

# **HP's 3 1/2-Inch Flexible Disc Drive Service Documentation**



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# **Section I**

## **The 3 1/2-inch Disc Drive**

## **Update for 9133V/XV Disc Memory**

Section I of this manual applies to the 3 1/2-inch disc drive in the HP 9133V/XV with the following exceptions and changes.

1. Page 4-1 under Selftests

See Section IV page 3-3 for a description of the User Confidence Selftest and selftest indications.

2. Page 4-5 paragraph 2

The frequency counter may also be connected to the 'INDEX' test point on the controller assembly in the 9133V/XV. See page 4-2 in Section IV for the location of this test point.

3. Page 4-5 under 'Head Radial Alignment'

Oscilloscope connections may also be made to test points on the controller assembly in the 9133V/XV. See page 4-2 in section IV for test point locations.

    Channel B: Connect to the 'INDEX' test point

4. Page 4-9 under 'Read Amplifier Gain and Offset'

Oscilloscope connections may also be made to test points on the controller assembly in the 9133V/XV. See page 4-2 in Section IV for test point locations.

    Channel A: Connect to the 'READ DATA' test point

5. Page 4-12 under 'PLL Free-Run Frequency'

Connect the frequency counter to pin 26 of U20 on the 09133-69509 PCA on the controller assembly in the 9133V/XV. Adjust R27 to adjust the frequency if necessary.

# Chapter 1

## General Information

### Introduction

This manual describes the operation, maintenance, and repair of HP's 3 1/2-inch disc drive. The disc drive module is used as the kernel of this manual. Care, maintenance, adjustments, and repair of this module are covered in the first section.

The 3 1/2-inch disc drive is used in several products, such as, the 9121D/S, the 9133A, etc. These different configurations and associated components are explained in their respectively tabbed sections.

The following topics are discussed in this chapter:

Description	Handling Flexible Disc Media
Maintenance and Handling	Write Protect
Disc Drive	Media Monitor
Flexible Disc Media	Controls and Indicators
Disc Guard and Auto shutter	Front Panel
Initializing and Initializing Errors	Rear Panel
Operating Cleanliness	

### Description

The 3 1/2-inch Disc Drive is HP's new Micro Flexible Disc Drive. This drive offers extreme compactness and is lightweight, 4.0 inches wide, 2.0 inches high, 5.1 inches deep, and weighs just 1.5 lbs.

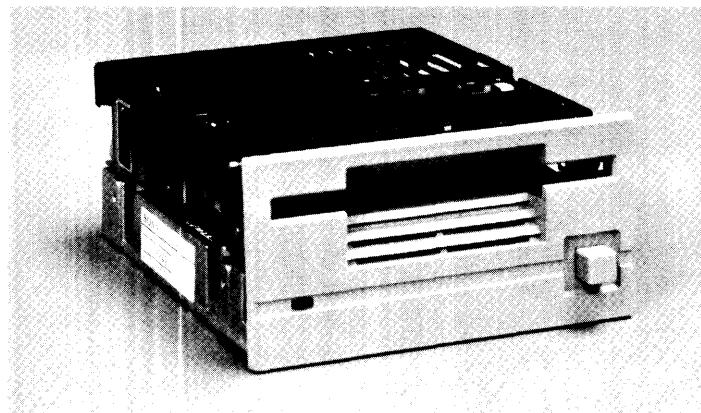


Figure 1-1. The HP 3 1/2-inch Disc Drive

## Maintenance and Handling

### Disc Drive

The HP 3 1/2-inch Disc Drive does not require regular maintenance. However, the load pad will wear out over a period of time and must be replaced. This is a complicated process and should only be attempted by a trained service person. The maintenance schedule for the load pad depends upon the use of the drive. A normally used drive requires head load pad replacement every 5 years; whereas, a heavily used drive requires the replacement every 1 to 2 years.

The terms used above (normally and heavily) refer to head/media contact time or the time the front panel LED is on. Normally refers to usage of less than 20 minutes a day; whereas, used heavily refers to use of more than 2 hours a day.

Load pad replacement is described in the "Assembly Access" section. The load pad adjustment along with other important adjustments are described in "Selftest and Adjustments".

The performance and life of the flexible disc read/write head and the flexible disc media depend directly on how carefully they are handled.

Be sure to follow the disc care and handling guidelines presented on the following pages and the operating environment restrictions presented in the Specifications Section.

### Flexible Disc Media

The removable storage medium used in the 3 1/2-inch Disc Drive is a flexible mylar disc coated with a thin layer of magnetic oxide. The disc is enclosed in a protective plastic jacket with a slot for head access to the recording surface. The rigid plastic shell provides extra protection and reduces disc-to-case friction (see Figure 1-2). A metal centering hub ensures rapid and accurate positioning when the disc is inserted in the drive.

Each disc may contain 286 Kbytes of formatted data. Since some storage is used for a directory, the exact amount available for user storage depends upon the controller and the number of files stored. Refer to the appropriate computer mass storage programming or reference manual for details.

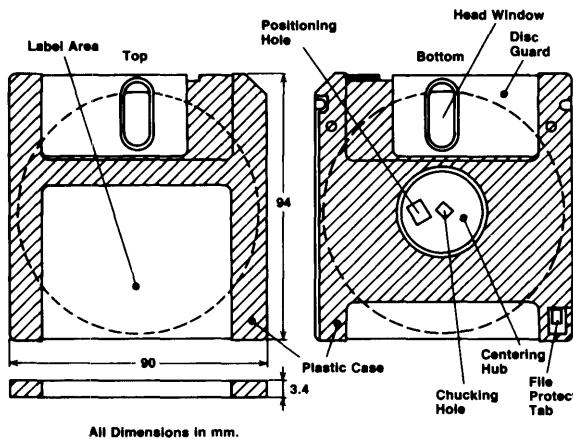


Figure 1-2. The Micro-Flexible Disc

## Disc Guard and Auto Shutter

The disc guard which slides back and forth across the front of the disc protects the recording surface from foreign object contamination. This guard must be positioned exposing the disc to read or write data onto the disc.

Some of the drives feature the "Auto Shutter" which automatically opens and closes the guard as the disc is inserted and removed from the drive. The drives with the Auto Shutter require the spring loaded disc guard for proper operation of the Auto Shutter. However, either disc type (spring loaded or manually operated disc guard) will work in either type of disc drive.

A field upgrade kit adding the auto shutter is available under P/N 09121-88875. This kit contains the auto shutter mechanism and instructions for installation and alignment.

## Initializing and Initializing Errors

Each flexible disc must be initialized before it can be used for data storage. The initialization procedure marks each disc sector, checks for defective tracks, and establishes file directories.

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### Note

Before the head comes in contact with the medium to initialize a new disc, the motor speed is checked. The motor speed must be within a specified tolerance before the disc is initialized. If the tolerance is not met, a write protect error is given and the disc is not initialized. Discard the disc as its spinning friction is too high.

The motor speed should be checked and/or adjusted before discarding the disc. See the section titled "Selftest and Adjustments".

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Refer to your computer programming or reference manual for the correct initialization procedure.

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### CAUTION

DISC DRIVE PERFORMANCE AND RELIABILITY ARE DEPENDENT ON THE TYPE OF MEDIA USED. DISC DRIVE SPECIFICATIONS CAN BE ASSURED ONLY WHEN USING HP MEDIA. THE USE OF IMPROPER MEDIA CAN RESULT IN PREMATURE DISC FAILURE OR DAMAGE TO THE DISC DRIVE.

ON SOME DISC PRODUCTS, HP MAY QUALIFY OTHER NON-HP MEDIA. WHEN TESTED, THIS MEDIA MET HP SPECIFICATIONS. HOWEVER, HP DOES NOT WARRANT OR SUPPORT THIS MEDIA AND CANNOT CONTROL CHANGES IN ITS SPECIFICATIONS OR QUALITY. THE SELECTION AND USE OF SUCH PRODUCTS IS THE CUSTOMER'S RESPONSIBILITY. HP RESERVES THE RIGHT TO EXCLUDE FROM WARRANTY AND MAINTENANCE AGREEMENT COVERAGE ANY REPAIRS WHICH HP REASONABLY DETERMINES OR BELIEVES WERE CAUSED BY THE USE OF MEDIA NOT PROVIDED BY HP. HP WILL UPON REQUEST PROVIDE SUCH REPAIRS ON A TIME AND MATERIAL BASIS.

WARRANTY AND MAINTENANCE AGREEMENT COVERAGE OF REPAIRS NOT CAUSED BY THE USE OF NON-HP MEDIA IS UNAFFECTED.

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## Operating Cleanliness

The critical elements involved in the read/write process are shown in Figure 1-3. The read/write head must maintain contact with the disc during read and write operations. Also shown are various types of contaminants and their size relationships. A contaminant particle hard enough and of the right size may scratch the media oxide coating or the head surface. Even if not hard enough to scratch, it may be large enough to lift the head from the surface, causing data errors or damage to the media.

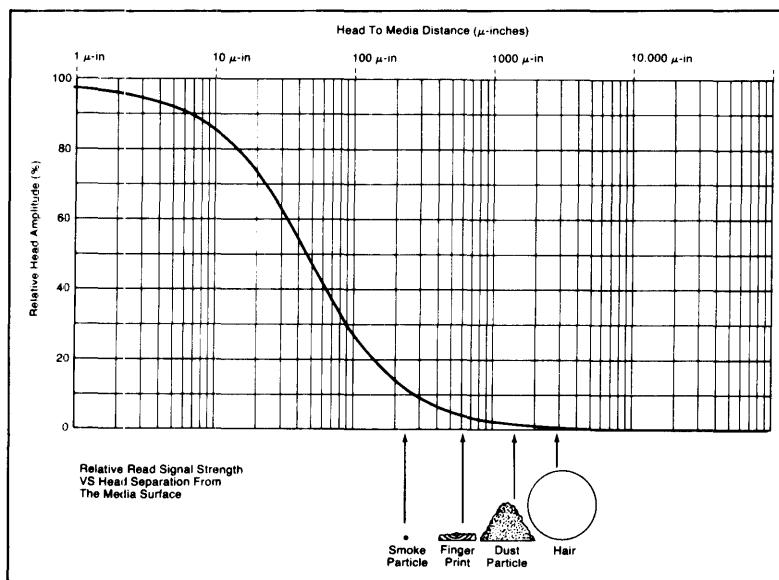


Figure 1-3. Head/Media Critical Elements

## Handling Flexible Disc Media

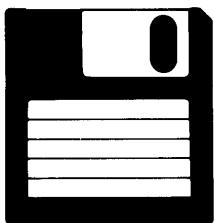
The flexible disc is basically maintenance free, but it is delicate and MUST BE HANDLED CAREFULLY. Remember, the disc contains your valuable data and programs, and should be treated accordingly. A good rule of thumb is to treat your disc as you would a valuable record album. Here are some specific Do's and Don'ts to avoid loss of data or damage to your discs.

EVEN A LITTLE CARELESSNESS IN DISC HANDLING CAN DRAMATICALLY REDUCE THE LIFE OF THE DISC.

### Do's

#### Back Up Discs Frequently

There is always a chance of losing data when mass storage devices are accessed. There are many causes in any computer system - a programming bug, operator error, power failure, or hardware failure. In the case of flexible discs, additional conditions must be considered - media failure from contamination or wearout. ONE SURE PROTECTION AGAINST DATA LOSS IS FREQUENT BACKUP OF YOUR FILES.

**Slide the Disc Guard Over The Head Window When Not In Use**

This is the single most important thing to remember about handling your disc because it prolongs disc life by protecting it from dust, finger prints, and scratches. NEVER ATTEMPT TO BLOW DUST FROM THE DISC, the lubrication contained in the plastic jacket also serves to keep the disc clean. Between uses discs should be stored upright in a dust free container. The box in which the discs are shipped, or a similar container, is a good choice.

**Operate Your System In A Clean Environment**

Airborne contaminants and particles accidentally dropped onto the disc will cause your disc to wear out prematurely and may cause unreliable data storage and retrieval operations. Some of the most common contaminants are DUST, SMOKE, ASHES, ERASER CRUMBS, and BREADCRUMBS. NEVER ATTEMPT TO BLOW SMALL PARTICLES FROM THE DISC. Chemical vapors may also cause premature wearout.

**Maintain Proper Temperature And Humidity**

The proper operating range is 10° C (50° F) to 45° C (115° F) and 20% to 80% relative humidity. While temperature is usually easy to control, it may be necessary to make special provisions to keep the humidity in the proper range. Although the disc will continue to operate outside the normal humidity range, it will wear out more quickly and will have a higher error rate.

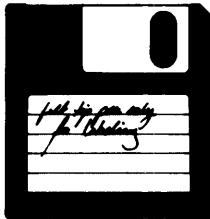
**Avoid Magnetic Fields**

The data is stored on the disc magnetically, and can be erased by an external magnetic field. Avoid placing a disc near power transformers, magnets, large disc memories or motors.

**Remove Disc From Drive When Not In Use**

Remove the disc completely from the drive when access is not needed for an extended period of time.

### Use A Felt Tip Pen To Label Your Disc



Use a soft felt tip pen to label your disc, and be careful to write only in the label area.

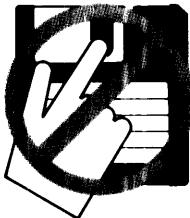
### Replace Discs Frequently

Although discs are designed to provide many hours of useful life, they will eventually wear out. The life of a disc is VERY dependent on how carefully it is handled and how much it is used.

The following guidelines refer to head/media contact time or the time the front panel LED is on. The terms use here (normally and heavily) also refer to load pad replacement mentioned earlier in this section. A disc used normally (less than 20 minutes a day) should last half a year. A disc that is used heavily (more than 2 hours a day) should not be expected to last more than 2 months. Discs should be replaced whenever they begin to show signs of circular marring. See the following section titled "Media Monitor".

### Don't

#### Do Not Touch The Surface Of The Disc



The thickness of a fingerprint is enough to lift the head off the disc and cause errors. The oils in a fingerprint will also collect dust which can cause a disc to wear out sooner than it normally would.

#### Do Not Bend Or Fold The Disc



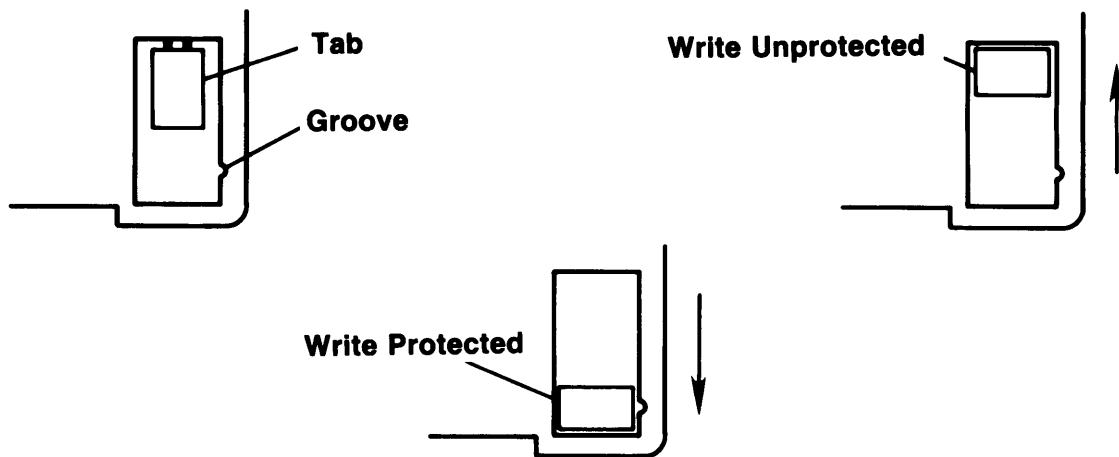
The disc is flexible but will not operate if it is creased. Using ball point pens, rubber bands, paper clips, etc. can crease the disc or damage the plastic case.

#### Do Not Try To Clean A Disc

The inside surface of the disc jacket is covered with a special material that cleans the disc as it rotates. Any other method of cleaning may cause solvent damage to the media or scratch the disc, causing loss of data. If a disc becomes dirty or scratched, immediately transfer the data to a new disc and discard the old disc.

## Write Protect

The micro-flexible disc is write unprotected when you receive it. To prepare the disc for write protected operation do the following (see Figure 1-4):



**Figure 1-4. Disc Write Protect**

1. Score the attachment point of the write protect tab with a sharp object
2. Break off the write protect tab
3. Align the protrusion on the tab with the groove in the disc
4. Depress the tab into the groove - tab should fit snugly

Write protection is accomplished by sliding the tab away from the center of the disc.

## Media Monitor

As the flexible disc becomes worn, the friction between the disc and the read/write head increases. Because the same read/write head accesses the data from all your discs, it is very important that this friction be kept to a minimum level. To insure long wear life of the read/write head, you should make the following visual media check each time you insert a disc into your drive.

Checking for disc wear is a simple visual inspection of the disc surface before you insert the disc into the drive. When viewing the disc surface you should look for any signs of circular marring. This is done by sliding open the disc guard revealing the disc surface. If you see any sign of circular marring on either side of the exposed surface, the disc should be immediately copied and discarded. Circular marring generally occurs first on the upper (label side) surface of the disc.

A good disc should always reflect a hatchmark type of pattern. Compare a new (never used) disc to a disc you have used for a few hours. There should be no visible difference.

An internal test has been implemented to provide you with an upper limit indication for disc use. When a disc reaches this limit, the head loaded indicator (front panel LED) blinks on and off. This indication is continued until you remove the disc or until the host computer sends a command to the drive. The drive accepts and performs the command from the host, after

which it resumes the disc "worn out" indication. AT THIS TIME, YOU SHOULD COPY YOUR DATA TO ANOTHER DISC. If the use of this disc is not discontinued, the disc will eventually be write-protected. If this "auto" write protected disc is ejected and reinserted into a drive, it will be un-write protected for a short period of time, after which the "worn out" indication will start again and the disc will again be write protected.

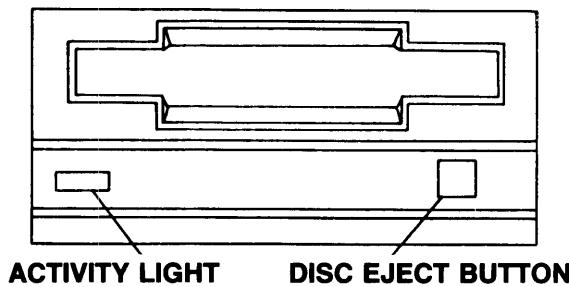
Visually inspecting the disc prior to inserting it into the drive and taking the appropriate action when you receive the "worn out" indication will insure the long life of the read/write head.

## Controls and Indicators

### Front Panel

The disc eject button is used to remove a disc from the drive. Depression of this button ejects the disc. See the following figure.

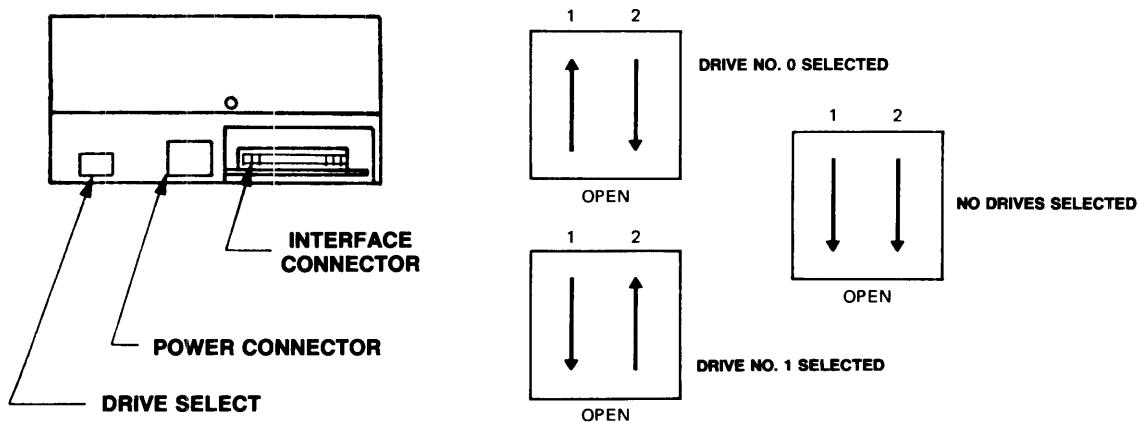
The activity light indicates that the read/write head is loaded and a read or write operation is in effect. DO NOT PRESS THE DISC EJECT BUTTON WHEN THE ACTIVITY LIGHT IS ON.



**Figure 1-5. Front Panel Controls**

### Rear Panel

The drive select switch SW1 is located at the rear of the drive. This switch designates drive 0 or drive 1 depending on its setting. See Figure 1-6 for location and switch settings.



**Figure 1-6. Drive Select Switch**

# **Chapter 2**

## **3 1/2-inch Drive Theory of Operation**

### **Introduction**

A complete disc drive peripheral consists of a power supply, controller electronics assembly, drive electronics assembly, and drive electromechanical components. See Figure 2-1.

HP's 3 1/2-inch Disc Drive appears in various packaging and configurations (9121D/S, 9133A, etc). In these configurations, the drive electronics and electromechanical components remain the same. The controller electronics assembly and power supply are totally different in appearance. For this reason, the actual controller assembly (limited information) and power supply for each configuration are presented under the tabbed section. Since the controller assembly theory of operation must be the same to operate the same drive it is presented here with the drive electronics and electromechanical components.

Here are the topics discussed in this chapter:

Electromechanical Components	
Drive Mechanism	Microprocessor
Read/Write Head	Flexible Disc Controller
Head Positioning Mechanism	Loop Management
Drive Electronics	Recording Format
Input Signal Description	Media
Output Signal Description	Tracks
Drive Electronics Interface Timing	Recording
Controller Assembly	Track Numbering
Interface Chip	Track Format

Figure 2-1 represents the mechanical and electrical components of a disc drive.

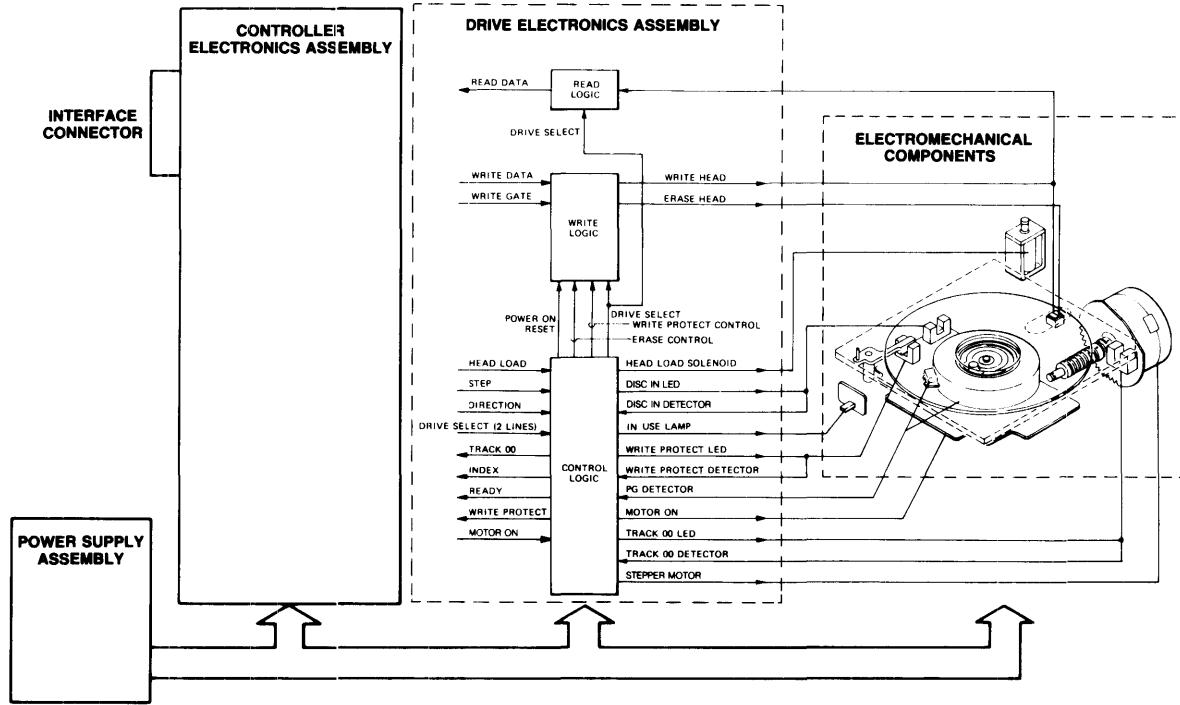


Figure 2-1. Drive Components and Assemblies

## Electromechanical Components

The electromechanical components of the drive consists of a drive mechanism, read/write head, a head positioning mechanism, and control interlocks.

### Drive Mechanism

The drive mechanism is composed of a long life brushless DC motor. The rotating speed of the motor is 600 rpm which requires 1 second starting time. The index pulse (sensor mounted to the side of the motor) is generated using a photo sensor and Hall Effect sensor combination. Disc rotation is achieved via a spring loaded bearing (attached to the motor) that fits into a receiving portion of the metal centering hub on the disc. This metal centering hub also ensures excellent track positioning accuracy with little wear.

### Read/Write Head

The read/write head is a single-element ceramic device with tunnel erase elements to provide erase areas between the tracks. The head is mounted on a carriage assembly that is positioned by a stepper motor. The flexible disc is inserted through the disc access door on the front of the disc drive. During a read/write operation, the head is in direct contact with the flexible disc.

### Head Positioning Mechanism

A mechanism that includes a stepper motor and needle screw positions the read/write carriage assembly to the flexible disc. The stepper motor, driven by pulse signals from the drive PCB, increments the head one track per three pulses. The HP-IB channel supplies the controller PCB with head positioning commands which in turn supplies positioning data to the drive PCB.

## Drive Electronics

The drive electronics includes read and write circuits, control circuits for head positioning, and read, write, and erase enabling circuits.

The drive electronics circuitry is contained on the drive PCB which is attached to the bottom of the disc drive frame. The drive PCB is connected between the controller PCB and the various electromechanical components of the disc drive thereby providing the necessary interface for disc drive operation. The drive PCB recognizes when the disc drive is selected and initiates the proper head positioning actions. For write operations, the drive PCB turns on write and erase current generators and provides the correct write current transitions. During read operations, data obtained from the flexible disc is amplified, conditioned, and sent to the controller PCB. The drive PCB also contains interlock circuits that prevent drive write operations if the flexible disc is write protected. In addition, the drive PCB makes available status information.

