCA.
`*** ERROR - 127`	Replace U27 on the logic A PCA.
`*** ERROR - 128`	Replace U28 on the logic A PCA.
`*** ERROR - 129`	Replace U29 on the logic A PCA.
`*** ERROR - 130`	Replace U30 on the logic A PCA.
`*** ERROR - 131`	Replace U31 on the logic A PCA.
`*** ERROR - 132`	Replace U32 on the logic A PCA.
`*** ERROR - 133`	Replace U33 on the logic A PCA.
`*** ERROR - 134`	Replace U34 on the logic A PCA.
`*** ERROR - 135`	Replace U35 on the logic A PCA.
3. Repeat the RAM test.	If the problem is still not corrected, replace the logic A PCA.

Table 8-6. MMU Troubleshooting and Repair

Use the following procedure to troubleshoot and repair an MMU problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Step	Indicated Action
1. If one of the following error messages appears, take the indicated action.	
`*** ERROR - User portion of MMU failed`	Repeat the test. If an MMU failure is indicated a second time, replace the logic A PCA.
`*** ERROR - Supervisor portion of the MMU failed`	Repeat the test. If an MMU failure is indicated a second time, replace the logic A PCA.
2. If two or more RAM ICs are identified as bad (errors 120 through 135), an MMU problem is probable.	Replace the logic A PCA.

Table 8-7. Keyboard Troubleshooting and Repair

Use the following procedure to troubleshoot and repair a keyboard problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Step	Indicated Action
1. If you get one of the following messages, take the indicated action. Otherwise go on to step 2.	
`*** ERROR - Found devices on both loops!`	If only one device is plugged in, go to step 4.
`*** ERROR - No autoconfig returned by keyboard`	Repeat the test. If the error message is still reported, go to step 2.
`*** ERROR - No loop back returned by keyboard`	Repeat the test. If the error message is still reported, go to step 2.
`*** ERROR - No device detected on either loop`	Go to step 2.
`*** ERROR - No keyboard ID received`	Go to step 2.
`*** ERROR - The ID read doesn't correspond to a keyboard ID.`	Go to step 2.
`*** ERROR - No hard reset returned`	Repeat the test. If the error message is still reported, go to step 2.
`*** ERROR - No poll command received`	Go to step 5.
`*** Cannot execute test without a functional display`	Check the display (table 8-8). Repeat the test.
`*** ERROR - Keyboard was not changed, or bad controller IC`	Plug the keyboard into the other jack and repeat the test. If the error message is still reported, go to step 3.
`*** ERROR - Keyboard received a loop error`	Repeat the test. If the error message is still reported, go to step 5.
`*** ERROR - Keyboard received an over-flow error`	Repeat the test. If the error message is still reported, go to step 4.
`*** ERROR - Keyboard received a framing error`	Repeat the test. If the error message is still reported, go to step 4.
`*** ERROR - Keyboard received a parity error`	Repeat the test. If the error message is still reported, go to step 4.

Table 8-7. Keyboard Troubleshooting and Repair (Continued)

Step	Indicated Action
`*** ERROR - Keyboard time-out error.`	Repeat the test. If the error message is still reported, go to step 2.
`*** ERROR - incorrect key count`	Repeat the test. If the error message is still reported, replace the keyboard assembly.
`*** ERROR - Not all keys responded with both (down and up) keycodes`	Repeat the test. If the error message is still reported, replace the keyboard assembly.
2. Connect a known-good keyboard and cable to the computer. Run the complete keyboard test.	If the unit fails the test, reconnect the original keyboard and cable, then go on to step 3. If the unit passes the test, the problem is in either the keyboard cable or the keyboard PCA. Reconnect the original keyboard assembly using a known-good cable and repeat the test: ■ If the test is now passed, replace the cable. ■ If the test is failed, replace the keyboard PCA.
3. Remove the back panel and set up the computer to troubleshoot the logic A PCA (refer to table 8-27). Turn on the power and check for +12 Vdc (11.4 to 12.6 Vdc) on pin 5 of the logic A PCA power connector (pin 1 has a square designator).	If the voltage is not present or is out of range, verify the power supply (refer to table 8-3). If the voltage is correct, go on to step 4.
4. Connect a known-good keyboard connector assembly to the logic A PCA. Plug in the keyboard and repeat the complete keyboard test.	If the unit passes the test, replace the keyboard-connector assembly. If the unit does not pass, go to step 5.
5. Check that the frequency of the signal on pin 22 of U58 on the logic A PCA is in the range 45 to 75 Hz, nominally 60 Hz.	If the frequency is correct, go to step 6. If the frequency is not correct, replace U59 on the logic A PCA. If the frequency still is not correct, replace the logic A PCA.
6. Check that the frequency of the signal on pin 24 of U58 on the logic A PCA is in the range 7.952 to 7.968 MHz.	If the frequency is correct, replace the logic A PCA. If the frequency is not correct, check the system clocks (refer to table 8-23).

Table 8-8. Display/GPU Troubleshooting and Repair

Use the following procedure to troubleshoot and repair a display/GPU problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: Do not attempt to repair the display assembly itself. It is a *tuned assembly* and must be replaced with an exchange assembly if it is faulty.

Early versions of the display assembly may have a small PCA installed on the back of the assembly. This PCA contains some circuitry that has been incorporated into the display assembly main PCA in later units. Do not remove the small PCA, if present, from a display assembly or transfer it to a new display assembly.

Step	Indicated Action
1. If the entire display pattern is shifted down and to the left, it is likely that the GPU is running in CRT mode. That is, the GPU is configured for a CRT monitor rather than for the electroluminescent (EL) panel display. This is caused by a bit in the real-time clock becoming changed from its normal value.	To reconfigure the GPU for normal operation, proceed as follows: **a.** Insert the System Disc in the disc drive and turn on the computer. This resets the bit in the real-time clock, but the display is still shifted. **b.** Turn off the power. **c.** Turn on the power again. The display should now be back in its normal (EL) mode.
2. Set up the computer to troubleshoot the logic B PCA (refer to table 8-27). Repeat the display test. If you get one of the following error messages, take the indicated action. Otherwise go on to step 3.	
`*** ERROR - 201`	If the error message appears, or if you hear a *descending* musical scale, a GPU failure is probable. Replace U1 (the GPU) on the logic B PCA.
`*** ERROR - GPU time out error`	Check pin 33 of U1 for a 3-MHz signal: ■ If not present, troubleshoot the 3-MHz system clock (table 8-23). ■ If present, replace U1 on the logic B PCA.
`*** ERROR - Display RAM (R/W) error`	Replace the logic B PCA.

Table 8-8. Display/GPU Troubleshooting and Repair (Continued)

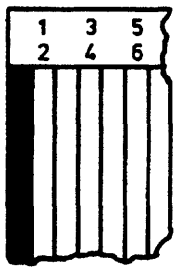
Step	Indicated Action
3. Run the display-pattern tests. Press CTRL C to stop at a checkerboard pattern. **Note:** If the display is not functioning, you can reach the checkerboard pattern output as follows. Turn on the computer to start the service ROM sequence test. Wait until the printer prints out the test results. When the HP-IB test message is printed, the sequence test is complete. Press the f6 function key to start the display test, wait about 15 seconds for the first beep, then press CTRL C to stop at the first pattern. Press the space bar four times to reach the first checkerboard pattern.	Look for any of the following display problems: ■ Missing pixels (picture elements). ■ Bright or dark spots. ■ Bright or dark lines. If you observe such symptoms, connect a new display assembly. If this corrects the problem, replace the display assembly. If the display is dim or there is no display output, connect a new display assembly. If this corrects the problem, replace the display assembly. If the problem persists, connect a new display flex cable; replace if necessary. If the problem persists, go to step 4. If the display image is distorted (out of synchronization), go to step 5.
4. Check the display voltages from the logic B PCA at the display end of the display flex cable.	Pins 3 and 4 should be in the range +26V to +30V with the display disconnected. Pin 5 should be +5 Vdc (4.75V to 5.25V). The flex cable connector has the following pin out:  If any of the voltages are missing, repeat the test with a new flex cable. If the voltages are still missing or are out of range, verify the power supply (refer to table 8.3). If the power supply is good, replace the logic B PCA.

Table 8-8. Display/GPU Troubleshooting and Repair (Continued)

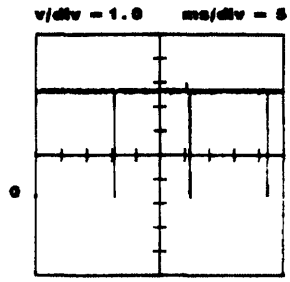
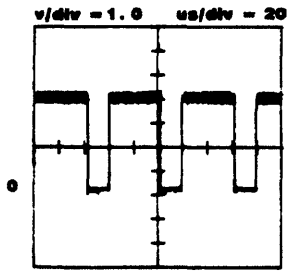
Step	Indicated Action
5. Check the 6-MHz video clock signal at pin 11 of U13 on the logic B PCA.	If the signal is not present, check for the clock signal at pin 13 of U13. ■ If the signal is present at pin 13, but not at pin 11, replace U13 on the logic B PCA. ■ If the signal is not present at pin 13 of U13, troubleshoot the 6-MHz system clock (refer to table 8-23).
6. Run the display test on the service ROM and stop at a checkerboard pattern. While the checkerboard pattern is on the display, check the VSYNC signal at pin 45 of U1 (the GPU) on the logic B PCA.	The waveform should be as follows:  If the waveform is not present, replace U1 on the logic B PCA.
7. While the checkerboard pattern is still on the display, check the HSYNC signal at pin 5 of U10 on the logic B PCA.	The waveform should be as follows:  If HSYNC is not present at pin 5, check for HSYNC at pin 12 of U10 on the logic B PCA. ■ If HSYNC is present at pin 12, but not at pin 5, replace U10 on the logic B PCA. ■ If HSYNC is not present at pin 12 of U10, check for a signal at pin 46 of U1 on the logic B PCA. If not present, replace U1. If present, replace the logic B PCA.

Table 8-8. Display/GPU Troubleshooting and Repair (Continued)

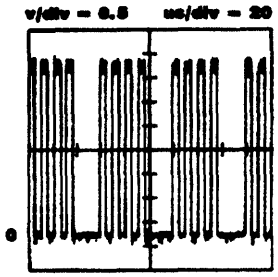
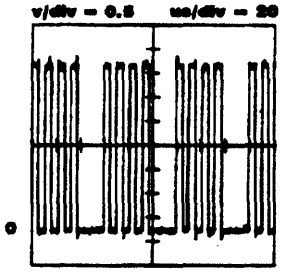
Step	Indicated Action
8. While the checkerboard pattern is still on the display, check the BVID signal at pin 13 of U7 on the logic B PCA.	The waveform should be as follows:  If the waveform is not present, replace the logic B PCA.
9. While the checkerboard pattern is still on the display, check the TVID signal at pin 13 of U8 on the logic B PCA.	The waveform should be as follows:  If the waveform is not present, replace the logic B PCA. If all waveforms are present, but the display is still not working, replace the display assembly.

Table 8-9. Disc Drive Troubleshooting and Repair

Use the following procedure to troubleshoot and repair a disc drive problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Step	Indicated Action
1. For any disc failure, insert a new, formatted floppy disc in the drive and repeat the test.	If the test is failed with the new disc, go on to step 2.
2. Remove the back panel from the computer. Check that the switch on the back of the disc drive is in the *down* position (see figure 6-23b).	If the switch is not in the down position, correct it and repeat the test. Otherwise, go on to step 3.
3. Prepare the computer to troubleshoot the logic B PCA (refer to table 8-27). Repeat the test. Take the indicated action for the error message displayed.	
`*** ERROR - Disc CRC error.`	(Cyclic Redundancy Check error.) Go to step 4.
`*** ERROR - Disc interrupt error.`	Troubleshoot the interrupt circuitry (refer to table 8-24).
`*** ERROR - Disc record not found.`	Go to step 4.
`*** ERROR - Disc time-out error.`	Go to step 4.
`*** ERROR - Disc (W/R) data mismatch.`	Go to step 4.
`*** ERROR - Lost data bit during read sector command.`	Go to step 4.
`*** ERROR - Lost data bit during write sector command.`	Go to step 4.
`*** No disc detected in unit.`	Make sure a formatted disc is properly installed in the drive and repeat the test. If the error message is repeated, check the $\overline{\text{DSKCHG}}$ signal at pin 3 of U20 on the logic B PCA. ■ Pin 3 should be high (4.75 to 5.25 Vdc). If not, replace the disc drive. ■ If pin 3 of U20 is high, check pin 4 of U20. Pin 4 should be low (0.0 to 0.3 Vdc). If not, replace U20. If pin 3 of U20 is high and pin 4 is low (but the error message still appears), replace the logic B PCA.
`*** The disc in the unit is worn. Please replace with a new formatted disc.`	Repeat the test with a new blank, formatted disc.

Table 8-9. Disc Drive Troubleshooting and Repair (Continued)

Step	Indicated Action
`*** The disk is write protected.`	Repeat the disc test making sure that the disc is not write protected (the colored tab should block the hole). If the error message is repeated (with an unprotected disc), check the $\overline{\text{WRPT}}$ signal at pin 1 of U20 on the logic B PCA. ■ Pin 1 should be high (4.75 to 5.25 Vdc). If not, replace the disc drive. ■ If pin 1 of U20 is high, check pin 2 of U20. Pin 2 should be low (0.0 to 0.3 Vdc). If not, replace U20. If pin 1 of U20 is high and pin 2 is low (but the error message still appears), replace the logic B PCA.
`*** ERROR - The length of the index pulse is bad.`	Go to step 4.
`*** ERROR - There was a time out waiting for the index pulse.`	Go to step 4.
4. Check that +5 Vdc (4.75V to 5.25V) and +12 Vdc (11.4V to 12.6V) are present on the outside pins of the disc-drive power connector.	If the voltages are not present, verify the power supply (refer to table 8-3).
5. Substitute a known-good disc-drive flex cable. Repeat the test.	If the test is passed, replace the flex cable.
6. Connect a known-good disc drive and repeat the test (you don't need to install the drive for the test).	If the test is passed, replace the disc drive.
7. Check for a 2-MHz signal at pin 24 of U18 on the logic B PCA.	If the signal is not present, troubleshoot the 2-MHz system clock (refer to table 8-23). If the signal is present, go on to step 8.
8. Turn off the computer. Remove the service ROM and reinstall the operating system ROM. Turn the computer back on. Pull pin 22 of U18 high (+5 Vdc), then reset by touching pin 19 of U18 to ground.	
9. Ground pin 22 of U18 on the logic B PCA. Wait 90 seconds, then check the frequency of the signal appearing at pin 16 of U18.	If the frequency is not in the range 510 to 530 kHz, adjust C16.

Table 8-9. Disc Drive Troubleshooting and Repair (Continued)

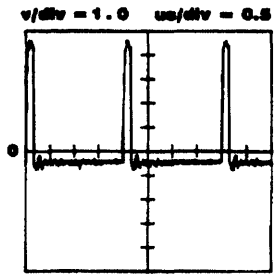
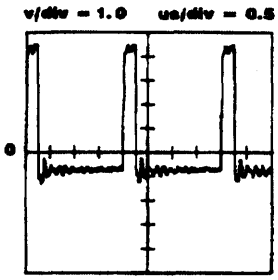
Step	Indicated Action
10. Check pin 31 of U18 for a 125 ns wide pulse.	The waveform should appear as follows:  If the pulsewidth is not in the range 119 to 131 ns, adjust R44 on the logic B PCA.
11. Check pin 29 of U18 for a 250 ns wide pulse.	The waveform should appear as follows:  If the pulsewidth is not in the range 238 to 262 ns, adjust R45 on the logic B PCA.
12. Rerun the disc drive test.	If an error message appears, replace the logic B PCA.

Table 8-10. Real-Time Clock Troubleshooting and Repair

Use the following procedure to troubleshoot and repair a real-time clock problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: If the unit keeps time when connected to the power, but not when disconnected, the battery BT1 is probably bad. Always check the battery voltage before replacing any components.

If the battery jumper P1 is removed, or the battery is replaced, the time of day will have to be reset.

Step	Indicated Action
1. Set up the computer to troubleshoot the logic B PCA (refer to table 8-27).	
2. Check the voltage of battery BT1.	The nominal battery voltage is 3.0 Vdc. If the voltage is not in the range 2.5 to 3.5 Vdc, replace the battery and reset the time.
3. If you get one of the following error messages, take the indicated action.	
`*** ERROR - 244`	Replace U44 on the logic B PCA.
`*** ERROR - REAL TIME CLOCK failure`	Replace the logic B PCA.
`*** ERROR - Probable REAL TIME CLOCK failure`	Go to step 4.
`*** ERROR - REAL TIME CLOCK interrupt error`	Troubleshoot the interrupt circuitry (refer to table 8-24).
4. Adjust the RTC oscillator as follows: Monitor the oscillator frequency at pin 7 of U40 on the logic B PCA. Use a six-digit frequency counter. (If a six-digit frequency counter is not available, and the customer requires the maximum accuracy, replace the logic B PCA.)	Set the oscillator frequency to 32768 ±0.3 Hz by adjusting trim capacitor C43 on the logic B PCA.

Table 8-11. Speaker Troubleshooting and Repair

Use the following procedure to troubleshoot and repair a speaker problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Step	Indicated Action
1. If you did not hear the ascending musical scale during the speaker test, set up the computer to troubleshoot the logic B PCA (refer to table 8-27).	
2. While running the speaker test in continuous mode, check the waveform at pin 1 of U40 on the logic B PCA with an oscilloscope set at 0.5 Volts per division and 1 millisecond per division.	You should see a series of square waves of increasing frequency corresponding to the ascending scale. If the peak-to-peak voltage is within the range 9.5 to 10.5 volts, replace the speaker. If the square wave is not present or the peak-to-peak voltage is not correct, go on to step 3.
3. While running the speaker test in continuous mode, check the waveform at pin 3 of U40 on the logic B PCA.	If the peak-to-peak voltage is in the range 4.75 to 5.25 volts, replace U40 on the logic B PCA. If the square wave is not present or the peak-to-peak voltage is not correct, replace the logic B PCA.

Table 8-12. HP-IB Troubleshooting and Repair

Use the following procedure if a failure of the *built-in* HP-IB is indicated (by either the short HP-IB test on the service ROM or the HP-IB test on the service diagnostic disc). *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: The following procedure applies only to the built-in HP-IB. For problems with an external HP-IB interface, refer to the *Integral Personal Computer Interface and Memory Module Assembly-Level Service Manual.*

Step	Indicated Action
1. Set up the computer to troubleshoot the logic B PCA (refer to table 8-27).	
2. Repeat the short HP-IB test on the service ROM.	If the message `*** ERROR - 241` appears, replace U41 on the logic B PCA. If the message `*** ERROR - The HP-IB failed` appears, go on to step 3.
3. Run the continuous HP-IB test (on the service ROM) by pressing (SHIFT) and the HP-IB test function key. (Press (ESC) to stop.) Refer to the schematic in figure 12-9 while performing the following steps.	
4. Probe pins 1 through 4, 9, 11, and 13 through 17 on the HP-IB back-panel connector with a logic probe or oscilloscope. Refer to figure 8-8 for the pin assignments.	Each pin should be toggling high (+2.7 to +3.3Vdc) and then low (0.0 to +0.3 Vdc). If any of the outputs are not toggling high and low, go on to step 5. If all of the pins are toggling, the problem cannot be traced to the component level. Replace the logic B PCA.

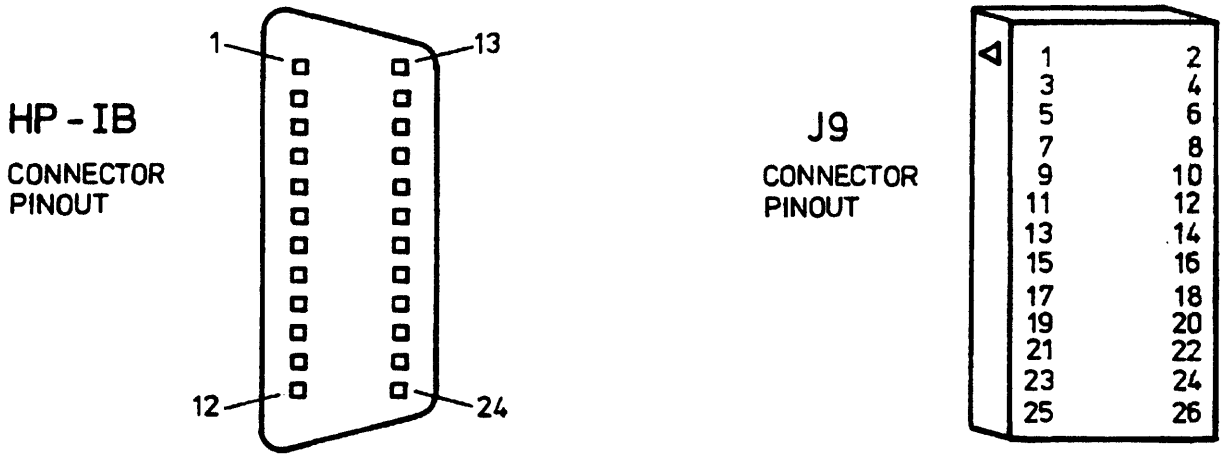


Figure 8-8. Connector Pin Assignments

Table 8-12. HP-IB Troubleshooting and Repair (Continued)

Step	Indicated Action
5. Probe pins 1 through 8, 10, 17, and 21 of connector J9 on the logic B PCA. Refer to figure 8-8 for the pin assignments (pin 1 is nearest the power connector).	If all of the pins are toggling high and low at J9, but some are not toggling at the back-panel connector, replace the HP-IB ribbon-cable assembly (which includes the back-panel connector). If any of the pins are not toggling high and low at J9, go on to step 6.
6. Probe pins 2 through 9 of U42, and pins 3, 4, and 9 of U43 on the logic B PCA.	If all of the pins are toggling high and low, but the corresponding J9 pins are not, replace the logic B PCA. Otherwise, go on to step 7.
7. Probe pins 12 through 19 of U42 on the logic B PCA.	If pins 12 through 19 are all toggling high and low, but any of pins 2 through 9 are not, replace U42. Go to step 8. If any of pins 12 through 19 are not toggling, replace U41. Go to step 8.
8. Probe pins 14, 19, and 20 of U43.	If pins 14, 19, and 20 are toggling high and low, but any of pins 3, 4, and 9 are not, replace U43. If any of pins 14, 19, and 20 are not toggling, replace U41.
9. Rerun the short HP-IB test on the service ROM.	If an error message appears, replace the logic B PCA.

Table 8-13. Printer Error Messages

Use the following procedure to troubleshoot and repair printer problems. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Step	Indicated Action
1. Repeat the service ROM printer test by pressing the PRINTER TEST (f3) key on the test menu. The printer will print out any error messages, and will then print out the test pattern shown in figure 8-9.	If any error messages appear, go to step 2. If no error messages appear, but a printer problem is suspected, proceed with the printer power-on diagnostics in table 8-14.
2. Take the action indicated for the error messages that appear. If you need to troubleshoot the printer control circuitry on the logic B PCA, prepare the computer as described in table 8-27.	
`*** ERROR - Printer received a FRNS. Data sent was:`	Printer received a Frame Received Not as Sent. Replace the logic B PCA.
`*** ERROR - 231`	Replace U31 on the logic B PCA.
`*** Possible printer failure, try the test again.`	Repeat the test three times; if the error message is still reported, replace the the logic B PCA.
`*** ERROR - Printer status. The status byte reads:_ _ _ _ _ _ _ _`	Repeat the test.
The status-byte bits read from left (most significant bit 7) to right (least significant bit 0). If a bit is set (displayed as "1"), it means:	
Bit 7: self test failed.	If the yellow light in the switch panel is flashing, troubleshoot the printer ROM, RAM, and CPU (refer to table 8-17).
Bit 6: (always 0)	
Bit 5: out-of-paper	Install paper in the printer. If the printer is not out of paper, check the out-of-paper switch.
Bit 4: waiting for the top-of-form button to be pressed.	Press the white top-of-form button in the switch panel.
Bit 3: buffer full.	Repeat the test. If the yellow light in the switch panel is flashing, troubleshoot the printer ROM, RAM, and CPU (refer to table 8-17).
Bit 2: buffer empty	Repeat the test. If the yellow light in the switch panel is flashing, troubleshoot the printer ROM, RAM, and CPU (refer to table 8-17).
Bit 1: (always 0)	
Bit 0: carriage motion disabled.	Check the printer mechanism.