The drive has 13 interface signals going to and from the Drive Electronics assembly. Eight of these signals are input to the drive, and five signals are output from the drive. These signals are listed next:

### **Input Signals to the Drive Electronics Assembly and Pin Numbers**

Drive Select (two lines)	2,4
Direction Select	6
Step	8
Head Load	14
Write Data	10
Write Gate	12
Motor On	1

### **Output Signals from the Drive Electronics Assembly and Pin Numbers**

Index	18
Track 0	20
Write Protect	22
Ready	26
Read Data	24

### **Input Signal Descriptions**

Drive Select 1,2 - A logical 0 on this line selects the designated drive for operation.

Direction Select - This line defines the direction of the head movement when the step line is activated. A logical "1" on this line defines the direction as "out", and when the step line is activated the head moves to the outside of the disc. A logical 0 on this line defines the direction as "in", and when step is active the head moves toward the disc center.

Step - This line causes the read/write head to move in the direction defined by the Direction Select signal line. The transition from logical 0 to logical 1 initiates the stepping motion. Three steps or pulses are required to move one track.

**Head Load** - This line causes the read/write head to contact the disc surface. If the drive is not selected this line is disabled. When a disc is inserted into the drive, the head is momentarily loaded, automatically by the drive, to properly seat the disc on the spindle.

**Write Data** - This line is used for data that is to be written on the disc. A transition from logical one to logical zero changes the polarity of the read/write head current and causes a data bit to be written on the disc. This data line is active when the following signals are in the indicated states:

Signal	Logical State
Write Gate	0
Ready	0
Write Protect	1

**Motor On** - A logical 0 on this line will turn on the motor, assuming the drive is selected and a disc is inserted; a logical 1 turns off the motor.

## Output Signal Descriptions

**Index** - This signal line is used to indicate a reference position on a track. The line is usually a logical one; it becomes logical zero when the drive senses the index mark. The trailing edge of the signal should be used to determine position. This line becomes a logical one when the drive is not selected.

**Track 0** - This line indicates that the read/write head is located at track 0 (the outermost track). Logical zero on this line is the indication. A logical one indicates that the read/ write head is not at track 0. When the drive is powered up, the read/write head is positioned at track 0, and when the drive is not selected this line becomes a logical 1.

**Write Protect** - Write protect indicates a write protected disc. A logical zero on this line indicates that the disc is write protected and you cannot write on the disc. A logical one on this line indicates the disc is not write protected and you can write data on the disc. If no disc is resident in the drive, this signal appears as a logical zero. If the drive is not selected, this signal is set to a logical one.

**Ready** - This line is a logical zero if the following conditions are all true:

- A disc is inserted.
- The motor is rotating.
- This drive unit is selected.

At all other times, this signal line is a logical one.

**Read Data** - This line contains the data and clock signal together. This signal line is normally a logical one and gets pulsed when data is read. The falling edge of the pulses are interrupted as data.

## Drive Electronics Interface Timing

The following figure shows the timing relationship for the signals going to and from the drive electronics assembly.

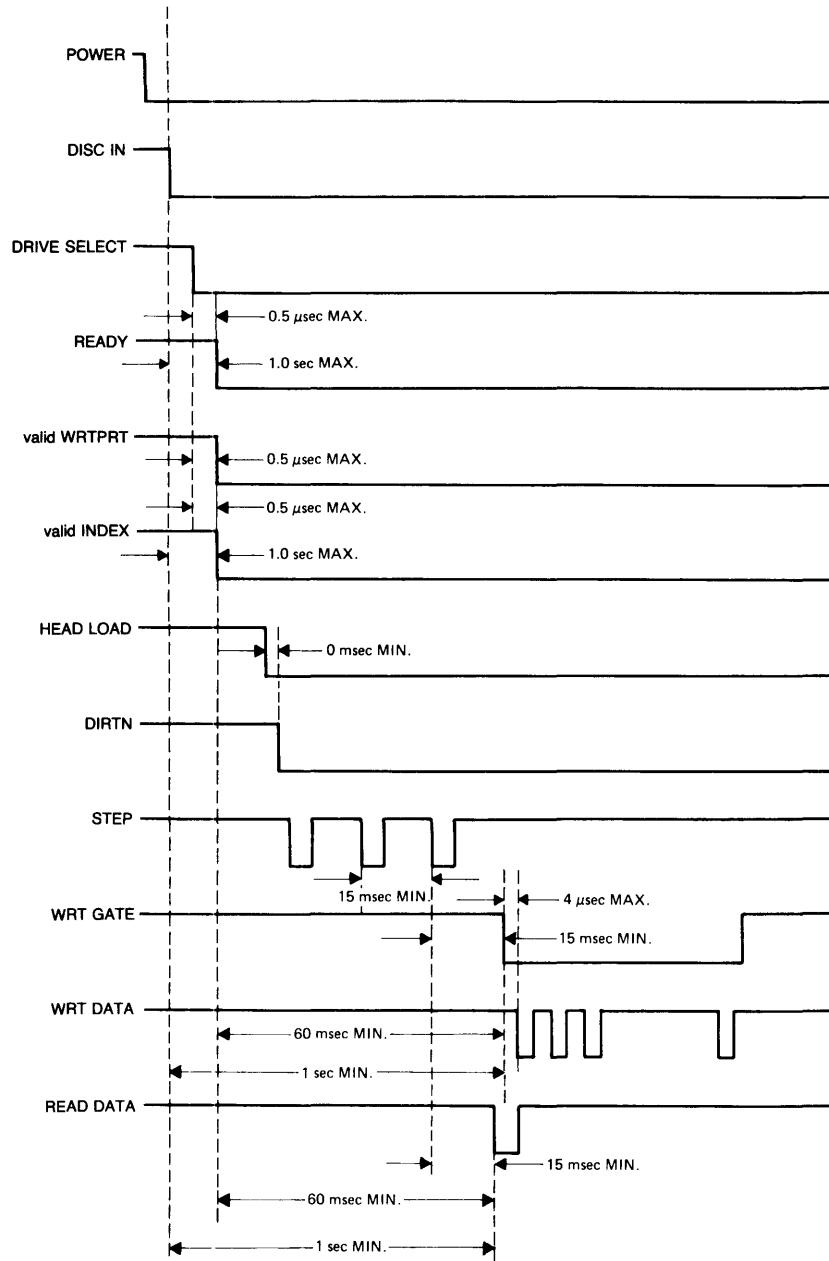
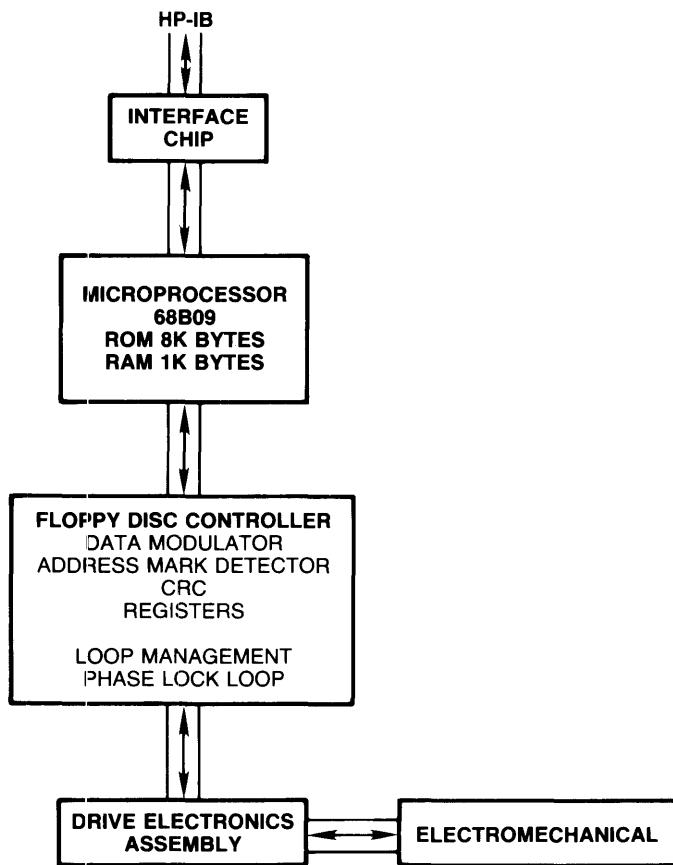


Figure 2-2. Drive Electronics Timing

## Controller Assembly

The Controller assembly is described here with a functional diagram. Physical location of the major components are presented in each of the product tabbed sections.

The Controller section of the printed circuit board interfaces between the Drive Electronics and the HP-IB interface. It consists of an interface chip, microprocessor which accesses 8 Kbytes of ROM and 1 Kbytes of RAM, and a Flexible Disc Controller. The flexible disc controller interfaces between the microprocessor and the disc drive itself. The flexible disc controller controls the following: data modulation, precompensation, cyclic redundancy check (CRC), address mark detection, and various registers. Additionally, a discriminator and phase lock loop complete the controller assembly functions. See the following figure.



**Figure 2-3. Controller Assembly**

### Interface Chip

The interface chip interfaces between the microprocessor and the host controller. It provides the handshake protocol, talker/listener addressing, serial and parallel poll responses, generates service requests, and provides data transfer. Data transfer is provided using 16 data registers: 8 registers for the microprocessor to write to and 8 registers to read from.

### Microprocessor

The microprocessor (68B09) accesses 8 Kbytes of ROM and 1 Kbytes of RAM. The ROM contains the 59 Amigo command interpretations along with the selftest code. The RAM is used as a scratch pad for the microprocessor and a data buffer for data going to and from the disc.

## Flexible Disc Controller

As mentioned earlier, the flexible disc controller functions are: data modulation, precompensation, cyclic redundancy check (CRC), address mark detection, and register control.

System circuitry modulates data to be written onto the disc in Modified Frequency Modulation (MFM) format.

Transitions which are written close together tend to appear shifted apart when read back. This effect is known as bit shift. Because of the small bit cell used, bit shift is noticeable. To compensate for this bit shift, certain MFM transitions are written closer together or farther apart (125 nanoseconds). This action is called precompensation. Precompensation is applied beginning with track 44.

The CRC generates or compares the 16 bit cyclic redundancy check digit in the ID and data fields to check for errors.

The following registers are controlled by the flexible disc controller:

- Command - Contains the current command being executed
- Status - Holds the current status information
- Data - Contains parallel data
- Data Shift - Holds serial data
- Track - Holds track number of current head position (data is compared with data in ID field during read, write verify)
- Sector - Contains target sector number

## Loop Management

The loop management contains a discriminator and phase lock loop. The discriminator counts bits to determine the location of a sync field as apposed to a data field. Once a sync field is detected, the phase lock loop is locked and the serial data (transitions and clocks) is sent to the flexible disc controller. Here the data is decoded and converted into 8-bit bytes.

After the data is converted to 8-bit bytes, it is stored in RAM until a complete sector (256 bytes) is obtained. The CRC is then read and checked. If it matches the CRC written with the data, the data is sent to the HP-IB.

## Recording Format

This section describes the recording format used in the HP Micro-Flexible Disc Drive. The 3 1/2-inch drive supports the HP standard micro-flexible disc format (hereafter referred to as the HP format).

## Media

A single-sided flexible disc is used as the recording medium. The disc is composed of flexible recording material and is enclosed in a square plastic jacket.

## Tracks

There are 70 physical tracks on each side of the disc, with a spacing of 0.0074 inch between tracks (135 tracks per inch). The outermost track is track 0 and the innermost track is track 69.

## Recording

Information is stored on the disc as a series of magnetic flux reversals. Since a single head is used to read from and write on the disc, a self-clocking code (MFM) is used to store and read the information.

The portion of the disc or the duration of the time used to store a single bit is referred to as a bit cell. The first part of the bit cell is called the clock window and the remainder of the bit cell is called the data window. A flux reversal in the clock window is called a clock transition and a flux reversal in the data window is called a data transition. A bit cell that contains a data transition stores a 1 and a bit cell with no data transition stores a 0.

## Track Numbering

Each track has a physical address as described previously. There is also a logical track address associated with each “good” track. The logical track address is written in the ID field of each sector on the track. If a flexible disc has no “bad” tracks, the logical address of a track is the same as the physical address.

A disc with  $n$  bad tracks can be made to look like a  $70 - n$  track disc with no bad tracks. To do this, the logical track address stored in the ID field of each sector of every bad track is set to FFH. Tracks of this type are known as invisible tracks. All non-invisible tracks are then sequentially assigned logical track numbers. Logical track 0 is the outermost good track, not necessarily physical track 0.

The HP format uses a double-density encoding scheme known as modified frequency modulation (MFM). The rules for MFM coding are as follows:

- A 0 bit cell has no data transition.
- A 1 bit cell has a data transition.
- A 0 bit cell has a clock transition if there is no data or clock transition in the preceding bit cell.
- A 1 bit cell never has a clock transition.

## Track Format

Each track is divided into sectors, with 256 data bytes per sector. The data contained in one sector is the smallest amount of information written at one time. The disc is soft-sectored, that is, there is no hardware indication of where each sector starts. Instead, the beginning of each sector is indicated by information recorded on the disc.

In order to allow soft-sectoring, each sector is divided into two fields. First, there is an ID field which contains information to identify the sector. Next, there is a data field which contains the actual data. The ID field is written only when the disc is formatted, not during a data sector write operation. Thus, an ID field serves as a fixed marker for the beginning of each sector. The entire data field is rewritten each time a write operation occurs to the sector.

The makeup of the ID and data fields is similar. Both fields start with a series of sync-up bytes. These bytes end with a long string of identical bits. During a read, this bit string allows the decoder circuitry on the controller PCB time to synchronize itself with the data on the disc. Next comes a preaddress mark field and an address mark byte that indicates the beginning of an ID or data field. The data stored in this byte indicates the type of field. In order that no other byte can be mistaken for the preaddress field, these bytes contain an abnormal pattern of clock transitions.

Following the address marks comes a series of information bytes. In an ID field, these bytes indicate the logical cylinder, head, and sector address of the sector. In a data field, these bytes are the data being stored in the sector.

At the end of each field are two cyclic redundancy check (CRC) bytes. These bytes allow the detection of most errors that occur in the storage and recovery of information from the disc.

There are gaps between each field on a track. The gaps allow for variations in disc rotational speed, and time for the hardware to prepare for the next field.

The sectors are accessed consecutively according to their logical address. However, the sectors may occur in any physical order around the track. This allows the sectors to be interleaved to optimize system performance.

**Table 2-1. Track Format**

NUMBER OF BYTES	HEX VALUE	DESCRIPTION
32	4E	Post-index gap
12	00	ID Address Mark Sync
3	A1	(Note 1)
1	FE	ID Address Mark
1	XX	Cylinder Number (Note 2)
1	XX	Head Number (Note 3)
1	XX	Sector Number (Note 4)
1	XX	Sector Length (Note 5)
16X	XX	CRC (Note 6)
12	4E	ID Gap
22	00	Data Address Mark Sync
12	A1	(Note 1)
3	FB	Data Address Mark
1	XX	Data
256	XX	CRC (Note 6)
2	XX	Sector Post-/Pre-amble
46 (Note 7)	4E	Pre-index Gap
204 (Note 8)	4E	

1. Missing clock transition between bits 4 and 5.
2. Cylinder numbering begins at 0.  
Invisible tracks have cylinder number = FFH.
3. This will be 0. (lower head)  
Invisible tracks have head number = FFH.  
Defective tracks have bit 5 of head number set to 1. This is the D bit.

## **2.10 3 1/2-Inch Disc Drive**

4. Sector numbering begins at 0.  
Invisible tracks have sector number = FFH.
5. Length =  $2^{\exp(7 + \text{sector length})}$ ; where sector length = 0,1,2,3
6. Sixteen bit Cyclic Redundancy Check. The polynomial is  $G(X) = X^{\exp 16} + X^{\exp 12} + X^{\exp 5} + X^{\exp 1}$ . The CRC register is initialized to ones and includes all information starting with the address mark and up to the CRC characters.
7. The intersector gaps allow for  $\pm 3.5\%$  motor speed variation.
8. Minimum PRE-INDEX GAP size based on  $\pm 3\%$  motor speed variation. Additional bytes (4E) are written until the index pulse occurs.

# Chapter 3

## Assembly Access

### Introduction

This section describes the assembly removal for the 3 1/2-inch drive. Just the items necessary to access the adjustments and checkpoints are removed. The following section covers the removal and replacement of the main cover, front panel, load pad, and the drive electronics PCB. For information on the removal of the entire drive, see the removal section under the tabbed section pertaining to your device.

The following topics are covered in this section:

- Main Cover Replacement
- Front Panel Replacement
- Load Pad Replacement
- Drive Electronics Assembly Removal

### Main Cover Replacement

The main cover is held secure using three flanges and one securing screw. Removing the screw and lifting the end of the main cover allows the flanges to be disengaged and the cover removed. See the following figure. Reverse the procedure for installation.

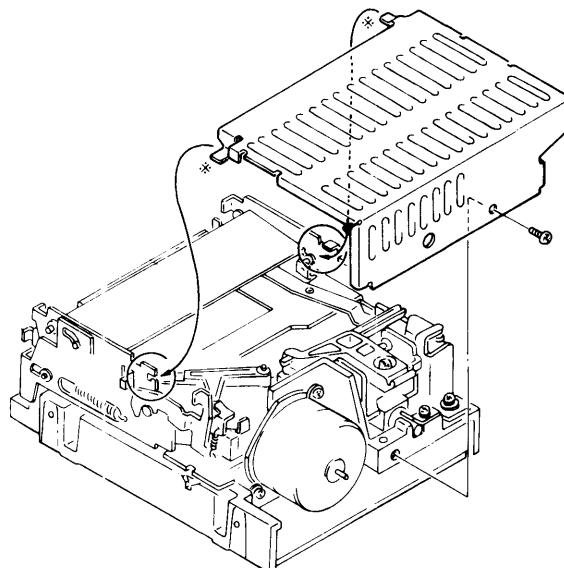
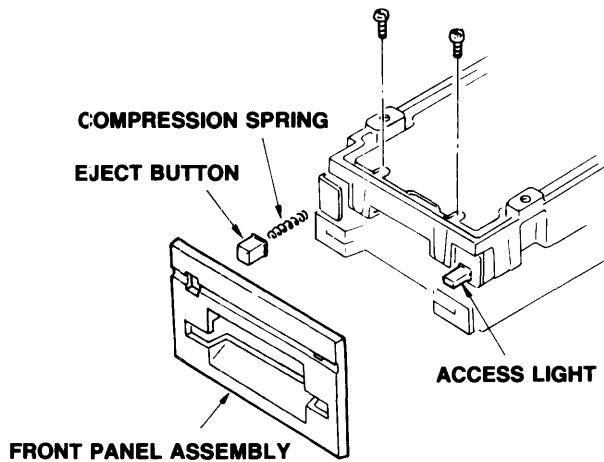


Figure 3-1. Main Cover Replacement

## Front Panel Replacement

The front panel contains the eject button, disc access light, and the slot allowing the disc access to the drive mechanism. This panel is held in place using two screws and nut plates. The screws are accessed from the bottom side of the drive. See the following figure. The nut plates are placed in slots in the front panel. Sufficiently loosening the screws allows the nut plates to be slipped from the front panel, thus staying attached to the drive. The eject button and loading spring are removed with the front panel, whereas, the LED (disc access light) remains attached to the drive.



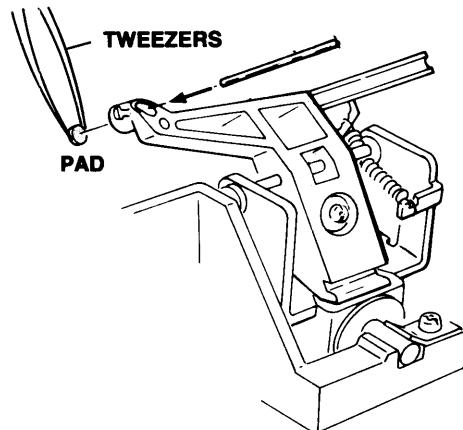
**Figure 3-2. Front Panel Replacement**

## Load Pad Replacement

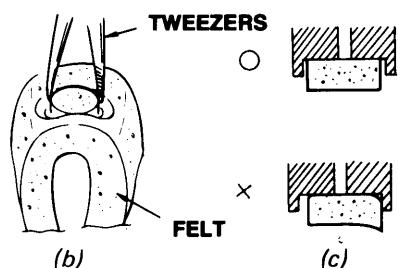
Replacing the load pad first requires that the main cover is removed. See the previous section titled “Main Cover Replacement” for that information.

Once the main cover is removed, lift and hold the load pad arm. Use care so as not to exert any unnatural force against the arm. Remove the old load pad using a tweezers. See Figure 3-3.

New load pads are available in a stamped felt material P/N 09121-88811. Bending the felt in a U shape allows you to access the individual load pads with a tweezers. Remove a load pad by catching it as lightly as possible on both sides with the tweezers and peeling it from the felt. Be careful so as not to crush or permanently distort the load pad. With the load pad between the tweezers insert it directly into the recessed area of the load pad arm. Center it into the recessed area making sure to seat the load pad evenly. See Figure 3-4.



**Figure 3-3. Removing the Load Pad**



**Figure 3-4 Load Pad Replacement**

Holding the load pad arm slightly above the read/write head, check that the new load pad is parallel with the read/write head.

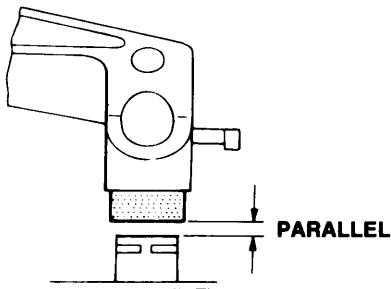


Figure 3-5. Load Pad and Head Reference

## Drive Electronics Assembly Removal

Removing the drive electronics assembly requires the drive be placed upright on either side. Remove the three screws holding the assembly to the casting. Note the position of the noise shield as it must be reinstalled in the same manner. Also, note the slot in the casting in which the assembly is inserted. See the following figure.

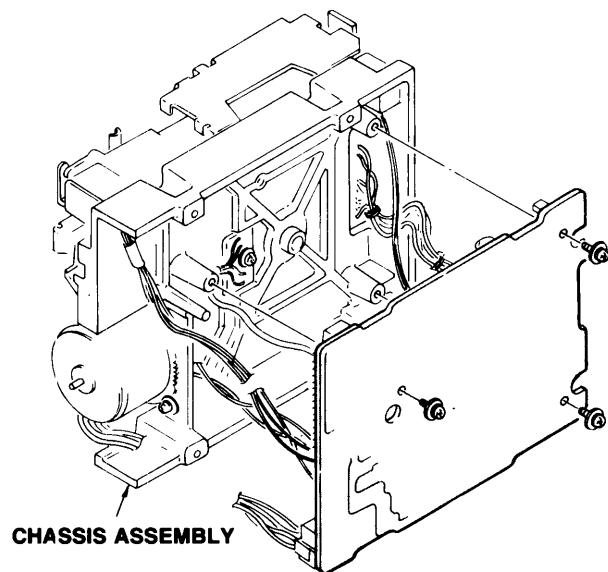
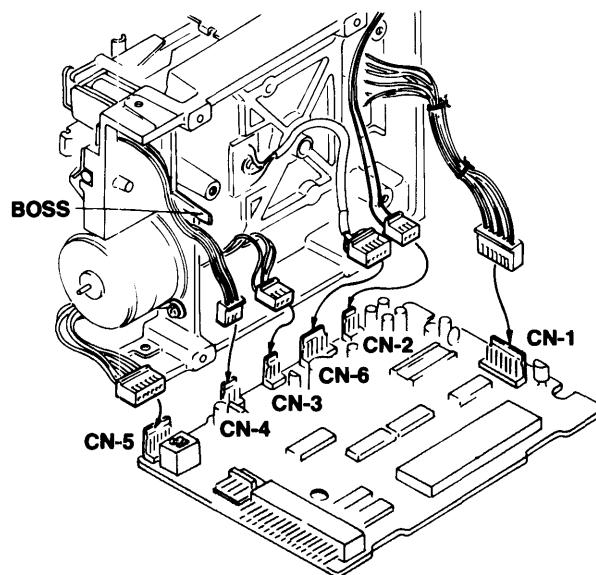


Figure 3-6. Drive Electronics Assembly Removal

If for any reason the drive electronics assembly is completely removed, refer to the following figure for cable placement.



**Figure 3-7. Drive Electronics Assembly Cable Location**



# Chapter 4

## Selftests and Adjustments

### Introduction

This section explains the selftests and adjustments available for ensuring the proper operation of the 3 1/2-inch drive. All selftests must be run with the drive installed in the disc memory. The selftests and adjustment procedures are the same for the 3 1/2-inch drive in all installations.

An Exerciser Tape, inserted into an HP 85 Personal Computer that is connected to your disc memory, is used to position the drive for all the adjustments except load pad position and head load force.

The following topics are discussed in this section:

#### Selftests

- Power-on Selftest
- User Confidence Selftest (9121 Only)
- Remote Selftest
- Service Selftest

#### Adjustments

- Equipment Required
- Exerciser Tape
- Head Cleaning

#### Motor Speed

- Head Radial Alignment
- Head Compliance
- Load Pad Position and Head Load Force
- Read Amplifier Gain and Offset
- Other Checks

- Amount of Disc Access
- PLL Free-run Frequency

### Selftests

There are three selftest modes on the 9121 and the 9133; power-on, remote, and service selftests. An additional user confidence selftest mode is accessible on the 9121 using the address switches. This user confidence test is available on the 9133 after the top cover is removed. See "User Confidence Selftest".

#### Power-on Selftest

The power-on selftest exercises the RAM, the FDC (flexible disc controller) chip, and calculates a checksum for the ROM. The processor goes no farther, waiting for service, if RAM or ROM tests fail. Next tested is the FDC. If this test fails, the selftest LED turns on and does not flash. The processor continues to initialize the system and allows the host to talk to the disc drive if possible. The confidence test LED flashes five times if all tests are passed successfully.

The confidence test LED is visible through the slots in the front of the 9121D/S and visible through a rear panel hole on the 9133.

## User Confidence Selftest

The user confidence selftest (9121 only) is initiated by toggling the left-hand-most address switch on the back panel from up to down to up.

The user confidence selftest for the 9133 is initiated by removing the top cover and shorting the "CT" Confidence Test pins on the Controller assembly. See the component locator for that assembly under the 9133 tabbed section.

If each drive contains a disc that is NOT write protected, a complete selftest is performed: a RAM, ROM, HP-IB, FDC, seek, motor speed, format, and read verify test. The RAM test reads and writes checkerboard patterns into the RAM. The ROM test calculates a checksum for the ROM and compares that to a precalculated value. The HP-IB test reads and writes to selected registers on the HP-IB chip and then sets the chip up to talk to itself and echo data back to the processor. No testing of the interface to the host occurs. All HP-IB cables must be disconnected from the disc memory for the test to operate correctly. The FDC test reads and writes to selected registers on the chip. The seek test steps the head to track 69 and then back to track 0, testing for movement on each drive. The motor speed test measures the index period and compares it to the drive specifications. The format test formats the discs in each drive.

---

### **WARNING**

**ALL DATA ON THESE DISCS IS DESTROYED AND IS UNRECOVERABLE.**

---

The read test verifies the CRCs on the discs. If all these tests are passed successfully, the confidence test LED flashes ten times. If any test fails, no flashing occurs and the LED turns on for 5 seconds.

If the media inserted in drive 0 is write protected, then the formats test is skipped. If all the other tests are passed successfully, the confidence test LED flashes ten times. If no media is inserted in drive 0, then the seek motor speed, format, and read tests are skipped. If the other tests are passed the confidence test LED flashes ten times. If a failure occurs, the LED turns on for 5 seconds.

If the back panel switch is left in the down position, the behavior of the 9121D/S is unpredictable.

After this user confidence test, the drives are reset and the 9121D/S appears, to the host, to have just been powered-on.

## Remote Selftest

The remote selftest is the test initiated by the host controller with the proper HP-IB passed command. It is basically the same as the full user confidence test without the HP-IB test. Results of the test are available over the HP-IB. See the Initiate Selftest command description in this document for more details.

## Service Selftest

The service test uses the HP-IB address switches to select one test to be run.

Address	Test	#Flashes
0	RAM	1
1	ROM	2
2	HP-IB	3
3	FDC	4
4	Drive Seek	5
5	Motor Speed	6
6	Format	7
7	Read/Verify	8

Each test is initiated by shorting the selftest pins on the PC board. See the printed circuit board drawing in each tabbed section for pin location. If continuous testing is desired, the Loop pins should be shorted as well. At the start of each test, the confidence test LED is on for about five seconds. If the selected test is successful, the LED flashes the number of times indicated by the previous table. If the test fails the LED will be lit for 5 seconds.

## Adjustments

The following list of equipment is needed to complete all of the adjustment procedures:

### Equipment Required

9121D/S or 9133

HP-85 with ROM drawer, I/O ROM, 16K Memory Module, and an HP-IB interface

Amigo Protocol Exerciser and Service Package (HP Part No. 5061-2808)

Oscilloscope, 1740A or equivalent Frequency counter which can measure 100 msec period and 1MHz frequency

3 1/2-inch alignment disc (09121-89400)

3 1/2-inch level disc (09121-89401)

3 1/2-inch cleaning disc (09121-89405)

3 1/2-inch regular disc (92191A = box of 10)

Load pad (09121-88811)

Tension gauge, calibrated in grams (8750-0051)

Pad weight (09121-88810)

Radial alignment tool (8710-1518)

# 1 Pozidrive screwdriver

# 2 Posidrive screwdriver

3/16 Slotted screwdriver

Small pocket screwdriver

Small needle-nose pliers

Tweezers

3 1/2-inch Disc Drive Service Manual (09121-90030)

Four power cords

One HP-IB cable

### The Exerciser Tape

Connect the HP-IB cable to the disc memory and insert the tape into the HP-85. Turn on power to the HP-85 and the disc memory. Respond to the screen prompts to obtain an interpretation of the selftest and status bytes for the disc memory. Select the AUTO mode of the exerciser. This mode of the Exerciser tape allows you to execute a preset sequence of operations.

Select the SERV softkey to load the service routines program.

---

**NOTE**

In the following oscilloscope set-up instructions, the amplitude settings assume that 10:1 probes are being used. If 1:1 probes must be used, multiply these settings by 10.

---

## Head Cleaning

After the service program has loaded, select the Head Clean function. Use the special cleaning disc for this operation. Be aware that this function actually performs a Format operation, so if a regular disc is inserted in the drive all data on it will be lost. This routine will last approximately 30 seconds.

## Motor Speed

The motor speed is automatically checked and displayed when this function is selected. If the motor speed is out of spec this appears on the Display. To adjust the motor speed the front panel of the drive must be removed. See the disassembly chapter for information on drive removal.

---

**CAUTION**

ALWAYS DISCONNECT LINE POWER WHEN REPOSITIONING  
THE DISC DRIVES FOR THESE TESTS.

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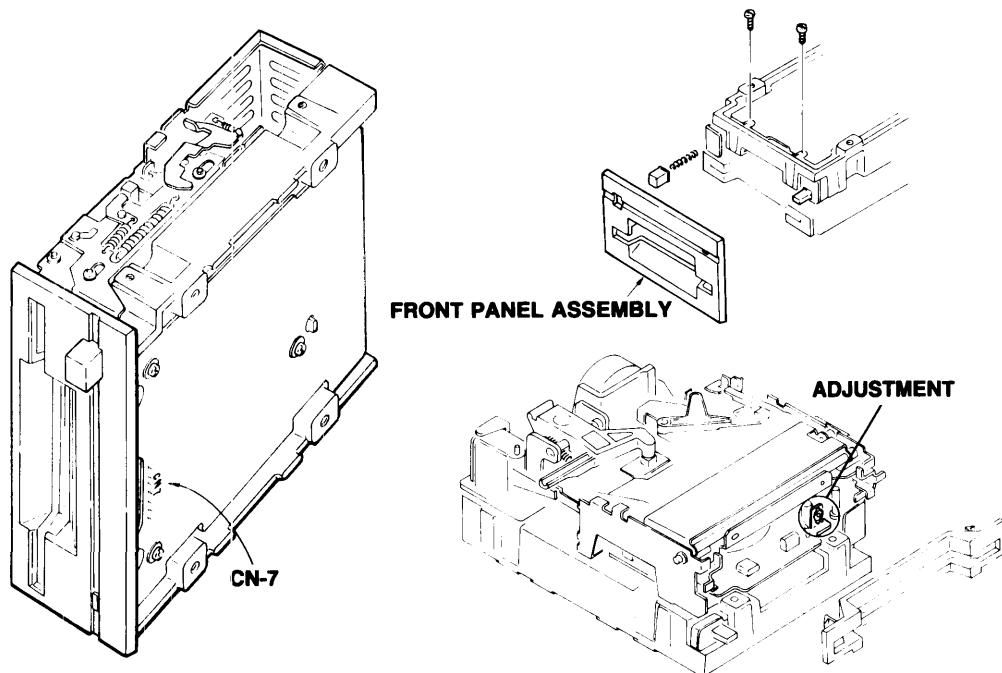


Figure 4-1. Motor Speed Adjustment

Rest the drive mechanism on its side to allow access to the test point connector CN7 on the front of the drive electronics assembly. See Figure 4-1. Reconnect the line cord and turn on power to the drive.

Connect the frequency counter to pin 3 on CN7. Select the ALIGN service routine, then the Motor Speed function in the Service Program. This portion of the ALIGN routine loads the head on track 35 of a standard disc. With the disc inserted and the head loaded, the frequency counter should measure a period of 100msec,  $\pm 1.5$  msec. If this measurement is not within spec, the motor speed adjustment potentiometer must be adjusted. See Figure 4-1.

---

**CAUTION**

ALWAYS MAKE THIS ADJUSTMENT WITH A PLASTIC ADJUSTING TOOL. IT IS POSSIBLE TO SHORT ACROSS THE POTENTIOMETER WHEN MAKING THE ADJUSTMENT.

---

---

**NOTE**

The head should be loaded on track 35 while performing this adjustment in order to obtain the optimum motor speed.

---

## **Head Radial Alignment**

Select the Radial Alignment check routine. This routine allows a cat's eye pattern to be used to check the radial alignment of the head. The cat's eye is produced using the sum of signals written on two non-concentric circular tracks of sine waves recorded on the alignment disc.

Oscilloscope connections for this procedure are given next:

Channel A: Connect to pin 8 of CN7 (Read Amp Output) on the drive electronics PCA; 0.02 V/div; AC coupled  
Channel B: Connect to CN7, pin 3 (Index Pulse); 0.2 V/div; AC coupled  
Trigger: Internal on Channel B  
Time Base: 10msec/div  
Mode: Normal  
Display: Channel A

Insert the Alignment disc and apply power to the disc memory.

Measure the amplitudes of the adjacent cat's eyes. Their ratio should be between 0.8 and 1.2. See Figure 4-2. Press k1 to seek head to Track 69 (the outermost track) and then back to Track 32. Take the ratio of the cat's eyes again. The two ratios should not differ by more than 30%. This procedure checks the hysteresis in the head positioning mechanism.

If the ratios differ by more than 30%, the following adjustment must be made.

Remove the Drive Electronics Assembly – See Figure 3-6 and Figure 4-2.

#### 4-6 3 1/2-Inch Disc Drive

Loosen the steppermotor screws labeled A in Figure 4-2.

Insert the Alignment Tool (8710-1518) as shown and rotate the steppermotor until the cat's eye ratio is within  $\pm 5\%$  of each other.

Tighten the screws labeled A during the adjustment and recheck the ratios.

Reassemble the drive.

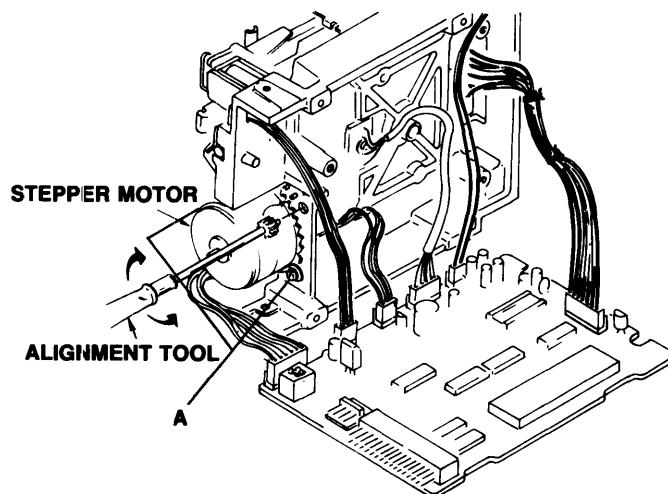


Figure 4-2. Radial Alignment Adjustment

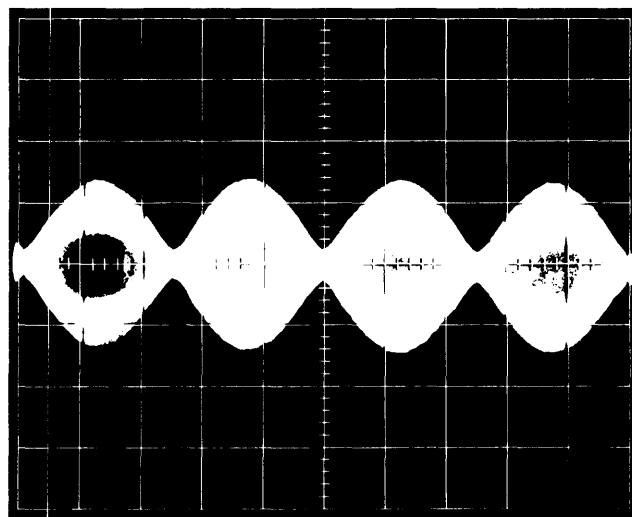


Figure 4-3. Head Radial Alignment

Move the Channel A probe to CN7, pin 4. Switch Channel A to DC-coupled, 0.1 V/div. Press k1 to seek to Track 1. The DC level at pin 4 should now be over 3 V. Press k1 again to seek to Track 0. The DC level should now be less than 0.5 V. This procedure checks the operation of the Track 0 sensor. It should always be performed whenever the Head Radial Alignment is adjusted. If you are unable to obtain these results, change the drive.

## Head Compliance

Select the Head Compliance check function. This routine causes a 2F signal to be written on Track 69 of the Level Disc and allows you to check the resulting read signal level. Set up the scope as in the Index-to-Phase section, but display Channel A only. Measure the amplitude of the signal envelope. Place the pad weight on the load pad arm. (See Figure 4-4). Again measure the amplitude of the envelope. This level must meet the following two conditions:

- 1) It should not be greater than the first level (before the weight was put on).
- 2) It should not decrease from the first level by more than 5%.

If these conditions are not met, perform the procedures in the section titled "Load Pad Position and Head Load Force", then check head compliance again. If the conditions are still not met, replace the load pad.

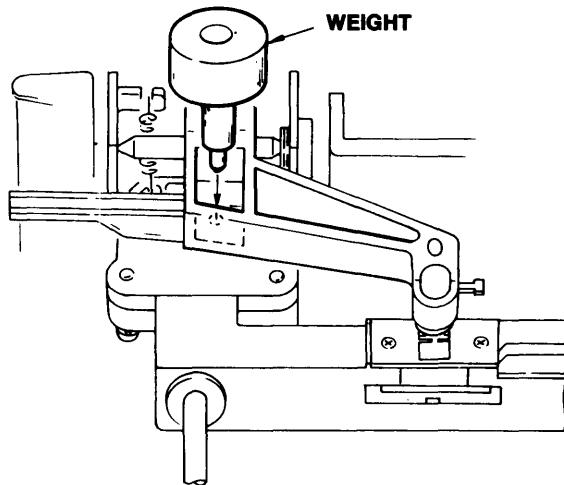


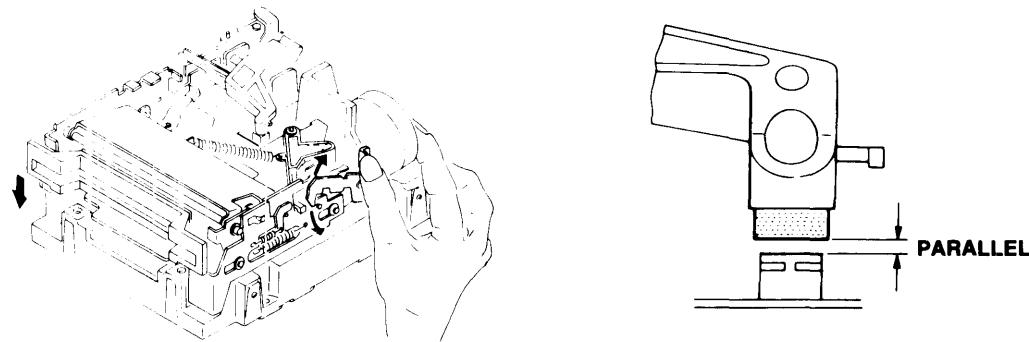
Figure 4-4. Head Compliance

## Load Pad Position and Head Load Force

Turn off power to the drive. Remove the disc drive from the disc memory. Remove the main cover from the drive mechanism. With no media inserted, set the drive mechanism to disc-in mode by releasing the latch on the upper right rear of the mechanism. (See Figure 4-5.)

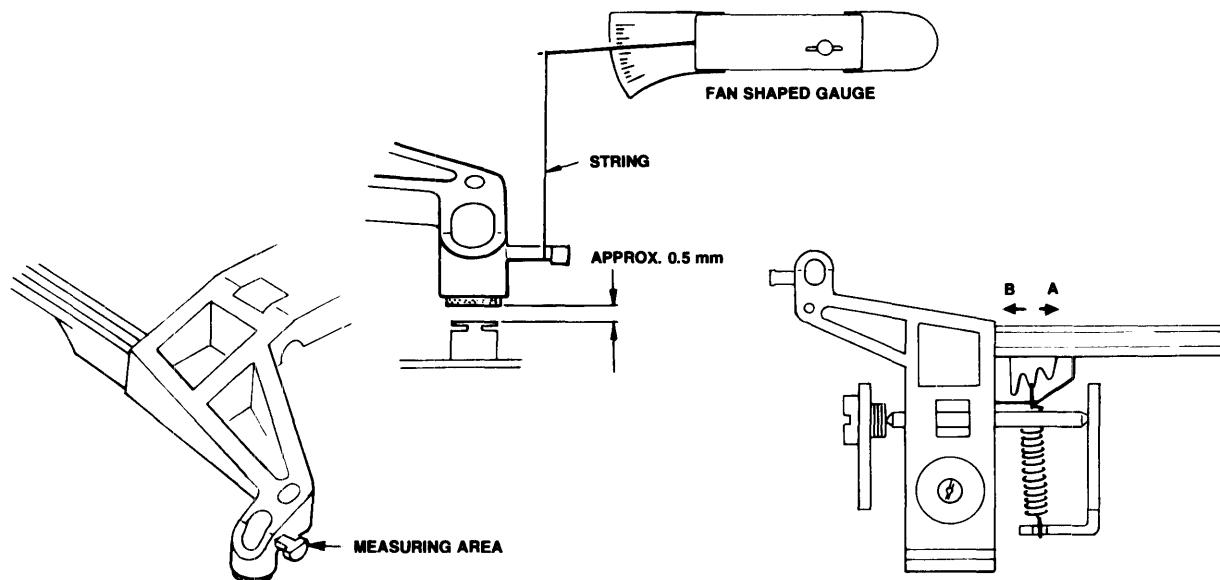
Look at the load pad from the front and from the side of the mechanism. The pad should appear centered in its mounting hole in the load pad arm when sighting along both directions. Also the pad should meet the head squarely. If it is offset when viewed from the front, loosen

the screw on the top of the pad arm and reposition the arm. If it is offset when viewed from the side, remove the three slotted screws which hold the drive electronics PCA onto the drive mechanism, then loosen the two slotted screws which are accessible through cutouts in the bottom of the drive casting. Reposition the pad arm, tighten the screws, and repeat the checks.



**Figure 4-5. Load Pad Position**

To check the head load force, attach the string loop from the tension gauge around the small arm near the load pad. See Figure 4-6. Press the head load arm(the plastic arm attached to the head load solenoid) down to load the pad against the head. Lift the load pad arm by lifting the tension gauge straight upward. When the pad just begins to lift off the head, note the reading on the tension gauge. This force should be  $11 \pm 1$  gram.



**Figure 4-6. Head Load Force**

If the required force is too great, move the spring on the load pad arm to the notch toward the inside of the drive mechanism. If the force was too small, move the spring to the notch toward the outside of the drive. Check the force again. Before any media is used in the drive the head must be cleaned because the head may have been contaminated by its contact with the load pad. Place the cover back on the drive mechanism, press the eject media button, and reconnect the drive electronics PCA. Select the Head Clean function in the Service Program and follow the directions in the routine.

### **Read Amplifier Gain and Offset**

Select the Read Amp function in the service program. Connect scope as follows:

Channel A: Connect to CN7, pin 6 (Read Data); 0.5 V/div; AC coupled

Channel B: Connect to CN7, pin 8 (Read Amp Output); 0.02 V/div; AC coupled

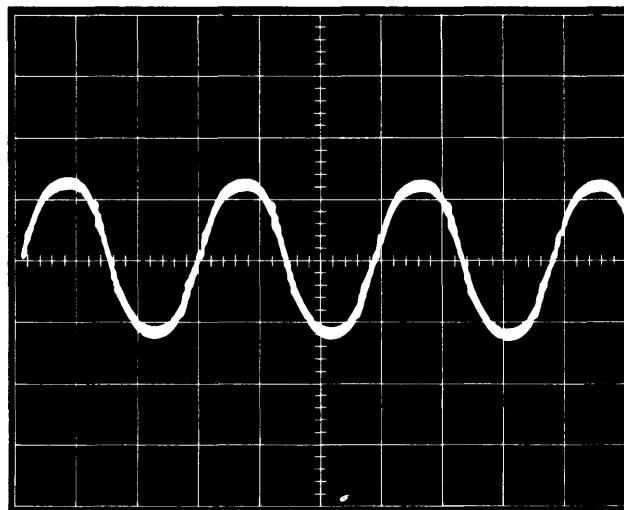
Trigger: Internal trigger on Channel B

Mode: Normal

Time Base: 1 usec/div

Display: Channel B

Apply power to the disc memory, insert the Level disc, and follow the instructions in the routine. After writing the 2F signal on Track 0, check for a sine wave of 4 usec period and 0.5 V p-p,  $\pm 0.30$  V amplitude on the scope. See Figure 4-7.



**Figure 4-7. 2F: 1 usec./div Signal**

Next, the drive writes a 1F signal on Track 0. Switch the time base to 2 usec/div; the scope should then show a complex wave of 8 usec and 0.8 V. See Figure 4-8.

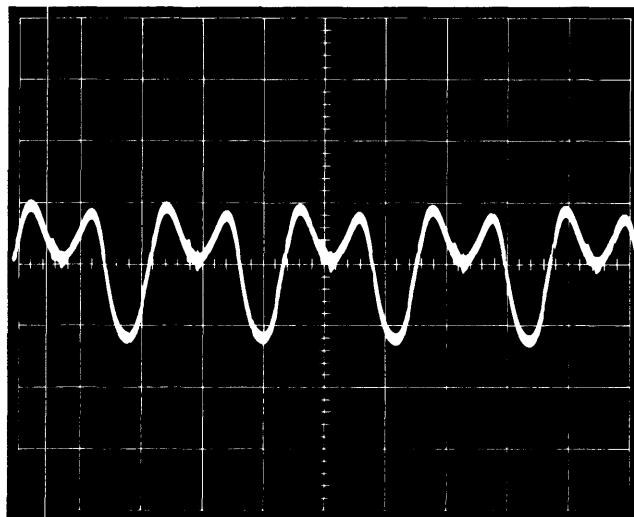


Figure 4-8. 1F: 2 usec./div Signal

Next, a worst case data pattern is written on the disc. The Channel B signal should be a complex wave of 6 usec and 1 V. See Figure 4-9.

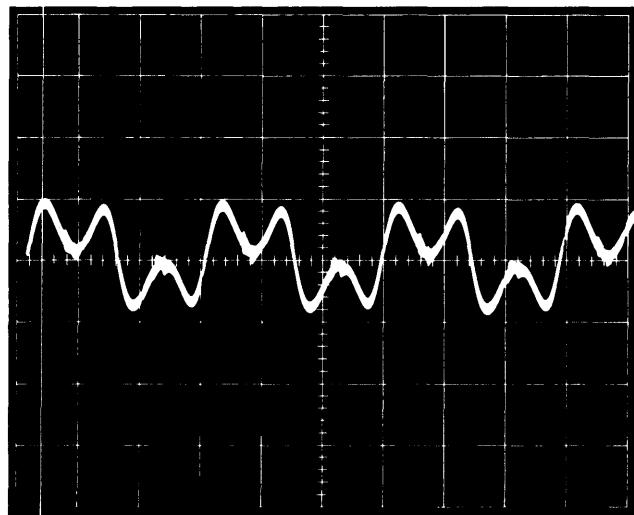
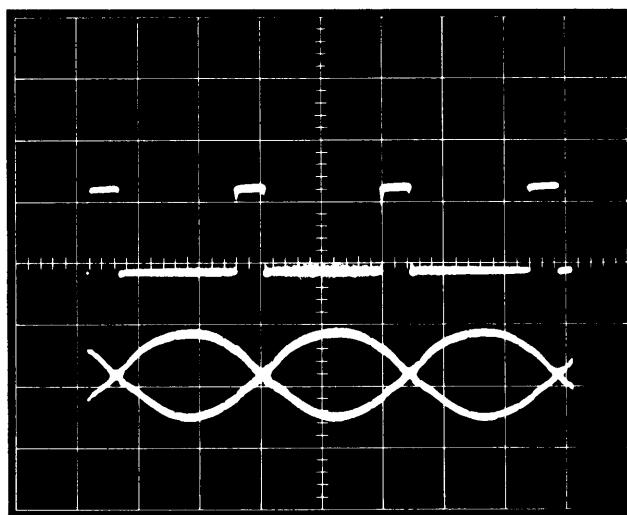


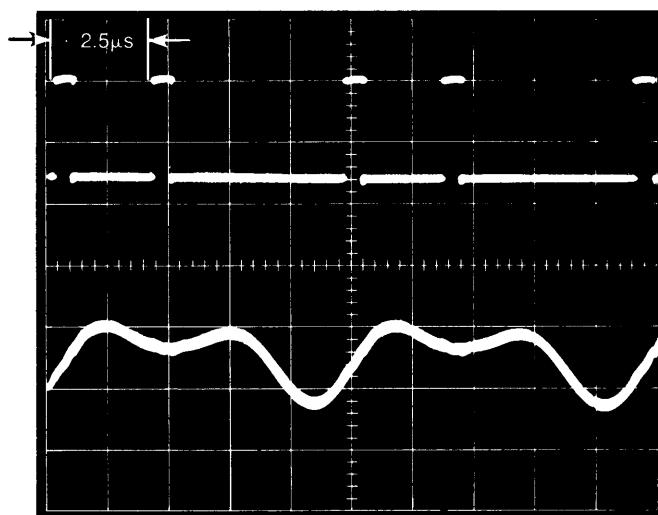
Figure 4-9. Worst Case Signal

Next a 2F signal is written on Track 0. The scope should show a sine wave of 4 usec and 1.5 V. Next a 2F signal is written on Track 69. The scope should show a sine wave of 4 usec and 0.8 V. Before pressing k1 to continue the routine, switch to Chopped Display and expand the time base to 0.5 usec/div. See Figure 4-10. Check the period of the Read Data pulses on Channel A. This period should be  $2.0 \text{ usec} \pm 30 \text{ nsec}$ . If necessary, adjust RV-3 on the drive electronics PCA to bring the signal into spec. Return the time base to 1 usec/div, and continue the program by pressing k1. The worst-case  $\pm$  data pattern will then be written on Track 69.



**Figure 4-10. Read Data Pulses**

Check the separation of the closer-spaced data pulses on Channel A. This spacing should be less than 2.5 usec. See Figure 4-11.