Table 8-13. Printer Error Messages (Continued)

Step	Indicated Action
*** ERROR - Printer system. The status byte reads:_____	Repeat the test.
The system-status bytes mean:	
11000110 - self test failed.	If the yellow light in the switch panel is flashing, troubleshoot the printer ROM, RAM, and CPU (refer to table 8-17).
11000010 - manual intervention required.	Check the printer mechanism.
10100011 - not ready to receive data, or 10100001 - ready to receive.	Repeat the test. If the yellow light in the switch panel is flashing, troubleshoot the printer ROM, RAM, and CPU (refer to table 8-17).
*** ERROR - Printer test end of transmission error.	Repeat the test. If the error message is still reported, replace the logic B PCA.
*** Printer indicates (OUT OF PAPER).	Install paper in the printer. If the printer is not out of paper, check the out-of-paper switch.
*** Printer time out error.	Check the 3-Mhz and 2-MHz clock signals at pin 9 of U28 and pin 22 of U31, respectively, on the logic B PCA. ■ If both are present, replace the logic B PCA. ■ If either is not present or bad, troubleshoot the system clocks (refer to table 8-23).
3. Proceed with the printer power-on tests in table 8-14.	

Table 8-14. Printer Power-On Diagnostics

Use the following procedure to completely evaluate the operation of the built-in ink-jet printer. *In each of these steps, always turn off the power before you connect or disconnect a cable, or replace a component.*

Note: If you need to troubleshoot the printer control circuitry on the logic B PCA, prepare the computer as described in table 8-27.

Step	Indicated Action
1. Turn off the computer.	
2. Install paper in the printer.	
3. Remove the service ROM and reinstall the operating system ROM. *The tests that follow must be run with paper in the printer and with the operating system installed.*	
4. Turn on the power. Note the actions of the carriage and the attention light (the yellow LED in the switch panel). The normal power-on sequence is: a) The yellow LED blinks twice, then goes out. b) The carriage sweeps past the home-switch position twice, then parks at the left margin.	If the printer powers up correctly, go on to step 7 below. If you observe any of the symptoms listed below, take the indicated action. After you have corrected the problem, repeat the power-on test, then go on to step 7 below.
The printer fails to power up (the motors do not move and the yellow LED does not blink).	Verify the power supply (refer to table 8-3), then check the printer control circuitry (refer to table 8-16).
The yellow LED fails to light, but the printhead moves.	Go to step 5 below.
The yellow LED stays on continuously, indicating an out-of-paper condition.	If you have not installed paper in the printer, turn off the power, install the paper, then repeat step 4 from the beginning. If there is paper in the printer, check the out-of-paper switch and the printer control circuit (refer to table 8-16).
The yellow LED continues blinking after power on.	Troubleshoot the printer ROM, RAM, and CPU (refer to table 8-17).
The yellow LED blinks twice, stays off for several seconds, then resumes blinking.	The problem may be: 1) a bad carriage motor, 2) the mechanism will not allow the carriage to move, 3) a failure in the printer control circuit, or 4) a bad home switch. Go to step 6 below.
The carriage motor fails to move, but the display indicates that the power is on.	Go to step 6 below.
The printhead crashes to the left.	The problem may be: 1) a defective home switch, 2) a binding in the mechanism, or 3) a printer control circuit problem. Go to table 8-16.

Table 8-14. Printer Power-On Diagnostics (Continued)

Step	Indicated Action
5. If the yellow LED fails to light, measure the voltage at pin 41 of U28 while you switch on the power.	The voltage should go high twice, then stay high: ■ If it does, the LED is probably bad. Replace the switch panel. ■ If the voltage does not go high, replace U28. If the LED still does not light, troubleshoot the printer control circuitry (refer to table 8-16).
6. If the carriage motor fails to move, disconnect the motor and plug in a known-good one. (There's no need to mount the motor in the mechanism.) Turn on the power.	If the new motor rotates at power on, install it, then verify that it can move the mechanism. If it can't, check the mechanism for any type of binding (gear, housing, carriage cable, etc.) If the new motor does not rotate at power on, troubleshoot the printer control circuitry (refer to table 8-16).
7. Press the LF (line feed) button a few times. The paper should advance one line at a time. (Tapping the button causes the paper to advance one dot row at a time.)	If the paper advances smoothly, go on to step 11. If the paper does not advance properly, make sure that the paper is installed correctly, and that nothing is preventing it from traveling through the paper path. Then go on to step 8.
8. Disconnect the printer switch panel and plug in a known-good panel. (You do not need to install the panel for this test.) Press the LF button.	If the paper advances correctly, install the new switch panel. If the paper does not advance, reconnect the original switch panel and go on to step 9.
9. Disconnect the paper-advance motor and plug in a known-good motor. (You do not need to install the motor for the test.)	
10. Press the LF button.	If the motor does not rotate, troubleshoot the paper-advance circuitry (refer to table 8-20). If the new motor runs at turn on, install it, then press LF again. If the paper does not line feed smoothly, check the mechanism for any sort of binding (gears, bearings, etc.)
11. Press the FF (form feed) button.	If the paper form feeds (advances one full page) smoothly, go on to step 13. If the paper does not advance, make sure that the paper is installed correctly, and that nothing is preventing it from traveling through the paper path, then go on to step 12.

Table 8-14. Printer Power-On Diagnostics (Continued)

Step	Indicated Action
12. Disconnect the printer switch panel and plug in a known-good panel (you do not need to install it yet). Press the FF button on the new panel.	If the paper advances correctly, install the new switch panel. If the paper does not advance, reinstall the original switch panel and check for any type of binding in the mechanism.
13. Test the top-of-form button, (the white square button) as follows: Note the current top-of-form position, press and hold the LF button until the paper advances a few lines, then press the top-of-form button. (The printhead should sweep twice and park at the home position.) Now press the FF button to verify the new top-of-form position. (The paper should advance to the same relative position on the next page as was set with the top-of-form button.)	If the printer does not respond to the top-of-form button, disconnect the printer switch panel and plug in a known-good panel. Repeat step 13. ■ If the new switch panel corrects the problem, install it. ■ If the new panel doesn't correct the problem, troubleshoot the printer control circuitry (refer to table 8-16).
14. Run the printing self test as follows: Turn off the computer. Hold down the LF button while turning on the power. When you release the LF button, the printer should print a test pattern like that in figure 8-9. *Note that for some localizations (for example, Japanese) the extended character set is different. However, the print-pitch section should appear the same.*	
15. As the printer outputs the test pattern, observe its operation. Check for any of the symptoms listed in table 8-15 and take the appropriate action.	

Note: The printer controller (IC U28 on the logic B PCA) generates the test pattern shown in figure 8-9. (Later versions of the printer controller may not generate the first three lines shown in the figure.) However, the printer ROM (IC U32 on the logic B PCA) determines the character set of the printer. The printer ROM is localized for some languages. Currently the standard printer ROM is used for all languages except Arabic, Hebrew, and Japanese. Figure 8-9 shows the test pattern for the standard version of the printer ROM. The extended character set is different for units localized for Arabic, Hebrew, or Japanese.

ThinkJet
The Personal Printer from Heulett-Packard

CHARACTER SETS

PRINT PITCHES

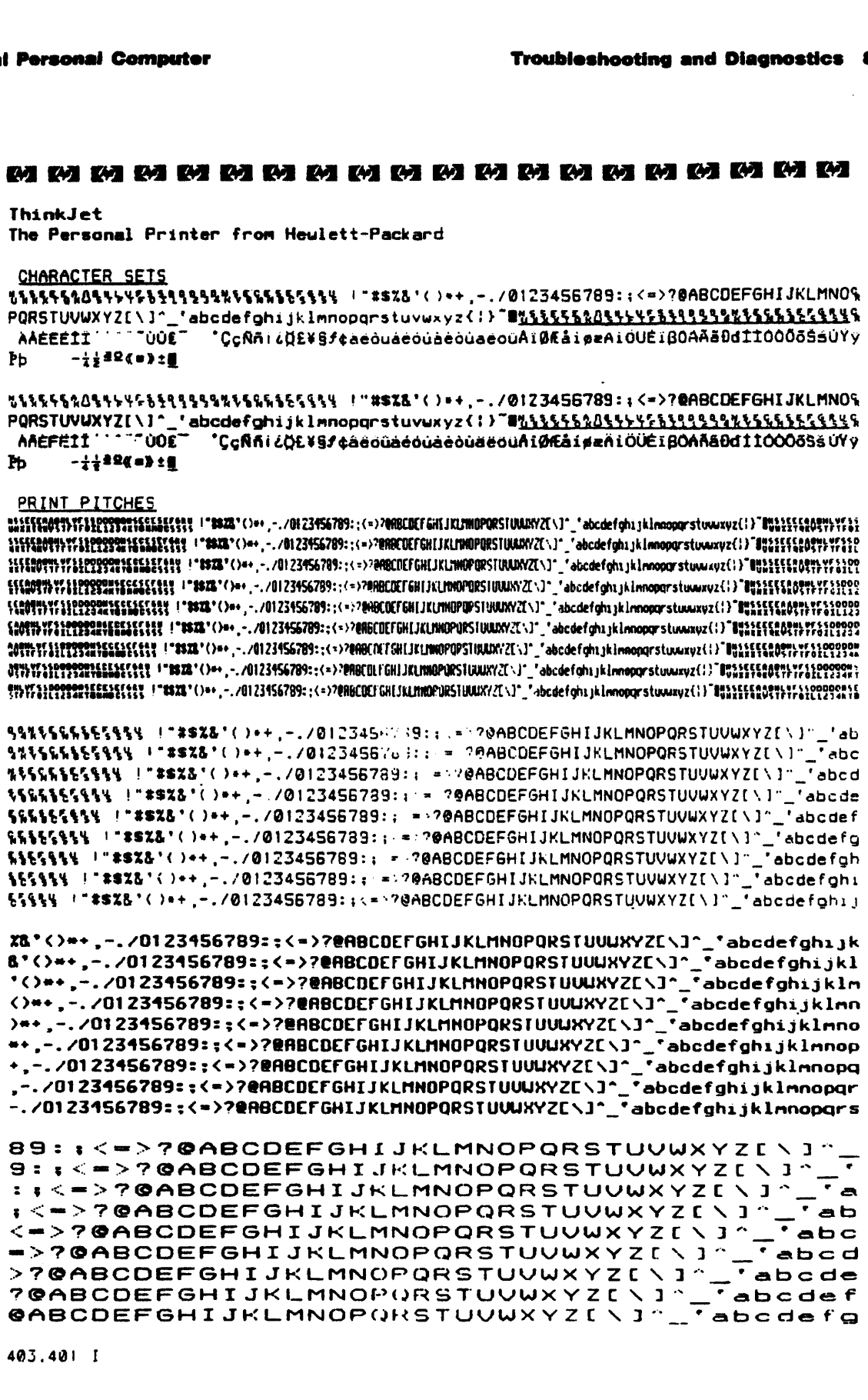


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Figure 8-9. Printer Test Pattern

Table 8-15. Printer Self-Test Results

This table lists the common symptoms that you may observe when running the *printing self test*. You can run this test with the service ROM installed by pressing the PRINTER TEST (f3) key on the test menu. You can also run the test with the operating system ROM installed by pressing and holding the LF button while switching on the power.

Symptom	Probable Cause	Indicated Action
Missing dots.	Printhead needs cleaning or activation.	Follow the procedure in table 8-22, "Activating the Printhead."
	Printhead is defective.	Replace the printhead.
	Printhead flex cable or connector is bad.	Replace carriage assembly.
	Printhead circuitry is faulty.	Troubleshoot printhead circuitry (refer to table 8-21).
Print is too light.	The wrong paper is in use.	Use the specified paper (refer to table 1-1).
	Printhead is running out of ink.	Replace the printhead.
	Printhead circuitry is faulty.	Troubleshoot printhead circuitry (refer to table 8-21).
Printer will not advance paper.	Paper path is not clear.	Clear the paper path.
	Switch panel is bad.	Replace switch panel.
	Paper-advance motor or connector is bad.	Replace motor or connector.
	Paper drive gears are not operating.	Check for binding in mechanism.
	Paper-advance circuitry is faulty.	Troubleshoot paper-advance circuitry (refer to table 8-20).
Improper paper advance.	Paper path is not clear.	Clear the paper path.
	Paper-advance motor or connector is bad.	Replace motor or connector.
	Bail arm needs adjustment.	Adjust bail arm (refer to section 6.9.2).
	Pin wheels need adjustment.	Adjust pin wheels (refer to section 6.9.2).
	Paper-advance circuitry is faulty.	Troubleshoot paper-advance circuitry (refer to table 8-20).
Carriage slams into side plate when homing.	Home switch is faulty.	Replace home switch (refer to section 6.9.2).
	Carriage motor or connector is bad.	Replace motor or connector.
	Home-switch circuitry is faulty.	Troubleshoot home-switch circuitry (refer to table 8-19).

Table 8-15. Printer Self-Test Results (Continued)

Symptom	Probable Cause	Indicated Action
Carriage stalls before it completes homing activity. (Yellow LED remains flashing.)	Drum cap on cable assembly is faulty.	Replace printer mechanism assembly.
	Gear box for the carriage drive is faulty.	Replace printer mechanism assembly.
	Idler pulley is faulty.	Replace idler pulley.
	Wear shoe on the carriage is faulty.	Replace carriage assembly.
Out-Of-Paper condition indicated with paper installed.	Out-of-paper switch is faulty.	Replace switch (refer to section 6.9.2).
	Control circuit is faulty.	Troubleshoot control circuit (refer to table 8-16).
Controller locks up; nothing is printed.	Printer flex cable is faulty.	Replace carriage assembly.
	Control circuit is faulty.	Troubleshoot control circuit (refer to table 8-16).
Printer turns on, but there is no homing activity, and the yellow LED does not light.	Switch panel is faulty.	Replace switch panel.
	Carriage motor or connector is faulty.	Replace motor or connector.
	Control circuit is faulty.	Troubleshoot control circuit (refer to table 8-16).
Carriage stalls while printing.	Carriage motor is faulty.	Replace motor.
	Carriage-drive gear box is faulty.	Replace printer mechanism assembly.
	Carriage is binding.	Check mechanism for any type of binding.
	Control circuit is faulty.	Troubleshoot control circuit (refer to table 8-16).
Printer is noisy while printing.	Carriage motor is faulty.	Replace carriage motor.
	Carriage-drive gear box is faulty.	Replace printer mechanism assembly.
Printer operates, but prints wrong character set.	Wrong version of printer ROM installed.	Check localization of printer ROM (IC U32 on the logic B PCA). Refer to table 9-12.

Table 8-16. Troubleshooting the Printer Control Circuitry

Use the following procedure to troubleshoot the printer control circuitry on the logic B PCA. (If you have not already done so, prepare the computer to troubleshoot the logic B PCA as described in table 8-27.) *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: The operating system ROM must be installed in the computer during the tests that follow, and paper must be installed in the printer.

If no paper is installed when the computer is turned on, the yellow attention LED will stay on continuously until paper is added. When paper is added with the power on, the yellow LED will begin blinking continuously until the white button (top-of-form/continue operation) is pressed.

Step	Indicated Action
1. Check Vcc at pin 35 of U28 and pin 1 of U31 on the logic B PCA. (U28 and U31 are shown in the printer controller schematic, figure 12-7.)	If Vcc is not in the range 4.75 to 5.25 Vdc, verify the power supply (refer to table 8-3). Repair the power supply if necessary (refer to table 8-4), then repeat the test. If Vcc is not present, but the power supply is supplying +5 Vdc, replace the logic B PCA.
2. Check HPE at pin 46 of U28 on the logic B PCA while the printer is printing. HPE should be high while the printer is printing.	If HPE is not high, replace U28 and repeat the test. If HPE is still not high during printing, replace the logic B PCA.
3. Check Vph at the cathode of CR2 on the logic B PCA while the printer is printing. (CR2 is shown in the printhead supply schematic, figure 12-8.)	Vph should be in the range 22.5 to 24.0 Vdc while the printer is printing. If it is not, replace the logic B PCA.
4. Turn on the power. Note the actions of the carriage and the attention light (the yellow LED). The normal power-on sequence is: a) The yellow LED blinks twice, then goes out. b) The carriage sweeps past the home-switch position twice, then parks at the left margin. If you observe any of the symptoms listed below, take the indicated action, then repeat the power-on test.	
The yellow LED stays on continuously.	A problem in the paper sense circuitry is indicated. Check that pin 41 of U28 on the logic B PCA is high when paper is installed. If not, replace the out-of-paper switch. If this does not correct the problem, replace the logic B PCA.

Table 8-16. Troubleshooting the Printer Control Circuitry (Continued)

Step	Indicated Action
The yellow LED continues blinking after power on.	Troubleshoot the printer ROM, RAM, and CPU following the procedure in table 8-17.
The yellow LED blinks twice, stays off for several seconds, then resumes blinking.	If the carriage motor moves twice through the home-switch position, as in a normal power-up sequence, troubleshoot the home-switch circuitry following the procedure in table 8-19. If the carriage motor doesn't go through its normal power-up sequence, troubleshoot the carriage-motor circuitry (table 8-18) first, then troubleshoot the home-switch circuitry (table 8-19).

Table 8-17. Troubleshooting the Printer ROM, RAM, and CPU

If the printer ROM, RAM, or CPU fails the power-on self test, the attention light (the yellow LED in the switch panel) will flash continuously, and one of the pins of U28 on the logic B PCA will pulse to indicate the failed component. Use the following procedure to isolate the problem. (If you have not already done so, prepare the computer to troubleshoot the logic B PCA as described in table 8-27.) *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: The operating system ROM must be installed in the computer during the tests that follow, and paper must be installed in the printer.

Step	Indicated Action
1. Check for the 3-MHz clock signal at pin 9 of U28 on the logic B PCA.	If the signal is not present, troubleshoot the 3-MHz system clock (refer to table 8-23).
2. If the yellow LED continues blinking after power-on, isolate the problem by probing pins 16, 17, 18, 19, 22, and 23 of U28, each in turn, for a pulse approximately one second after power on. Take action according to the following steps. **Note:** At power-on, each pin may pulse once as the CPU resets. This first pulse occurs almost immediately and does not indicate an error. Wait approximately one second for a second pulse, slightly longer than the first.	
3. Turn off the power and connect a logic probe to pin 16 of U28 on the logic B PCA. Turn on the power and watch for a pulse after about one second.	If a pulse occurs on pin 16 of U28 (DOT 12), a printer CPU failure is indicated. Replace U28 on the logic B PCA.

Table 8-17. Troubleshooting the Printer ROM, RAM, and CPU (Continued)

Step	Indicated Action
4. Repeat the procedure for pins 17, 18, 19, 22, and 23 of U28 on the logic B PCA. In each case, turn off the power, connect a logic probe to the pin, then turn on the power and watch for a pulse after about one second.	If a pulse occurs on pin 17 of U28 (DOT 11), an internal ROM failure is indicated. Replace U28 on the logic B PCA. If a pulse occurs on pin 18 of U28 (DOT 10), an internal RAM failure is indicated. Replace U28 on the logic B PCA. If a pulse occurs on pin 19 of U28 (DOT 9), a timer failure is indicated. Replace U28 on the logic B PCA. If a pulse occurs on pin 22 of U28 (DOT 6), an external RAM failure is indicated. Replace U27 on the logic B PCA. If a pulse occurs on pin 23 of U28 (DOT 5), an external ROM failure is indicated. Replace U32 on the logic B PCA (localized for some languages).

Table 8-18. Troubleshooting the Carriage-Motor Circuitry

If you have trouble with the carriage, check that the ROM, RAM, CPU, power supply, switch panel, and carriage motor are operational, then troubleshoot the carriage-motor circuitry as follows using a logic probe. (If you have not already done so, prepare the computer to troubleshoot the logic B PCA as described in table 8-27.) *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: The operating system ROM must be installed in the computer during the tests that follow, and paper must be installed in the printer.

Step	Indicated Action
1. Probe pins 4, 5, 6, and 7 of U28 on the logic B PCA, each in turn, while you press the top-of-form button (the square, white button on the switch panel).	If any pin fails to toggle several times, replace U28.
2. Probe pins 8 and 10 of U29 and pins 8 and 10 of U30 on the logic B PCA, each in turn, while you press the top-of-form button.	If any pin fails to toggle, replace the corresponding IC. If the carriage moves with difficulty and then stops after a few seconds, or if there appear to be slight variations in the width of the printed characters, check CR8, C26, CR9, and C27 on the logic B PCA for opens and shorts. *If you replace an open diode, replace the corresponding capacitor as well.*

Table 8-19. Troubleshooting the Home-Switch Circuitry

The typical symptom of bad home-switch circuitry is that the carriage will move initially to the right, reverse direction, and crash into the left side frame for a few seconds, then come to rest.

Use a logic probe to troubleshoot the home-switch circuitry as described below. (If you have not already done so, prepare the computer to troubleshoot the logic B PCA as described in table 8-27.) *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: The operating system ROM must be installed in the computer during the tests that follow, and paper must be installed in the printer.

Do not troubleshoot the home-switch circuitry unless the carriage is capable of moving through the home switch. If the carriage fails to move, the problem is located elsewhere.

Step	Indicated Action
1. Verify the operation of the printer switch panel if you have not already done so (refer to table 8-14).	
2. Install a known-good home switch. Probe pin 46 of U28 on the logic B PCA while you press the top-of-form button (the square, white button on the switch panel).	If the pin does not pulse high for about two seconds and then return low, replace U28.
3. Probe pin 6 of U34 on the logic B PCA while you press the top-of-form button.	If the pin does not pulse low for about two seconds, and then return high, replace U36 on the logic B PCA.
4. Check the voltage on pin 5 of U34 on the logic B PCA.	If it isn't in the range 4.75 to 5.25 Vdc, check IC U34 on the logic B PCA and its associated resistors, and replace as required.
5. Probe pin 7 of U34 on the logic B PCA while you press the top-of-form button.	If pin 7 is low, and then pulses high several times, this indicates that the home-switch circuitry is working properly. If the home-switch is good, IC U28 may be bad; if not, replace IC U34 on the logic B PCA.
6. Press the LF and then the FF key.	If the paper does not advance normally, go to table 8-20.
7. Run the printing self test by turning off the power, pressing the LF key and holding it down, and then turning the power on.	If the printer doesn't print the test pattern shown in figure 8-9, go to table 8-21.

Table 8-20. Troubleshooting the Paper-Advance Circuitry

Make sure that the paper motor is operational and that the switch panel is good, then proceed as follows. Use a logic probe in this procedure. (If you have not already done so, prepare the computer to troubleshoot the logic B PCA as described in table 8-27.) *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: The operating system ROM must be installed in the computer during the tests that follow, and paper must be installed in the printer.

Step	Indicated Action
1. Probe pins 1, 2, 3, and 48 of U28 on the logic B PCA, each in turn, while you press the LF or FF button on the switch panel.	Each pin should toggle several times. If any pin does not toggle, replace U28.
2. Probe pins 2 and 16 of U29, and pins 2 and 16 of U30 on the logic B PCA, each in turn, while you press the LF button for a few seconds.	Each pin should toggle several times. If any pin doesn't toggle, replace the corresponding IC.
3. Run the printing self test by turning off the power, pressing the LF key and holding it down, and then turning the power on.	If the printer doesn't print the test pattern shown in figure 8-9, go to table 8-21.

Table 8-21. Troubleshooting the Printhead Circuitry

To troubleshoot the printhead circuitry, make sure the printhead and carriage assembly are functional, then proceed as follows. Use a logic probe in this procedure. (If you have not already done so, prepare the computer to troubleshoot the logic B PCA as described in table 8-27.) *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: The operating system ROM must be installed in the computer during the tests that follow, and paper must be installed in the printer.

Step	Indicated Action
1. Probe pins 1 through 5 of U36 and pins 1 through 7 of U37 on the logic B PCA, each in turn, during the printer self test. (Turn off the power, press and hold the LF key, turn the power on, and release LF.) Each pin should toggle as the unit attempts to print. **Note:** Pin 5 on IC U36 will toggle on only a few of the printed lines.	If any of the pins fail to toggle, replace U28 on the logic B PCA.
2. Using an oscilloscope, check the signals on pins 12 through 16 of U36 and pins 10 through 16 of U37 on the logic B PCA while you run the printing self test. (If an oscilloscope is not available, a logic probe can be used to see if the voltages on each pin are toggling.)	If the pulses on any of the pins are not narrow and negative going, from about +24 Vdc to logic ground, replace the corresponding IC.

Table 8-22. Activating the Printhead

If the printer stops printing after a few lines, the printhead probably needs activation. Follow the procedure below.

WARNING

The ink in the printhead contains diethylene glycol. *It is harmful if swallowed.* If ink is swallowed, induce vomiting, and contact a physician.

CAUTION

Be careful not to puncture the ink bladder with the paper clip when activating the printhead. If punctured, the ink will leak out, possibly causing damage to the computer.

Step	Indicated Action
1. Open the printhead carrier latch by pushing it down. 2. Lift the printhead out. 3. Straighten a section of a paper clip. 4. Hold the printhead so the shiny print plate faces up. 5. Insert the paper clip into the hole at the bottom of the printhead. Push gently until a bead of ink appears on the print plate. 6. Remove the paper clip. Wipe off the print plate with a soft tissue. 7. Insert the printhead into the carrier. Close the latch by lifting it up. Make sure that the latch is fully closed.	
8. Repeat the printing self test.	If the printhead still won't print after you have activated it, replace it. **Note:** Any time you replace the printhead, you should also replace the absorber (the small rectangular pad opposite the printhead when in the home position). A new absorber comes with each new printhead. Insert a pencil in the hole at the top of the absorber and lift it out. Reinsert the new absorber in the mounting clip.

Table 8-23. Troubleshooting the System Clocks

Use the following procedure to troubleshoot the system clocks. (If you have not already done so, prepare the computer for troubleshooting as described in table 8-27.) *Always turn off the power before you connect or disconnect a cable or replace a component.*

Note: If a clock signal is missing elsewhere in the computer circuitry, troubleshoot the corresponding system clock. For example, if the 4-MHz clock signal is missing, troubleshoot the 4-MHz clock starting at step 3.

Step	Indicated Action
1. **7.96-MHz Clock:** Check for a 7.96-MHz signal (7.952 to 7.968 MHz) on pin 9 of U2 on the logic A PCA.	If the 7.96-MHz signal is not present, check for a 15.92-MHz signal (15.904 to 15.936 MHz) on pin 11 of U2 on the logic A PCA. ■ If the 15.92-MHz signal is present, replace U2 on the logic A PCA. If the trouble is still not corrected, replace the logic A PCA. ■ If the 15.92-MHz signal is not present, replace U1 on logic A PCA. If the trouble is still not corrected, replace the logic A PCA.
2. **3-MHz, 6-MHz, and 12-MHz Clocks:** Check for the 3-MHz, 6-MHz, and 12-MHz signals on pins 6, 2, and 3, respectively, of U9 on the logic B PCA. The ranges are as follows: 3 MHz: 2.997 to 3.003 MHz 6 MHz: 5.994 to 6.006 MHz 12 MHz: 11.988 to 12.012 MHz	If any frequency is missing or incorrect, check for a 24-MHz signal (23.976 to 24.024 MHz) on pin 4 of U9 on the logic B PCA. ■ If the 24-MHz signal is present, replace U9. If the trouble is still not corrected, replace the logic B PCA. ■ If the 24-MHz signal is not present, check C13 for a short, check R4 for an open, then (if necessary) replace U14 on the logic B PCA. (Refer to figure 12-5.) If the trouble is still not corrected, replace the logic B PCA.
3. **4-MHz Clock:** Check for a 4-MHz signal (3.996 to 4.004 MHz) on pin 13 of U46 on the logic B PCA.	If the 4-MHz signal is not present, check for a 12-MHz signal on pin 2 of U46 on the logic B PCA. ■ If the 12-MHz signal is present, replace U46 on the logic B PCA. ■ If the 12-MHz signal is not present, go to step 2.
4. **2-MHz Clock:** Check for a 2-MHz signal (1.998 to 2.002 MHz) on pin 5 of U16 on the logic B PCA.	If the 2-MHz signal is not present, check for a 4-MHz signal on pin 3 of U16. ■ If the 4-MHz signal is present, replace U16. ■ If the 4-MHz signal is not present, go to step 3.

Table 8-24. Troubleshooting DTACK and Interrupt Problems

Use the following procedure to troubleshoot DTACK and interrupt problems. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

DTACK Problems:

The DTACK (data transfer acknowledge) circuitry is located on the logic A PCA. If this circuitry does not correctly decode DTACK signals, an error message will occur. Follow steps 1 and 2 below.

Step	Indicated Action

1. If any of the error messages below appear, repeat the test.
`*** Received no DTACK from the disc.`
`*** Received no DTACK from the display.`
`*** Received no DTACK from the HP-IB.`
`*** Received no DTACK from the keyboard.`
`*** Received no DTACK from the MMU.`
`*** Received no DTACK from the printer.`
`*** Received no DTACK from the RAM.`
`*** Received no DTACK from the Real Time Clock.`
`*** Received no DTACK from the speaker.`	

2. If the error message reappears, a problem with the DTACK circuitry is probable.	Replace the logic A PCA.

Interrupt Errors:

An interrupt error may be caused by a problem in the interrupt-encoding circuitry on the logic A PCA, the circuitry on the logic B PCA, or an internal or external peripheral. If an interrupt error message appears, follow the procedure below to isolate the problem.

The interrupt encoder IC (U60 on the logic A PCA) reads the logic states of its seven input pins (pins 4, 3, 2, 1, 13, 12, and 11) and encodes a three-bit interrupt level on its output pins (pins 6, 7, and 9). (See figure 12-1.) *The input and output pins are active low.* The table below shows how the the output-pin states correspond to the input-pin states for a currently-active interrupt (H=high, L=low, X=don't care). For example, if the input pins have the states "HHLHHHH", the output pins should have the states "LHL" indicating interrupt level 5.

Note: An interrupt may have previously occurred (resulting in an error message), but may not be currently active.

If more than one U60 input pin is low, the *highest-level* interrupt has priority. For example, if U60 input pins 13 and 2 are both low, only interrupt level 5 will be active. The output pins will indicate "LHL".

Table 8-24. Troubleshooting DTACK and Interrupt Problems (Continued)

U60 Input Pins							U60 Output Pins			Interrupt
4	3	2	1	13	12	11	6	7	9	Level
L	X	X	X	X	X	X	L	L	L	7
H	L	X	X	X	X	X	L	L	H	6
H	H	L	X	X	X	X	L	H	L	5
H	H	H	L	X	X	X	L	H	H	4
H	H	H	H	L	X	X	H	L	L	3
H	H	H	H	H	L	X	H	L	H	2
H	H	H	H	H	H	L	H	H	L	1
H	H	H	H	H	H	H	H	H	H	No Interrupt

Step	Indicated Action
1. Set up the computer to troubleshoot the logic A PCA (refer to table 8-27). Determine the logic states of the U60 input and output pins with a logic probe. Compare the input and output with the above table.	If the output-pin states do not correspond correctly to the input-pin states, replace U60. If the output-pin states do correspond correctly to the input-pin states, go on to step 2.
2. Take the action indicated for the specific error message below:	
`*** ERROR - INTERRUPT LEVEL 1 occurred when it should not have.`	Substitute a known-good logic B PCA; replace if necessary. If the problem persists, replace the logic A PCA.
`*** ERROR - REAL TIME CLOCK interrupt error.`	Substitute a known-good logic B PCA; replace if necessary. If the problem persists, replace the logic A PCA.
`*** ERROR - INTERRUPT LEVEL n occurred when it should not have.` *Where* `n` = *2 or 7.*	Substitute a known-good keyboard; replace if necessary. If the problem persists, replace the logic A PCA.
`*** ERROR - INTERRUPT LEVEL n occurred when it should not have.` *Where* `n` = *3 through 6.*	Remove, one at a time, any peripherals and interfaces that are connected to the computer. Repeat the test after each removal. ■ If the problem is corrected, troubleshoot the defective device. ■ If the problem persists, substitute a known-good logic B PCA; replace if necessary. If the problem persists, disconnect the I/O backplane PCA. If this corrects the problem, replace the I/O backplane PCA; otherwise, replace the logic A PCA.
`*** ERROR - Disc interrupt error.`	Substitute a known-good logic B PCA; replace if necessary. If the problem persists, replace the logic A PCA.

Table 8-24. Troubleshooting DTACK and Interrupt Problems (Continued)

Interrupt Turn-On Problems:

If the computer does not turn on, but the fuse and the power supply are good, an interrupt problem may be preventing the computer from powering up. Follow steps 1 through 4 to isolate the problem.

Step	Indicated Action
1. Remove any external I/O interfaces and repeat the turn-on test.	If the computer turns on, isolate the problem to an individual interface, then troubleshoot the interface. If the computer does not power up, go on to step 2.
2. Disconnect the keyboard and repeat the test.	If the computer powers up correctly, replace the keyboard assembly. If the computer does not power up, reconnect the keyboard and go on to step 3.
3. Disconnect the I/O backplane PCA, the HP-IB ribbon-cable assembly, and the keyboard-connector assembly (each in turn) repeating the turn-on test after each.	If the computer powers up correctly after disconnecting an assembly, replace the defective assembly. If the computer does not power up, reconnect the assemblies and go on to step 4.
4. Substitute known-good logic boards, one at a time. Substitute logic B first, then logic A, repeating the turn-on test in each case.	Replace the defective PCA.

Table 8-25. Troubleshooting External I/O Problems

Use the following procedure to troubleshoot external I/O problems. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: To completely check the two I/O ports (A and B) you must run two tests for each port: the external RAM test to check the data and address lines, and the serial interface test to check the interrupt lines. The external RAM test is part of the service ROM tests (refer to section 8.5.3). The serial interface test is part of the service diagnostic disc tests (refer to section 8.5.4).

Step	Indicated Action
1. If you have not already done so, run the external RAM test and the serial interface test for each port. Use a known-good memory module and serial interface for the tests.	If either port fails one of the tests, unplug the I/O backplane PCA and plug in a known-good one (you don't need to install it yet).
2. Repeat the external RAM and serial interface tests.	If all of the tests are passed with the new I/O backplane PCA, install it. If any of the tests fail, replace the logic A PCA.

Table 8-26. Troubleshooting the Plug-In ROM Assembly

Use the following procedure to troubleshoot and repair a ROM problem. *In each of these steps, always turn off the power before you connect or disconnect a cable or replace a component.*

Note: A ROM problem can prevent the computer from turning on. If the computer will not turn on, refer to table 8-2, "Turn-On Problems."

Step	Indicated Action
1. Turn on the computer with the operating system ROM installed.	

2. Insert the service diagnostic disc and run the ROM test (refer to section 8.5.4).	If the computer doesn't turn on, refer to table 8-2.
	If the error messages
	`*** The ROM Assembly failed.`
	`*** Checksum does not match.`
	appear, the procedure depends on the operating system version:
	■ If the computer has the HP-UX System III operating system, there is no component-level repair. Replace the plug-in ROM assembly.
	■ If the computer has the HP-UX System V operating system, the above messages will be followed by an error message identifying the defective IC. Proceed with step 3.

3. Replace the ROM IC(s) identified as bad. *If more than two ROM error messages appear, go to step 5 instead.*	
`*** ERROR-301 (U1-ROM0L on O.S. ROM PCA)`	Replace U1 (ROM 0, low byte) on the operating system PCA.
`*** ERROR-302 (U2-ROM1L on O.S. ROM PCA)`	Replace U2 (ROM 1, low byte) on the operating system PCA.
`*** ERROR-303 (U3-ROM0H on O.S. ROM PCA)`	Replace U3 (ROM 0, high byte) on the operating system PCA.
`*** ERROR-304 (U4-ROM1H on O.S. ROM PCA)`	Replace U4 (ROM 1, high byte) on the operating system PCA.
`*** ERROR-401 (U1-ROM2H on Option ROM PCA)`	Replace U1 (ROM 2, high byte) on the option ROM PCA.
`*** ERROR-402 (U2-ROM3H on Option ROM PCA)`	Replace U2 (ROM 3, high byte) on the option ROM PCA.
`*** ERROR-403 (U3-ROM2L on Option ROM PCA)`	Replace U3 (ROM 2, low byte) on the option ROM PCA.
`*** ERROR-404 (U4-ROM3L on Option ROM PCA)`	Replace U4 (ROM 3, low byte) on the option ROM PCA.
4. Repeat the ROM test.	If the problem is still not corrected, go on to step 5.
5. Replace the operating system ROM PCA and repeat the ROM test.	If the problem is still not corrected, replace the option ROM PCA (if present).

Table 8-27. Troubleshooting Setup

This table gives the procedure to set up the computer for troubleshooting the logic A and logic B PCAs. As you proceed with the steps below, refer to chapter 6 "Removal and Replacement" for the correct disassembly procedures.

- To troubleshoot the logic A PCA, perform steps 1 through 4.
- To troubleshoot the logic B PCA, perform steps 1 through 6.

Step

1. Turn off the power and remove the power cord.
2. Remove the back cover from the computer (if you have not already done so).
3. Remove the operating system ROM assembly and install the service ROM assembly if you have not already done so. *(Exception: Leave the operating system ROM installed if you are using the built-in printer diagnostic tests.)*
4. Remove the metal shield to uncover the logic A PCA.

   In this configuration you can troubleshoot the logic A PCA.
5. Remove the six screws that hold the PCA mounting panel. Tilt the panel down and toward you (unhook the cable clip from the printer-mechanism cables). Support the panel to prevent any strain on the cables (see figure 8-10).
6. Now uncover the logic B PCA as follows: Remove the four screws holding the logic B shield. Carefully lift the shield, without detaching the display and printer cables. Support the shield in an upright position with the printer cable clip (see figure 8-10) so that it will not fall on the PCA (possibly causing a short).

   In this configuration you can troubleshoot the logic B PCA.

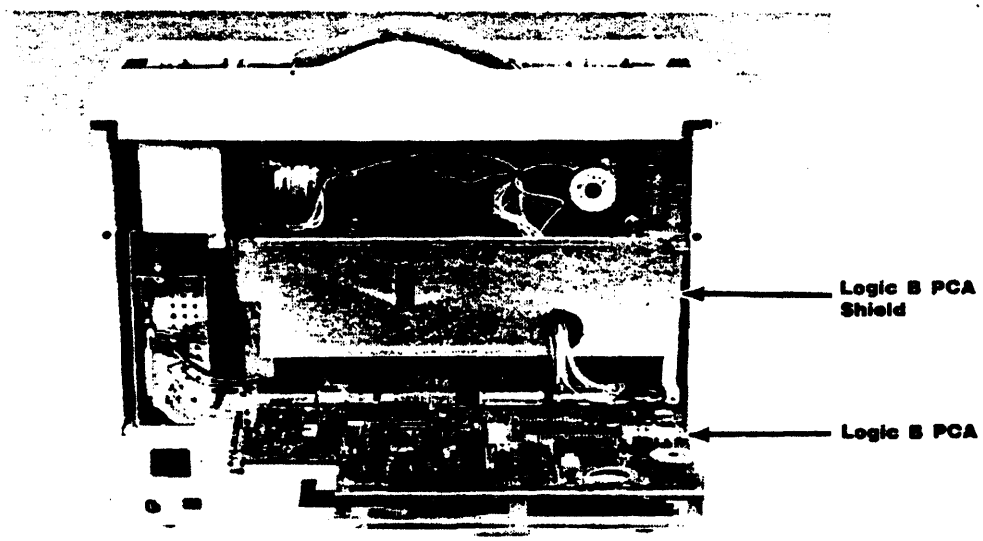


Figure 8-10. Troubleshooting Setup

Chapter 9
Replaceable Parts

9.1 Introduction

This chapter lists the replaceable parts and assemblies of the Integral Personal Computer (HP 9807A).

9.2 Ordering Information

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

- Product model and serial number.
- HP part number.
- Part description.
- Complete reference designation, if applicable.

9.3 Illustrated Parts Breakouts

The rest of this chapter identifies the replaceable parts of the Integral PC. Replaceable mechanical parts and assemblies are identified in exploded views. Replaceable electronic parts are identified in component location diagrams. For each illustration, a corresponding table gives the part numbers and descriptions.

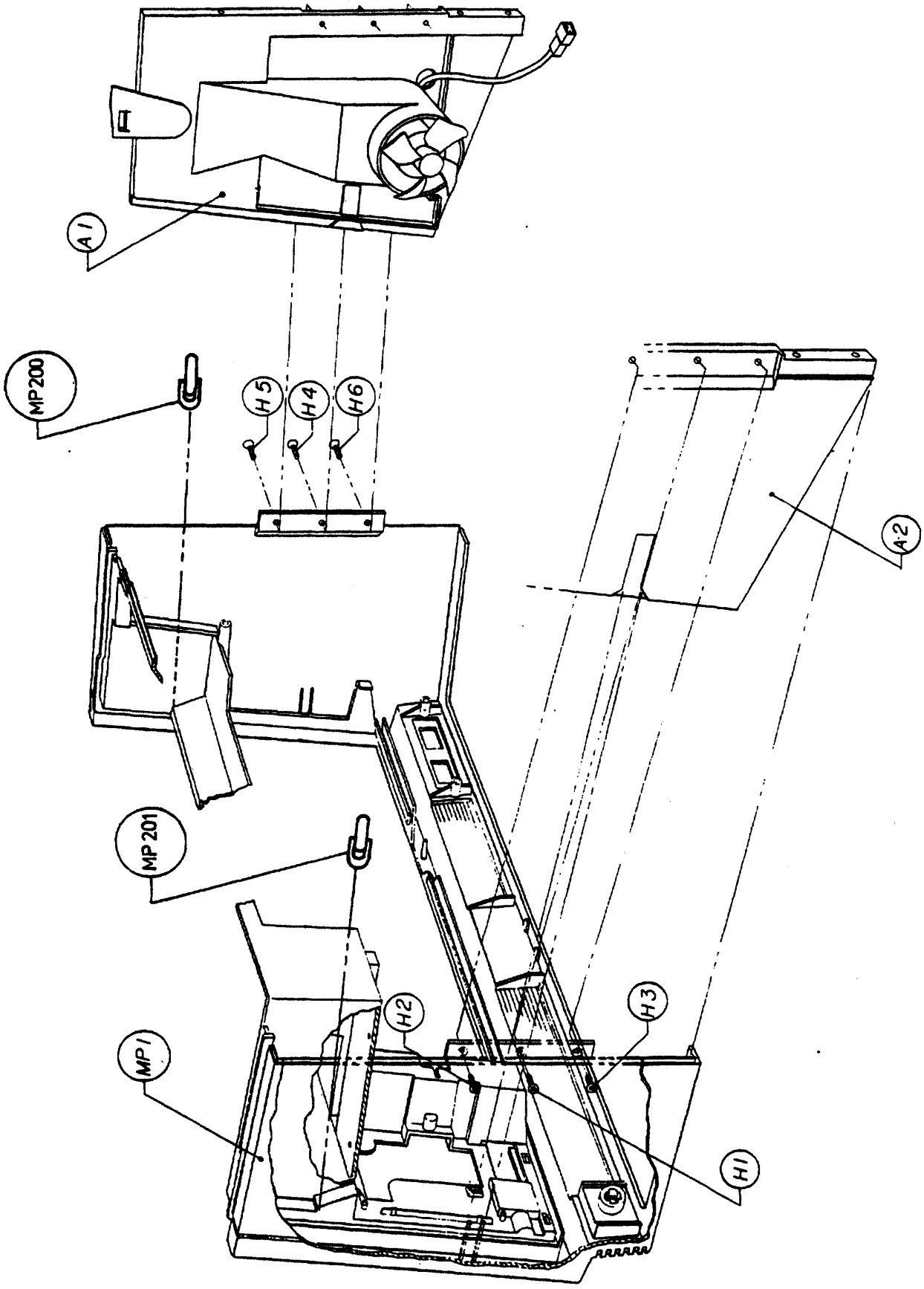


Figure 9-1. Front Case Assembly Exploded View

Table 9-1. Front Case Assembly Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
A1	00095-60920	ASSEMBLY, side support, left	1
A2	00095-60921	ASSEMBLY, side support, right	1
H1–6	0624-0631	SCREWS, 9-19 flto 0.375	6
MP1	00095-40011	CASE, front	1
MP200, 201	00095-40044	CUSHIONS, paper door	2
	00095-80046*	FOAM	1

* The foam is not shown in figure 9-1, but it covers the air vent slots at the bottom of the front case. Use industrial tape (0460-1797) or equivalent to secure the foam.

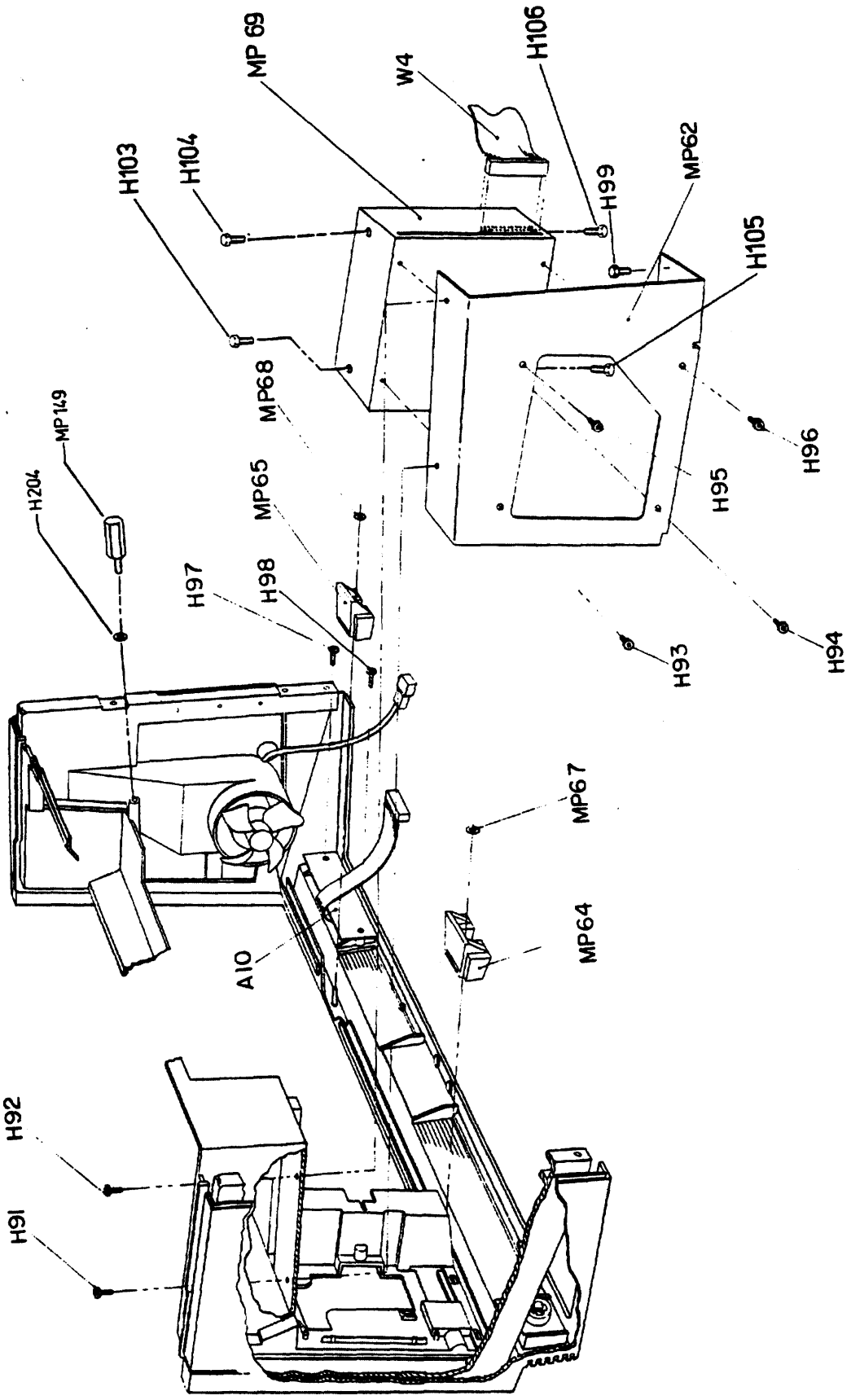


Figure 9-2. Front Disc Assembly Exploded View

Table 9-2. Front Disc Assembly Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
A10	00095-60936	ASSEMBLY, keyboard connector	1
H91, 92	0515-1257	SCREW, back case	2
H93–96	0515-1259	SCREW, TIO M3 6.0LG	4
H97, 98	0624-0634	SCREW, plastic	2
H99	0515-1251	SCREW, M3–10 SEMS	1
H103-106	0515-1259	SCREW, T10 M3 6.0 LG	4
H204, 205*	3050-0393	WASHER, flat metal	2
MP62	00095-00006	BRACKET, disc	1
MP64, 65	00095-40022	CUSHIONS, keyboard	2
MP67, 68	0510-0958	RETAINER, cushion	2
MP69	09114-67511 09114-69511	ASSEMBLY, disc drive (new) (exchange)	1
MP149, 150*	0380-1759	STANDOFF, hex	2
W4	00095-60014	ASSEMBLY, disc cable	1

* MP150 and H205 are not shown in figure 9-2. They are located behind the logic PCA mounting panel as are MP149 and H204.