**Figure 4-11. Checking separation**

## Other Checks

### Amount of Disc Access

Select the # Spins function in the ALIGN routine in the service program. This function reads and displays the number of disc access revolutions recorded on the disc. This is the number of head loaded revolutions. The upper limit on this "Media Monitor" internal test is 1 500 000 revolutions. With a disc which has been formatted but not fully initialized, this number will be invalid.

**PLL Free-Run Frequency**

Connect the frequency counter to pin 12 of U33 for the 9121D/S and pin 12 of U37 for the 9133. See the Controller Assembly (Tabbed Sections) for this location. While the drive or drives are idle, a frequency of 1.00 MHz, + /-10 kHz should be obtained. If necessary, adjust trimpot R3 (at the front of the PCA) to adjust this frequency.

This check should be performed whenever read errors or disc interchangeability problems occur.

## **Section II**

# **9121D/S**

This section contains information on the 3 1/2-inch Flexible Disc Drive installation in the HP 9121D/S. The following chapters are contained in this section.

- Chapter 1 General Information**
- Chapter 2 Installation**
- Chapter 3 Interface Information**
- Chapter 4 Troubleshooting**
- Chapter 5 Assembly Access**

All selftests and adjustments for this product are explained in Section I.

# **Chapter 1**

## **General Information**

### **Introduction**

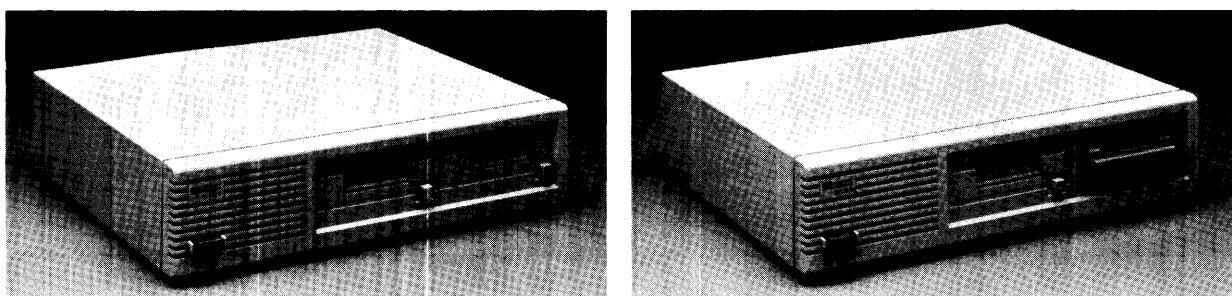
This chapter contains general information on the HP 9121D/S Disc Drive. Included in this section is the following:

- Product Description
- Specifications
- Equipment Supplied
- Unpacking Your HP 9121D/S Disc Memories
- Cleaning the Case

### **Product Description**

The HP 9121D/S Disc Memories (Figures 1-1) are random access data storage devices. The HP 9121S contains a single 3 1/2-inch disc drive providing 286.72 Kbytes of storage capacity. The HP 9121D contains two 3 1/2-inch disc drives providing a total storage capacity of 573.44 Kbytes.

The 9121D/S Drives have been designed to emulate the HP 82900 Series Disc Drives. The 82900s are HP's 5 1/4-inch Flexible Disc Drives. Thus, HP computers that support the 82900 Flexible Disc Drives will support the 9121D/S. Refer to the Mass Storage Manual of your computer for programming information for the HP 82900 5 1/4-inch Flexible Disc Drive.



**Figure 1-1. HP 9121D/S Flexible Disc Memories**

## Technical Specifications

Listed next are the electrical and physical specifications for the HP 9121D/S disc memories.

	<b>HP 9121S</b>	<b>HP 9121D</b>
Number of drives	1	2
Net Weight	3.6 kg (8.5 lbs)	4.5 kg (10 lbs)
Height	76 mm (2.99 in.)	
Depth	285 mm (11.2 in.)	
Width	325 mm (12.8 in.)	
Interface	HP-IB	
HP Double Density format		
Encoding:	MFM	
Rotational Speed:	600 RPM	
Bit Density @ 600 RPM:	Track 69 (Inside track) 7610 BPI	
Track Density:	135 tracks per inch	
Tracks per Surface:	70	
Surfaces used per disc:	1	
Capacity		
Bytes/Sector:	256	
Sectors/Track:	16	
Tracks:	70	
Bytes/Drives (Formatted):	286.72 Kbytes	

### NOTE

All of HP's computers spare 4 complete tracks. This reduces the useable user space to  $256*16*66$  (bytes/sector times sector/track times unspared tracks). This total equals 270.34 Kbytes. Additionally, directories further reduces useable user space. This, as implemented by HP, generally takes track 0. Actual useable space then is somewhere less than 270.34 Kbytes.

Access Time		
Track-to-Track Seek:	15 ms/track, plus	15 ms settling
Maximum Track-to-Track		
Seek (70 tracks):	1070 ms	
Average Track-to-Track:	370 ms	
Maximum Rotational Latency:	100 ms	
Average Rotational Latency:	50 ms	
(Seek plus Latency plus Motor on time):	2.170 s	
Average Data Access Time:	420 ms	

Data Transfer Rates:

Interleave	Burst Rate	Avg. Transfer Rate
	(1) (Bytes/sec)	(2) (Bytes/sec)
1	3.2K	2.6K
2	60.9K	17.1K
3	40.8K	12.1K
4	20.6K	9.2K
5	14.8K	7.6K
6	11.6K	6.4K
7	9.5K	5.5K
8	7.0K	4.8K
9	6.2K	4.3K
10	5.5K	3.9K
11	5.0K	3.5K
11	5.0K	3.5K
13	3.9K	3.0K
14	3.6K	2.8K
15	3.4K	2.6K

Maximum burst transfer rate of the 9121D/S is 64.5 Kbytes/s for writing and 67 Kbytes/s for reading.

- (1) Minimum average burst rate required to utilize this interleave efficiently without introducing extra disc rotational latencies.
- (2) Average data rate for a multiple-track read or write.

#### Power Requirements

86-125 volts or 195-250 volts @67 watts RMS

48-66 Hertz

Fuse 1A, 250V for 86-125V operation

Fuse .5A, 250V for 195-250V operation

#### Environmental Specs

##### Operating Limits

Temperature: 10° C to 45° C (50° F to 115° F)

Humidity: 20 to 80% with maximum wet bulb temperature (non-condensing) not to exceed 29° C (85° F).

Altitude: 0 to 4572 m (0 to 15 000 ft)

##### Non-operating Limits

##### (Storage and Transit)

Temperature: -40° C to 60° C (-40° F to 140° F)

Altitude: -304 to 15240 m (-1000 to 50 000 ft)

---

**NOTE**

The flexible disc in the HP 9121D/S Disc Memory is designed for operation in a typical office environment. Use of the equipment in an environment containing dirt, dust, or corrosive substances will cause the flexible disc drives and media life to be drastically reduced.

---

## **Equipment Supplied**

The following equipment is supplied with each HP 9121D/S disc memory.

**Table 1-1. Equipment Supplied**

Description	Quantity	HP Part Number
Power Cable	1	Dependent on location (see Chapter 2)
* Operator's Manual	1	09121-90000
Fuse	1	2110-0001
		or
	1	2110-0012
		195 to 250VAC .5 Amp Dependent on Location

\* This manual is available in the following languages:

German -- 09121-90006

French -- 09121-90007

Spanish -- 09121-90008

Italian -- 09121-90009

A package of ten discs has been set up as a product. This product is orderable using the 92191A product number.

A field upgrade kit adding the auto shutter is available under P/N 09121-88875. This kit contains the auto shutter mechanism and instructions for installation and alignment.

A new shielded top cover is available for those early versions of the 9121D/S whose owners are placing computer CRTs on top of the drives. This top cover is ordered using P/N 09121-88866. This shielded top cover is now included with all drives. It began with serial number 2229A03802 for the 9121D and 2244A00341 for the 9121S.

## **Unpacking Your HP 9121D/S Disc Memories**

Your disc memory was carefully inspected before shipment. Remove the unit from the shipping carton and carefully inspect the unit for any physical damage that may have occurred during shipment. If you find any damage, you should immediately notify your dealer and file a claim with any carriers involved.

---

**CAUTION**

THE DISC MEMORY IS A PRECISION INSTRUMENT. MECHANICAL SHOCK CAN MISALIGN THE READ/WRITE HEAD, RESULTING IN READ ERRORS AND/OR DAMAGED DISCS WHETHER THE DISC IS OPERATING OR NOT.

---

If the disc memory is moved, be careful when picking it up and setting it down.

Carefully repack the disc memory in a shipping carton before transporting it to another site.

---

**NOTE**

Evidence of excessive shock will void the warranty.

---

Please check to insure that you have received all of the standard equipment. If any items are incorrect or missing, please contact the dealer from whom you purchased the unit.

## **Cleaning the Case**

The disc memory case consists of a pearl grey plastic material and is not painted. The rear panel has been painted with a durable, long lasting, non-toxic paint. This design will preserve the appearance of your disc memory for many years. When you want to clean the case, following the next instructions will sustain the quality finish. If the case finish should become damaged, consult your local Hewlett-Packard sales and service office for touch-up paints that are available.

---

**CAUTION**

CHEMICAL SPRAY-ON CLEANERS USED FOR APPLIANCES AND OTHER HOUSEHOLD AND INDUSTRIAL APPLICATIONS MAY DAMAGE THE CASE FINISH. THESE OR OTHER CHEMICAL CLEANERS SHOULD NOT BE USED.

---

Before cleaning the disc memory case, disconnect the power cord and any interconnecting cables. Dampen a clean, soft, lint-free cloth in a solution of clean water and mild soap. Wipe the soiled areas of the case, ensuring that no cleaning solution gets inside the unit. For cleaning more heavily soiled areas, a 50%-50% solution of clean water and isopropyl alcohol may be used. Wipe the case areas that had cleaning solution applied with a clean, soft, lint free cloth dampened in clean water, then dry the case with a dry, soft, clean cloth. A non-abrasive eraser may be used to remove pen and pencil marks.

---

**CAUTION**

DO NOT USE DETERGENTS THAT CONTAIN AMMONIA, BENZENES, CHLORIDES, OR ABRASIVES.

---



# Chapter 2

## Installation

### Introduction

This section provides the installation and initial power-on procedures for the HP 9121D/S. The topics covered in this section are as follows:

Setting the Line Voltage Select Switches  
Fuses  
Power Cords  
The HP-IB Interface  
Selecting the Device Address  
Controls and Indicators  
Applying Power

Loading the Flexible Disc  
Manual Shutter  
Auto Shutter  
Basic System Operation  
Write Protect Error On Initialization  
Data Errors

### Setting the Line Voltage Select Switches

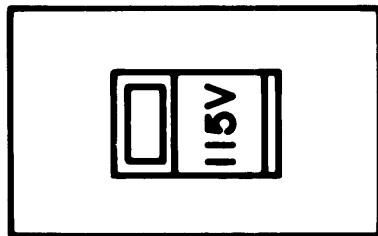
The voltage select switches on the rear panel must be set to the nominal line voltage for the area in which it is operating. Figure 2-1 shows the setting of the voltage select switches for the various line voltages.

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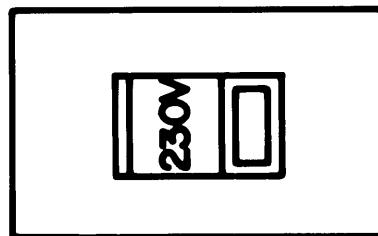
#### CAUTION

ALWAYS TURN THE AC POWER SWITCH OFF OR DISCONNECT THE AC LINE CORD BEFORE CHANGING THE LINE VOLTAGE SELECT SWITCH POSITION. CHANGING THE LINE VOLTAGE SELECT SWITCH SETTING WHILE AC POWER IS ON COULD DAMAGE THE DISC MEMORY.

---



86-125 Vac



195-250Vac

Figure 2-1. Line Voltage Select Switches

## Fuses

A different fuse is required for each of the two voltage ranges of 110-120 and 220-240 VAC. Table 2-1 gives the correct fuse ratings and part numbers. The fuse included in your 9121D/S depends upon where the equipment is to be delivered.

**Table 2-1. Fuses**

	Voltage Range	Fuse Rating	HP Part Number
HP 9121D/S	96 & 125VAC	1.A 250 VAC-Normal Blow	2110-0001
HP 9121D/S	196 & 250VAC	.5A 250 VAC-Normal Blow	2110-0012

One fuse is provided in the unit and it depends upon where the equipment is to be delivered. When servicing the drive, check to ensure that the correct fuse is installed.

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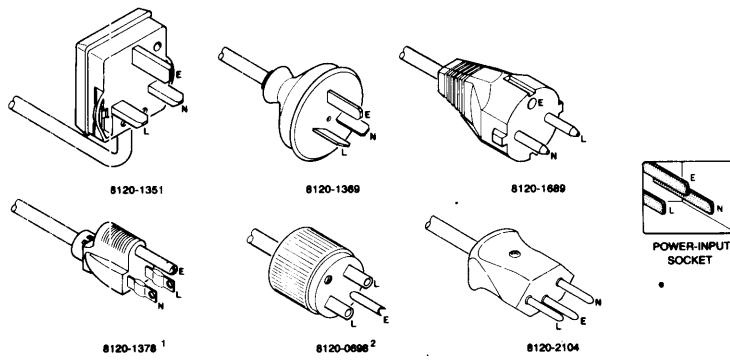
**WARNING**  
ALWAYS DISCONNECT THE DISC MEMORY FROM ANY AC LINE  
BEFORE CHANGING FUSES.

---

## Power Cords

Power cords supplied by HP have polarities matched to the power input socket on the equipment (Figure 2-2).

- L = Line or active conductor (also called "live" or "hot")
- N = Neutral or identified conductor
- E = Earth or safety ground



<sup>1</sup>UL and CSA approved for use in the United States of America and Canada with equipment set for either 100 or 120 Vac operation.

<sup>2</sup>UL and CSA approved for use in the United States of America and Canada with equipment set for either 200 or 240 Vac operation.

**Figure 2-2. Available Power Cords**

**WARNING**

IF IT IS NECESSARY TO REPLACE THE POWER CORD, THE REPLACEMENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL AS WELL AS THE EARTH OR SAFETY GROUND CONDUCTOR. OTHERWISE, A SAFETY HAZARD MIGHT EXIST IF AN INTERNAL FAILURE OCCURS.

The cord packaged with the equipment depends upon where the equipment is to be delivered.

## The HP-IB Interface

The HP 9121D/S are connected to the computer via the Hewlett-Packard Interface Bus (HP-IB). Refer to the figure below for a list of the HP-IB interface cables used with HP computers.

<u>Length</u>	<u>Accessory Number</u>
1 metre	10833A
2 metres	10833B
4 metres	10833C
.5 metre	10833D

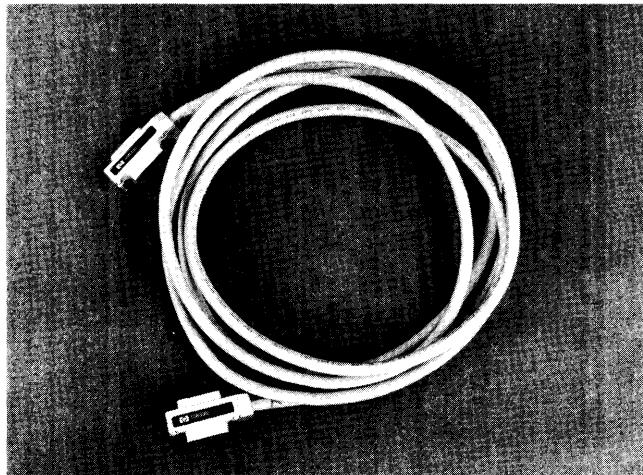


Figure 2-3. HP-IB Interface Cables

### HP-IB Interface Restrictions:

1. All the AC line switches must be turned "OFF" when connecting (and disconnecting) devices to your system.
2. The total length of cable permitted in one bus system must be less than or equal to two metres times the number of devices connected together (the interface card is counted as one device).
3. The total length of the cable must not exceed 20 metres. For example, a system containing six devices can be connected together with cables that have a total length less than or equal to 12 metres (six devices x 2m/device = 12 metres). The individual lengths of cable may be distributed in any manner desired as long as the total length does not exceed the allowed maximum. If more than 10 devices are to be connected together, cables shorter than two metres must be used between some of the devices to keep the total cable length less than 20 metres.

4. The maximum number of devices that can be connected together in one bus system is 15.

There are no restrictions to the way cables may be connected together; however, it is recommended that no more than four piggyback connectors be stacked together on one device. The resulting structure could exert enough force on the connector mounting to damage it.



**Figure 2-4. Interface Connection**

## Selecting the Device Address

Each device in an HP-IB system must be set to a unique device address. The 9121D contains two separate drives, but is one device and requires one address. See the mass storage information of your controller for addressing information concerning drive 0 and drive 1. See Figure 2-5 for switch locations.

Prior to setting the device address switches, turn the disc memory AC line switches OFF.

The switches can be set to any one of eight device addresses, ranging from decimal 0 through 7. Refer to Figure 2-5 to set these switches to the desired device address.

Address	Test**	Switch Segments		
		4	2	1
0	Up	DOWN	DOWN	DOWN
1	Up	DOWN	DOWN	UP
2	Up	DOWN	UP	DOWN
3	Up	DOWN	UP	UP
4	Up	UP	DOWN	DOWN
5	Up	UP	DOWN	UP
6	Up	UP	UP	DOWN
7	Up	UP	UP	UP

UP  
DOWN

\*\* = Up for normal operation  
Up - Down - Up for selftest.

**Figure 2-5. Device Address Switch Setting**

## Controls and Indicators

The controls and indicators are located on the front panel. These controls and indicators, as shown in Figure 2-6, are the following: one disc access light for each drive unit (the disc access lights are illuminated whenever the disc is accessed for data storage or retrieval and momentarily when the drive is powered up), one power ON/OFF switch, and the selftest LED (seen through the air inlet).

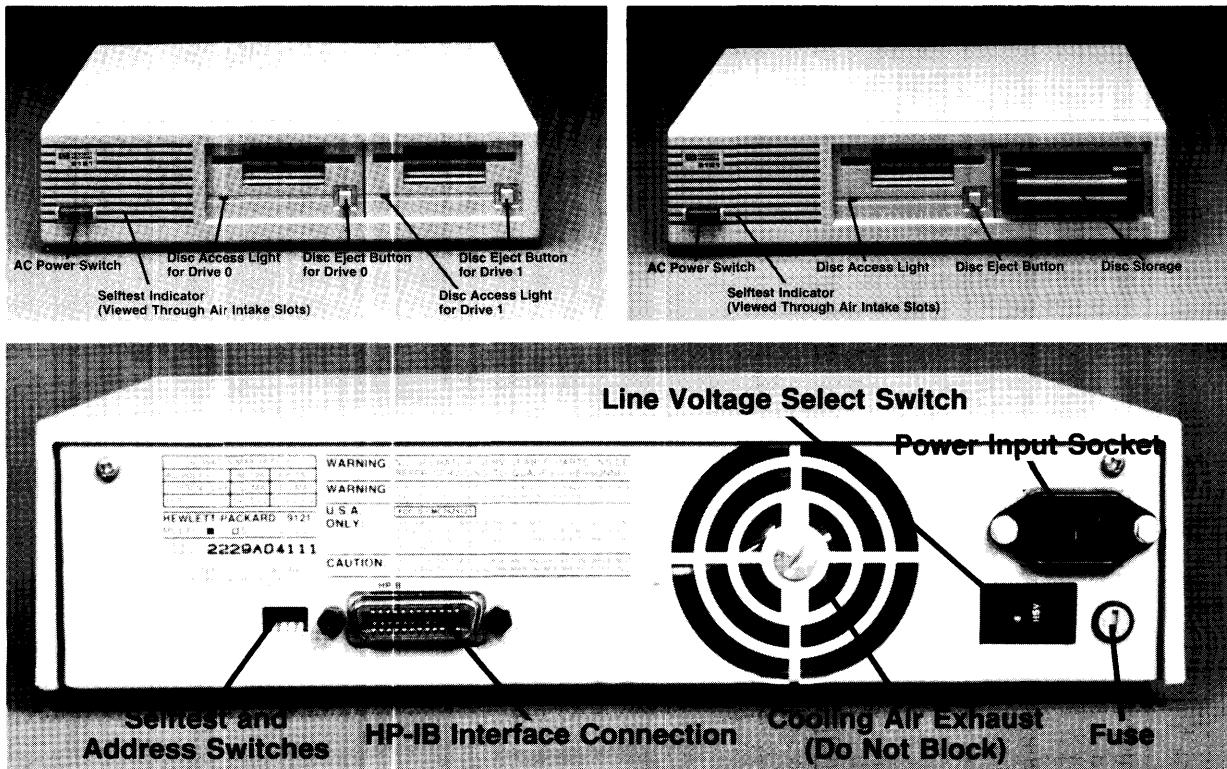


Figure 2-6. Front and Rear Panels

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### CAUTION

THE ACTIVITY LIGHT ON THE FRONT OF EACH DRIVE INDICATES USAGE OF THAT DRIVE. DO NOT DEPRESS THE DISC EJECT BUTTON WHEN THE ACTIVITY LIGHT IS ON.

---

## Applying Power

Before turning the disc memory on, be sure to perform all the procedures in the first part of this section.

Locate the AC line switch on the front panel and set it to the "ON" or "1" position. The disc drive requires about 10 seconds after the application of power before it is ready for operation or before you insert your disc. See the section titled "Selftest" for the power-on selftest indication.

## Loading the Flexible Disc

To install and remove flexible discs, perform these steps.

1. Do not attempt to insert the disc into the drive without power applied.

### Manual Shutter

2. Slide the disc guard away from the head window exposing the disc surface. Insert the exposed head window first with the metal centering hub down. Carefully slide the disc into the drive until you feel it contact the rear of the drive. Do not force the disc.

### Auto Shutter

Slide the disc into the drive until you feel it contact the rear of the drive. Do not force the disc.

Remember, either type of disc (manual or auto shutter) will work in either type of drive. If you do not have the auto shutter mechanism in the drive and the disc, you must follow the procedure described with using the manual shutter.

3. Remove the disc by depressing the disc eject button and pulling the disc straight out. Always slide the disc guard over the head window immediately after removing the disc from the drive.

Refer to Figure 2-7 for proper loading of the flexible disc.

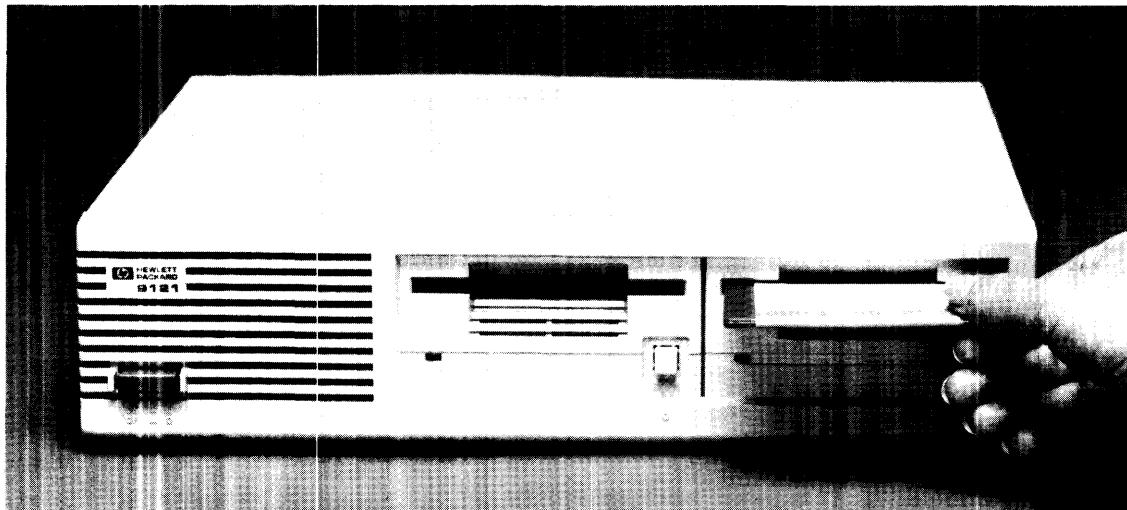


Figure 2-7. Disc Loading

## Basic System Operation

Before using a blank flexible disc, it must be formatted or initialized for use with your computer. This process checks the disc for defects (areas where information cannot be stored), reserves spare tracks, and creates a file directory. The directory holds the name and location of each file on the disc. When a disc is first initialized, the directory is empty, so no files are listed when you catalog the disc.

The 9121D/S drive emulates the 82901 drive. Thus, you program it using mass storage ROM or driver statements that your computer manuals describe for the 82901 disc drive.

### **Write Protect Error on Initialization**

A motor speed check is performed when a disc is inserted to be initialized. If the motor speed is on either side of the tolerance allowed, a Write Protect Error is generated and the disc is not initialized. If your drive is operating properly, this indication is one of a defective disc. Discard the disc.

The motor speed should be checked and/or adjusted before discarding the disc. See the section titled "Selftest and Adjustments".

### **Data Errors**

Two error conditions cause the selftest LED to come on and stay on until the condition disappears. These conditions are a command sequence-error over the HP-IB (from the host controller) and a data error from the disc. Whenever these conditions occur it is best to retry the last operation. If a retry is successful, the error and error indication are cleared. If the condition remains after several retries, perform the service selftest and or the remote selftest to determine the cause of the error condition.



# **Chapter 3**

## **Interface Information**

### **Introduction**

This chapter presents an overview of the HP-Interface Bus. The command set for controlling the HP 9121D/S disc is presented in the Appendix. You should be thoroughly familiar with the appropriate Input/Output (I/O) operations of your computer before using the HP 9121D/S disc memories.

### **Overview of the HP-Interface Bus**

The following is the definition of the terms and concepts used to describe HP-IB system operations.

#### **HP-IB System Terms:**

1. Byte - A unit of information consisting of eight binary digits (bits).
2. Device - Any unit that is compatible with the IEEE Standard 488-1975.
3. Device Dependent - A response to information sent on the HP-IB that is characteristic of an individual device's design and may vary from device to device.
4. Operator - The person who operates either the system or any device in the system.
5. Addressing - The characters sent by a controlling device to specify which device will send information on the bus and which device(s) will receive that information.
6. Polling - The process typically used by a controller to locate a device that needs to interact with the controller. There are two types of polling:

Serial Poll - This method obtains one byte of operational information about an individual device in the system. The process must be repeated for each device from which information is desired.