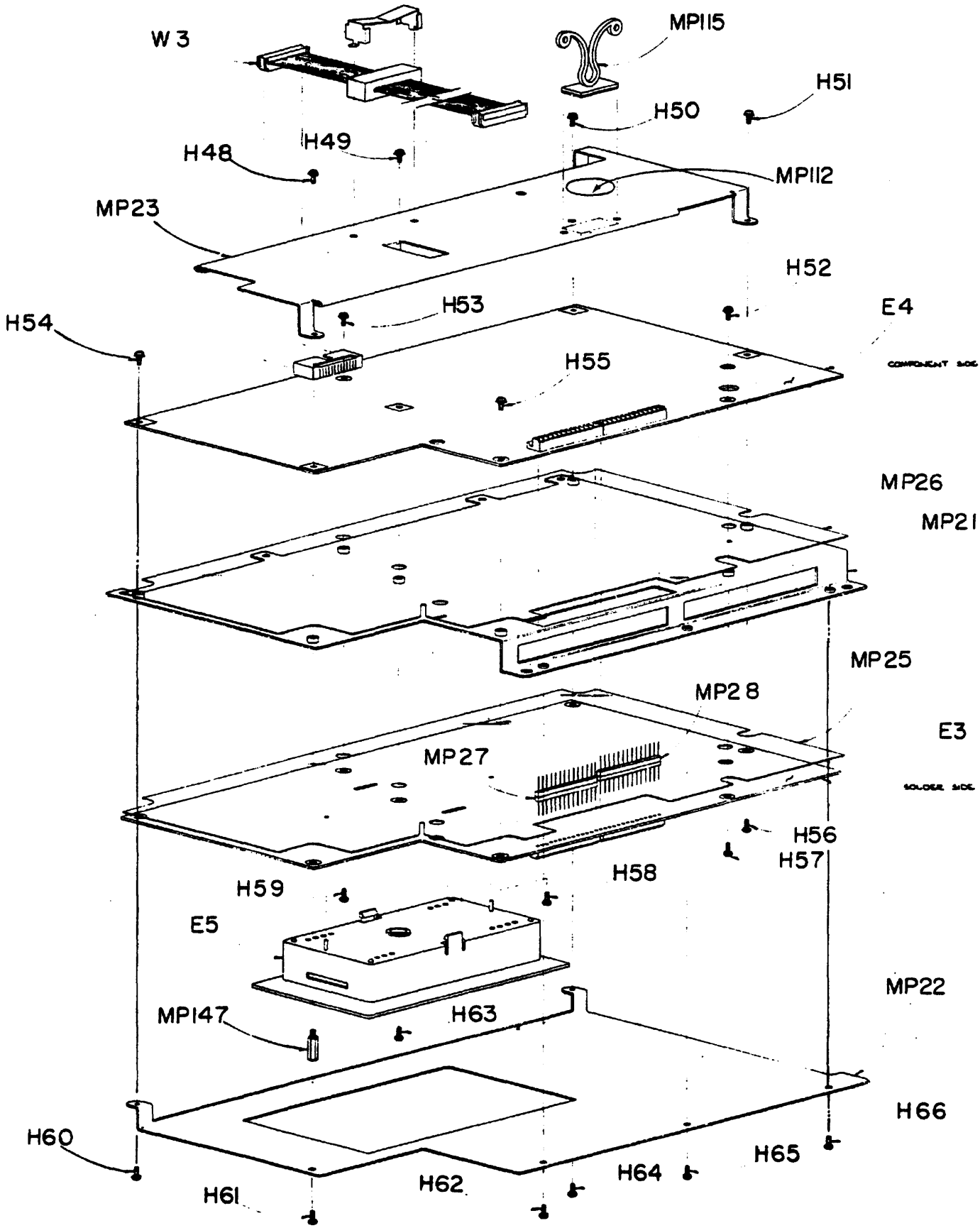


Figure 9-3. Logic Shield Assembly Exploded View

Table 9-3. Logic Shield Assembly Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
E3	00095-60953 00095-69053	ASSEMBLY, logic A (new) (exchange)	1
E4*	00095-60952 00095-69052	ASSEMBLY, logic B (new) (exchange)	1
E5	00095-40033	ROM GUIDE	1
H48–66	0515-1250	SCREW, TI0 M3 5.4LG	19
MP21	00095-00007	GROUND-PLANE	1
MP22	00095-00026	SHIELD A	1
MP23	00095-00028	SHIELD B	1
MP25, 26	00095-80043	INSULATOR, logic board	2
MP27, 28	1252-0193	CONNECTOR, logic A/B	2
MP112	0400-0231	GROMMET, round	1
MP115	1400-1281	CABLE CLAMP, kurly lok	1
MP147	0380-1762	STANDOFF, hex M/F	1
W3	00095-60017	ASSEMBLY, display cable	1
	0515-1259†	SCREW, T10 M3 6.0LG	6
	00095-80103‡	ESD GUARD, Logic A and B (clear plastic)	1
	0361-1186‡	SNAP RIVET, plastic	1

* All new and exchange logic B PCAs are shipped with the standard version of the printer ROM (U32) installed in its socket. If you are servicing a unit localized for Arabic, Hebrew, or Japanese, refer to the reassembly note on page 6-9 concerning localized printer ROMs.

† The six screws that hold the logic PCA mounting panel to the chassis are not shown in figure 9-3. They are identified in figure 6-5.

‡ The clear plastic ESD guard and the snap rivet that holds it are not shown in figure 9-3. (See figure 6-3.)

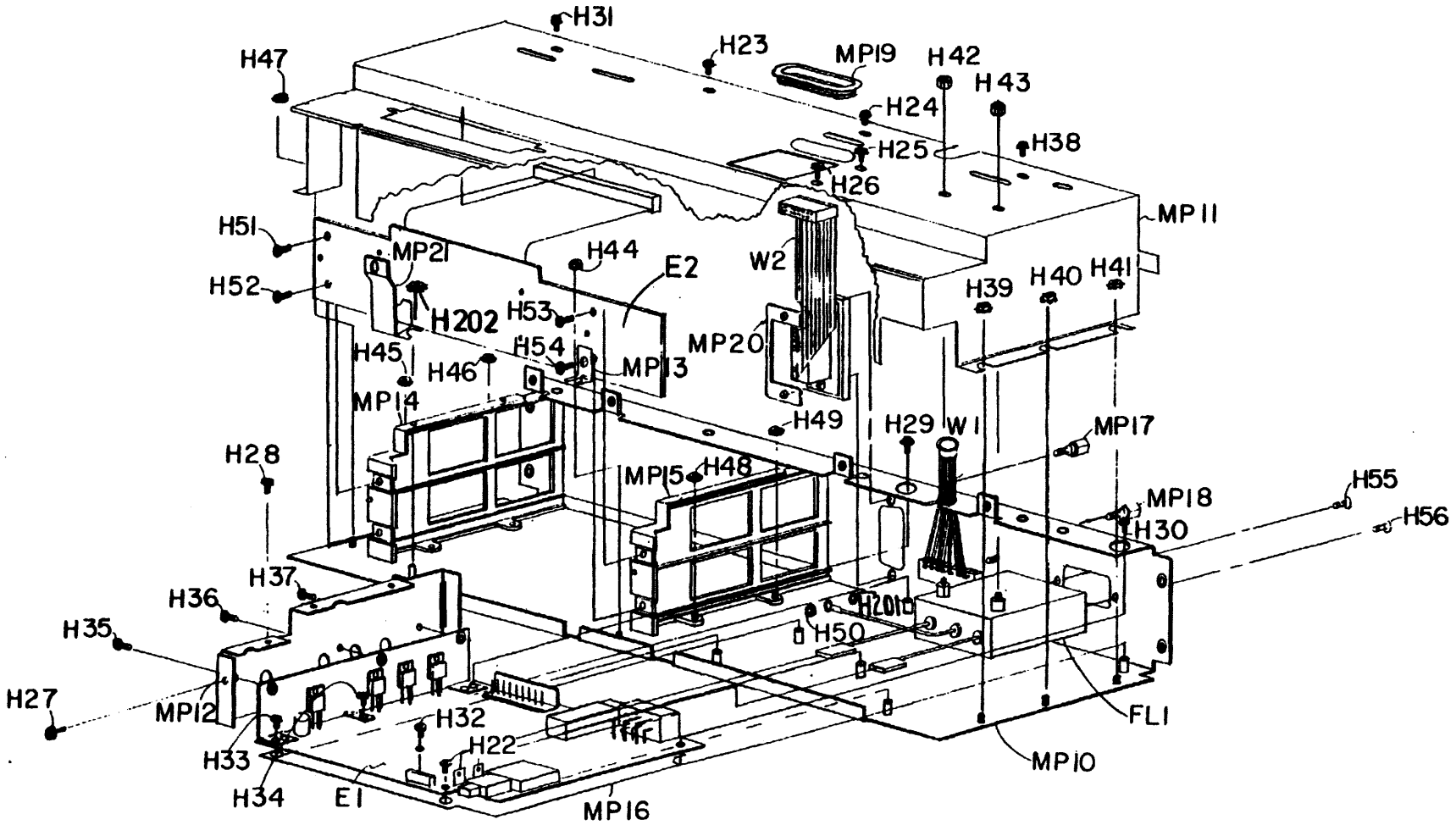


Figure 9-4. Base Assembly Exploded View

Table 9-4. Base Assembly Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
E1	00095-60906 00095-69003	ASSEMBLY, power supply (new) (exchange)	1
E2	00095-60919	ASSEMBLY, I/O	1
FL1	00095-60024	FILTER, power line	1
H22	0515-1246	SCREW, T10 M3 PATCH LOK	1
H23–38	0515-1259	SCREW, T10 M3 6.0LG	16
H39–50	0535-0031	NUT, hex M3 with washer	12
H51–54	0624-0633	SCREW, 6 by 19	4
H55, 56	0515-1342	SCREW, M3-6 with lock washer	2
H201	2190-0597	WASHER, lock	1
H202	0535-0031	NUT, hex M3 with washer	1
MP10	00095-00003	CHASSIS, bottom	1
MP11	00095-00004	COVER	1
MP12	00095-00013	SHIELD, power supply	1
MP13	00095-00029	BRACKET, ground	1
MP14, 15	00095-40019	GUIDES, card	2
MP16	00095-80011	INSULATOR, power supply	1
MP17, 18	0380-1772	POST, jack (with washer)	2
MP19	0400-0231	GROMMET	1
MP20	1600-1420	BRACKET	1
MP21	00095-00037	BRACKET, I/O ground	1
W1	00095-60007	ASSEMBLY, power-cable harness	1
W2	00095-60098	ASSEMBLY, HP-IB ribbon-cable	1

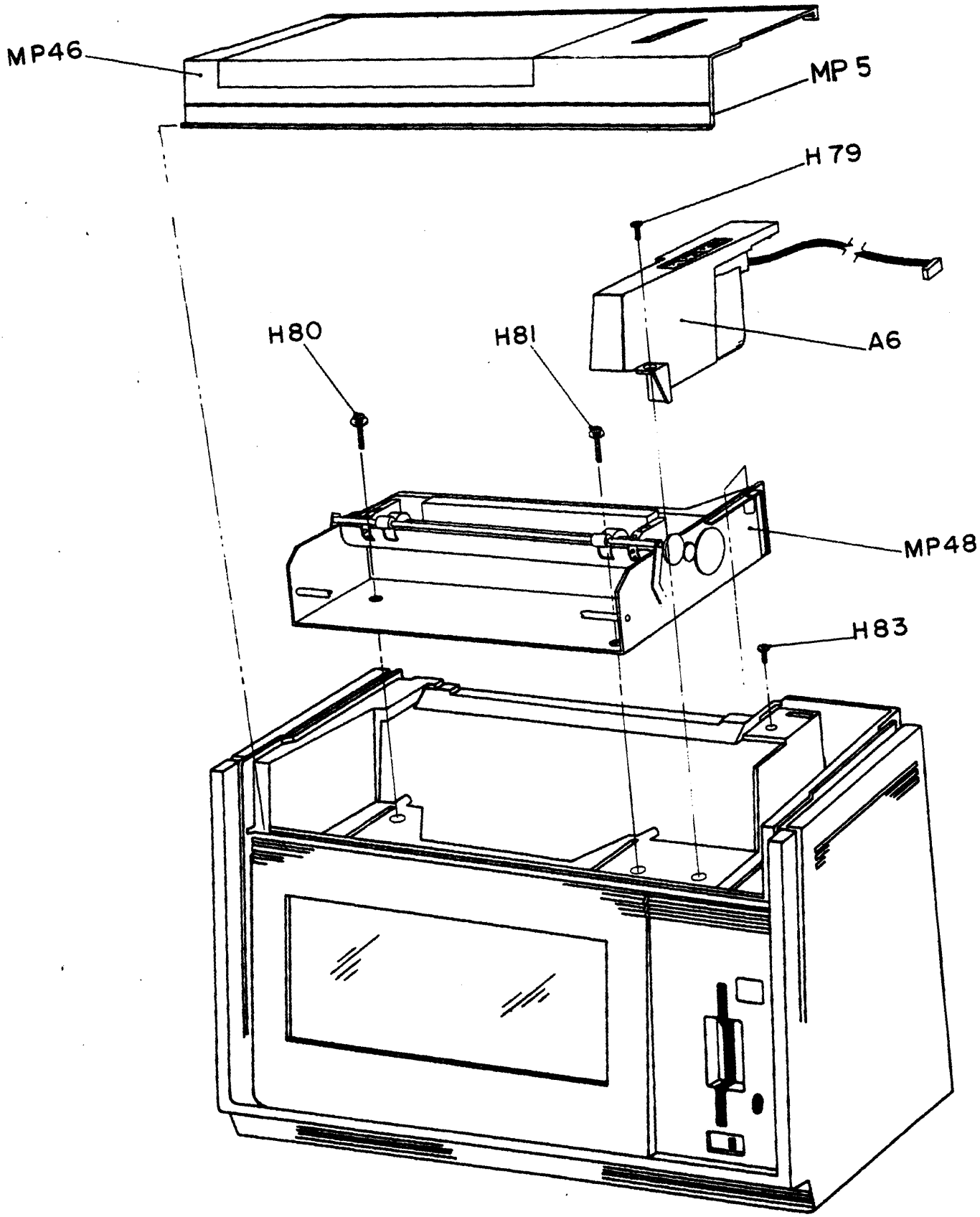


Figure 9-5. Front Printer Exploded View

Table 9-5. Front Printer Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
A6	00095-60922	ASSEMBLY, switch cover	1
H79	0515-1257	SCREW, switch cover	1
H80, 81	0515-1383	SCREW, M4-14 PATCH LOK	2
H83	0624-0634	SCREW, plastic	1
MP5	00095-80024	LABEL, paper door	1
MP46	00095-60944	ASSEMBLY, paper door	1
	1400-0401*	CABLE TIE	1
	1400-1281*	CABLE CLAMP, Kurly Lok	1
MP48	02225-60908†	ASSEMBLY, printer mechanism	1

* The cable tie and cable clamp are not shown in figure 9-5. They are used to restrain the printer mechanism cables (see figure 8-10).

† The printer mechanism assembly includes all printer mechanical parts including the motors and cables.

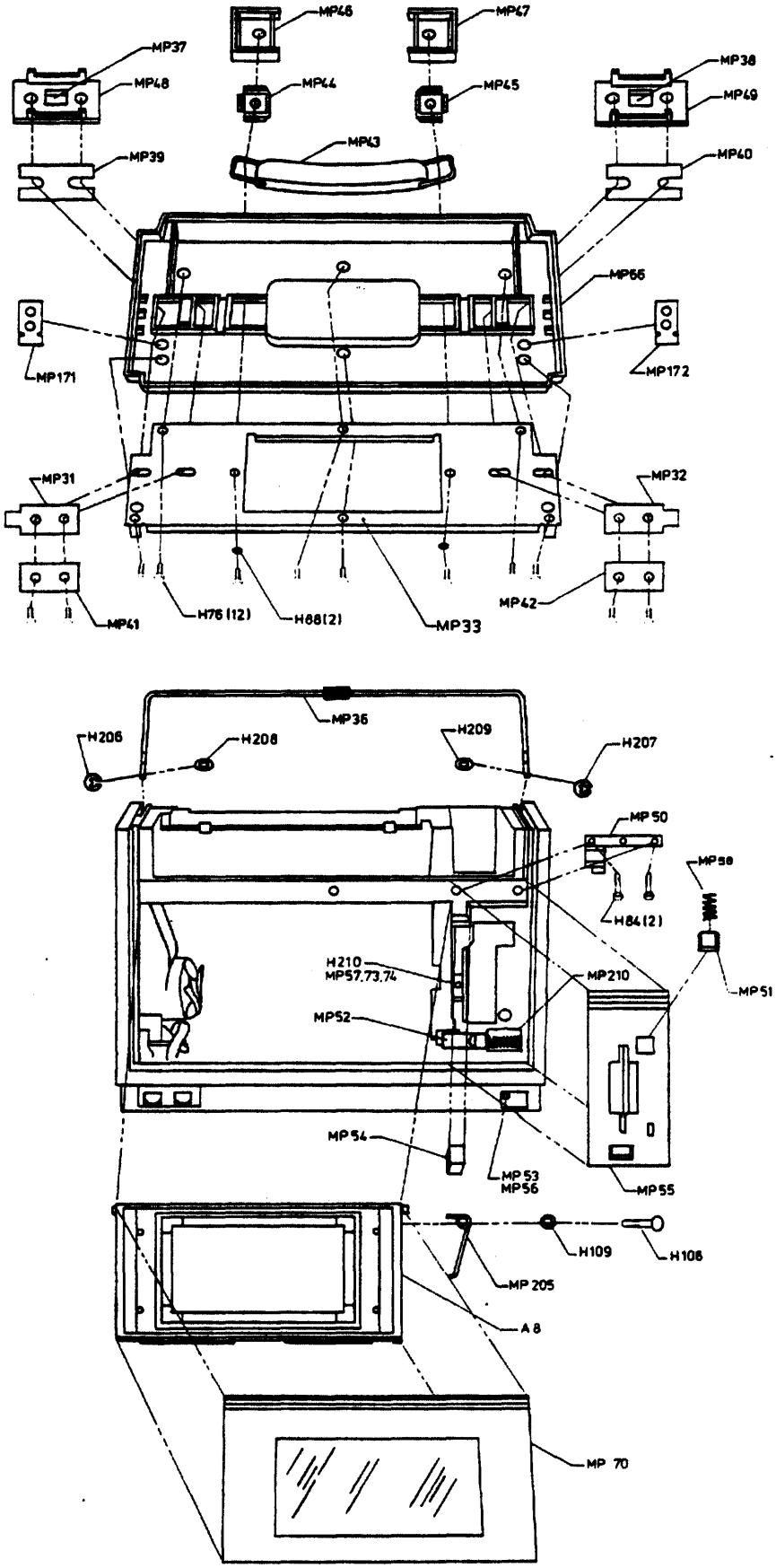


Figure 9-6. Front Assemblies Exploded View

Table 9-6. Front Assemblies Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
A8	00095-60907 00095-69004	ASSEMBLY, display (new) (exchange)	1
H76	0515-1249	SCREW, TIO M3 8LG	12
H84	0515-1259	SCREW, TIO M3 6.0LG	2
H88	3050-0393	WASHER, FL MTLC	2
H108	0624-0630	SCREW, #4, 0.250 plastic	1
H109	3050-1206	WASHER, flat, 0.138ID	1
H206, 207	0510-0015	E-RING	2
H208, 209	3050-0480	WASHER, spring	2
H210	0515-1259	SCREW, dashpot bracket	1
MP31, 32	00095-00015	LID, bottom latch	2
MP33	00095-00016	LID, carrier plate	1
MP36	00095-60162	LID, bail	1
MP37, 38	00095-40036	LATCH, button	2
MP39, 40	00095-80019	LATCH, top slide pad	2
MP41, 42	00095-80020	LATCH, bottom slide pad	2
MP43	1440-0168	HANDLE, spring glide	1
MP44, 45	1600-1429	RETAINER, spring glide	2
MP46, 47	00095-00032	CAP, end	2
MP48, 49	00095-00031	LID, top latch	2
MP50	00095-00020	CLAMP, pivot	1
MP51	00095-40007	BUTTON, Sony A	1
MP52	00095-40008	LATCH, display B	1
MP53	00095-40009	BUTTON, power	1
MP54	00095-40024	PAD, tolerance	1
MP55	00095-40028	BEZEL, disc	1
MP56	00095-80013	SPRING, power	1
MP57	00095-80017	BRACKET, dashpot	1
MP58	1460-2085	SPRING, SB	1
MP66	00095-40003	ASSEMBLY, lid	1
MP70	00095-60926	ASSEMBLY, display bezel	1
MP73	00095-80016	SCREW, dashpot	1
MP74	1520-0246	DASHPOT	1
MP171, 172	00095-80117	INSULATOR, carrier plate	2
MP205	00095-80089	SPRING, display panel	1
MP210	00095-00011	SPRING, display latch	1

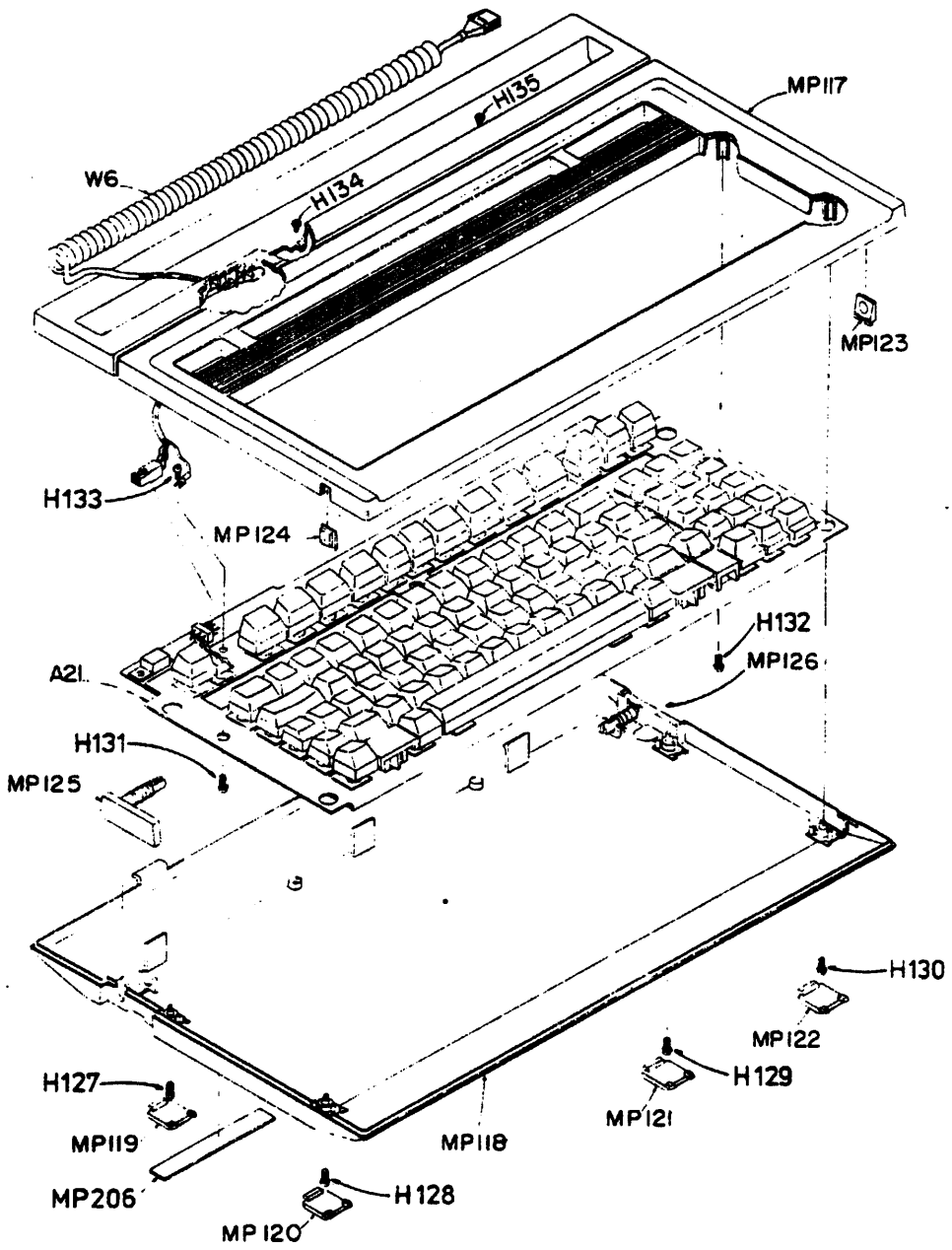


Figure 9-7. Keyboard Exploded View

Table 9-7. Keyboard Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
A21*	00095-60908	ASSEMBLY, Keyboard, US	1
	00095-60909	UK	
	00095-60912	German	
	00095-60913	French	
	00095-60914	Italian	
	00095-60957	Swedish	
	00095-60958	Finnish	
	00095-60959	Danish	
	00095-60960	Norwegian	
	00095-60961	German Swiss	
	00095-60962	French Swiss	
	00095-60963	Belgian	
	00095-60964	Euro-Spanish	
	00095-60965	Japanese	
	00095-60980	Arabic	
	00095-60981	Hebrew	
H127–132	0515-1251	SCREW, M3 10 SEMS	6
H133†	0515-1259	SCREW, TI0 M3 6.0LG	1
H134, 135	0624-0630	SCREW, #4 0.250 plastic	2
MP117	00095-40015	CASE, top	1
MP118	00095-40016	CASE, bottom	1
MP119–122	00095-40020	FEET, keyboard	4
MP123, 124	00095-40031	BUTTON, keyboard	2
MP125	00095-60034	ASSEMBLY, left keyboard leg	1
MP126	00095-60035	ASSEMBLY, right keyboard leg	1
MP206	00095-80047	LABEL, keyboard	1
W6	00095-60101	CABLE, keyboard	1

* Additional keyboards may become available.

† On early production units a 5.5 mm hex nut is used to secure the ground lug.

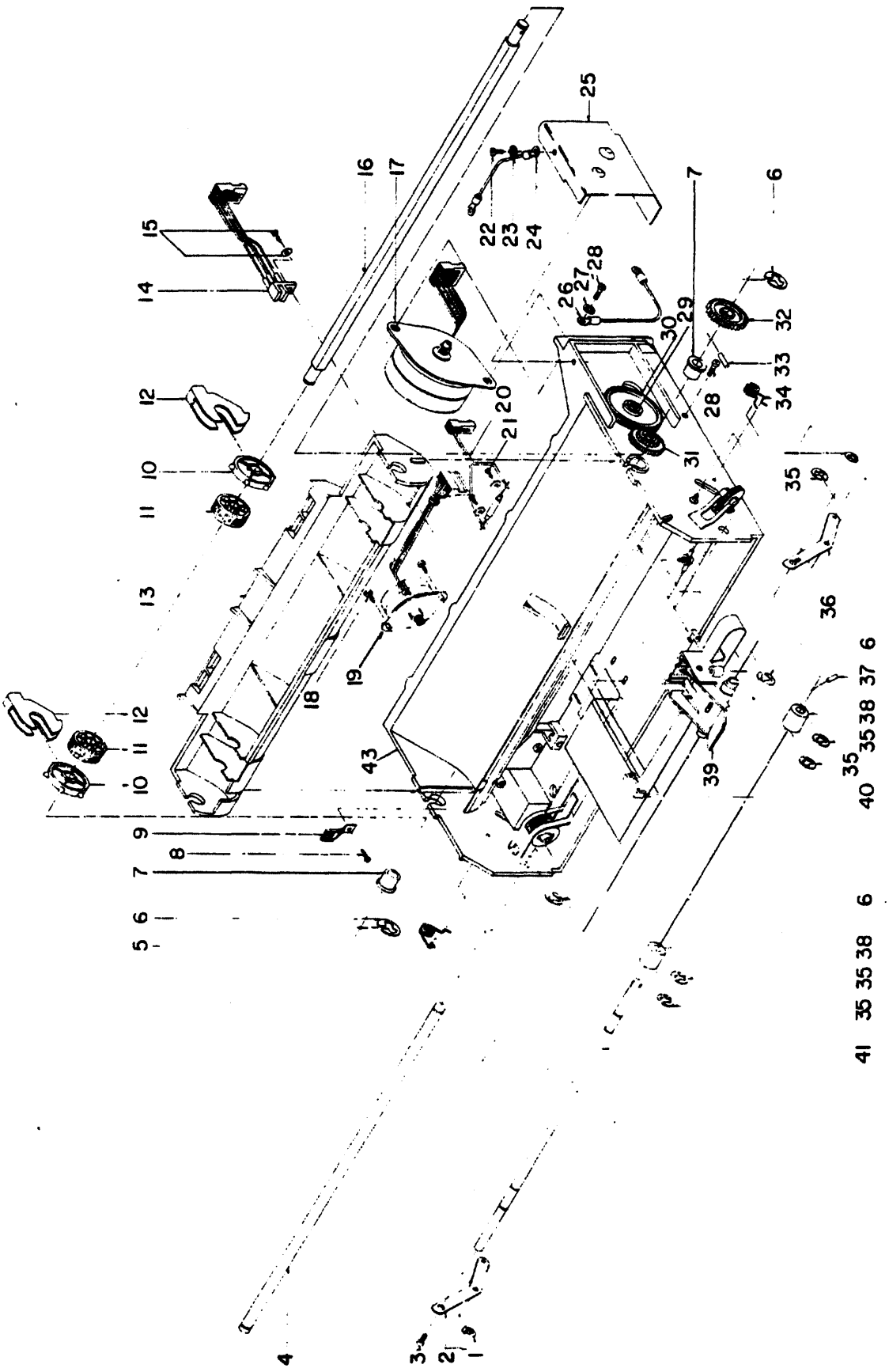


Figure 9-8. Printer Exploded View

Table 9-8. Printer Replaceable Parts

Index Number	HP Part Number	Description	Quantity
1	0510-0952	RETAINER, E ring	2
2	02225-0005	ARM, left bail	1
3	0515-1068	SCREW, M3.0X.5X8.0	1
4	02225-20006	SHAFT, carriage	1
5	02225-20011	SPRING, left side	1
6	0510-0083	RETAINER, E ring	4
7	1410-0251	BEARING, sleeve	2
8	0624-0614	SCREW, 2-28X.250	2
9	02225-00012	SUPPORT, absorber	1
10	02225-40010	WHEEL, pin	2
11	02225-40030	WHEEL, grit	2
12	02225-40009	GUIDE	2
13	02225-40018	FRAME, platen	1
14	02225-60023	ASSEMBLY, home switch (opto switch)	1
15	0624-0623	SCREW, w/washer, home switch	1
16	02225-20009	SHAFT, platen	1
17	3140-0791	MOTOR, paper	1
18	0624-0621	SCREW, 4-20X.375	2
19	3140-0792	MOTOR, carriage	1
20	0490-1425	SWITCH, out-of-paper (reed switch)	1
21	0624-0611	SCREW, w/washer, SEM 2-28X.250	2
22	0624-0634	SCREW, 6-19X.50	1
23	2190-0065	WASHER, Star #6	1
24	02225-80036	WIRE	1
25	02225-00016	SHIELD, magnetic	1
26	02225-80037	WIRE	1
27	2190-0009	WASHER, Star #8	1
28	0515-1879	SCREW, 4X.7X10mm	2
29	0510-0015	RETAINER, E-ring	2
30	02225-40022	GEAR, idler	1
31	02225-40021	GEAR, cluster	1
32	02225-40023	GEAR, output P.D.	1
33	02225-20017	DOWEL	1
34	02225-20008	SPRING, right side	1
35	0510-0045	RETAINER, E-ring	5
36	02225-00004	ARM, right bail	1

Table 9-8. Printer Replaceable Parts (Continued)

Index Number	HP Part Number	Description	Quantity
37	02225-20018	DOWEL, bail shaft	1
38	02225-20001	ROLLER, pinch	2
39	02225-60909	ASSEMBLY, carriage	1
40	02225-40005	CLIP, flex circuit	1
41	02225-20007	SHAFT, bail	1
43	02225-60908*	ASSEMBLY, printer mechanism	1

* The printer mechanism assembly includes all printer mechanical parts including the motors and cables.

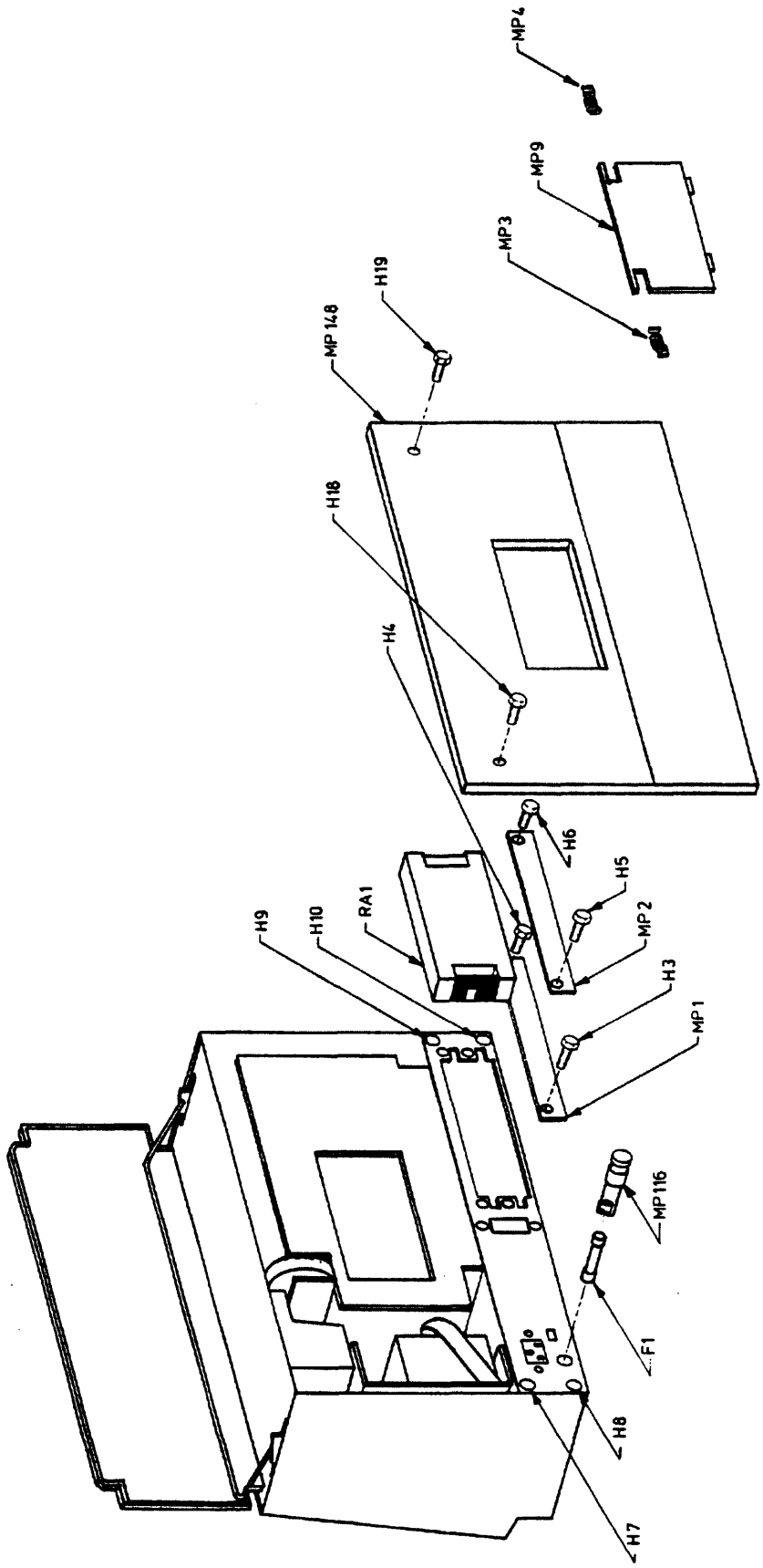


Figure 9-9. Rear Assemblies Exploded View

Table 9-9. Rear Assemblies Replaceable Parts

Reference Designation	HP Part Number	Description	Quantity
F1	2110-0043 2110-0496	FUSE, 1.5A (115 Vac) FUSE, 0.8A (230 Vac)	1
H3–6	0515-0259	SCREW, I/O cover	4
H7–10	0515-1247	SCREW, chassis	4
H18, 19	0515-1263	SCREW, back-case	2
MP1, 2	00095-00001	I/O cover, blank	2
MP3, 4	00095-40037	LATCH, ROM door	2
MP9	00095-40002	DOOR, ROM	1
MP116	2110-0565 2110-0567	CAP, fuseholder (115 Vac) CAP, fuseholder (230 Vac)	1
MP148	00095-40001	BACKCASE	1
	0535-0031*	NUT, hex M3 with washer	1
RA1†		ROM ASSEMBLY	1

* This nut is located in front of the I/O backplane PCA (see figure 6-29a). It is not shown in figure 9-9.

† The System V ROM assembly can be serviced to the component level. Refer to table 9-10 to identify the replaceable parts. The System III ROM assembly cannot be serviced to the component level. The System III replacement assembly number is 00095-60937. When you replace a System III ROM assembly you should also replace the plastic ROM cover (00095-40043).

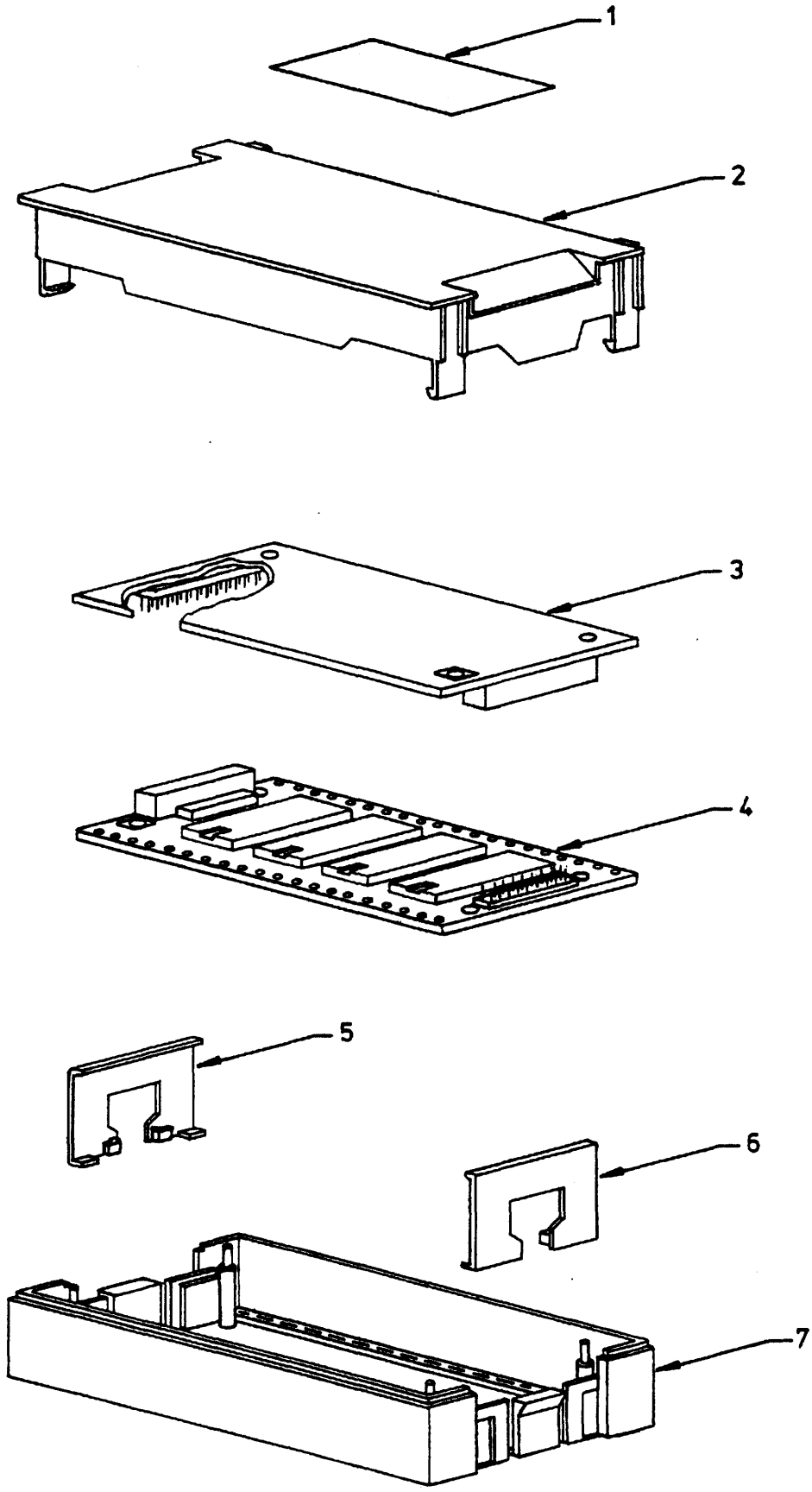


Figure 9-10. System V ROM Assembly Exploded View

Table 9-10. System V ROM Assembly Replaceable Parts

Index Number	HP Part Number	Description	Quantity
1*	82991-80003 82995-80001	LABEL, ROM (82991A) LABEL, ROM (82995A)	1
2	82991-40002	CASE, top	1
3†		PCA, option ROM	1
4	82991-60901	PCA, operating system ROM	1
5, 6	82991-40003	HANDLE	2
7	82991-40001	CASE, bottom	1

* There are two labels for the System V ROM assembly. The HP 82995A ROM Assembly, currently supplied with the computer, has label part number 82995-80001. The HP 82991A ROM Assembly, which comes with the System V upgrade kit, has label part number 82991-80003. Both assemblies are identical and contain the same parts, except the label.

† An option ROM PCA may or may not be present in the System V ROM assembly. No option ROM PCA is available at the time of publication. When an option ROM PCA becomes available, a service note will be issued.

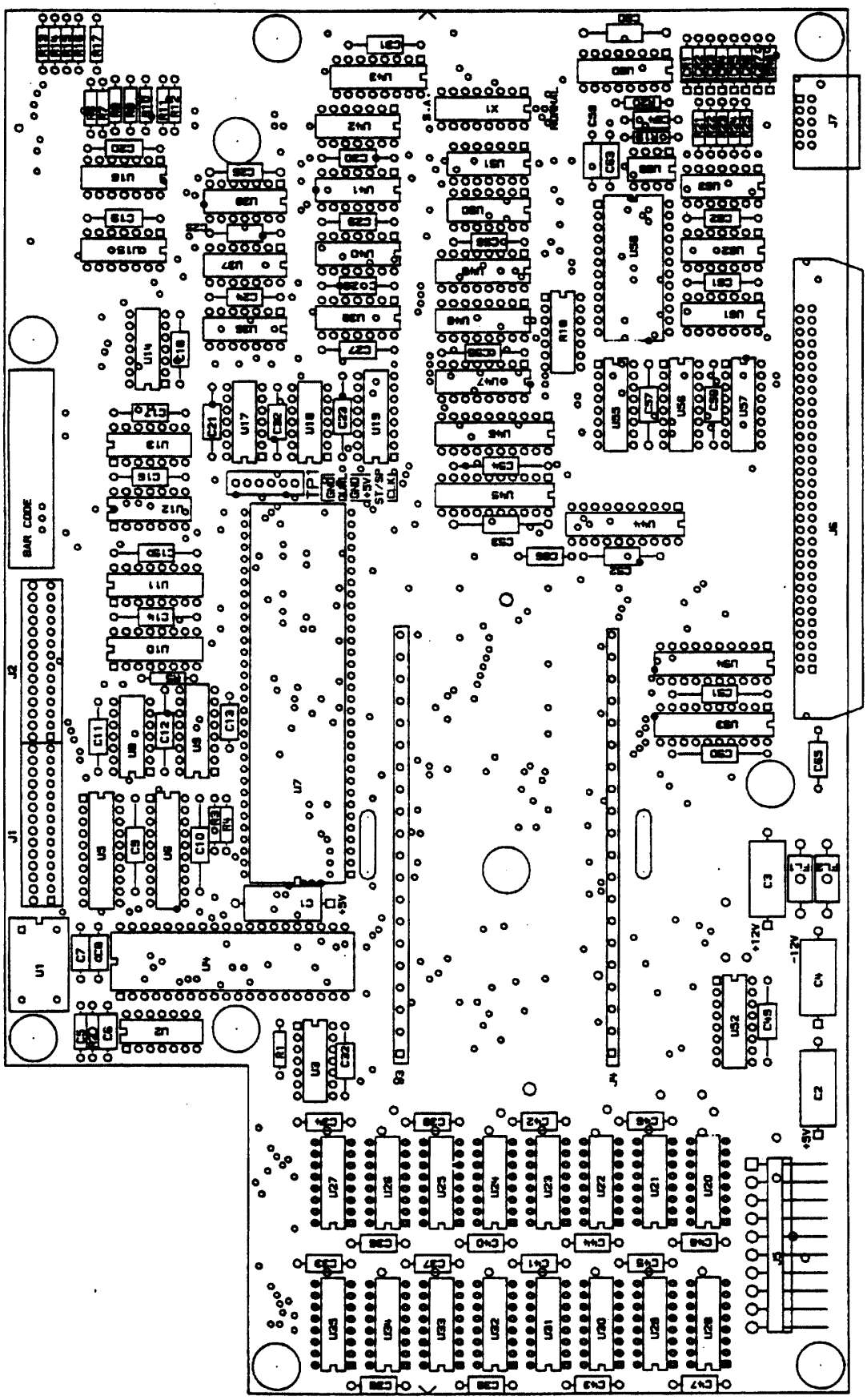


Figure 9-11. Logic A PCA Component-Location Diagram

Table 9-11. Logic A PCA Replaceable Electronic Parts

Reference Designation	HP Part Number	Description
J3, J4	1600-1432*	CONNECTOR, ROM
U1	1813-0467	INTEGRATED CIRCUIT, clock oscillator, 15.92 MHz
U2	1820-3493	INTEGRATED CIRCUIT, SN74AS74N
U20–35	1818-3308	INTEGRATED CIRCUIT, DRAM, 256K-byte
U59	1826-0180	INTEGRATED CIRCUIT, timer, 555
U60	1820-1851	INTEGRATED CIRCUIT, interrupt encoder

* This part number is for a strip of 20 pins. Each ROM connector (J3 and J4) has 20 pins.

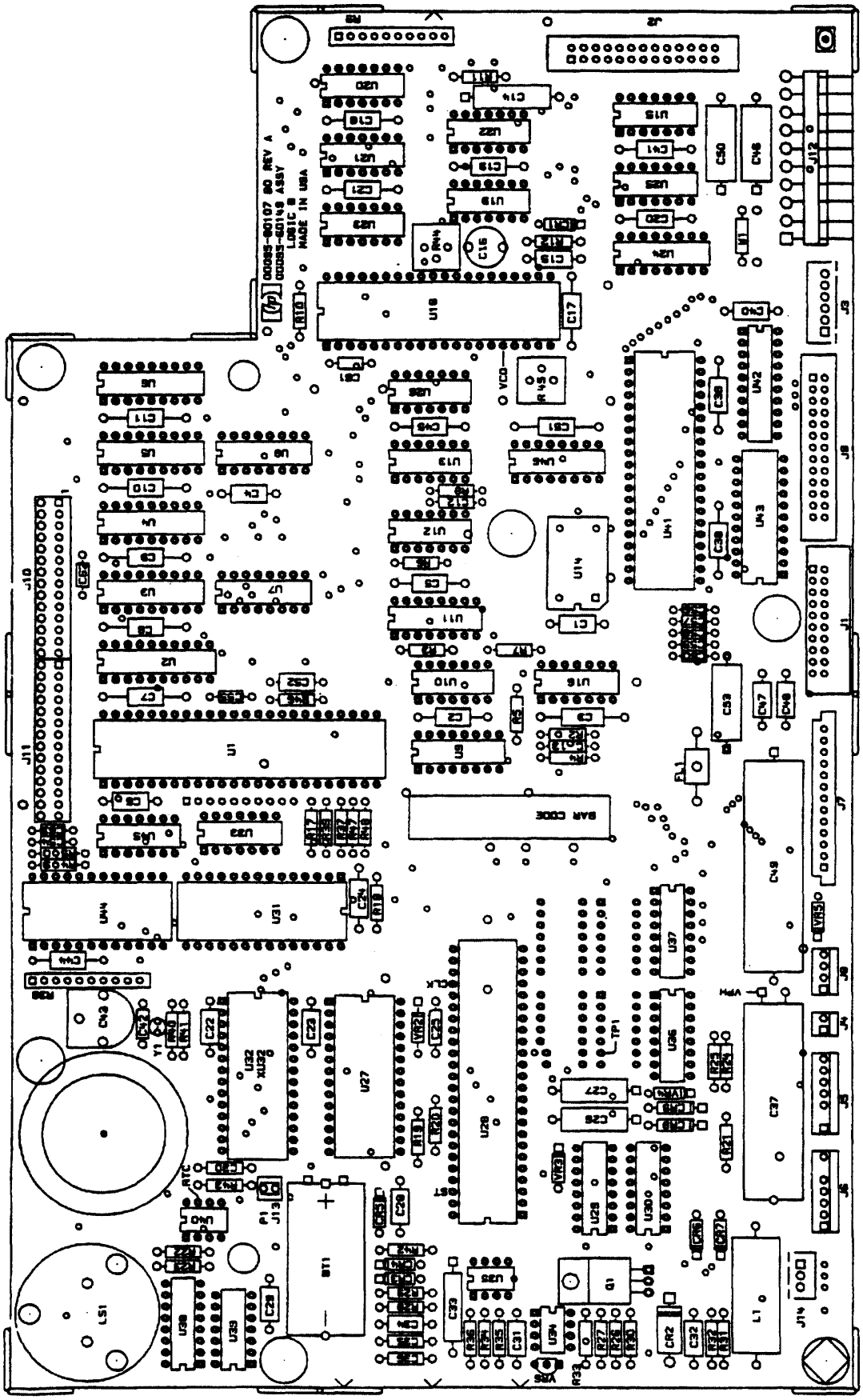


Figure 9-12. Logic B PCA Component-Location Diagram

Table 9-12. Logic B PCA Replaceable Electronic Parts

Reference Designation	HP Part Number	Description
Display		
U1	1LL3-0005	INTEGRATED CIRCUIT, GPU
U10	1820-1112	INTEGRATED CIRCUIT, SN74LS74AN
U13	1820-1197	INTEGRATED CIRCUIT, 74LS00
HP-IB		
U41	1820-2548	INTEGRATED CIRCUIT, 9914, HP-IB
U42	1820-2485	INTEGRATED CIRCUIT, SN75160A
U43	1820-2547	INTEGRATED CIRCUIT, SN75162A
Printer		
C26, 27	0180-3314	CAPACITOR, 1 μF, 50V
CR8, 9	1901-0693	DIODE, 1N4934
U27	1LG8-0001	INTEGRATED CIRCUIT, RAM, 1K-byte
U28	1LJ7-0015	INTEGRATED CIRCUIT, control, printer
U32*	1LG7-0064 1LG7-0078 1LG7-0079 1LG7-0080	IC, printer ROM (standard) IC, printer ROM (Arabic) IC, printer ROM (Hebrew) IC, printer ROM (Japanese)
U34	1826-0412	INTEGRATED CIRCUIT, LM393N
U36, 37	1858-0099	INTEGRATED CIRCUIT, transistor array
Real-Time Clock		
U44	1820-2813	INTEGRATED CIRCUIT, NS 58167 RTC
BT1	1420-0338	BATTERY, 3V
Speaker		
LS1	9164-0251	SPEAKER, 75 db min, 9V
U40	1826-0346	INTEGRATED CIRCUIT, LM 358
System Clocks		
U9	1820-3375	INTEGRATED CIRCUIT, SN74LS193N
U14	1813-0427	INTEGRATED CIRCUIT, clock oscillator, 24 MHz
U16	1820-1112	INTEGRATED CIRCUIT, SN74LS74AN
U46	1820-1430	INTEGRATED CIRCUIT, SN74LS161AN

* The standard printer ROM (1LG7-0064) is used for all languages except Arabic, Hebrew, and Japanese. If you are servicing a unit localized for one of those languages, refer to the reassembly note on page 6-9.