Parallel Poll - This method obtains information about a group of devices simultaneously.

#### **Interface Bus Concepts:**

Devices which communicate along the interface bus can be classified into three basic categories:

1. Talkers - Devices which send information on the bus when they have been addressed.

2. **Listeners** - Devices which receive information sent on the bus when they have been addressed.
3. **Controllers** - Devices that can specify the talkers and listeners for an information transfer. Controllers can be categorized as one of two types:

**Active Controller** - The current controlling device on the bus.

**System Controller** - The controller that can take priority control of the bus even if it is not the current active controller. Although each bus system can have only one system controller, the system can have any number of devices capable of being the active controller.

#### Message Concepts:

Devices which communicate along the interface bus are transferring quantities of information. The transfer of information can be from one device to another device, or from one device to more than one device. These quantities of information can be thought of as "messages". Typically, each message consists of two basic parts; the address portion specified by the controller and the information that comprises the message.

In turn, the messages can be classified into 12 types. The 12 types messages are defined as follows:

1. **The Data Message:**  
This is the actual information which is sent from one talker to one or more listeners along the interface bus. Data can be in either numeric form or a string of characters.
2. **The Trigger Message:**  
This message causes the listening device(s) to perform a device-dependent action.
3. **The clear Message:**  
This message causes either the listening device(s) or all of the devices on the bus to return to their predefined device-dependent states.
4. **The Remote Message**  
This message causes the listening device(s) to switch from local front-panel control to remote program control.
5. **The Local Message:**  
This message clears the Remote Message from the listening device(s) and returns the device(s) to local front-panel control.
6. **The Local Lockout Message:**  
This message prevents the operator from manually inhibiting remote program control.
7. **The Clear Lockout and Set Local Message:**  
This message causes all devices on the bus to be removed from local lockout and revert to local. This message also clears the Remote Message for all devices on the bus.
8. **The Request Service Message:**  
A device can send this message to signify that the device needs some type of interaction with the controller. This message is cleared by the device's Status Byte Message if the device no longer requires service.

**9. The Status Byte Message:**

A byte that represents the status of a single device on the bus. One bit indicates whether the device sent a Request Service Message and the remaining bits indicate operational conditions defined by the device. This byte is sent from a talking device in response to a serial poll operation performed by a controller.

**10. The Status Bit Message:**

A byte that represents the operational conditions of a group of devices on the bus. Each device responds on a particular bit of the byte thus identifying a device-dependent condition. This bit is typically sent by devices in response to a parallel poll operation.

**11. The Pass Control:**

This transfers the bus management responsibilities from the active controller to another controller.

**12. The Abort Message:**

The system controller sends this message to unconditionally assume control of the bus from the active controller. This message terminates all bus communications but does not implement a Clear Message.

These messages represent the full implementation of all HP-IB system capabilities. Each device in a system, however, may be designed to use only the messages that are applicable to its purpose in the system. It is important for you to be aware of the HP-IB functions implemented on each device connected to your HP-IB system to ensure the operational capability of the system.



# Chapter 4

## Troubleshooting

### Introduction

This chapter provides the physical location of key components, power supply circuit diagrams, power supply theory and troubleshooting, and a list of replaceable parts.

The following topics are discussed in this chapter:

Repair Philosophy  
Exchange Assemblies  
Non-exchange Assemblies  
Support Packages Contents Lists  
Product Support Package (PSP)

Field Support Inventory Package (FSI)  
Recommended Field Support Inventory  
Controller Electronics and Power Supply Assembly  
Power Supply  
Troubleshooting the Power Supply

### Repair Philosophy

The 3 1/2-inch Disc Drive assemblies are serviced on the exchange program. The assembly includes the drive and drive electronics board (the PC board attached to the lower side of the drive).

The selftest and alignment procedures are given to enable you to isolate problems and correct misalignment in the field.

Power supply information is presented in each tabbed section. Controller assembly detailed information is not presented.

### Exchange Assemblies

The following assemblies are exchange assemblies:

3 1/2-inch Flexible Disc Drive -- 09121-69511  
Controller/Power Supply Assembly -- 09121-69510

### Non-exchange Assemblies

The following assembly is not exchangeable

Fan Assembly -- 09121-68501

## Support Packages Contents Lists

The following packages lists are the contents for the PSP and the FSI.

### Product Support Package (PSP) -- 09121-67100

09121-88810 -- Pad Weight  
8710-1518 -- Radial Alignment Tool  
09121-89400 -- Disc, Alignment  
09121-89401 -- Disc, Level  
09121-89405 -- Disc, Cleaning  
8750-0051 -- Gauge, Tension  
5061-2808 -- HP-85 Test Package  
09121-90030 -- Manual, Service

### Field Inventory Parts Package (FSI) -- 09121-67197

09121-69510 -- Controller/Power Supply Assembly (9121)  
09133-66500 -- Controller Assembly (9133)  
09121-69511 -- 3 1/2-inch Flexible Disc Drive  
09121-68501 -- Fan Assembly  
09121-88811 -- Pad, Head Load  
2110-0587 -- Fuse, 2A

## Recommended Field Service Inventory

The following list of parts and assemblies is recommended for building your Field Service Inventory (FSI).

09121-69511 -- 3 1/2-inch Flexible Disc Drive  
09121-69520 -- Controller/Power Supply Assembly (9121)  
09133-66500 -- Controller Assembly (9133)  
09121-68501 -- Fan Assembly

## Controller Electronics and Power Supply Assembly

The controller electronics and power supply sections of the printed circuit assembly are presented in the next drawing. Along with the key components, the selftest control points are also labeled.

### Power Supply

The power supply generates four voltages: + 12, + 5, -12, and a raw 22 VAC for fan operation. The + 12 and + 5 each originate from their own secondary winding of the transformer and are rectified and regulated independently. Each of these secondaries are fused. The fuses are located on the PC board in the power supply area.

The -12 V (which is normally -10 V) is taken from the same secondary that drives the + 5 V. This source is run through a voltage doubler and then clamped with a 12 V zener. The fan gets its power from the same source that drives the + 12 V. This voltage is taken directly from the secondary which is 22 VAC. See Table 4-1 for the power supply specifications.

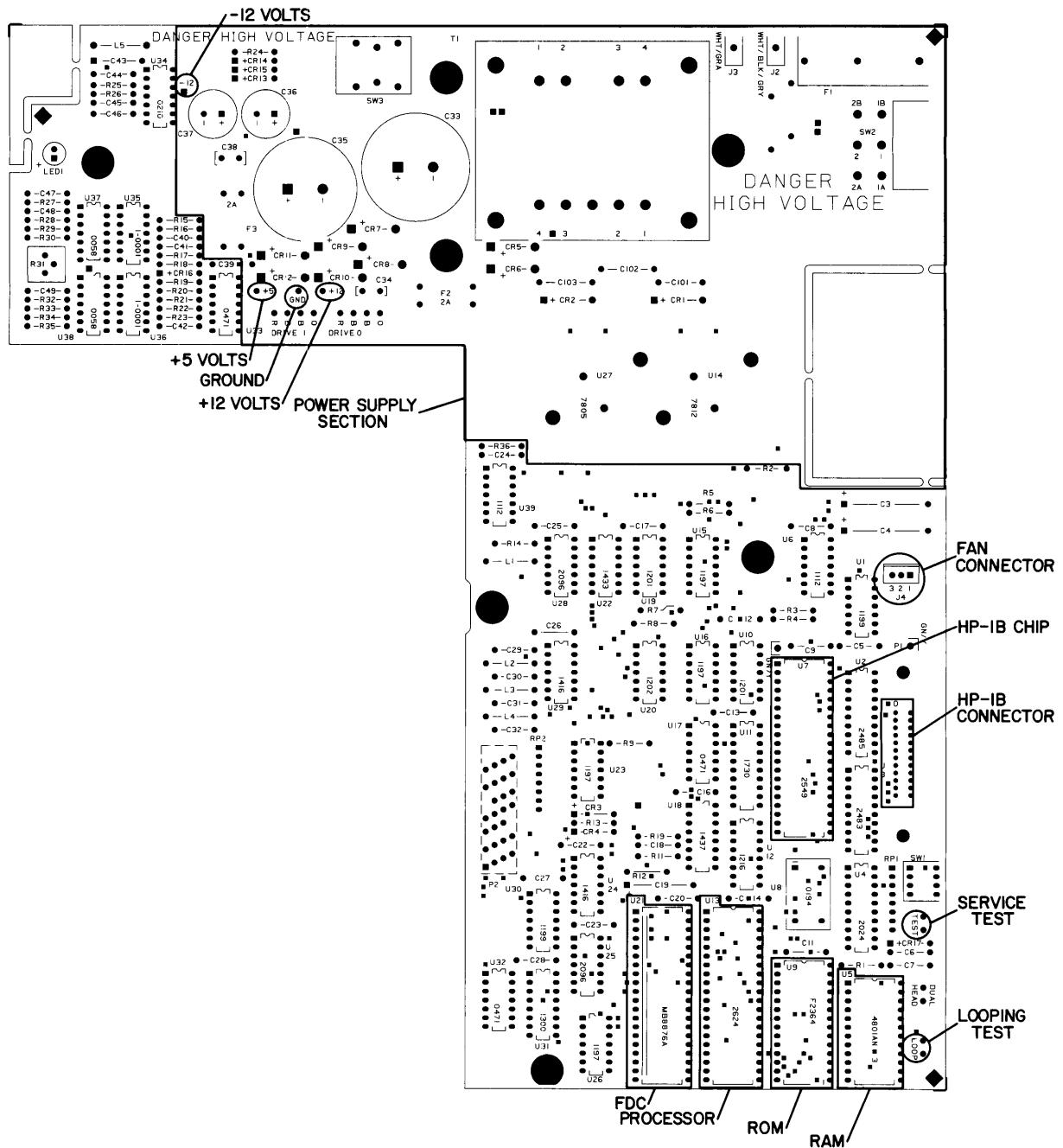


Figure 4-1. Controller and Power Supply Assembly

**Table 4-1. Power Supply Specifications****Total Power Requirements**

0.75 Amps Max. at 125 Volts AC, 48-66 Hertz  
 0.375 Amps Max. at 250 Volts AC, 48-66 Hertz  
 $+ 5 \text{ V} \pm 5\% 1.55 \text{ Amps Typ.}$   
 $+ 12 \text{ V} \pm 5\% 0.85 \text{ Amps Typ.}$

**Controller Electronics Assembly**

$+ 5 \text{ V} 0.7 \text{ A}$  typical, voltage tolerance:  $\pm 5\%$   
 $+ 12 \text{ V} 0.10 \text{ A}$  typical, voltage tolerance:  $\pm 5\%$

**Dual Drive Assembly**

$+ 5 \text{ V} 0.8 \text{ A}$  typical, voltage tolerance:  $\pm 5\%$   
 $+ 12 \text{ V} 0.8 \text{ A}$  typical, voltage tolerance:  $\pm 5\%$

**DC Power Provisions**

**Output**  
 $+ 5 \text{ V} \pm 5\% 2 \text{ Amp Continuous}$   
 $+ 12 \text{ V} \pm 5\% 1 \text{ Amp Continuous}$

**Ripple and Noise**

10 mV pp (20 Hz to 20 M Hz)

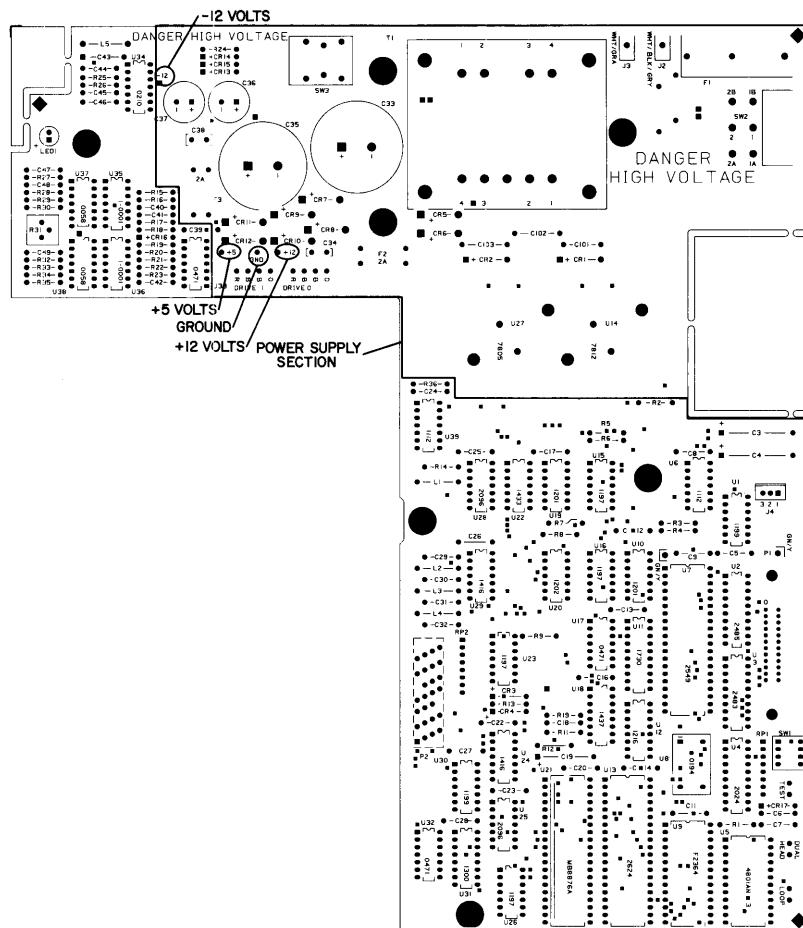
**Power Line Sag**

25 msec @ 115/230 VAC  
 11 msec @ 86/195 VAC

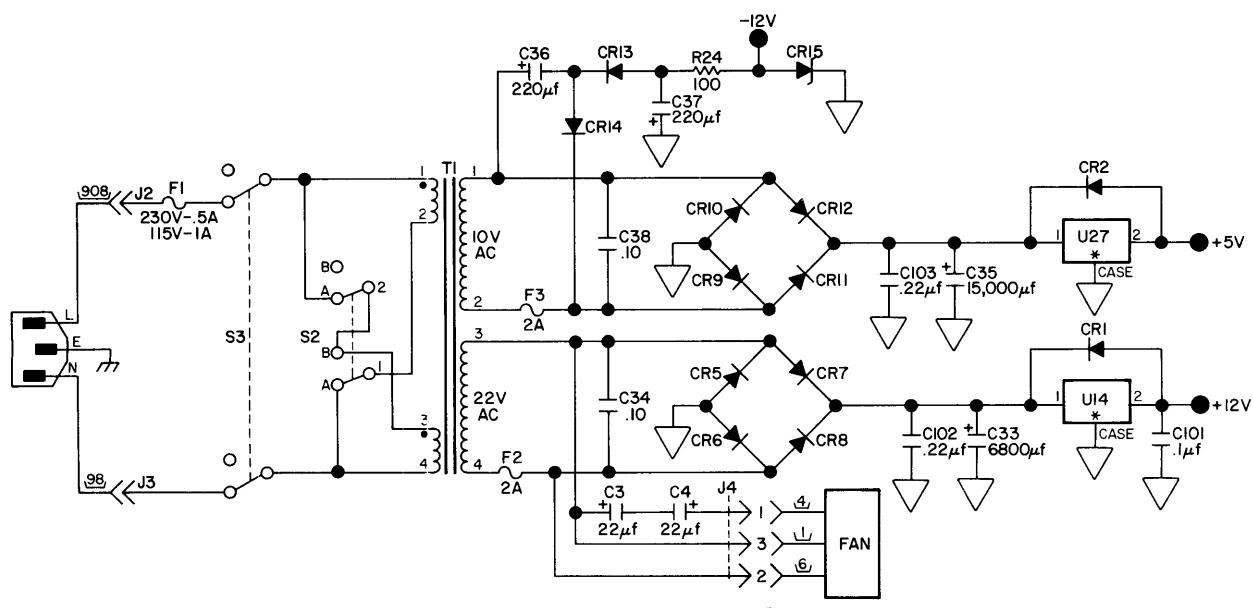
**Troubleshooting the Power Supply**

The following items should be checked in the following order if you are having power supply problems. See the following power supply schematic and component locator.

- There are three fuses associated with the 9121D/S supply
  1. The line voltage fuse F1 located on the rear panel.
  2. Both secondaries of the transformer have fuses in the circuits. These fuses are located on the PC board in the power supply section.
- The +12 and + 5 volt supplies should be within 5% on their expected voltages. The -12 volt supply should be between -12 and -6 volts.
- The absolute minimum voltage allowed at the junction of CR11 and CR12 is 7 V. This voltage would normally be approximately 10 V. The absolute minimum voltage allowed at the junction of CR7 and CR8 is 14 V. This voltage would normally be approximately 22 V.
- Rectifiers are more likely to fail than the regulators.



**Figure 4-2. Power Supply Component Locator**



**Figure 4-3. Power Supply Schematic Diagram**



# Chapter5

## Assembly Access

### Introduction

This chapter provides information for disassembly of the 9121D/S disc memories. An exploded view is also provided with the instructions. The exploded view references part numbers that are listed in the replaceable parts section.

The following topics are discussed in this chapter:

- Safety Considerations
- Top Cover Removal
- Drive Removal
- Fan Removal
- Printed Circuit Assembly Removal
- 9121D/S Parts Lists

The following tools are required for disassembly and reassembly of the disc memories.

- #2 Posidrive Screwdriver
- #1 Posidrive Screwdriver
- 9/32 Nut Driver
- Needlenose Pliers

### Safety Considerations

#### General

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

#### Safety Symbols



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.



Indicates hazardous voltages.



Indicates earth (ground) terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

**WARNING**

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

**CAUTION**

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly performed, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

## Safety Earth Ground

This is a safety class I product and is provided with a protective earthing terminal. An uninterrupted safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

## Before Applying Power

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual. Also, check the fuse to ensure that the correct fuse is installed for the power configuration being used.

If this product is to be energized via an auto-transformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the main power source.

## Servicing

Any servicing, adjustment, maintenance or repair of this product must be performed only by service-trained personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow) are to be used for replacement.

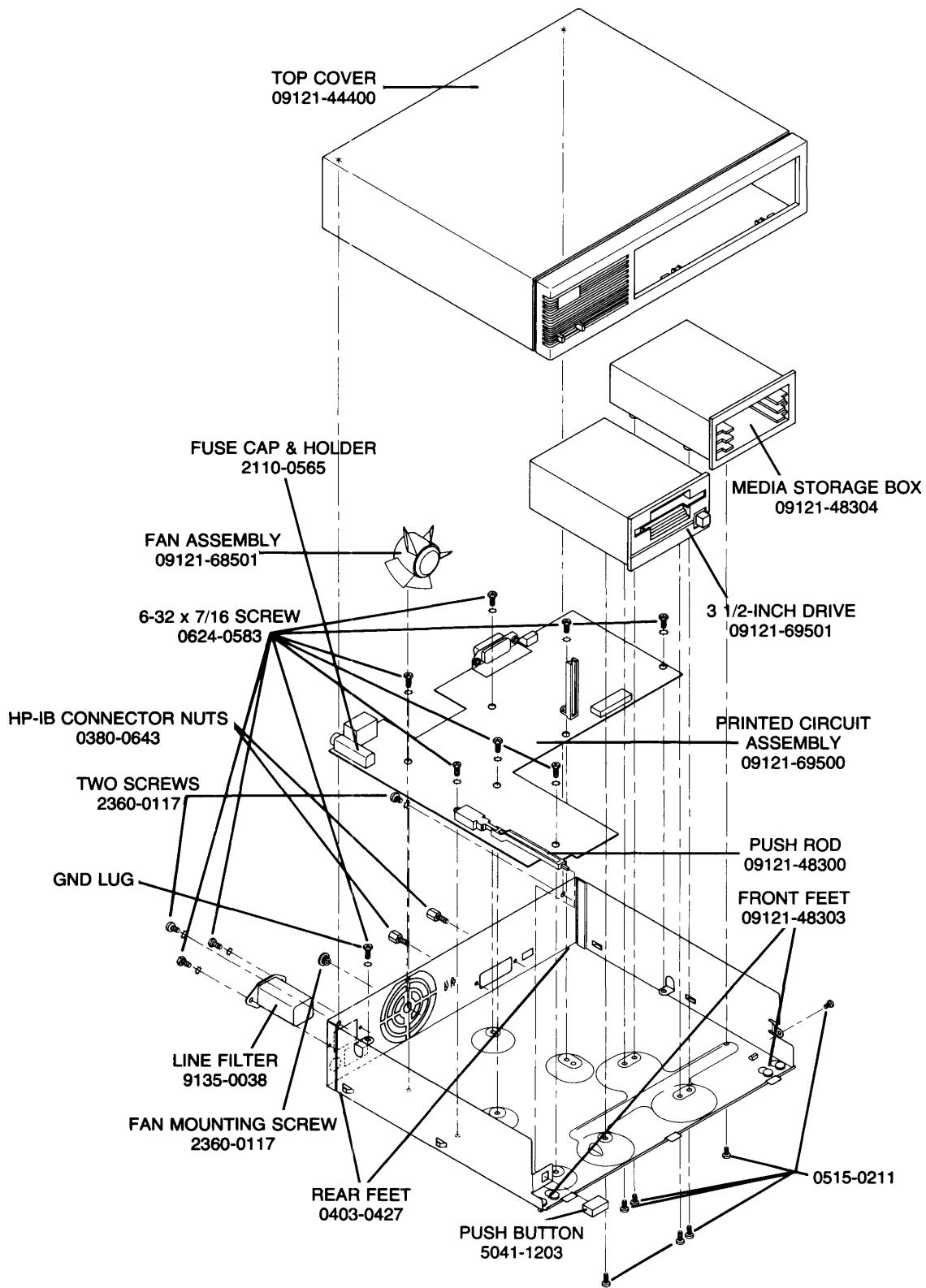


Figure 5-1. HP 9121D/S Disc Memory Exploded View

## Top Cover Removal

To access the internal assemblies, the top cover must first be removed. Performing the following steps allows you to remove the top cover.

- Power cord disconnected
- Remove the rear panel two screws
- Press power switch to the on position (this clears the switch from the front panel or remove the switch by pulling it straight out the front)
- Rotate the rear of the case up and toward the front as soon as it clears the chassis. See the following figure.
- Assembly is the reverse of the above process. See the following note.

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### NOTE

The three plastic guides must be in position under the drives and PC assembly before the top case is rotated downward.

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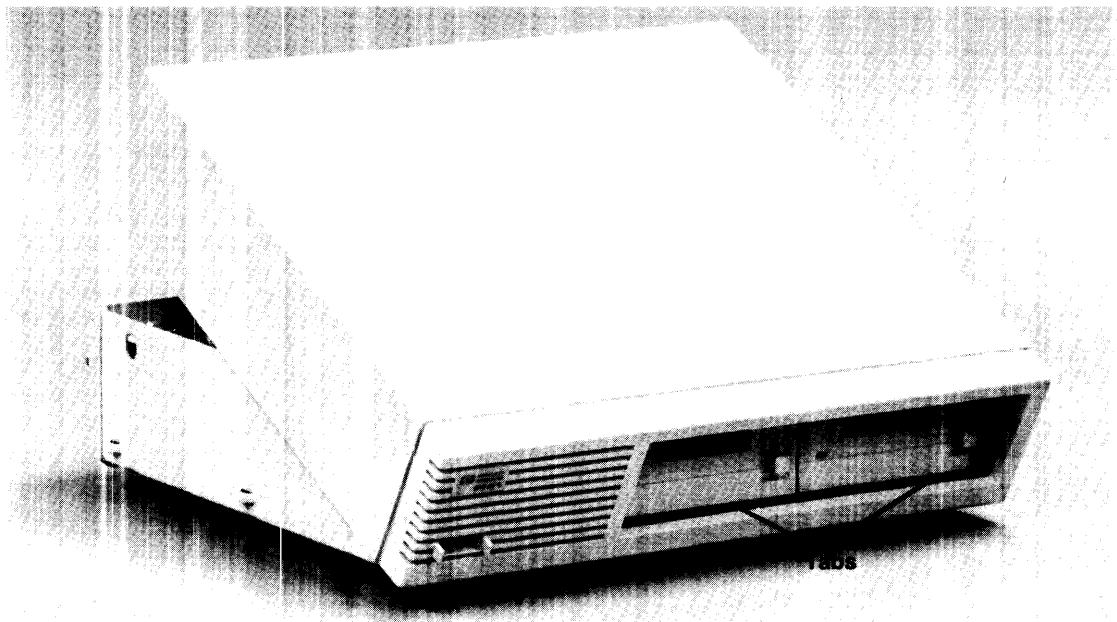


Figure 5-2. Top Cover Removal

## Drive Removal

Each drive is attached with three screws and there are two cables connecting each drive. Drive 0 is attached with three screws up through the bottom of the chassis. Drive 1 (the second drive on the 9121 D) is attached using two screws through the bottom of the chassis and one in from the middle of the side.

Removal of these three screws and the two cables removes the drives. Patch Lok or a securing device is to be used on these screws when the drives are installed.

**CAUTION**

CAUTION MUST BE USED WHEN REINSTALLING THE CONNECTORS TO THE DRIVES. IT IS POSSIBLE TO MISSALIGN THE PINS WHEN INSTALLING THE CONNECTORS.

## Fan Removal

The fan assembly is attached using one screw through the rear panel. Removing this screw and the wire cable and connector removes the fan assembly.

## Printed Circuit Assembly Removal

To remove the printed circuit assembly complete the following steps.

Remove the two power input leads from the line filter to the PC assembly. These wires are color coded and the codes are marked on the PC board; also, some units will have different width spade lugs. DO NOT GET THESE WIRES REVERSED when they are reattached.

Remove the seven screws attaching the PC assembly to the chassis.

Remove the two screws attaching the HP-IB connector to the rear panel.

Lift the PC assembly from the chassis.

## 9121D/S Parts Lists

This section contains the replaceable parts lists for the 9121D/S. The CD column is required when ordering a part from HP. Please include this check digit number with your order.