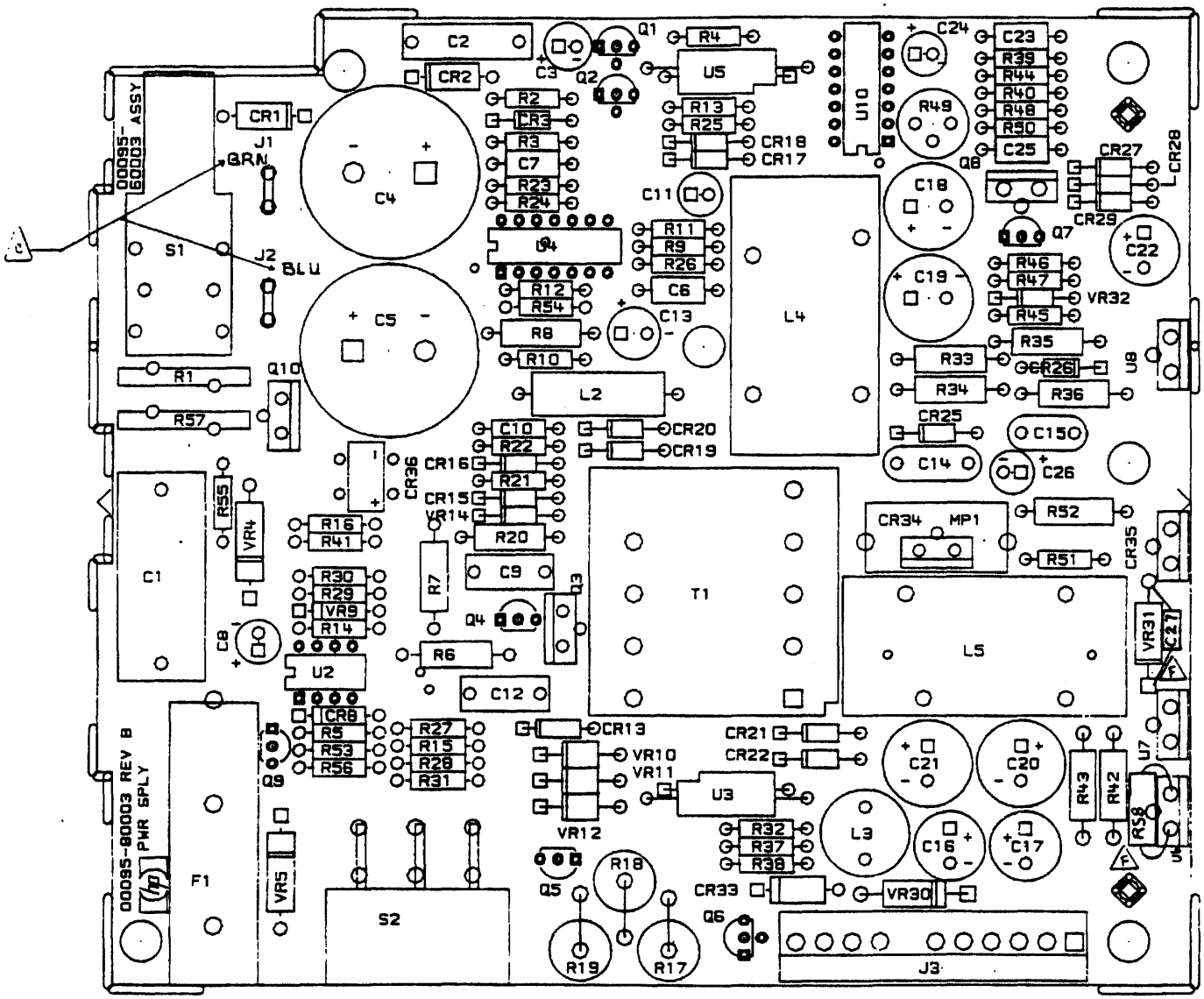
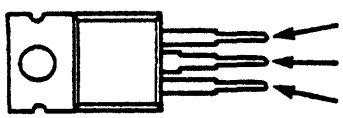


Figure 9-13. Power Supply PCA Component-Location Diagram

TO-220 Top View	U6	U7	U8	CR34 & CR35
	Output	Input	Output	Ground
	Input	Output	Ground	Output
	Ground	Adjust	Input	Input

U3 & U5
TOP VIEW

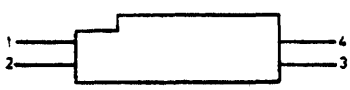


Table 9-13. Power Supply PCA Replaceable Electronic Parts

Reference Designation	HP Part Number	Description
C1	0160-5093	CAPACITOR, 0.33 μF
C4, 5	0180-3509	CAPACITOR, 220 μF, 250V
C13	0180-3510	CAPACITOR, 10 μF, 35V
C16, 17	0180-3511	CAPACITOR, 33 μF, 50V
C18, 19	0180-3610	CAPACITOR, 470 μF
C20, 21	0180-3513	CAPACITOR, 470 μF, 10V
CR1, 2	1901-0731	DIODE, 1N4004(S)
CR13	1901-0831	DIODE, 1N4937
CR19–22	1901-1065	DIODE, 1N4936
CR34	1901-1143	RECTIFIER, FE16F
CR35	1906-0300	RECTIFIER, SB1660
CR36	1906-0306	RECTIFIER
F1	2110-0642	FUSEHOLDER, extra post
J1, 2	1251-6901	CONNECTOR, single contact
L3	9140-0899	INDUCTOR, 1 mH
L4	9140-0931	INDUCTOR, 1 mH
L5	9140-0932	INDUCTOR, 100 μH
Q1, 7	1853-0573	TRANSISTOR, 2N6709, PNP
Q2, 5, 6	1854-1028	TRANSISTOR, 2N3904, NPN
Q3	1855-0510	TRANSISTOR, 1RF830
Q4	1853-0563	TRANSISTOR, 2N3906, PNP
Q8	1884-0295	TRANSISTOR, TYP212
Q10	1884-0309	THYRISTOR, Triac
R49	2100-0567	RESISTOR, trimmer, 2 kΩ, 10%
S1	3101-2730	SWITCH, pushbutton, DPDT
S2	3101-2609	SWITCH, slide, DPDT
U2	1826-0412	INTEGRATED CIRCUIT, LM393N
U3	1990-1021	ISOLATOR, optical coupled
U4	1826-1208	INTEGRATED CIRCUIT, MC34060
U6	1826-0418	INTEGRATED CIRCUIT, LM 7912CT
U7	1826-1216	INTEGRATED CIRCUIT, LT350AT
U8	1826-0106	INTEGRATED CIRCUIT, 15V regulator
U10	1820-0439	INTEGRATED CIRCUIT, LM 723CN
VR3	1902-0656	DIODE, 1N4754A 39V

Table 9-13. Power Supply PCA Replaceable Electronic Parts (Continued)

Reference Designation	HP Part Number	Description
VR4, 5	1902-1486	DIODE, 1N5388B, zener
VR9, 32	1902-0952	DIODE, zener (5.6V, 0.4W)
VR30, 31	1902-0644	DIODE, 1N5363B
	5180-1501*	INSULATOR SHEET

* The insulator sheet goes between the heat sink and the following components: U6, U7, CR35, and U8.

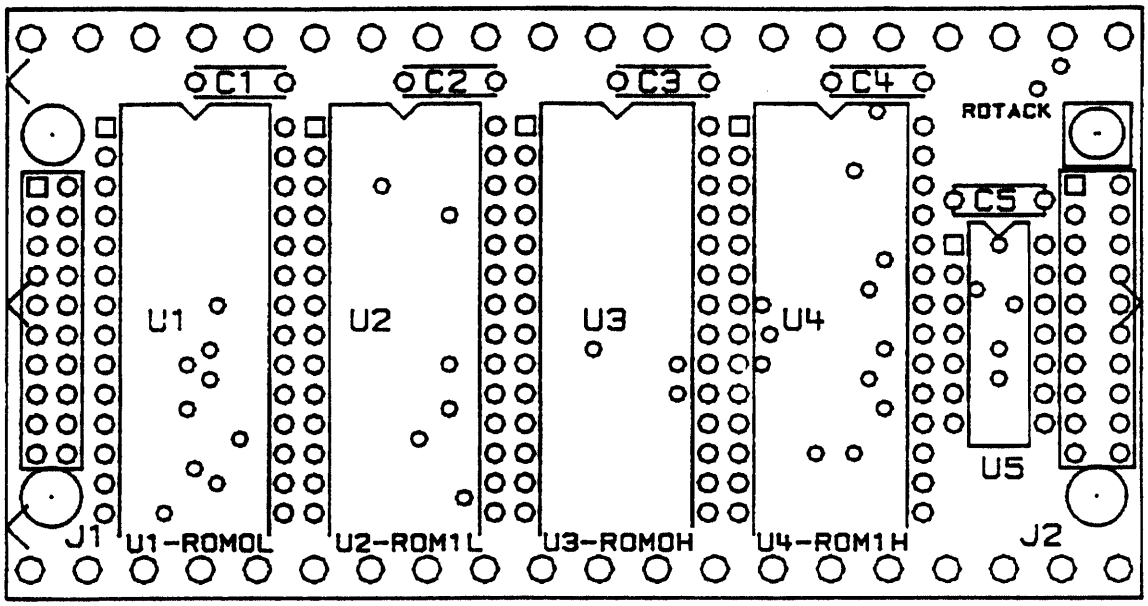


Figure 9-14. Operating System ROM PCA Component-Location Diagram

Table 9-14. Operating System ROM PCA Replaceable Electronic Parts

Reference Designation	HP Part Number	Description
U1	82991-60907	INTEGRATED CIRCUIT, U-ROM 0 L
U2	82991-60908	INTEGRATED CIRCUIT, U-ROM 1 L
U3	82991-60909	INTEGRATED CIRCUIT, U-ROM 0 H
U4	82991-60910	INTEGRATED CIRCUIT, U-ROM 1 H

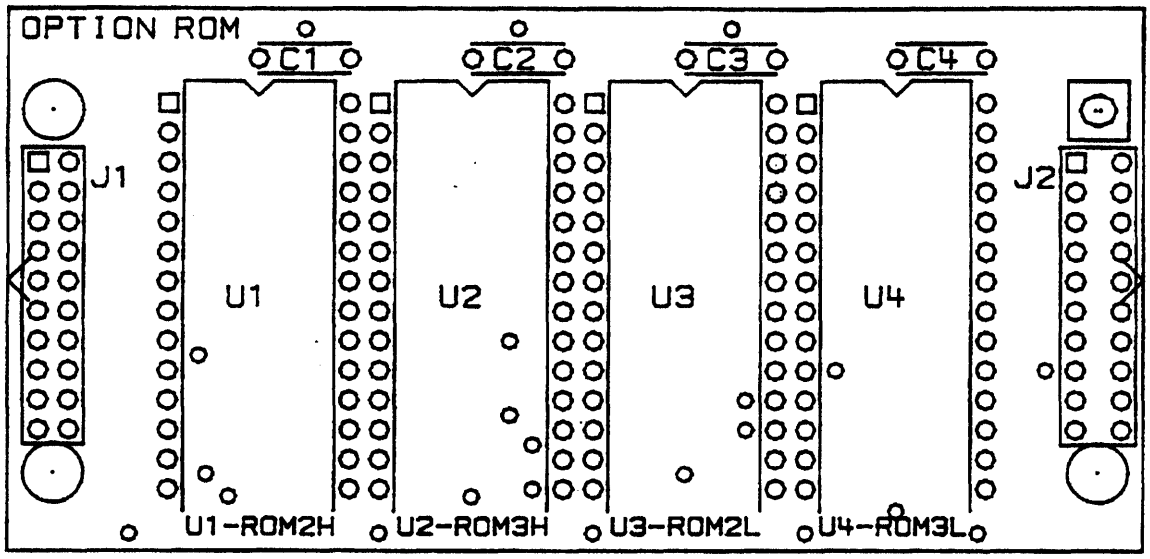


Figure 9-15. Option ROM PCA Component-Location Diagram

Note: The part number of the option ROM PCA, and the part numbers for its components, depend upon which option is present. No option ROM PCAs are available at the time of publication. When an option ROM PCA becomes available, a service note will be issued covering the part numbers and other service information.

Chapter 10
Reference

10.1 Introduction

This chapter provides some additional information that you will find helpful in troubleshooting and repairing the Integral PC.

10.2 Additional Technical Information

You may want to refer to the following manuals and IC data sheets for additional technical information:

- MC68000UM (AD3) User's Manual by Motorola.
- Micro-Floppy Disc Theory of Operations Manual by Sony.
- Micro-Floppy Disc Service Manual by Sony.
- FDC 2797 Floppy Disc Controller Data Sheet by Western Digital.
- HP 2225 Series ThinkJet Printer Service Manual.

Note: The printer in the Integral PC is a modified version of the HP 2225B ThinkJet Printer.

10.3 Keyboard Identification

The keyboard identification codes for the localized keyboards are listed in table 10-1. The codes are contained in the keyboard as a row of diodes built into the key matrix. The code is decoded by the keyboard controller.

Table 10-1. Keyboard Identification Codes

Nationality	Identification (hexadecimal)
US	BF
German	AF
UK	B7
French	BB
Katakana	BD
Latin Spanish	BE
Canadian English	A7
Italian	AB
Dutch	AD
Swedish	AE
European Spanish	B3
Belgian (Flemish)	B5
Finnish	B6
Swiss German	B4
Norwegian	BA
Danish	BC
Swiss French	B2

10.4 Connector Pin Assignments

This section gives the pin assignments for the ROM receptacle connectors, the logic A to logic B bus connectors, and the I/O backplane connectors.

10.4.1 The ROM Receptacle

The plug-in ROM assembly plugs into the ROM receptacle on the logic A PCA. This receptacle has two rows of pins, connector J3 and connector J4. Table 10-2 gives the pin assignments. For a discussion of the ROM bus signals, refer to section 5.5.2.

Table 10-2. ROM Receptacle Pin Assignments

Pin	Signal at J3	Signal at J4
1	A1	D3
2	A2	D2
3	A3	D4
4	A4	D1
5	A5	D5
6	A6	D0
7	A7	D6
8	A8	D7
9	A9	D11
10	A10	+5V
11	A11	GND
12	A12	D10
13	A13	D12
14	A14	D9
15	A15	D13
16	A16	D8
17	A17	D14
18	$\overline{\text{ROM0}}$	D15
19	$\overline{\text{RDTACK}}$	$\overline{\text{ROM2}}$
20	$\overline{\text{ROM1}}$	$\overline{\text{ROM3}}$

10.4.2 The Logic A to Logic B Bus Connectors

The logic A to logic B bus connects the I/O devices on the logic B PCA to the CPU on the logic A PCA. Table 10-3 gives the pin assignments for the connectors. For a discussion of the logic A to logic B bus signals, refer to section 5.7.2.

Table 10-3. Logic A to Logic B Bus Pin Connections

Pin	Signal at Logic A Connector J1 Logic B Connector J10	Signal at Logic A Connector J2 Logic B Connector J11
1	IBD7	$\overline{IR6}$
2	IBD6	$\overline{IR5}$
3	IBD5	$\overline{IR4}$
4	IBD4	$\overline{IR3}$
5	IBD3	$\overline{IR1}$
6	IBD2	PWRDN
7	IBD1	$\overline{SPKWR}$
8	IBD0	$\overline{HPIB}$
9	$\overline{RESET}$	$\overline{RTC}$
10	IBA5	$\overline{PRNT}$
11	IBA4	$\overline{DISP}$
12	IBA3	$\overline{DISC}$
13	IBA2	$\overline{WR}$
14	IBA1	$\overline{RD}$

10.4.3 The I/O Backplane Connectors

The external I/O bus is transferred to the I/O backplane PCA by a 64-conductor ribbon cable. This cable extends from connector J6 on the logic A PCA to the I/O backplane PCA. Table 10-4 gives the pin assignments for connector J6 in columns 2 and 3.

The I/O backplane PCA has two output connectors, one for port A and one for port B. Table 10-4 gives the pin assignments for these connectors in columns 4 and 5.

For a discussion of the external I/O bus signals, refer to section 5.8.2.

> **Note:** The Integral PC supports the Level 0 Subset of the P-bus (the Personal Computer Group compatible bus) with the exception that the I/O backplane connectors provide the outer two rows of pins only (row A and row C).

Table 10-4. I/O Backplane Connector Pin Assignments

Pin	Signal at J6 (Logic A PCA)		Signal at Output Connectors (Ports A and B)	
	Row A	Row C	Row A	Row C
1	GND	+12V	GND	+12V
2	BA1	+5V	BA1	+5V
3	BA3	BA2	BA3	BA2
4	BA5	BA4	BA5	BA4
5	BA7	BA6	BA7	BA6
6	BA9	BA8	BA9	BA8
7	BA11	BA10	BA11	BA10
8	GND	BA12	GND	BA12
9	BA13	BA14	BA13	BA14
10	BA15	BA16	BA15	BA16
11	BA17	BA18	BA17	BA18
12	BA19	BA20	BA19	BA20
13	BA21	BA22	BA21	BA22
14	BA23	GND	BA23	GND
15	BD0	BD1	BD0	BD1
16	BD2	BD3	BD2	BD3
17	BD4	BD5	BD4	BD5
18	BD6	BD7	BD6	BD7
19	BD8	BD9	BD8	BD9
20	BD10	BD11	BD10	BD11
21	BD12	BD13	BD12	BD13
22	BD14	BD15	BD14	BD15
23*	NPS0	NPS1	NPS†	GND
24*	GND	NBRESET	NBDMARQ‡	NBRESET
25	BR/NW	NBAS	BR/NW	NBAS
26	NBUD	NBLD	NBUD	NBLD
27*	GND	+5V	GRIN	GROUT
28	NBDTACK	NBIMA	NBDTACK	NBIMA
29	NBIR0	NBIR1	NBIR0	NBIR1
30	NBIR2	NBIR3	NBIR2	NBIR3
31	GND	+5V	GND	+5V
32	−12V	GND	−12V	GND

* For these pins only, the port A and B output connector pin assignments differ from those of connector J6 on the logic A PCA.

† NPS (port select) for port A is NPS0. NPS for port B is NPS1.

‡ The NBDMARQ pins on the port A and B connectors are tied together.

10.5 Error Messages

Table 10-5 lists the self-test error messages generated by the operating system ROM. If an error message appears in the copyright window, refer to the indicated table for troubleshooting instructions.

Table 10-5. Self-Test Error Messages

Error Message	Table Number
Rom checksum test error	8-26
Option rom checksum test error	8-26
Ram test error on internal ram	8-5
Ram test error on port __	8-5

Table 10-6 lists the error messages generated by the service ROM. If an error message appears, refer to the indicated table for troubleshooting instructions.

Table 10-6. Service ROM Error Messages

Error Message	Table Number
*** Cannot execute test without a functional display.	8-7
*** ERROR - Disc CRC error.	8-9
*** ERROR - Disc interrupt error.	8-24
*** ERROR - Disc record not found.	8-9
*** ERROR - Disc time-out error.	8-9
*** ERROR - Disc (W/R) data mismatch.	8-9
*** ERROR - Display RAM (R/W) error.	8-8
*** ERROR - Found devices on both loops!	8-7
*** ERROR - GPU time-out error.	8-8
*** ERROR - incorrect key count.	8-7
*** ERROR - INTERRUPT LEVEL n occurred when it should not have.	8-24
*** ERROR - Keyboard received a framing error.	8-7
*** ERROR - Keyboard received a loop error.	8-7
*** ERROR - Keyboard received an over-flow error.	8-7
*** ERROR - Keyboard received a parity error.	8-7
*** ERROR - Keyboard time-out error.	8-7
*** ERROR - Keyboard was not changed, or bad controller IC.	8-7
*** ERROR - Lost data bit during read sector command.	8-9

Table 10-6. Service ROM Error Messages (Continued)

Error Message	Table Number
*** ERROR - Lost data bit during write sector command.	8-9
*** ERROR - No autoconfig returned by keyboard.	8-7
*** ERROR - No device detected on either loop.	8-7
*** No disc detected in unit.	8-9
*** ERROR - No hard reset returned.	8-7
*** ERROR - No keyboard ID received.	8-7
*** ERROR - No loop back returned by keyboard.	8-7
*** ERROR - No poll command received.	8-7
*** ERROR - Not all keys responded with both (down and up) keycodes.	8-7
*** Possible printer failure, try the test again.	8-13
*** Printer indicates (OUT OF PAPER).	8-13
*** ERROR - Printer received a FRNS. Data sent was:	8-13
*** ERROR - Printer status. The status byte reads:--------	8-13
*** ERROR - Printer system. The status byte reads:--------	8-13
*** ERROR - Printer test end of transmission error.	8-13
*** Printer time-out error.	8-13
*** ERROR - Probable REAL TIME CLOCK failure.	8-10
*** ERROR - REAL TIME CLOCK failure.	8-10
*** ERROR - REAL TIME CLOCK interrupt error.	8-24
*** Received no DTACK from the disc.	8-24
*** Received no DTACK from the display.	8-24
*** Received no DTACK from the HP-IB.	8-24
*** Received no DTACK from the keyboard.	8-24
*** Received no DTACK from the MMU.	8-24
*** Received no DTACK from the printer.	8-24
*** Received no DTACK from the RAM.	8-24
*** Received no DTACK from the Real Time Clock.	8-24
*** Received no DTACK from the speaker.	8-24
*** ERROR - Supervisor portion of the MMU failed.	8-6

Table 10-6. Service ROM Error Messages (Continued)

Error Message	Table Number
*** The disc in the unit is worn. Please replace with a new formatted disc.	8-9
*** The disk is write protected.	8-9
*** ERROR - The external RAM failed.	8-5
*** ERROR - The HP-IB failed.	8-12
*** ERROR - The ID read doesn't correspond to a keyboard ID.	8-7
*** ERROR - The length of the index pulse is bad.	8-9
*** ERROR - There was a time out waiting for the index pulse.	8-9
*** ERROR - User portion of MMU failed.	8-6
*** ERROR - 120	8-5
*** ERROR - 121	8-5
*** ERROR - 122	8-5
*** ERROR - 123	8-5
*** ERROR - 124	8-5
*** ERROR - 125	8-5
*** ERROR - 126	8-5
*** ERROR - 127	8-5
*** ERROR - 128	8-5
*** ERROR - 129	8-5
*** ERROR - 130	8-5
*** ERROR - 131	8-5
*** ERROR - 132	8-5
*** ERROR - 133	8-5
*** ERROR - 134	8-5
*** ERROR - 135	8-5
*** ERROR - 201	8-8
*** ERROR - 231	8-13
*** ERROR - 241	8-12
*** ERROR - 244	8-10

Table 10-7 lists the error messages generated by the ROM test on the service diagnostic disc. (Refer to table 8-26 for all ROM service procedures.) The error messages generated by the I/O diagnostic tests are documented in the *Integral PC Interface and Memory Module Assembly-Level Service Manual*. The error messages generated by the bus expander test are documented in the *HP 82904A Bus Expander Service Manual*.