Level	Reference Designator	HP Part No.	CD	Description
1	A1	09121-69510	3	CTLR-PWR BD
.2	C3,4	0180-1794	3	C-F22UF35V
.2	C5-8,11-13,16, 17,23,25-28	0160-4832	4	C-F.01UF10 %
.2	C9,13,14, 20,22,39	0160-4832	4	C-F.01UF10 %
.2	C18,29-32,48,49	0160-5349	0	C-F200PF5 %
.2	C19	0180-1746	5	C-F15UF20V
.2	C33	0180-3260	2	C-F6800UF50V
.2	C34,38	0160-3622	8	C-F.1UF100V
.2	C35	0180-3007	5	C-F.015F25VAL
.2	C36,37	0180-0692	8	C-F220UF35VAL
.2	C40	0160-4805	1	C-F47PF5 %100V
.2	C41	0160-4830	2	C-F2200PF10 %
.2	C42	0160-4574	1	C-F1000PF10 %
.2	C43	0180-0291	3	C-F1UF35V10 %
.2	C44,46,47,101	0160-4835	7	C-F.1UF10 %50V
.2	C102,103	0160-5098	6	C-F.22UF10 %
.2	CR1,2	1901-0731	7	DIODE IN 4004

## 5-6 9121D/S

.2	CR3,4,13, 14,17	1901-0050	3	DIO SWITCHING
.2	CR5-12	1901-0673	6	DIO-PWR RECT
.2	CR15	1902-0029	8	DIO-ZNR 12V 5 %
.2	CR16	1901-0518	8	DIO-SM-SIG-S
.2	F1	2110-0001	8	FUSE 1A 250V
.2	F1	2110-0565	9	CAP-FUSE HOLDER
.2	F1	2110-0642	3	FUHLR-EXTR POST
.2	F2,3	2110-0587	5	FUSE 2A 250V
.2	F2,3	2110-0589	7	FUHLDR-CLIP TYPE
.2	J2,3	1251-7821	1	CONN-SGL CONT
.2	J4	1251-6429	3	CONN-POST-TY-HDR
.2	L1-4	9140-0183	7	IDCTR 20UH 10 %
.2	L5	9100-0539	3	IDCTR (MSIC)
.2	LED1	1990-0450	4	LED-LMP
.2	P2	09121-61601	5	RIBBON CBL ASSY
.2	R1,9	0683-1025	9	R-F1K5 %.25W
.2	R2,24	0683-1015	7	R-F100 OHM.05
.2	R3-6,10,14, 15,18,36	0683-1025	9	R-F1K5 %.25W
.2	R7,8,17,30,34	0757-0442	9	R-F10K.01 1/8W
.2	R11	0757-0430	5	RES 2.21K1 %
.2	R12	0698-3154	0	R-F4.22K1 %
.2	R13	0698-3152	8	R-F3.48K1 %
.2	R16,35	0698-3154	0	R-F4.22K1 %
.2	R19,21,32,33	0698-3445	2	R-F348 OHM 1 %
.2	R20,22	0757-0280	3	RES 1K1 %.125W
.2	R23,27	0698-3442	9	R-F237 OHM 1 %
.2	R25,28,29	0757-0417	8	R-F562 OHM 1 %
.2	R26	0698-3132	4	R-F261 OHM.01
.2	R31	2100-0554	5	R-V500 OHM 10 %
.2	RP1,2	1810-0204	6	NTWK-R 7X1K SIP
.2	SW1	3101-2264	1	SW-RKR 4-1A
.2	SW2	3101-2582	6	SW,LINE SELECT
.2	SW3	3101-0680	1	SW-PB-DPDT
.2	T1	09121-82500	7	TRANSFORMER
.2	T1	09121-82501	8	XFMR-SUPPORT
.2	U1,30	1820-1199	1	IC-74LS04
.2	U2	1820-2485	0	IC SN75160N
.2	U3	1820-2483	8	IC SN75161N
.2	U4	1820-2024	3	IC-SN74LS244
.2	U5	1818-1178	1	IC MK4118AN-3
.2	U6,39	1820-1112	8	IC-74LS74
.2	U7	1820-2549	7	IC-8291AP
.2	U8	1813-0194	9	XTAL-CLK-OSC
.2	U9	09121-15510	8	SONY CTRL E PROM
.2	U10,19	1820-1201	6	IC-SN74LS08N
.2	U11	1820-1730	6	IC SN74LS273N
.2	U12	1820-1216	3	IC-SN74LS138
.2	U13	1820-2624	9	IC-68B09
.2	U14	1826-1014	1	IC, REG. 12V 3A
.2	U15,16,23,26	1820-1197	9	IC-74LS00
.2	U17,32,33	1820-0471	0	IC-SN7406N
.2	U18	1820-1437	0	IC-SN74LS221
.2	U20	1820-1202	7	IC-74LS10N
.2	U21	1820-3006	3	IC-MB8876A CTLR
.2	U22	1820-1433	6	IC SN74LS164N

.2	U24,29	1820-1416	5	TTL TRGR 74LS14N
.2	U25,28	1820-2096	9	IC SN74LS393N
.2	U27	1826-0181	1	VRGTR LM323K
.2	U31	1820-1300	6	IC SN74LS195N
.2	U34	1826-0210	7	IC-LM361
.2	U35,36	1821-0001	4	XSTR-ARRAYCA3046
.2	U37,38	1858-0058	8	XSTR ARY 16P-DIP
1		0360-0001	5	TERM-SLDR 1.U9
1		0362-0616	2	CONN-SGL CONT
1		0380-0643	3	NUT #6-32/M3.5
1		0403-0427	1	BUMPER FOOT
1		0515-021	8	SCR-MACH M3X0.5
1		0624-0583	8	SCREW,6-32X7/16
1		0890-0029	0	TUBING-HT SHRIN
1		0890-0765	1	TBG-HT SHRK .18
1		09121-00100	1	BASE
1		09121-48300	3	PUSH ROD,PLASTIC
1		09121-48301	4	BUTTON, PUSH
1		09121-48302	5	PILLAR, SUPPORT
1		09121-48303	6	FOOT-MOLDED
1		0590-0305	9	NUT-HEX 6-32
1		09121-61602	6	PWR CBL ASSY
1		1205-0500	2	HEATSINK
1		1205-0503	5	XSTR MOUNT T03
1		1251-7651	5	CONN 24-PIN M
1		2200-0107	6	SCR-MACH 4-40
1		0360-0124	3	STUD-TERM
1		1200-0861	8	SKT-IC 28-CONT
1		8150-3284	5	WIRE 18 G/Y
1		0340-0122	9	INSUL-FLG-BSHG
1		1818-3188	7	2364 ROM
1		2200-0205	5	SCREW-MACHINE
1		7120-4296	7	LABEL-WARNING
1		7120-6830	9	LABEL INFO
1		09121-69511	8	FLPY DR. 3 1/2IN
1		1251-5987	6	CONN-POST-TP-SKT
1		2190-0409	8	WSHR-LK INTL
1		2360-011	6	SCR-MACH 6-32
1		3050-001	2	WSHR-FL MTLC
1		09121-68501	1	AXIAL FAN
1		7120-3428	5	LABEL-IDENT(CSA)
1		7120-3694	7	LABEL "UL"
1		7120-8795	9	LABEL ENGLISH
1		7124-2083	4	LABEL-WARNING
1		8150-041	7	WIRE 18 W/GY
1		8150-1273	8	WIRE 18 W/BK/GY
1		8150-3284	5	WIRE 18 G/Y
<b>9121S Only</b>				
1		09121-48304	7	Media Storage BX
1		09121-88865		Top Cover Assy
.2		09121-44400	6	Cover Plastic
.2		09121-00610	8	EMI Shield
.2		0590-0681	4	NUT-SHMET-U-TP



## **Section III**

# **HP 9133 Disc Memory**

This section contains information on the 3 1/2-inch Flexible Disc Drive installation in the HP 9133 Disc Memory. For information about the Winchester Drive, see the 9135-90030 service manual.

This section contains the following chapters.

- Chapter 1 General Information
- Chapter 2 Installation
- Chapter 3 Interface Information
- Chapter 4 Troubleshooting
- Chapter 5 Assembly Access

Chapters 1 through 3 contain general information on the 9133 Disc Memory. Chapters 4 and 5 zero in on the 3 1/2-inch installation as pertaining to the 9133. Winchester Drive information is not found in these chapters of this manual.

# Chapter 1

## General Description

### Introduction

This chapter contains general information about the HP 9133 disc Memory. Included in this section is the following:

- Product Description
- Specifications
- Equipment Supplied
- Unpacking Your HP 9133 Disc Memory
- Cleaning the Case

### Product Description

The HP 9133A disc memory (Figure 1-1) is a random access data storage device which contains a 5 Mbyte 5 1/4-inch Winchester disc drive and a 3 1/2-inch flexible disc drive.

The Winchester drive has been designed to emulate an HP 9895A 8 inch flexible disc drive master with three slave drives (1.15 Mbytes per drive). The 3 1/2-inch flexible disc emulates the HP 82902M 5 1/4-inch flexible disc drive with 286 Kbytes of data storage capacity. Thus, HP computers that support the 9895A and 82902M flexible disc drives can operate the 9133A.

The HP 9133A Option 010 consists of a modification to the Winchester controller PCA which causes the Winchester drive to appear as one large 4.82 Mbyte volume. The Winchester with option 010 responds to most of the commands used on the 9895A flexible disc drive.

Refer to your computer's Mass Storage Manual for programming information for the HP 82902M and 9895A flexible disc drives.

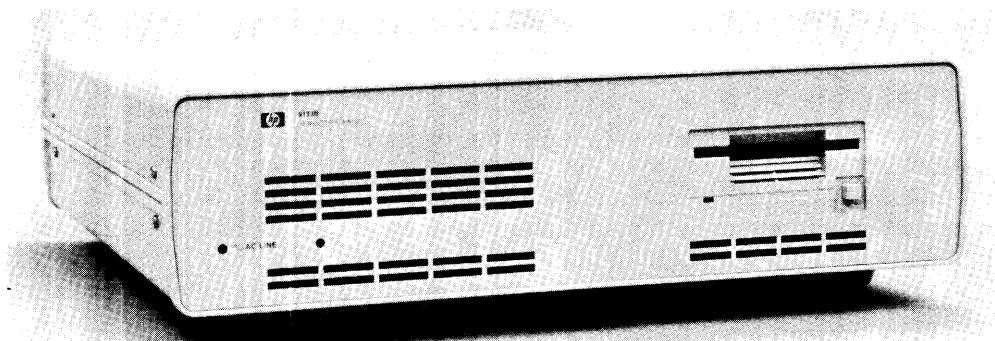


Figure 1-1. HP 9133A Disc Memory

## Technical Specifications

Listed below are the physical, electrical, and environmental specifications for the HP 9133A disc memory.

### **Physical**

Number of Drives:	1 - Winchester, 1 - 3 1/2-inch flexible disc
Net Weight:	15.5 kg (34.7 lbs)
Height	130 mm (5.125 in.)
Depth	476 mm (18.7 in.)
Width	425 mm (17 in.)

### **Electrical**

Power Source Requirements:	140 Watts
Line Frequency:	48 Hz to 66 Hz

### **Environmental**

Operating Temperature:	10° to 40° C (50° to 104° F)
Operating Humidity:	20 to 80%
Max. Wet Bulb Temperature:	25.5 C
Storage Humidity:	5 to 95% (non-condensing)
Operating Altitude:	0 to 4600 m (0 to 15,000 ft)
Storage Temperature:	-40° to 60° C (-40° to 140° F)
Storage Altitude:	-300 to 15,200 m (-1000 to 50,000ft)

### **Winchester Drive**

Formatted Storage Capacity:	4.6 Mbytes (4.82 Mbytes - Option 010)
Average Access Time:	90 ms
Maximum Access Time:	210 ms
Data Transfer Rates	
Sustained Average:	46 Kbytes/second
System:	System Dependent
Rotational Speed:	3600 RPM ± 1%

### **3 1/2-inch Flexible Disc Drive**

#### HP Double Density Format

Encoding:	MFM
Rotational Speed:	600 RPM
Bit Density @600 RPM:	Track 69 (Inside track) 7610 BPI
Track Density:	135 tracks per inch
Tracks per Surface:	70
Surfaces used per disc:	1
Capacity	
Bytes/Sector:	256
Sectors/Track:	16
Tracks:	70
Bytes/Drive (Formatted):	286 Kbytes
Access Time	
Track-to-Track Seek:	15 ms/track, plus 15 ms settling
Maximum Track-to-Track Seek (70 tracks):	1065 ms
Average Track-to-Track:	365 ms
Maximum Rotational Latency:	100 ms
Average Rotational Latency:	50 ms
Spindle Motor on time:	1 second

**Maximum Data Access Time**  
 (Seek plus Latency  
 plus Motor on time): 2.165 second  
**Average Data Access Time:** 415 ms  
**Data Transfer Rates:** (3 1/2-inch flexible disc only)

Interleave	<b>Avg. Transfer Rate</b> <b>(Kbytes/second)</b>
1	2.6
2	17.1
3	12.1
4	9.3
5	7.6
6	6.4
7	5.5
8	4.8
9	4.3
10	3.9
11	3.5
12	3.2
13	3.0
14	2.8
15	2.6

Average data rate for a multiple-track read or write.

Interleave for the Winchester is preset at the factory and cannot be changed.

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#### NOTE

The flexible disc drive in the HP 9133A disc memory is designed for operation in a typical office environment. Use of the equipment in an environment containing corrosive substances will cause the flexible disc drive and media life to be drastically reduced.

---

## Equipment Supplied

Please check to insure that you have received all of the standard equipment. If any items are incorrect or missing, please contact the dealer from whom you purchased the unit.

Description	Quantity	HP Part Number
Power Cable	1	Dependent on location (see Chapter 2)
Operator's Manual	1	09134-90000
Fuse	1	100 to 120VAC 2.5 Amp 2110-0083
	1	220 to 240VAC 1.5 Amp 2110-0043

A package of ten 3 1/2-inch flexible discs can be ordered using the 92191A product number.

A field upgrade kit adding the auto shutter is available under P/N 09121-88875. This kit contains the auto shutter mechanism and instructions for installation and alignment.

## Unpacking Your HP 9133A Disc Memory

Your disc memory was carefully inspected before shipment. Remove the unit from the shipping carton and carefully inspect the unit for any physical damage that may have occurred during shipment. If you find any damage, you should immediately notify your dealer and file a claim with any carriers involved.

---

### CAUTION

THE DISC MEMORY IS A PRECISION INSTRUMENT. MECHANICAL SHOCK CAN MISALIGN THE READ/WRITE HEADS, RESULTING IN READ ERRORS AND/OR DAMAGED DISCS WHETHER THE DISC IS OPERATING OR NOT.

---

If the disc memory is moved, be careful when picking it up and setting it down.

Carefully repack the disc memory in the original shipping carton before transporting it to another site.

---

### CAUTION

EVIDENCE OF EXCESSIVE SHOCK WILL VOID THE WARRANTY.

---

## Cleaning the Case

The disc memory case has been painted with a durable, non-toxic paint. It will preserve the appearance of your disc memory for many years. When you want to clean the case, following the instructions below will sustain the quality finish. If the case finish should become damaged, consult your local Hewlett Packard sales and service office for touch up paints that are available.

---

### CAUTION

CHEMICAL SPRAY-ON CLEANERS USED FOR APPLIANCES AND OTHER HOUSEHOLD AND INDUSTRIAL APPLICATIONS MAY DAMAGE THE CASE FINISH. THESE OR OTHER CHEMICAL CLEANERS SHOULD NOT BE USED. DO NOT USE DETERGENTS THAT CONTAIN AMMONIA, BENZENES, CHLORIDES, OR ABRASIVES.

---

Before cleaning the disc memory case, disconnect the power cord and any interconnecting cables. Dampen a clean, soft, lint-free cloth in a solution of clean water and mild soap. Wipe the soiled areas of the case, ensuring that no cleaning solution gets inside the unit. For cleaning more heavily soiled areas, a solution of 80% clean water and 20% isopropyl alcohol may be used. Wipe the case areas that had cleaning solution applied with a clean, soft, lint free cloth dampened in clean water, then dry the case with a dry, soft, clean cloth. A non-abrasive eraser may be used to remove pen and pencil marks.

# Chapter 2

## Installation

### Introduction

This section provides the installation and initial power-on procedures for the HP 9133. The topics covered in this section are as follows:

Setting the Line Voltage Select Switches  
Fuses  
Power Cords  
Interfacing the HP 9133A to Your System  
Selecting the Device Address  
The HP-IB Interface  
Controls and Indicators

Applying Power  
Loading the Flexible Disc  
Manual Shutter  
Auto Shutter  
Basic System Operation  
Write Protect Error On Initialization  
Data Errors

### Setting the Line Voltage Select Switches

The voltage select switches on the rear panel must be set to the nominal line voltage for the area in which it is operating. Figure 2-1 shows the setting of the voltage select switches for the various line voltages.

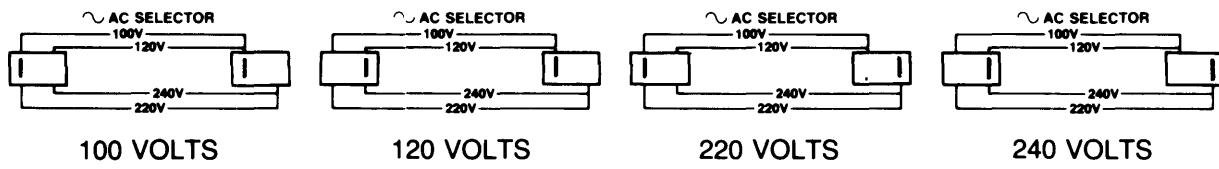


Figure 2-1. Line Voltage Select Switches

### Fuses

A different fuse is required for each of the two voltage ranges of 110-120 and 220-240 VAC. Table 2-1 gives the correct fuse ratings and fuse part numbers.

Table 2-1. Fuses

Voltage Range	Fuse Rating	HP Part Number
96 & 125VAC	2.5A 250 VAC-Normal Blow	2110-0083
196 & 250VAC	1.5A 250 VAC-Normal Blow	2110-0043

---

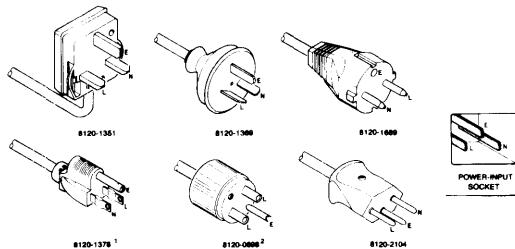
**WARNING**  
ALWAYS DISCONNECT THE DISC MEMORY FROM ANY AC LINE  
BEFORE CHANGING FUSES.

---

## Power Cords

Power cords supplied by HP have polarities matched to the power-input socket on the equipment (Figure 2-2).

- L = Line or active conductor (also called "live" or "hot")
- N = Neutral or identified conductor
- E = Earth or safety ground



<sup>1</sup>UL and CSA approved for use in the United States of America and Canada with equipment set for either 100 or 120 Vac operation.

<sup>2</sup>UL and CSA approved for use in the United States of America and Canada with equipment set for either 200 or 240 Vac operation.

Figure 2-2. Available Power Cords

---

**WARNING**  
IF IT IS NECESSARY TO REPLACE THE POWER CORD, THE REPLACEMENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL AS WELL AS THE EARTH OR SAFETY GROUND CONDUCTOR. OTHERWISE, A SAFETY HAZARD MIGHT EXIST IF AN INTERNAL FAILURE OCCURS.

---

The cord packaged with the equipment depends upon where the equipment is to be delivered.

## Interfacing the HP 9133A to Your System

The HP 9133A is connected to the computer via the Hewlett Packard Interface Bus (HP-IB). The device address switches are set prior to connecting the interface cable.

### Selecting the Device Address

Each device in an HP-IB system must be set to a unique device address. The HP 9133A contains two separate devices contained in the package. A device address switch is provided for each device. See Figure 2-3 for switch locations.

Prior to setting the device address switches, turn the disc memory AC line switches OFF.

The switches can be set to any one of eight device addresses, ranging from decimal 0 through 7. Refer to Figure 2-3 to set these switches to the desired device address.

Switch Segments						
Address	X	4	2	1		
0	***	UP	UP	UP	(Factory setting for Winchester)	
1	***	UP	UP	DOWN		
2	***	UP	DOWN	UP	(Factory setting for flexible disc)	
3	***	UP	DOWN	DOWN		
4	***	DOWN	UP	UP		
5	***	DOWN	UP	DOWN		
6	***	DOWN	DOWN	UP		
7	***	DOWN	DOWN	DOWN		

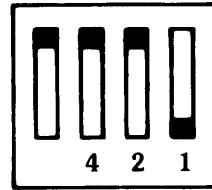


Figure 2-3 . Device Address Switch Setting

## The HP-IB Interface

Refer to Figure 2-4 for a list of the HP-IB interface cables used with HP computers.

Length	Accessory Number
1 metre	10833A
2 metres	10833B
4 metres	10833C
.5 metre	10833D

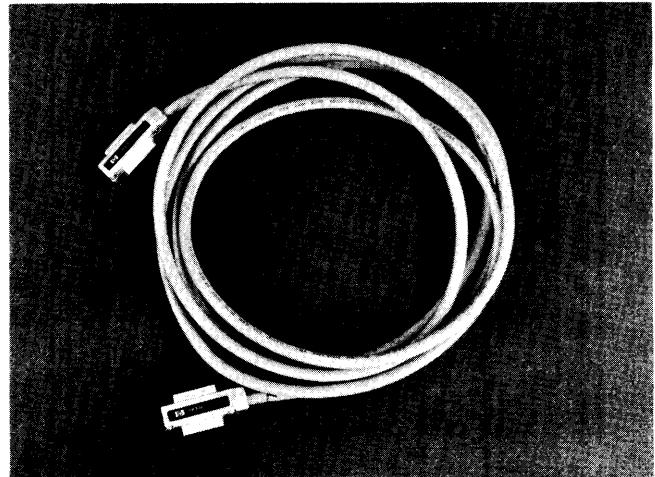


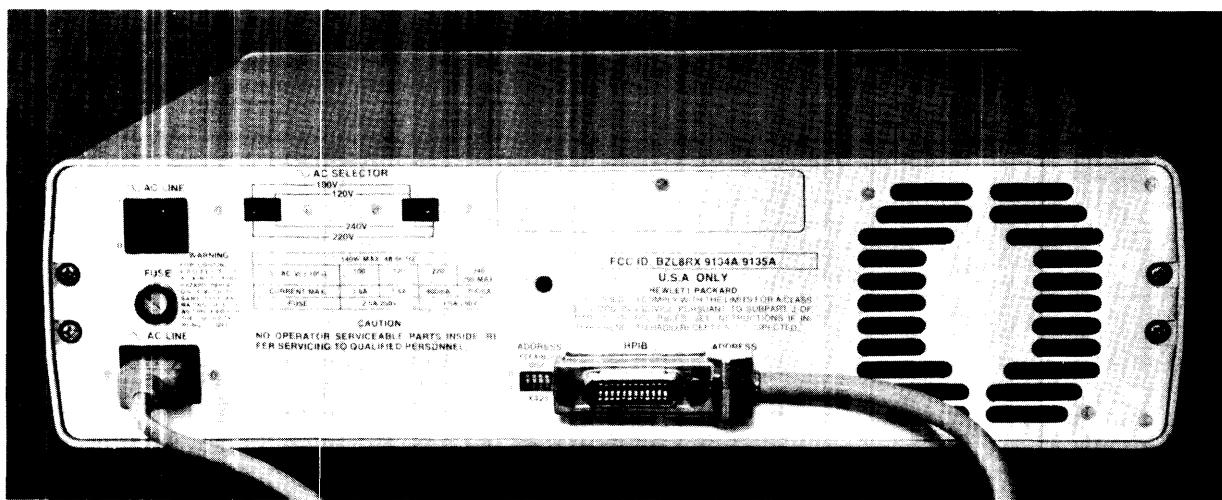
Figure 2-4. HP-IB Interface Cables

### HP-IB Interface Restrictions:

1. All the AC line switches must be turned "OFF" when connecting (and disconnecting) devices to your system.
2. The total length of cable permitted in one bus system must be less than or equal to two metres times the number of devices connected together (the interface card is counted as one device).

3. The total length of the cable must not exceed 20 metres. For example, a system containing six devices can be connected together with cables that have a total length less than or equal to 12 metres (six devices x 2m/device = 12 metres). The individual lengths of cable can be distributed in any manner desired as long as the total length does not exceed the allowed maximum. If more than 10 devices are to be connected together, cables shorter than two metres must be used between some of the devices to keep the total cable length less than 20 metres.
4. The maximum number of devices that can be connected together in one bus system is 15.

There are no restrictions to the way cables may be connected together; however, it is recommended that no more than four piggyback connectors be stacked together on one device. The resulting structure could exert enough force on the connector mounting to damage it.



**Figure 2-5. Interface Connection**

## Controls and Indicators

The indicators are located on the front panel. The indicators, as shown in Figure 2-6, are: a disc access light for the Winchester drive, and the head load indicator for the 3 1/2-inch flexible disc drive. The Winchester drive LED is illuminated whenever the disc is accessed for data storage or retrieval and momentarily when the drive is powered-up. The flexible disc drive LED lights up whenever the unit is powered up, the head is loaded, or when the drive is selected.

---

### CAUTION

THE ACTIVITY LIGHT ON THE FRONT OF THE DRIVE INDICATES USAGE OF THAT DRIVE. DO NOT DEPRESS THE DISC EJECT BUTTON WHEN THE ACTIVITY LIGHT IS ON.

---

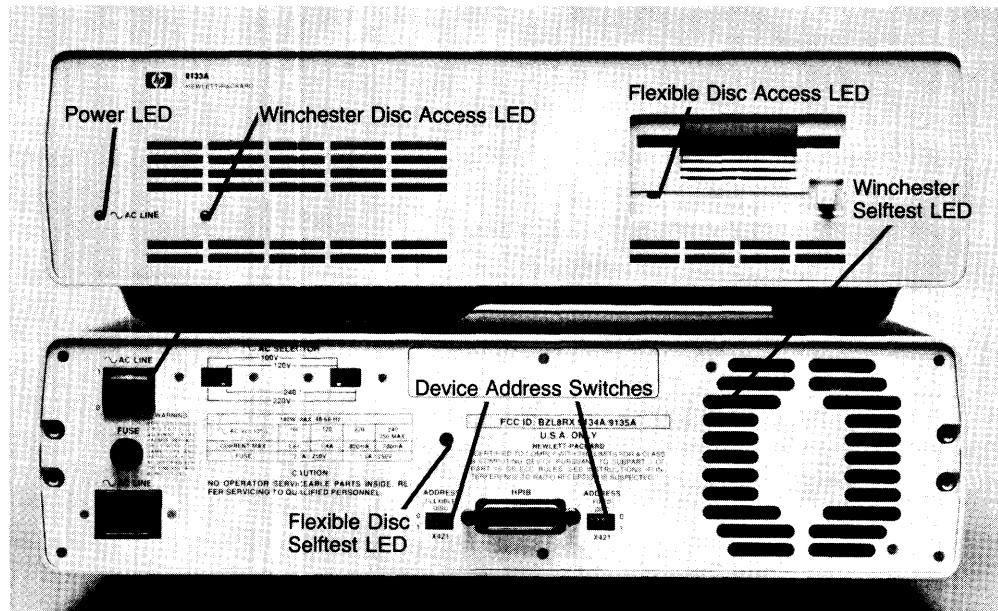


Figure 2-6. Front and Rear Panels

## Applying Power

Before turning the disc memory on, be sure to perform all the procedures in Chapter 2.

Locate the AC line switch on the rear panel and set it to the "ON" or "1" position. The disc drive requires about 20 seconds after the application of power before it is ready for operation or before you insert your disc. See the section titled "Selftest and Adjustments" for the power-on selftest indication.

## Loading and Unloading the Flexible Disc

To install and remove flexible discs:

1. Do not attempt to insert the disc into the drive without power applied.

### Manual Shutter

2. Slide the disc guard away from the head window exposing the disc surface. Insert the exposed head window first with the metal centering hub down. Carefully slide the disc into the drive until you feel it contact the rear of the drive. Do not force the disc.

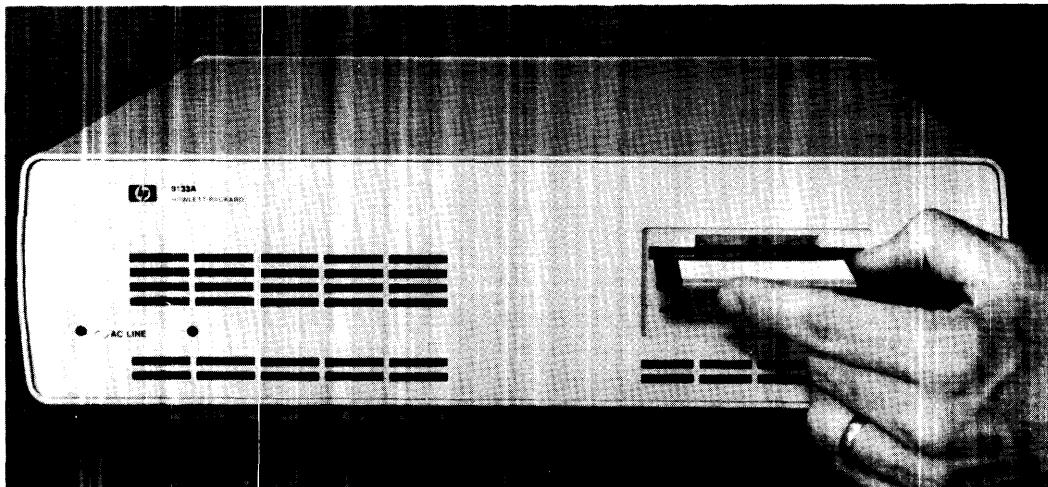
### Auto Shutter

Slide the disc into the drive until you feel it contact the rear of the drive. Do not force the disc.

Remember, either type of disc (manual or auto shutter) will work in either type of drive. If you do not have the auto shutter mechanism in the drive and the disc, you must follow the procedure described with using the manual shutter.

3. Remove the disc by depressing the disc eject button and pulling the disc straight out. Always slide the disc guard over the head window immediately after removing the disc from the drive.

Refer to Figure 2-7 for proper loading of the flexible disc.



**Figure 2-7. Disc Loading**

## **Basic System Operation**

Before using a blank flexible disc, it must be formatted or initialized for use with your computer. This process checks the disc for defects (areas where information cannot be stored), reserves spare tracks, and creates a file directory. The directory holds the name and location of each file on the disc. When a disc is first initialized, the directory is empty, so no files are listed when you catalog the disc.

The flexible disc drive in the 9133 emulates the 82901 drive. Thus, you program it using mass storage ROM or driver statements that your computer manuals describe for the 82901 disc drive.

### **Write Protect Error on Initialization**

A motor speed check is performed when a disc is inserted to be initialized. If the motor speed is on either side of the tolerance allowed, a Write Protect Error is generated and the disc is not initialized. If your drive is operating properly, this indication is one of a defective disc. Discard the disc.

The motor speed should be checked and/or adjusted before discarding the disc. See the section titled "Selftest and Adjustments".

### **Data Errors**

Two error conditions cause the selftest LED to come on and stay on until the condition disappears. These conditions are a command sequence-error over the HP-IB (from the host controller) and a data error from the disc. Whenever these conditions occur it is best to retry the last

operation. If a retry is successful, the error and error indication are cleared. If the condition remains after several retries, perform the service selftest and or the remote selftest to determine the cause of the error condition.



# Chapter 3

## Interface Information

### Introduction

This chapter presents an overview of the HP-Interface Bus. The command set for controlling the flexible disc is presented in the Appendix.

#### Overview of the HP-Interface Bus

The following is the definition of the terms and concepts used to describe HP-IB system operations.

HP-IB System Terms:

1. Byte - A unit of information consisting of eight binary digits (bits).
2. Device - Any unit that is compatible with the IEEE Standard 488-1978.
3. Device Dependent - A response to information sent on the HP- IB that is characteristic of an individual device's design and may vary from device to device.
4. Operator - The person who operates either the system or any device in the system.
5. Addressing - The characters sent by a controlling device to specify which device will send information on the bus and which device(s) will receive that information.
6. Polling - The process typically used by a controller to locate a device that needs to interact with the controller. there are two types of polling:
  - Serial Poll - This method obtains one byte of operational information about an individual device in the system. The process must be repeated for each device from which information is desired.
  - Parallel Poll - This method obtains information about a group of devices simultaneously.

Interface Bus Concepts:

Devices which communicate along the interface bus can be classified into three basic categories:

1. Talkers - Devices which send information on the bus when they have been addressed.
2. Listeners - Devices which receive information sent on the bus when they have been addressed.
3. Controllers - Devices that can specify the talkers and listeners for an information transfer. Controllers can be categorized as one of two types:

**Active Controller** - The current controlling device on the bus.

**System Controller** - The controller that can take priority control of the bus even if it is not the current active controller. Although each bus system can have only one system controller, the system can have any number of devices capable of being the active controller.

**Message Concepts:**

Devices which communicate along the interface bus are transferring quantities of information. The transfer of information can be from one device to another device, or from one device to more than one device. These quantities of information can be thought of as "messages". Typically, each message consists of two basic parts; the address portion specified by the controller and the information that comprises the message.

In turn, the messages can be classified into 12 types. The 12 types messages are defined as follows:

1. **The Data Message:**  
This is the actual information which is sent from one talker to one or more listeners along the interface bus. Data can be in either numeric form or a string of characters.
2. **The Trigger Message:**  
This message causes the listening device(s) to perform a device-dependent action.
3. **The clear Message:**  
This message causes either the listening device(s) or all of the devices on the bus to return to their predefined device-dependent states.
4. **The Remote Message**  
This message causes the listening device(s) to switch from local front-panel control to remote program control.
5. **The Local Message:**  
This message clears the Remote Message from the listening device(s) and returns the device(s) to local front-panel control.
6. **The Local Lockout Message:**  
This message prevents the operator from manually inhibiting remote program control.
7. **The Clear Lockout and Set Local Message:**  
This message causes all devices on the bus to be removed from local lockout and revert to local. This message also clears the Remote Message for all devices on the bus.
8. **The Request Service Message:**  
A device can send this message to signify that the device needs some type of interaction with the controller. This message is cleared by the device's Status Byte Message if the device no longer requires service.
9. **The Status Byte Message:**  
A byte that represents the status of a single device on the bus. One bit indicates whether the device sent a Request Service Message and the remaining bits indicate operational conditions defined by the device. This byte is sent from a talking device in response to a serial poll operation performed by a controller.
10. **The Status Bit Message:**  
A byte that represents the operational conditions of a group of devices on the bus. Each

device responds on a particular bit of the byte thus identifying a device-dependent condition. This bit is typically sent by devices in response to a parallel poll operation.

11. The Pass Control:

This transfers the bus management responsibilities from the active controller to another controller.

12. The Abort Message:

The system controller sends this message to unconditionally assume control of the bus from the active controller. This message terminates all bus communications but does not implement a Clear Message.

These messages represent the full implementation of all HP-IB system capabilities. Each device in a system, however, may be designed to use only the messages that are applicable to its purpose in the system. It is important for you to be aware of the HP-IB functions implemented on each device connected to your HP-IB system to ensure the operational capability of the system.



# **Chapter 4**

## **Troubleshooting**

### **Introduction**

This chapter provides the physical location of key components, power supply circuit diagrams, power supply troubleshooting, and a list of replaceable parts.

The following topics are discussed in this chapter:

- Repair Philosophy
- Exchange Assemblies
- Support Packages Contents Lists
- Product Support Package (PSP)
- Field Support Inventory Package (FSI)
- Recommended Field Support Inventory
- Controller Assembly
- Power Supply

### **Repair Philosophy**

The 3 1/2-inch Disc Drive assemblies are serviced on the exchange program. The assembly includes the drive and drive electronics board (the PC board attached to the lower side of the drive).

The selftest and alignment procedures are given to enable you to isolate problems and correct misalignment in the field.

Power supply information is presented in each tabbed section. Controller assembly detailed information is not presented.

### **Exchange Assemblies**

The following assemblies are exchange assemblies for the 3 1/2-inch drive portion of the 9133 Disc Memory:

3 1/2-inch Flexible Disc Drive -- 09121-69511  
Controller Assembly -- 09133-66500

## **Support Packages Contents Lists**

The following packages lists are the contents for the PSP and the FSI.

### **Product Support Package (PSP) -- 09121-67100**

09121-88810 -- Pad Weight  
8710-1518 -- Radial Alignment Tool  
09121-89400 -- Disc, Alignment  
09121-89401 -- Disc, Level  
09121-89405 -- Disc, Cleaning  
8750-0051 -- Gauge, Tension  
5061-2808 -- HP-85 Test Package  
09121-90030 -- Manual, Service

### **Field Inventory Parts Package (FSI) -- 09121-67197**

09121-69510 -- Controller/Power Supply Assembly (9121)  
09133-66500 -- Controller Assembly (9133)  
09121-69511 -- 3 1/2-inch Flexible Disc Drive  
09121-68501 -- Fan Assembly (9121D/S)  
09121-88811 -- Pad, Head Load (9121D/S)  
2110-0587 -- Fuse, 2A

## **Recommended Field Service Inventory**

The following list of parts and assemblies is recommended for building your Field Service Inventory (FSI).

09121-69511 -- 3 1/2-inch Flexible Disc Drive  
09121-69510 -- Controller/Power Supply Assembly (9121)  
09133-66500 -- Controller Assembly (9133)  
09121-68501 -- Fan Assembly (9121D/S)

## **Controller Assembly**

The controller electronics and -10V power supply sections of the printed circuit assembly are presented in Figure 4-1. Along with the key components the selftest control points are also labeled.

### **Power Supply**

The 3 1/2-inch drive requires the following three voltages: + 12, + 5, and -10V. The + 12 and + 5 are obtained from the Winchester supply. See the Winchester Service Manual (09134-90032) for information on these supplies. The -10V is generated on the Controller assembly. The schematic and component locator for the -10V power supply in Figures 4-2 and 4-3.

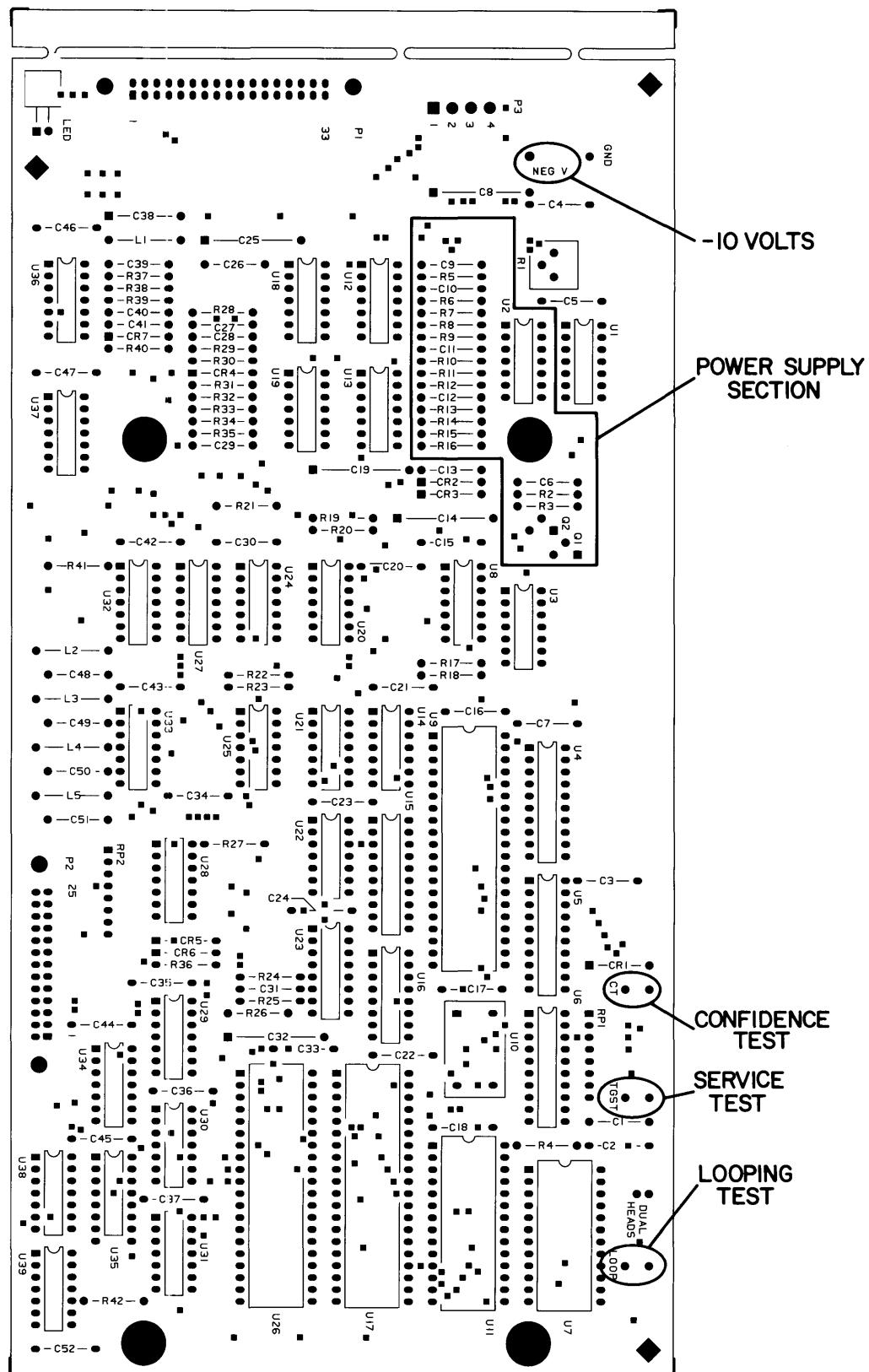
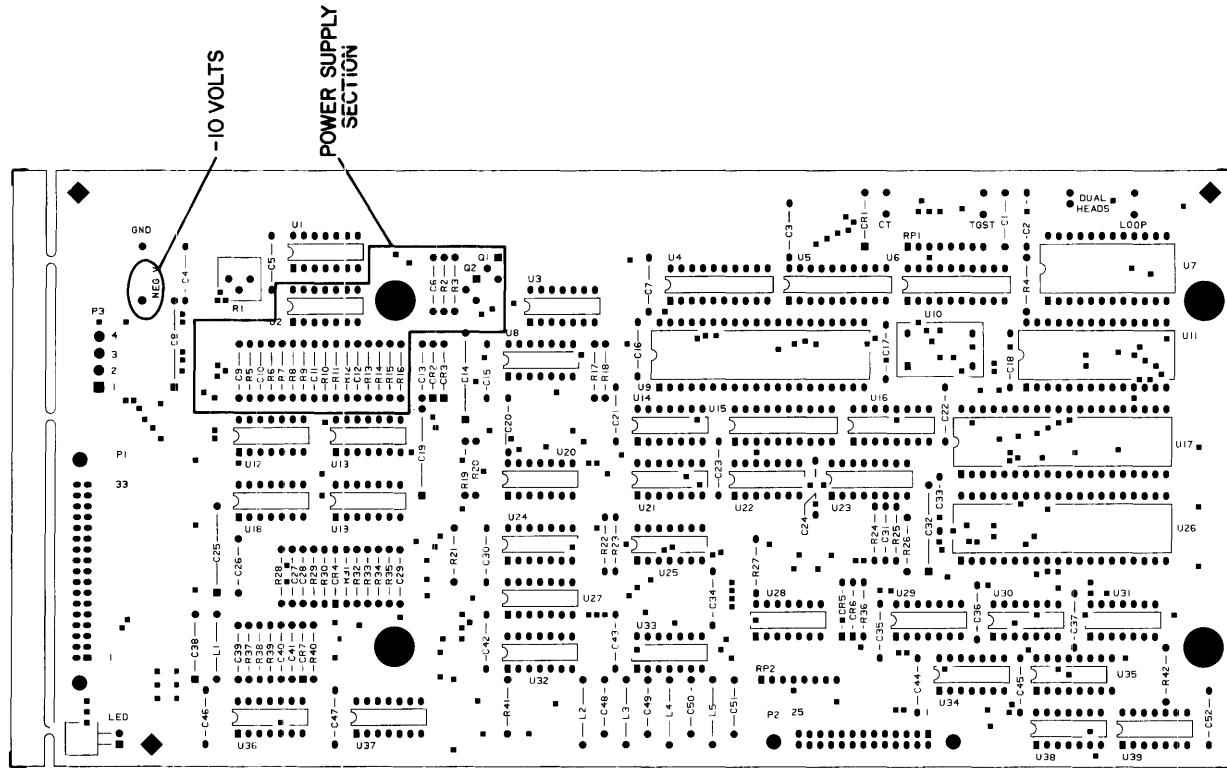
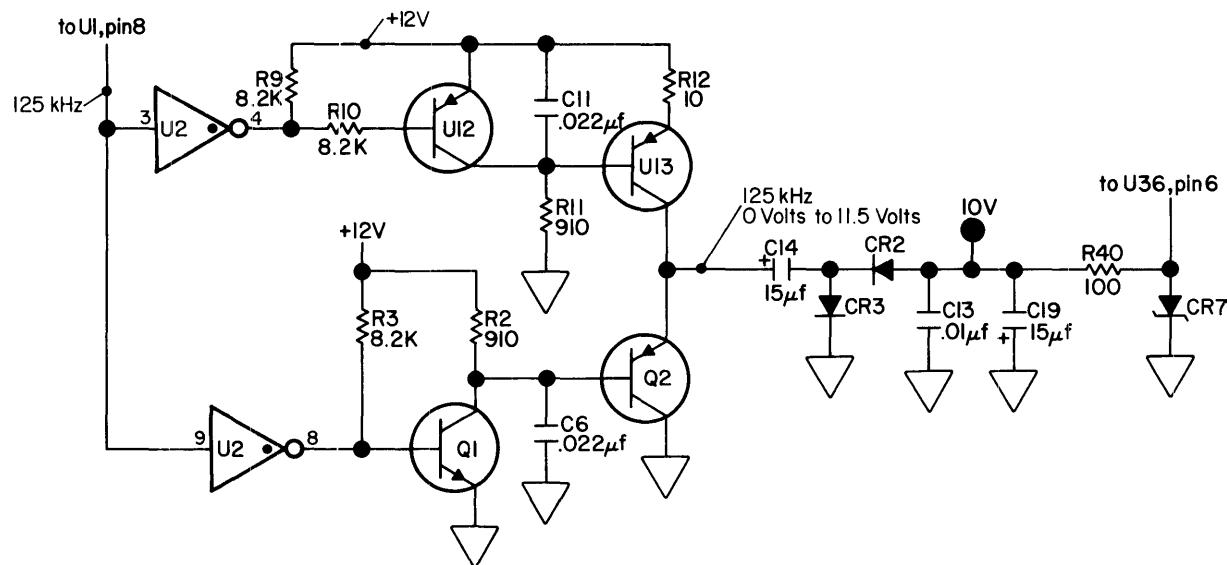


Figure 4-1. Controller and Power Supply Assembly

## 4-4 HP 9133 Disc Memory



**Figure 4-2. Power Supply Component Locator**



**Figure 4-3. Power Supply Schematic Diagram**

# Chapter 5

## Assembly Access

### Introduction

This chapter provides information for disassembly of the 9133 disc memories. An exploded view is also provided with the instructions. The exploded view references part numbers that are listed in the replaceable parts section.

The following topics are discussed in this chapter:

- Safety Considerations
- Top Cover Removal
- Controller Assembly Removal
- Sheet Metal Housing Removal
- Drive Removal
- 9133 Parts Lists

The following tools are required for disassembly and reassembly of the disc memories.

- #2 Posidrive Screwdriver
- #1 Posidrive Screwdriver
- 9/32 Nut Driver
- Needlenose Pliers

### Safety Considerations

#### General

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

#### Safety Symbols



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.



Indicates hazardous voltages.



Indicates earth (ground) terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

**WARNING**

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

**CAUTION**

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly performed, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

## Safety Earth Ground

This is a safety class I product and is provided with a protective earthing terminal. An uninterrupted safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

## Before Applying Power

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual. Also, check to ensure that the correct fuse is installed.

If this product is to be energized via an auto-transformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the main power source.

## Servicing

Any servicing, adjustment, maintenance or repair of this product must be performed only by service-trained personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow) are to be used for replacement.

## Top Cover Removal

To access the internal assemblies, the top cover must first be removed. Performing the following steps allows you to remove the top cover.