Table 10-7. Service Diagnostic Disc Error Messages

Error Message	Table Number
*** The ROM Assembly failed. *** Checksum does not match.	8-26
*** ERROR-301 (U1-ROM0L on O.S. ROM PCA)	8-26
*** ERROR-302 (U2-ROM1L on O.S. ROM PCA)	8-26
*** ERROR-303 (U3-ROM0H on O.S. ROM PCA)	8-26
*** ERROR-304 (U4-ROM1H on O.S. ROM PCA)	8-26
*** ERROR-401 (U1-ROM2H on Option ROM PCA)	8-26
*** ERROR-402 (U2-ROM3H on Option ROM PCA)	8-26
*** ERROR-403 (U3-ROM2L on Option ROM PCA)	8-26
*** ERROR-404 (U4-ROM3L on Option ROM PCA)	8-26

Chapter 11
Product History

11.1 Introduction

This service manual describes the Integral PC in its *current* configuration. However, the current configuration includes some changes from the original design. This chapter describes the design changes and tells how service procedures differ for early production units that do not incorporate the changes.

11.2 Design Changes

Several design changes have been made to improve the performance of the Integral PC and to reduce electromagnetic interference (EMI).

11.2.1 Logic PCA Changes

Both the logic A PCA and the logic B PCA have been redesigned to reduce EMI. Multilayer circuit boards are now used, and certain components have been changed.

From a service standpoint this presents no problem. The part numbers given in chapter 9 are for the present (multilayered) versions of the logic PCAs, and for the present replacement components. Use these part numbers when ordering replacement components or PCAs for all repairs, regardless of which version of the PCA the computer originally contained.

> **Note:** The old and new versions of the logic A and logic B PCAs are compatible with each other. You only need to replace the defective PCA, even if the other PCA is not multilayered.

Refer to Service Note 9807-1 for further information about the logic PCA changes.

11.2.2 Display Flex Cable Changes

In current production units the display flex cable has been split and given a double wrap around the ferrite core fastened to the logic B PCA shield (see figure 6-8). Earlier units did not have this double wrap. If you need to replace the display flex cable, order the present, double-wrapped version (listed in chapter 9) regardless of the original cable that came with the computer.

11.2.3 Shadow PCA Elimination

Early versions of the display assembly may have a small PCA installed on the back of the assembly. This is the "shadow PCA." It contains circuitry to prevent "shadows" from appearing on the display. This PCA has been eliminated in the current display assembly since the shadow circuitry has been added to the display assembly main PCA. The two versions of the display assembly are interchangeable. When replacing the display assembly, order the current assembly listed in chapter 9. For further information concerning this change, refer to Service Note 9807A-6.

> **Note:** Do not remove the shadow PCA from a display assembly that has it, nor transfer the shadow PCA to a replacement display assembly that does not have it. Replace the entire display assembly with an exchange assembly. The display assembly is a *tuned assembly*. It cannot be serviced to the component level in the field.

11.2.4 Power Supply Changes

Some minor component changes have been made to the power supply. Use the current replacement components (listed in chapter 9) for all power supply repairs. If you replace the power supply, use the current replacement PCA number listed in chapter 9. For additional information, refer to Service Notes 9807-2 and 9807-3.

11.2.5 Disc Drive Assembly Changes

The current 3½-inch disc drive assembly has a modified drive electronics PCA. However, the changes are internal to the assembly, and the new assembly is interchangeable with the original one. Order the current assembly (listed in chapter 9) whenever replacing a disc drive.

11.2.6 New Plug-In ROM Assembly

Current production units come equipped with the HP 82995A ROM Assembly, which contains the System V operating system. Earlier computers were equipped with the System III operating system, but may be upgraded to System V by installing the HP 82991A System V ROM Upgrade Kit. All System V ROM assemblies can be serviced to the component level.

If you are servicing a unit equipped with System III and the diagnostic tests indicate a ROM failure, replace the ROM assembly. The replacement System III ROM assembly is part number 00095-60937. When you replace the System III ROM assembly, you should also replace the plastic ROM cover (00095-40043).

Chapter 12
Diagrams

This chapter presents schematic diagrams for the circuits on the logic A and logic B PCAs, and for the power supply.

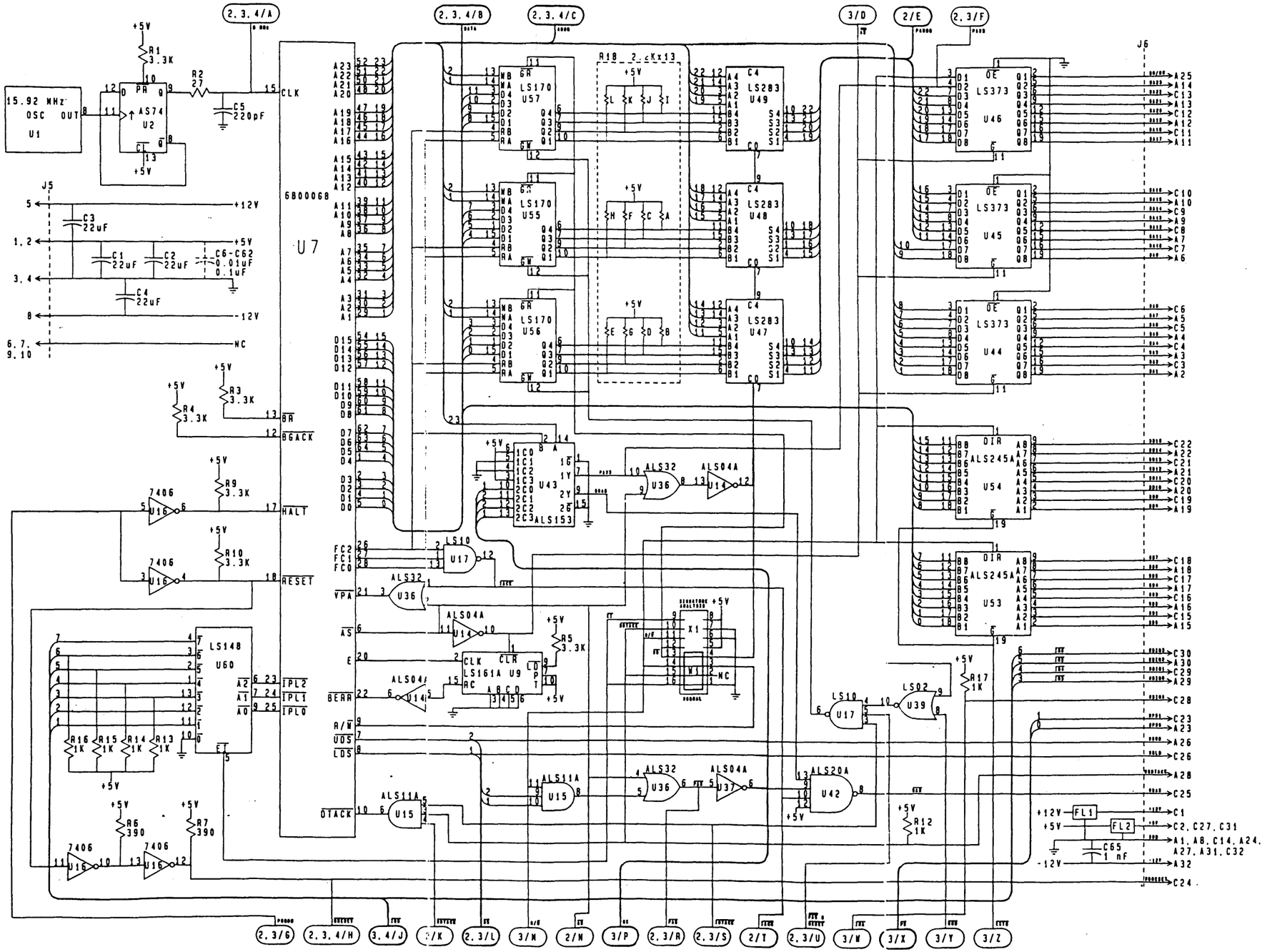


Figure 12-2. Logic A PCA—RAM, ROM Schematic Diagram

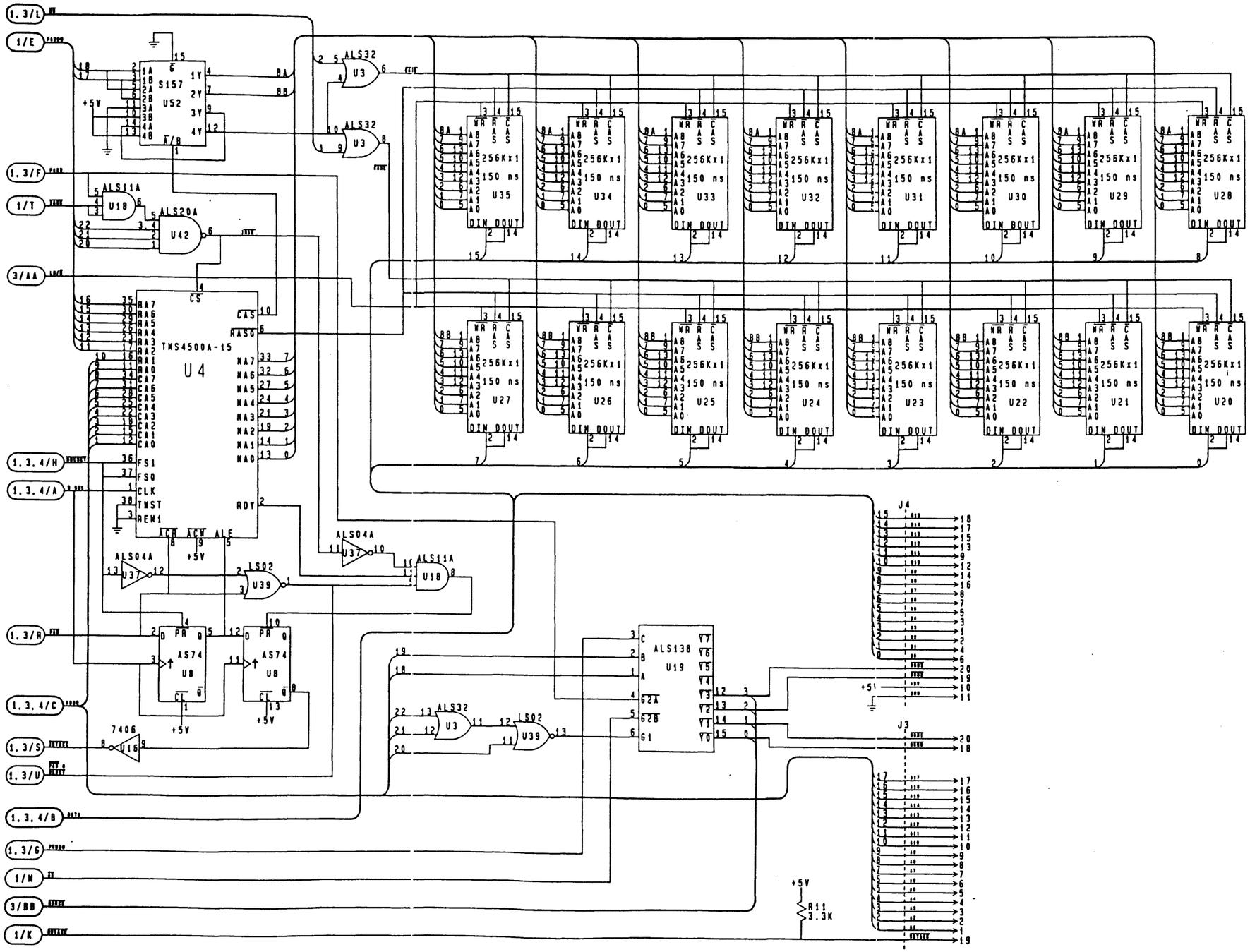


Figure 12-3. Logic A PCA—IDTACK, I/O, Logic B Interface Schematic Diagram

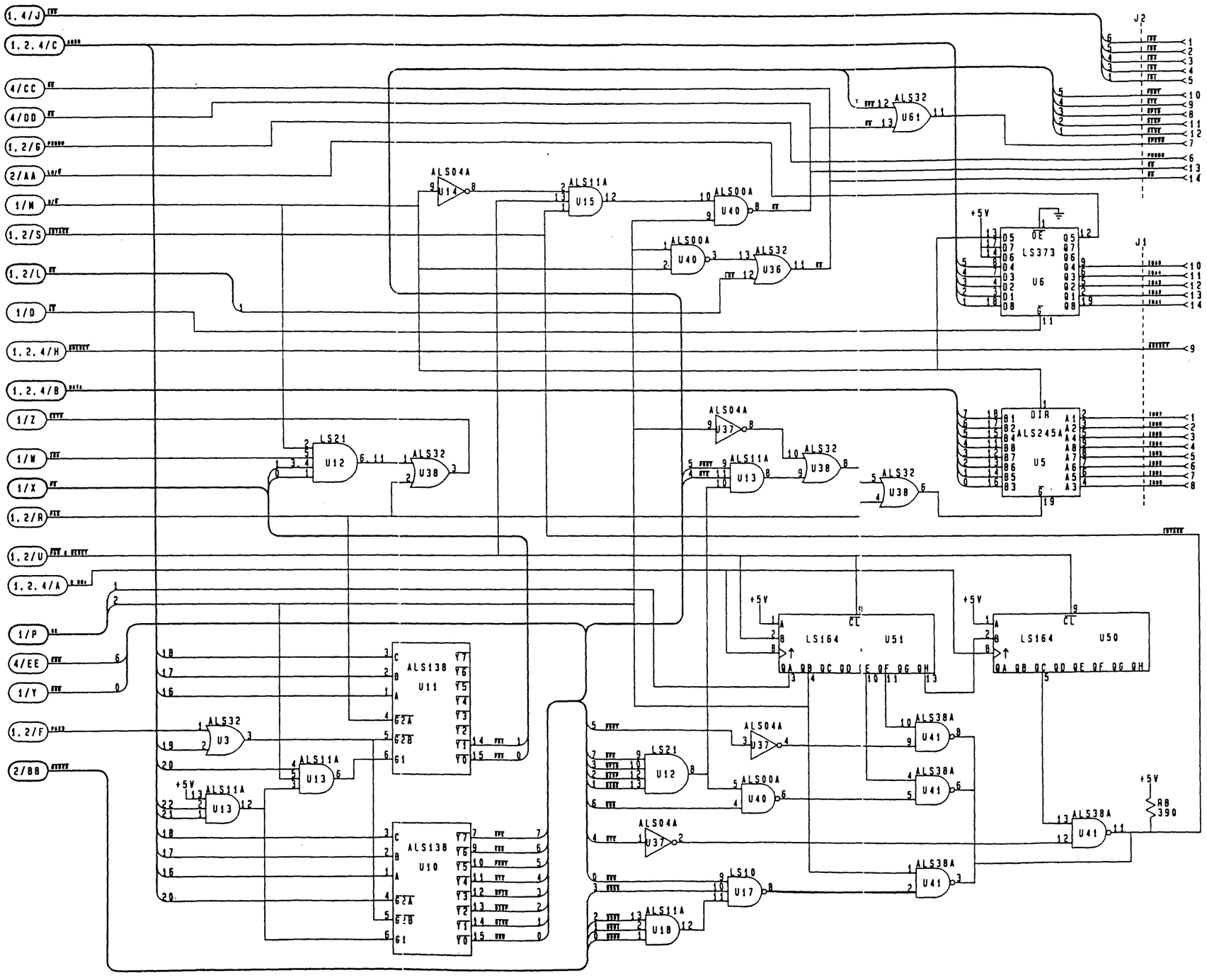


Figure 12-4. Logic A PCA—Keyboard Interface Schematic Diagram

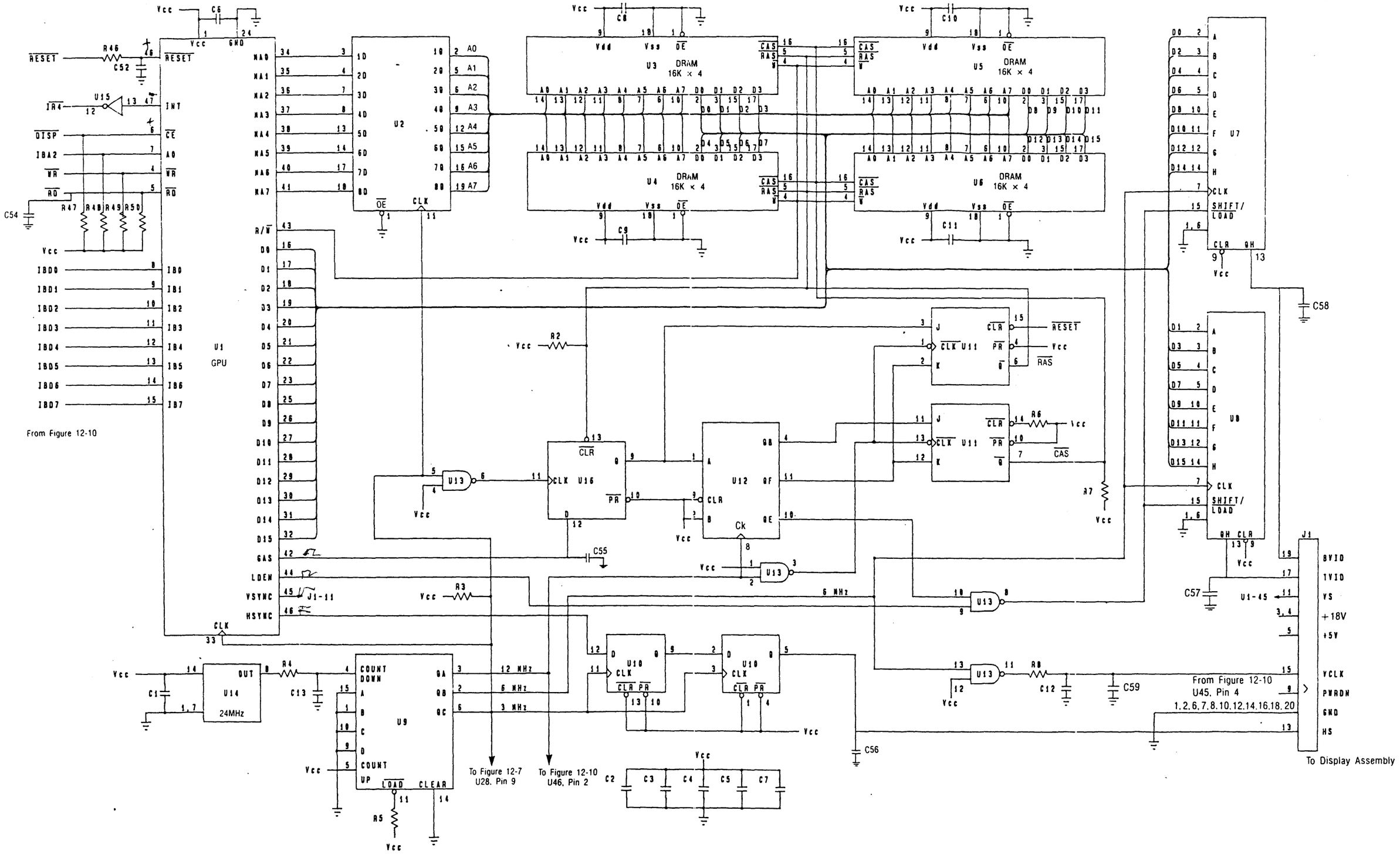
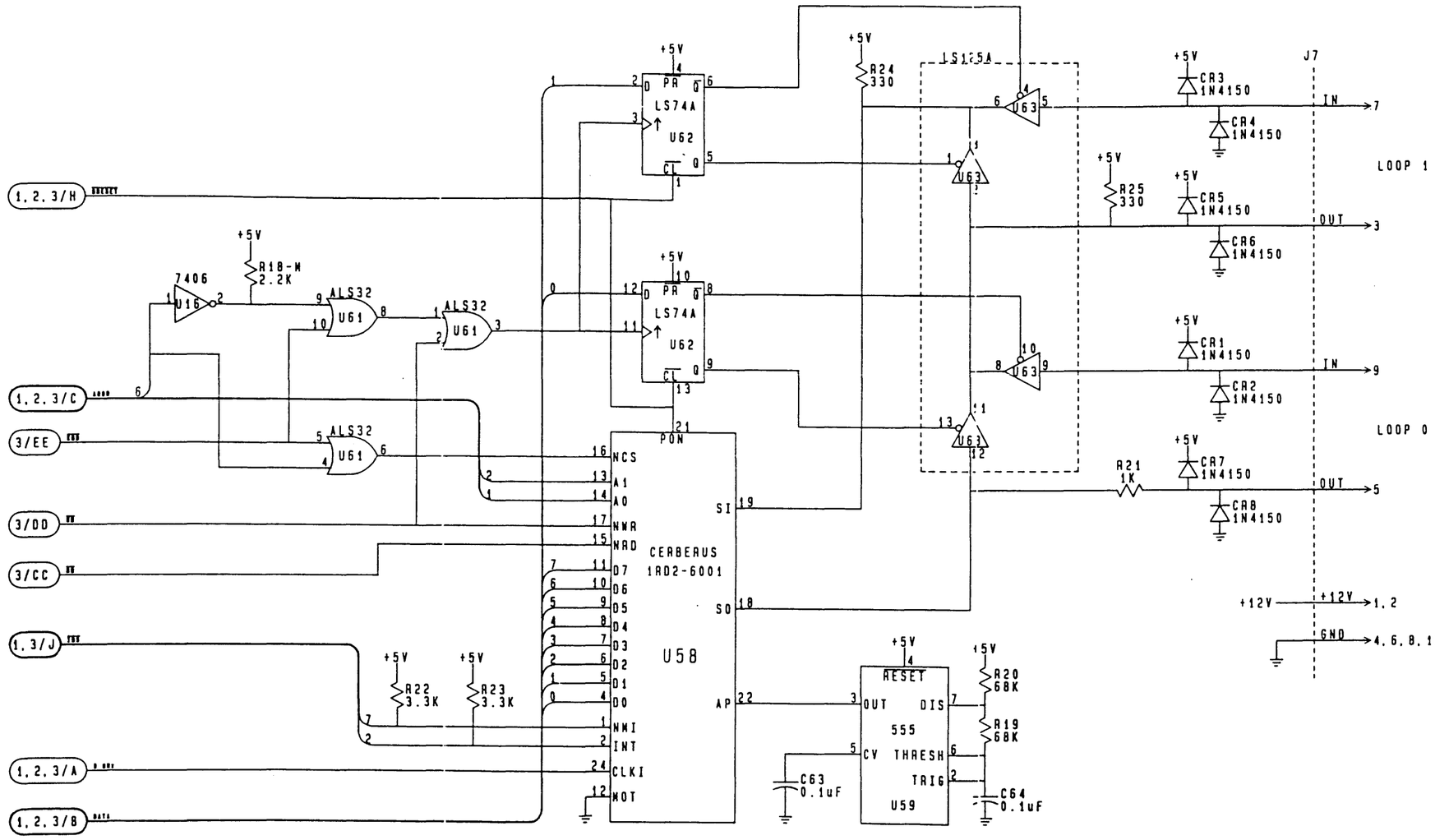
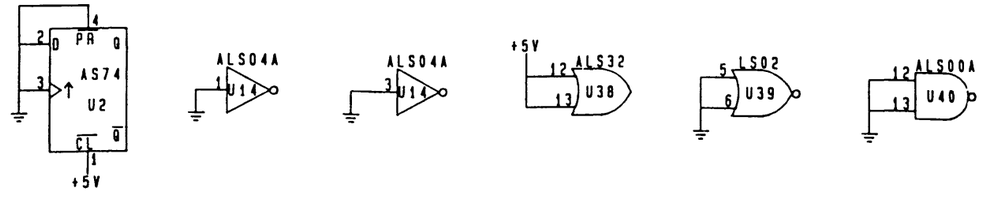


Figure 12-5. Logic B PCA—Display Control Schematic Diagram


1,2,3/H
1,2,3/C
3/EE
3/DD
3/CC
1,3/J
1,2,3/A
1,2,3/B
7406
U16
R18-M
2.2K
ALS32
U61
LS74A
U62
PR
CL
PON
CERBERUS
1RD2-6001
U58
NCS
A1
A0
NWR
NRD
D7
D6
D5
D4
D3
D2
D1
D0
NMI
INT
CLKI
MOT
SI
SO
AP
R22
3.3K
R23
3.3K
+5V
R24
330
R25
330
LS125A
U63
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
1N4150
IN
OUT
LOOP 1
LOOP 0
R21
1K
J7
+12V
GND
1,2
4,6,8,10
AESET
555
OUT
DIS
CV
THRESH
TRIG
U59
R20
68K
R19
68K
C63
0.1uF
C64
0.1uF


AS74
U2
ALS04A
U14
ALS32
U38
LS02
U39
ALS00A
U40
+5V

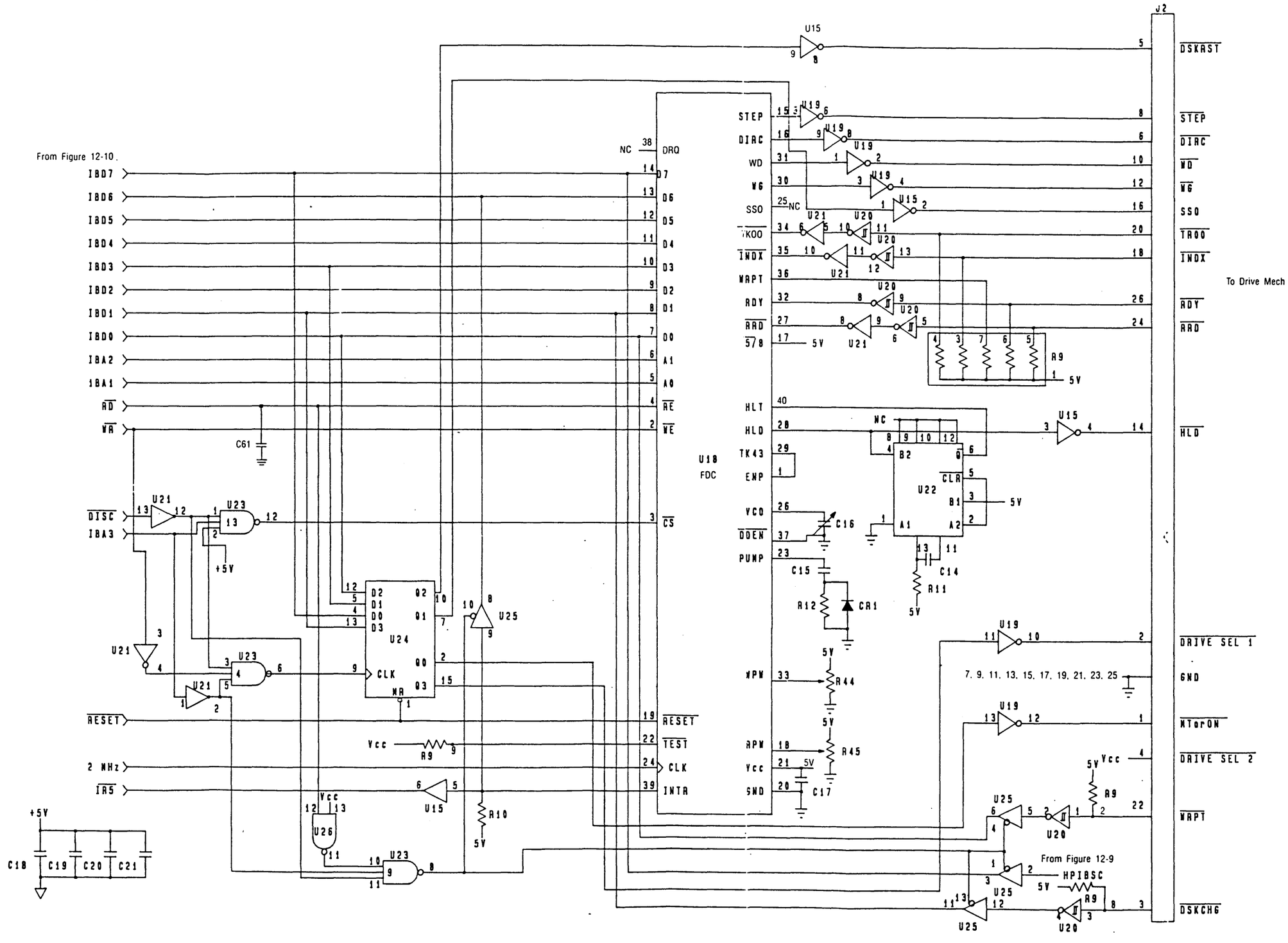


Figure 12-6. Logic B PCA—Disc Controller Schematic Diagram

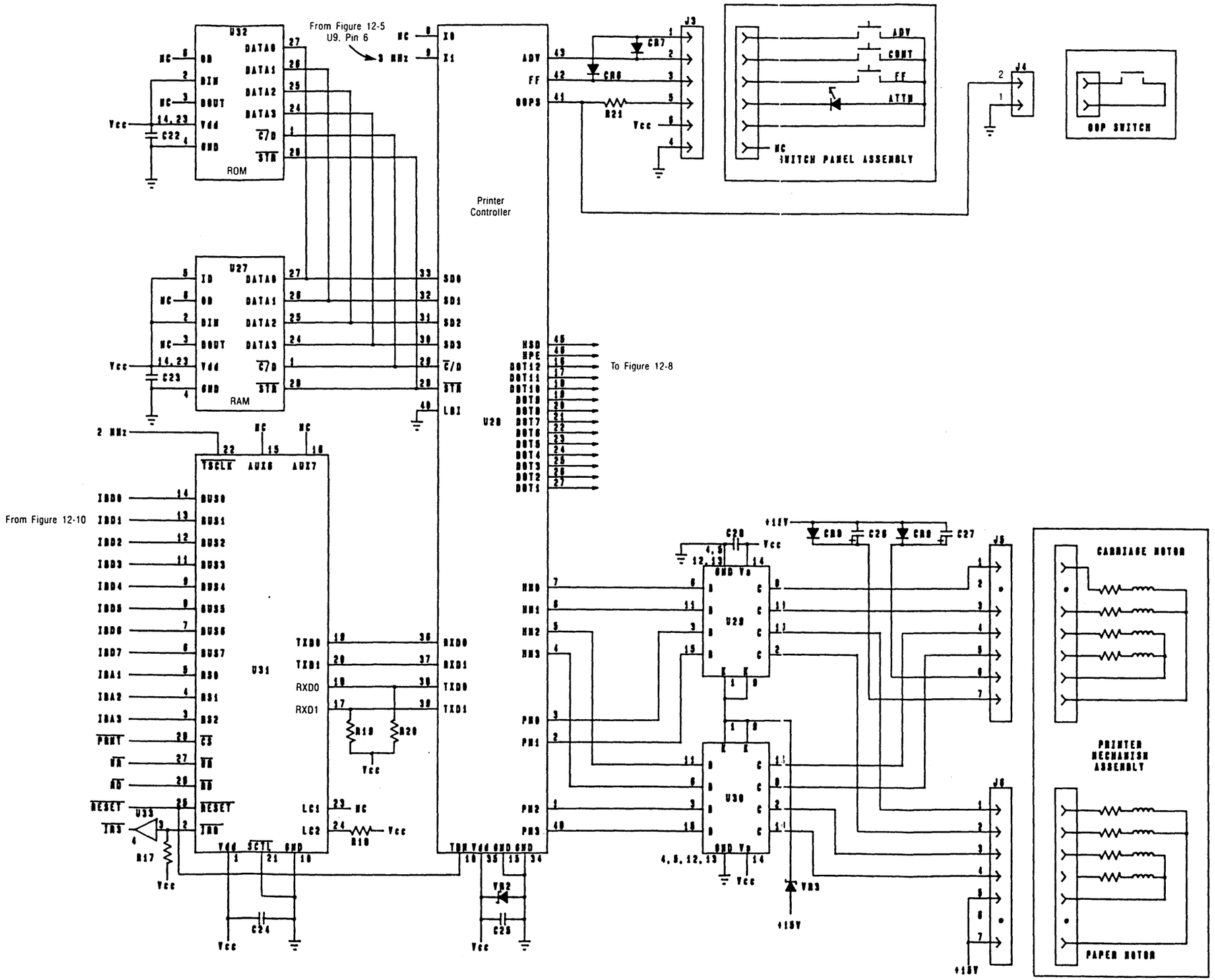


Figure 12-7. Logic B PCA—Printer Controller Schematic Diagram

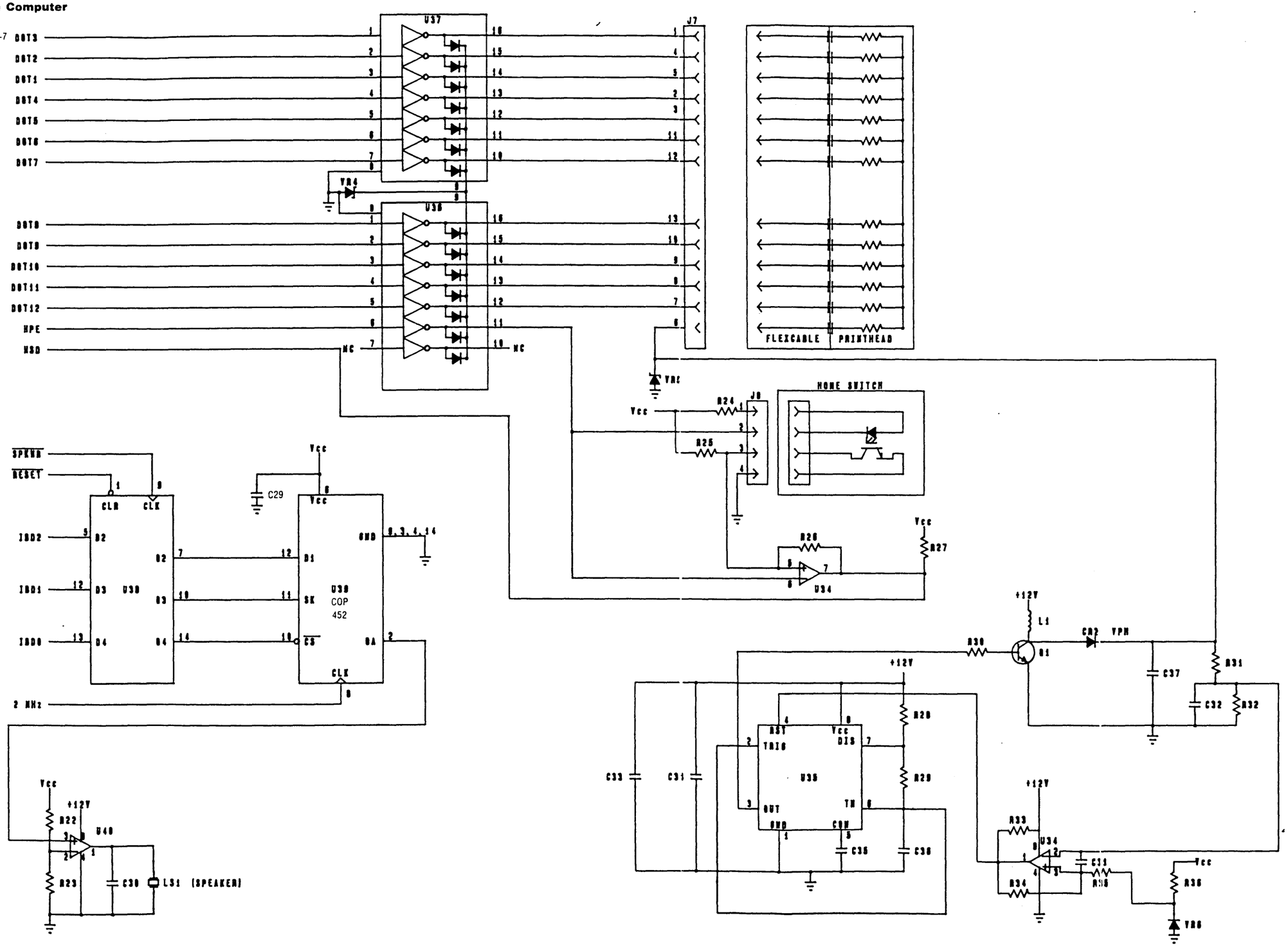


Figure 12-8. Logic B PCA—Printhead Supply and Drive, and Speaker Controller Schematic Diagram

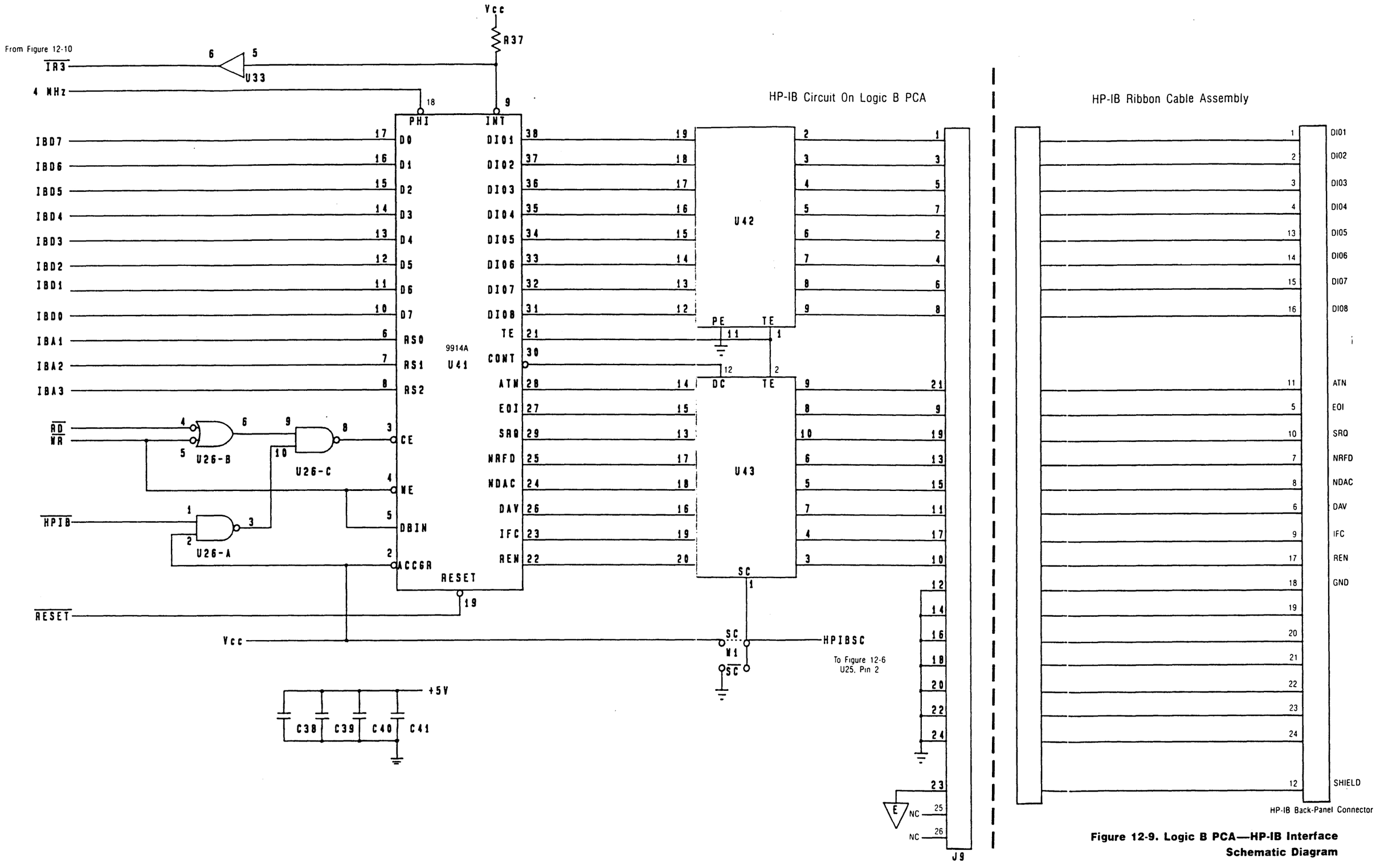


Figure 12-9. Logic B PCA—HP-IB Interface Schematic Diagram

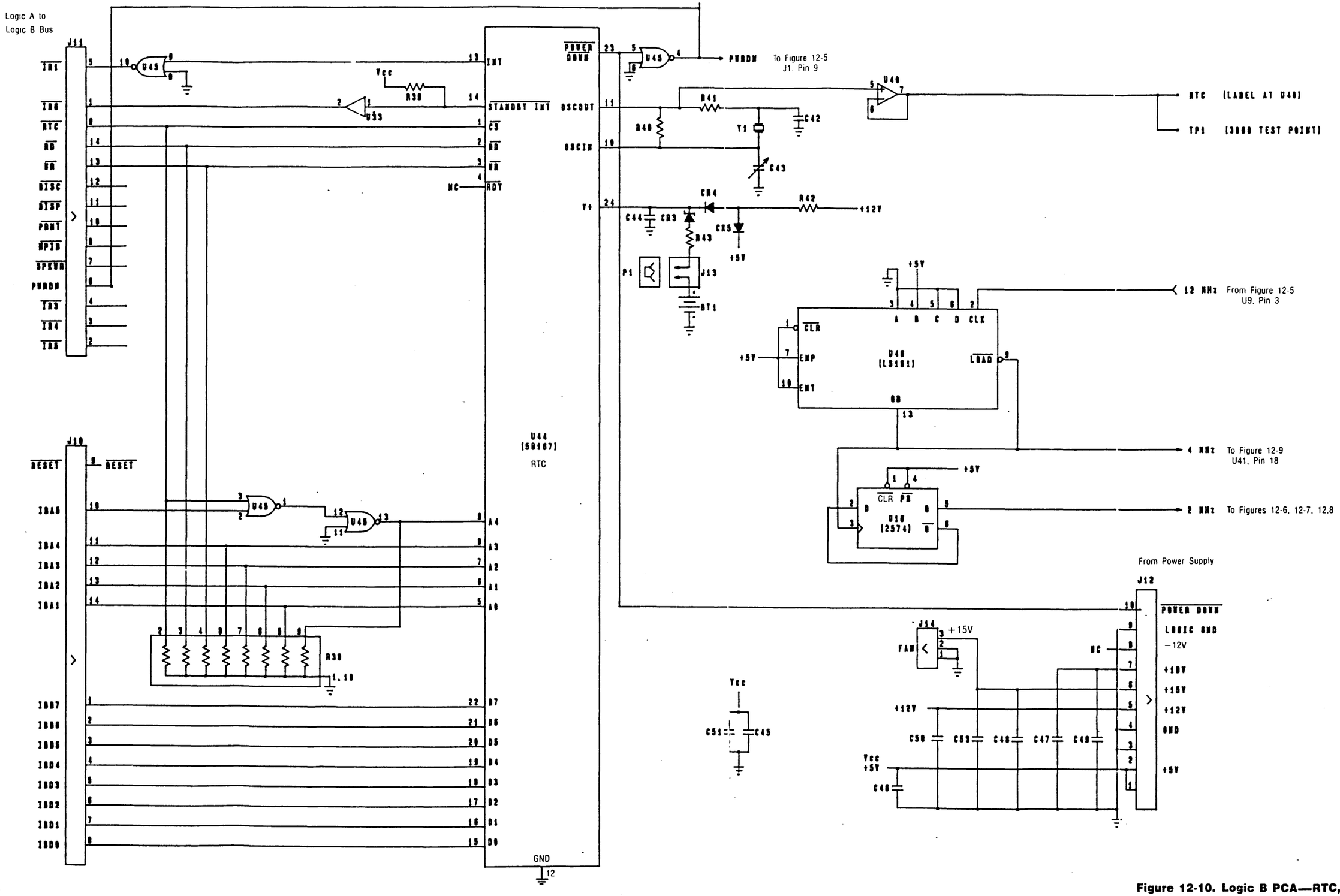
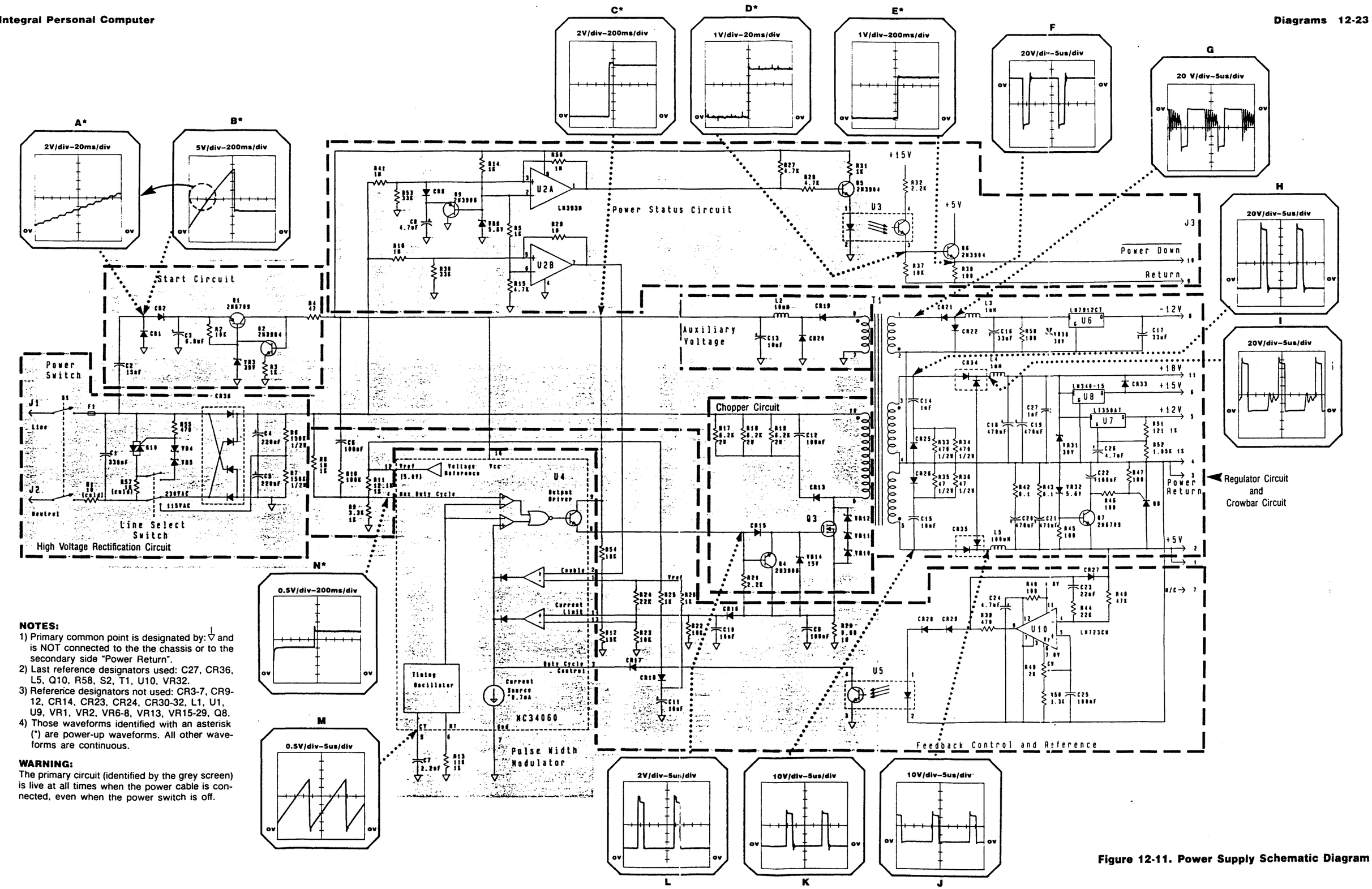


Figure 12-10. Logic B PCA—RTC, System, and Power Connect Schematic Diagram



NOTES:

1) Primary common point is designated by: ⏚ and is NOT connected to the the chassis or to the secondary side "Power Return".
2) Last reference designators used: C27, CR36, L5, Q10, R58, S2, T1, U10, VR32.
3) Reference designators not used: CR3-7, CR9-12, CR14, CR23, CR24, CR30-32, L1, U1, U9, VR1, VR2, VR6-8, VR13, VR15-29, Q8.
4) Those waveforms identified with an asterisk (*) are power-up waveforms. All other waveforms are continuous.

WARNING:

The primary circuit (identified by the grey screen) is live at all times when the power cable is connected, even when the power switch is off.

Figure 12-11. Power Supply Schematic Diagram

Reorder No. or
Manual Part No.
00095-90126-E0186