- Power cord disconnected
- Remove the four cover mounting screws shown in Figure 5-1

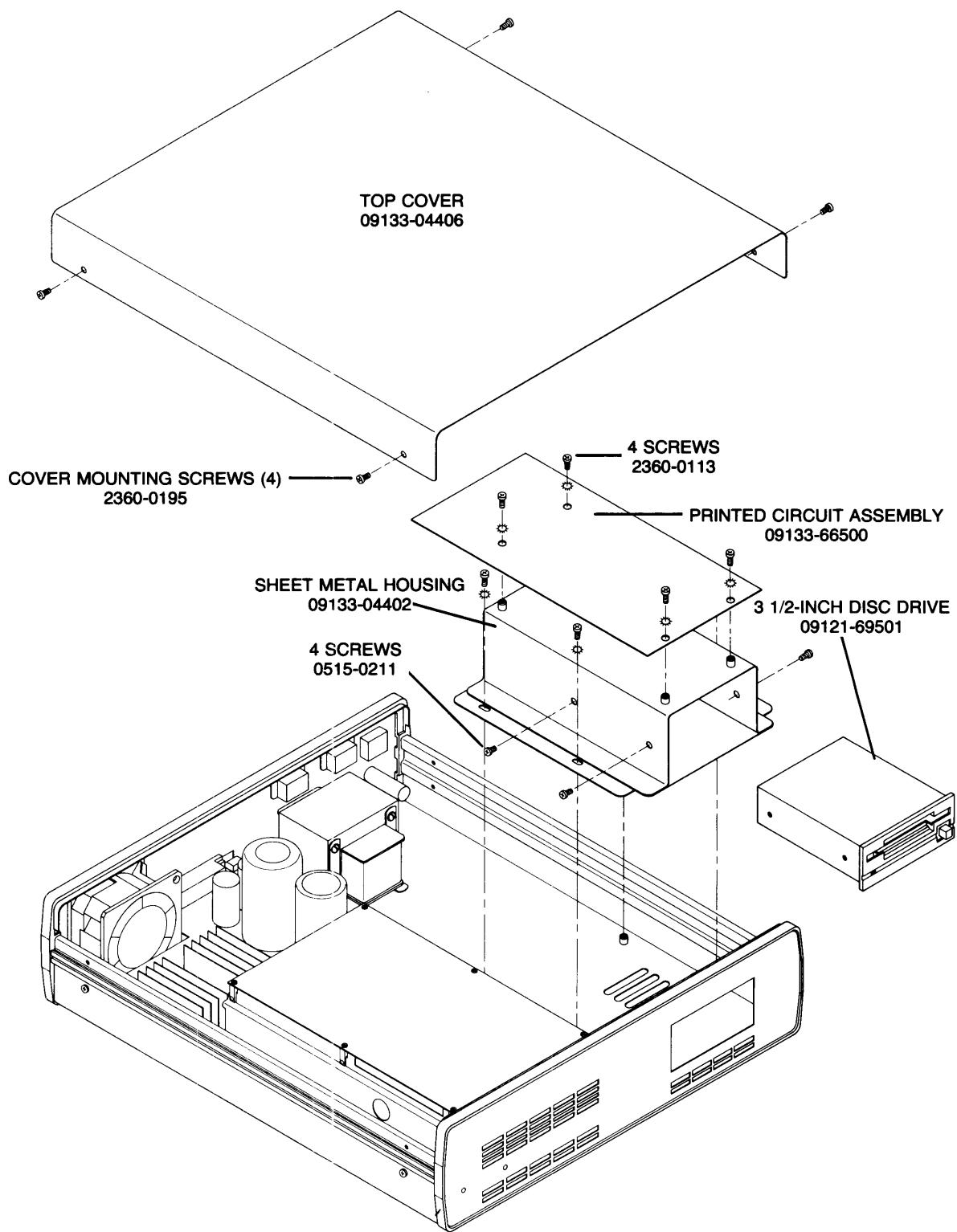
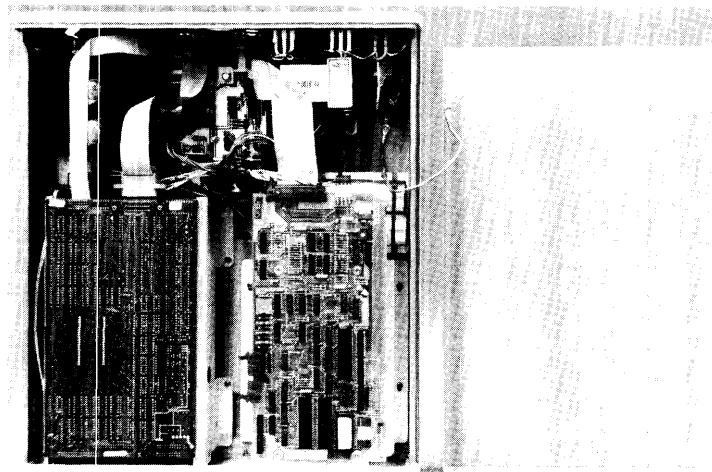


Figure 5-1. HP 9133 Disc Memory Exploded View

## 5-4 HP 9133 Disc Memory

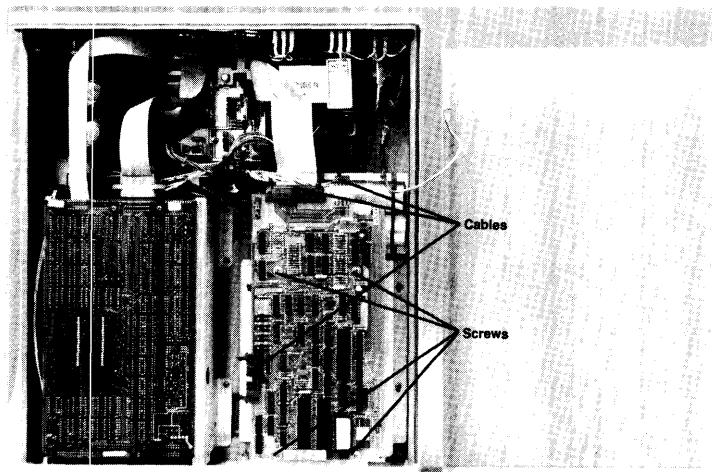
- Lift the top cover from the unit and lay it inverted to the side
- Remove the hex nut securing the ground strap



**Figure 5-2. Top Cover Removal**

## Controller Assembly Removal

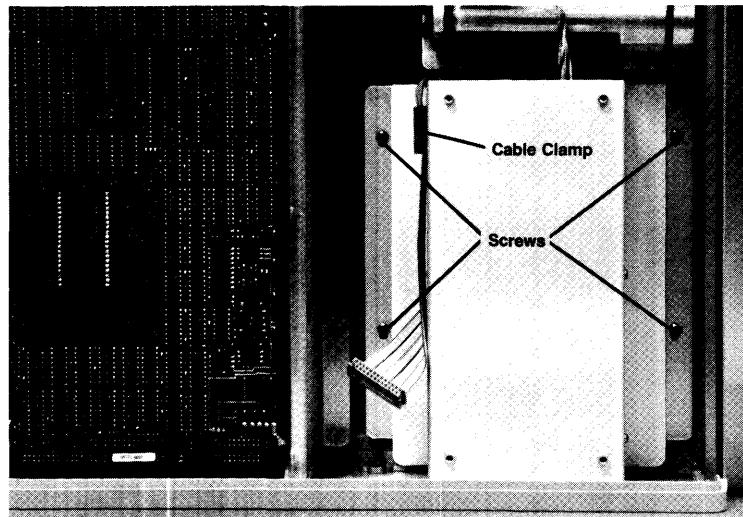
The Controller assembly is removed by disconnecting three cables and removing four screws. See Figure 5-3.



**Figure 5-3. Controller Assembly Removal**

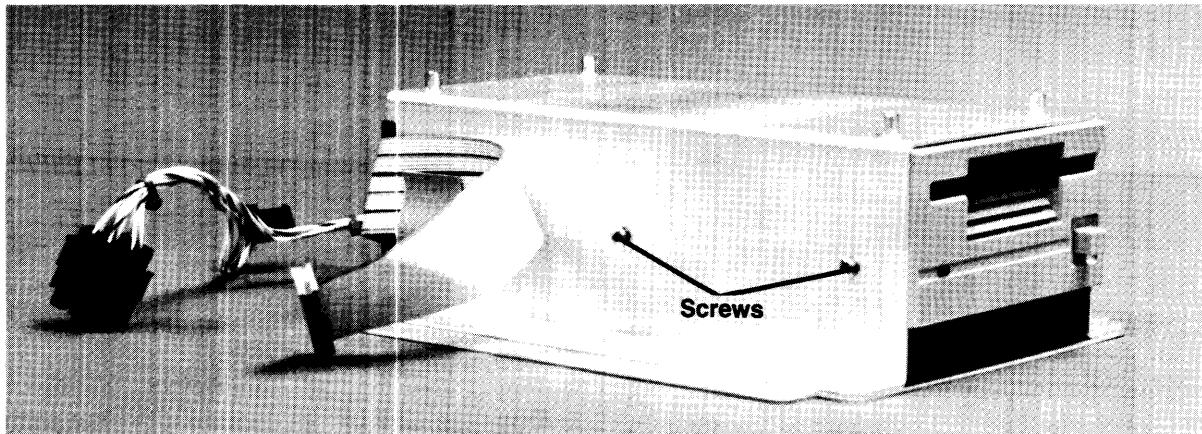
## Sheet Metal Housing Removal

The 3 1/2-inch drive is contained inside a sheet metal housing. When removing the drive, the housing must be removed. To do this remove the four screws shown in Figure 5-4. Lift the entire housing from the chassis.



**Figure 5-4. Sheet Metal Housing Removal  
Drive Removal**

The disc drive is secured to the sheet metal housing using four screws, two of which are shown in Figure 5-5. Remove these four screws and slide the drive out the rear of the sheet metal enclosure. Remove the cable from its secured position. See Figures 5-5 and 5-6.



**Figure 5-5. Drive Removal**

The two cables must then be removed from the drive. Reassembly is the reverse of this procedure.

## 5-6 HP 9133 Disc Memory

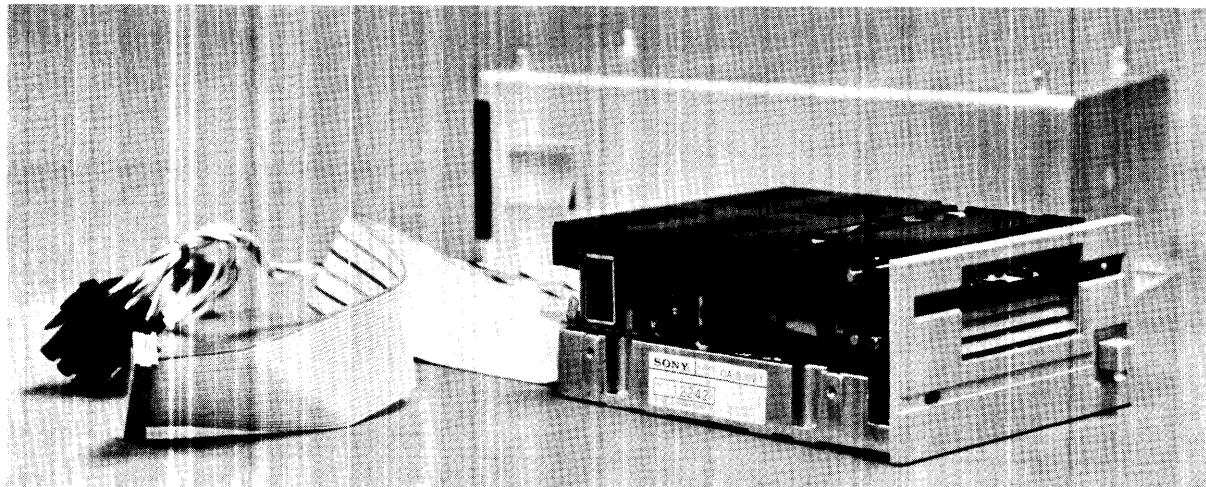


Figure 5-6. The 3 1/2-inch Disc Drive

## HP 9133 Parts Lists

This section contains the replaceable parts lists for the 9133. The CD column is required when ordering a part from HP. Please include this check digit number with your order.

Level	Reference Designator	HP Part No.	CD	Description
1	A1	09133-69500	5	CTRL ASSEMBLY
.2	C1,2,3,5,7,13, 15-18,20-24, 30,33-37,42-47,52	0160-4832	4	C-F.01UF10 %
.2	C4,9,39,41,26	0160-4835	7	C-F.1UF10 % 50V
.2	C6,11	0160-4833	5	C-F.022UF10 %
.2	C8,14,19,25,32	0180-1746	5	C-F15UF20V
.2	C10,12,31,48-51	0160-5349	0	C-F200PF5 %
.2	C27	0160-4805	1	C-F47PF5 % 100V
.2	C28	0160-4830	2	C-F2200PF10 %
.2	C29	0160-4574	1	C-F1000PF10 %
.2	C38	0180-0291	3	C-F1UF35V10 %
.2	CR1,2,3,5,6	1901-0050	3	DIO SWITCHING
.2	CR4	1901-0518	8	DIO-SM-SIG-S
.2	CR7	1902-0029	8	DIO-ZNR 12V5 %
.2	LED	1990-0618	6	LED-LMP RED
.2	L1	9100-0539	3	IDCTR(MSIC)
.2	L2,3,4,5	9140-0183	7	IDCTR 20UH 10 %
.2	P1	1251-5068	4	CONN 2X17 M
.2	P2	1251-8081	7	CONN-26 PIN M
.2	P3	1251-6377	0	4 PIN HEADER
.2	Q1,2	1854-0477	7	XSTR NPN 2N2222A
2	R1	2100-0554	5	R-V500 OHM 10 %
2	R2,11	0683-9115	4	R-F910 OHM .05
2	R3,10	0683-8225	5	R-F8.2K5 % .25W
2	R4,24,27,30	0683-1025	9	R-F1K5 % .25W
2	R5	0698-3442	9	R-F237 OHM 1 %

.2	R6,7	0757-0417	8	R-F562 OHM 1 %
.2	R8	0757-0442	9	R-F10K.01 1/8W
.2	R9	0683-8225	5	R-F8.2K5 %.25W
.2	R12	0683-1005	5	R-F10 OHM .25
.2	R13,14,31,33	0698-3445	2	R-F348 OHM 1 %
.2	R15,29	0757-0442	9	R-F10K.01 1/8W
.2	R16,28	0698-3154	0	R-F4.22K1 %
.2	R17-20,22,2, 37,41,42	0683-1025	9	R-F1K5 %.25W
.2	R21,40	0683-1015	7	R-F100 OHM .05
.2	R25	0757-0430	5	RES 2.21K1 %
.2	RP1,2	1810-0204	6	NTWK-R7X1K SIP
.2	R26	0698-3154	0	R-F4.22K1 %
.2	R32,34	0757-0280	3	RES 1K1 %.125W
.2	R35	0698-3442	9	R-F237 OHM 1 %
.2	R36	0698-3152	8	R-F3.48K1 %
.2	R38	0757-0417	8	R-F562 OHM 1 %
.2	R39	0698-3132	4	R-F261 OHM.01
.2	U1,30,32	1820-2096	9	IC SN74LS393N
.2	U2,22,37,38	1820-0471	0	IC-SN7406N
.2	U3,34	1820-1199	1	IC-74LS04
.2	U4	1820-2485	0	IC SN75160N
.2	U5	1820-2483	8	IC SN75161N
.2	U6	1820-2024	3	IC-SN74LS244
.2	U7	1818-1178	1	IC MK4118AN-3
.2	U8,39	1820-1112	8	IC-74LS74
.2	U9	1820-2549	7	IC-8291AP
.2	U10	1813-0194	9	XTAL-CLK-OSC
.2	U11 ROM	09121-15510	8	SONY CTRL E PROM
.2	U12,13	1858-0058	8	XSTR ARRY 16P-DIP
.2	U14,24	1820-1201	6	IC-SN74LS08N
.2	U15	1820-1730	6	IC SN74LS273N
.2	U16	1820-1216	3	IC-SN74LS138
.2	U17	1820-2624	9	IC-68B09
.2	U18,19	1821-0001	4	XSTR-ARRAYCA3046
.2	U20,21,28,31	1820-1197	9	IC-74LS00
.2	U23	1820-1437	0	IC-SN74LS221
.2	U25	1820-1202	7	IC-74LS10N
.2	U26	1820-3006	3	IC-MB8876A CTLR
.2	U27	1820-1433	6	IC SN74LS164N
.2	U29,33	1820-1416	5	TTL TRGR 74LS14N
.2	U35	1820-1300	6	IC SN74LS195N
.2	U36	1826-0210	7	IC-LM361
.2		0360-0124	3	STUD-TERM
.2		1200-0861	8	SKT-IC 28-CONT
.2		7120-6830	9	LABEL INFO



# **Section IV**

## **HP 9133V and 9133XV**

### **Disc Memories**

This section contains information on the 3 1/2-inch Flexible Disc Drive installation in the HP 9133V/XV Disc Memories.

This section contains the following chapters.

- Chapter 1 General Description**
- Chapter 2 Installation**
- Chapter 3 Basic Operating Procedures**
- Chapter 4 Troubleshooting**
- Chapter 5 Assembly Access**

Detailed information on the Winchester drive is not contained in this manual. For that information, see the Winchester Disc Drive Service Manual, P/N 09134-90032.

# Chapter 1

## General Description

### Introduction

This chapter contains general information about the HP 9133V/XV Disc Memories. Included in this section are the following:

- **Product Description**
- **Technical Specifications**

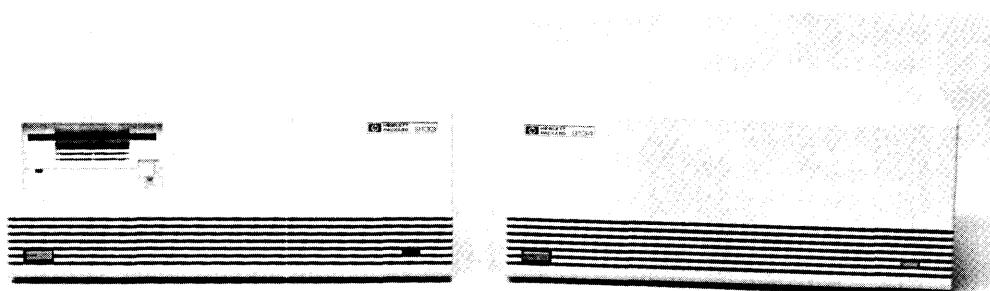
### Product Description

The HP 9133V and the 9133XV Disc Memories (Figure 1-1) are random access data storage devices; they each contain a 5 1/4-inch Winchester disc and a 3 1/2 inch flexible disc drive.

The 3 1/2-inch flexible disc drive in the 9133V and 9133XV emulates an HP 9121S flexible disc drive and can be operated by any computer which supports the 9121S or 82902M flexible disc drives.

The 9133V is available with the Winchester disc configured as a single volume with a formatted capacity of 4.8 MBytes, or as four volumes with a formatted capacity of 1.15 MBytes per volume as option 004. The four volume configuration emulates an HP 9895A 8-inch flexible disc drive master with three slave drives, and can be operated by any computer which supports the 9895A.

The 9133XV is available only with the Winchester disc configured as a single volume with a formatted capacity of 14.5 MBytes.



**Figure 1-1. HP 9133V/XV and HP 9134XV Disc Memories**

## Technical Specifications

Listed below are the physical, electrical, and environmental specifications for the HP 9133V/XV disc memories.

### Unit Specifications

<b>9133V/XV</b>	
Power Requirements:	
Source (selected by rear panel switch)	90 to 125Vac 180 to 250Vac
Line Frequency	48 to 66 Hz
Power Consumption(max)	125W
Environmental Range:	
Operating Temperature	10° to 40° C (50° to 104° F)
Storage Temperature	-40° to 60° C (-40° to 140° F)
Operating Humidity (non-condensing, 25° C max wet bulb temperature)	20% to 80%
Storage Humidity (non-condensing)	5% to 95%
Operating Altitude	0 to 4572m (0 to 15000 ft)
Storage Altitude	-304 to 1524m (-1000 to 50000 ft)
Size/Weight:	
Height	125mm(4.9 in)
Width	325mm(12.8 in)
Depth	285mm(11.2 in)
Net Weight	10kg(22 lb)
Shipping Weight	16.8kg(37 lb)

**Drive Specifications**

<b>Technical</b>	<b>3 1/2" Flexible Disc 9133V/XV</b>
Formatted Capacity:	
Bytes per Unit	270K
Bytes per Sector	256
Sectors per Track	16
Tracks per Surface	66
Surfaces per disc	1
Tracks per inch	135
Recording Format	dbl density
Max Sustained Transfer Rate*	17.8kByte/sec
Average Access Time	420 msec(on) 1420msec(off)
Rotational Speed	600rpm
Media Part Number (10 pack)	HP 92191A

\*Mainframe dependent

**Maximum Data Transfer Rates:  
(3 1/2-inch flexible disc only)**

<b>Interleave</b>	<b>Avg. Transfer Rate*</b> (KBytes/second)
1	2.6
2	17.1
3	12.1
4	9.3
5	7.6
6	6.4
7	5.5
8	4.8
9	4.3
10	3.9
11	3.5
12	3.2
13	3.0
14	2.8
15	2.6

\*Average Data rate for a multiple-track read or write. Rate is mainframe dependent.

Interleave for the Winchester is preset at the factory and cannot be changed.



# Chapter 2

## Installation

### Introduction

This section provides the installation and initial power-on procedures for the HP 9133V/XV. The following topics are covered in this section:

Equipment Supplied

Setting the Line VOLTAGE SELECT Switch

Fuses

Power Cords

Interfacing to Your System

Selecting the Device Address

The HP-IB Interface

#### Equipment Supplied

Description	Quantity	HP Part Number		
Power Cable	1	Dependent on location		
User's Manual	1	09133-90010		
Spare Fuse	1	90 to 125VAC or 180 to 250VAC	3 Amp	2110-0003
Flexible Disc Media	1	180 to 250VAC	2 Amp	2110-0002

### Setting the Line VOLTAGE SELECT Switch

The VOLTAGE SELECT switch on the rear panel was set to the line voltage for the original destination when shipped from the factory. Verify that the setting is correct for local line voltage before connecting to the power source.

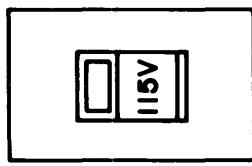
Figure 2-1 shows the setting of the VOLTAGE SELECT switch for the two ranges of line voltage.

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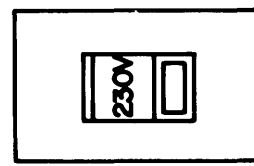
#### WARNING

ALWAYS TURN OFF THE AC POWER SWITCH BEFORE  
CHANGING THE VOLTAGE SELECT SWITCH.

---



90-125 Vac



180-250 Vac

Figure 2-1. Line VOLTAGE SELECT Switch

## Fuses

A different fuse is required for each of the two voltage ranges of 90-125 and 180-250V. The correct fuse for the original destination is installed and a spare fuse is included before shipment from the factory.

Table 2-1 gives the correct fuse ratings and fuse part numbers for each voltage range.

**Table 2-1. Fuses**

Switch Setting	Voltage Range	Fuse Rating	HP Part Number
115V	90-125VAC	3A 250 VAC-Normal Blow	2110-0003
230V	180-250VAC	2A 250 VAC-Normal Blow	2110-0002

---

**WARNING**

ALWAYS DISCONNECT THE DISC MEMORY FROM THE AC SOURCE BEFORE CHANGING FUSES.

---

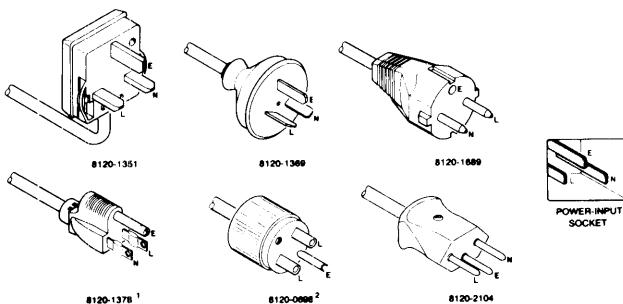
## Power Cords

Power cords supplied by HP have polarities matched to the power input socket on the equipment (Figure 2-2).

L = Line or active conductor (also called "live" or "hot")

N = Neutral or identified conductor

E = Earth or safety ground



<sup>1</sup>UL and CSA approved for use in the United States of America and Canada with equipment set for either 100 or 120 Vac operation.

<sup>2</sup>UL and CSA approved for use in the United States of America and Canada with equipment set for either 200 or 240 Vac operation.

**Figure 2-2. Available Power Cords**

---

**WARNING**

IF IT IS NECESSARY TO REPLACE THE POWER CORD, THE REPLACEMENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL. OTHERWISE, A SAFETY HAZARD MIGHT EXIST IF AN INTERNAL FAILURE OCCURS.

---

The correct power cord for the original destination is packaged with the equipment.

## Interfacing to Your System

The disc memory is connected to the computer via the Hewlett Packard Interface Bus (HP-IB). The device address switches are set prior to connecting the interface cable.

### Selecting the Device Address

Each device in an HP-IB system must be set to a unique device address. The two drives in an HP 9133V/XV are, for this purpose, considered separate devices; hence a device address switch is provided for each drive. See Figure 2-3 for switch locations.

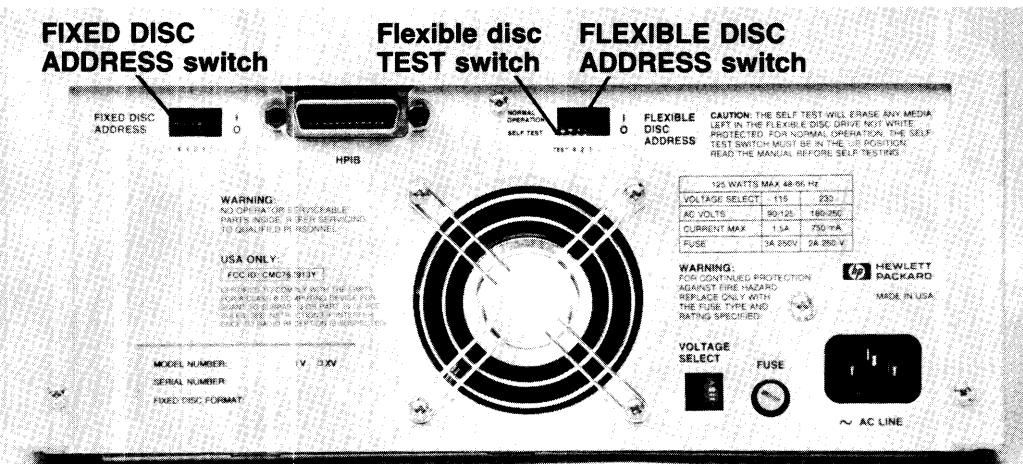


Figure 2-3. Device Address Switches

A device address switch can be set to any one of eight device addresses ranging from decimal 0 through 7 by proper positioning of the four switch segments within the device address switch. Table 2-2 lists the switch-segment positions for the eight device addresses.

Prior to setting the device address switches, turn the disc memory AC line switch OFF.

Table 2-2. Switch-Segment Positions

Address	*Test	4	2	1	
0	**	DOWN	DOWN	DOWN	(Factory setting for Winchester)
1	**	DOWN	DOWN	UP	
2	**	DOWN	UP	DOWN	(Factory setting for flexible disc)
3	**	DOWN	UP	UP	
4	**	UP	DOWN	DOWN	
5	**	UP	DOWN	UP	
6	**	UP	UP	DOWN	
7	**	UP	UP	UP	

\* Refer to Chapter 3 for test information.

\*\* The TEST switch segment on the flexible disc device address switch must be UP for normal operation. The position of this switch segment on the fixed disc device address switch does not affect operation.

**NOTE**

If the TEST switch segment on the flexible disc device address switch is in the down position, the computer will not be able to communicate with the disc drive and will probably indicate that the disc drive is not present.

**The HP-IB Interface**

Refer to Figure 2-4 for a list of the HP-IB interface cables used with HP computers.

**CAUTION**

ALWAYS SET THE AC LINE SWITCHES TO "OFF" (0) FOR THE COMPUTER AND THE DISC DRIVES WHEN INSERTING OR REMOVING THE INTERFACE CABLES. USE ONLY CABLES DESIGNED BY HEWLETT-PACKARD FOR YOUR EQUIPMENT. FAILURE TO DO SO COULD DAMAGE THE DISC DRIVE OR THE CONTROLLING COMPUTER.

Length	Accessory Number
1 metre	10833A
2 metres	10833B
4 metres	10833C
.5 metre	10833D

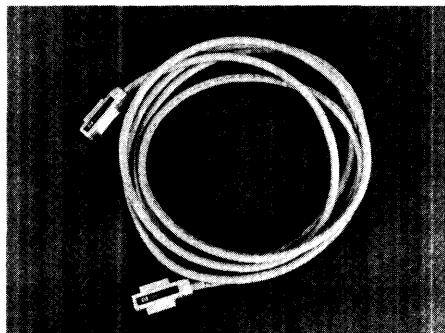


Figure 2-4. HP-IB Interface Cables

**HP-IB Interface Restrictions**

1. All the AC line switches must be turned "OFF" when connecting (and disconnecting) devices to your system.
2. The total length of cable permitted in one bus system must be less than or equal to two metres times the number of devices connected together (the interface card counts as one device; the 9133 counts as two devices).
3. The total length of the cable must not exceed 20 metres. For example, a system containing six devices can be connected together with cables that have a total length less than or equal to 12 metres (six devices x 2m/device = 12 metres). The individual lengths of cable can be distributed in any manner desired as long as the total length does not exceed the allowed maximum.
4. The maximum number of devices that can be connected together in one bus system is 15.

There are no restrictions on the way cables may be connected together; however, it is recommended that no more than four piggyback connectors be stacked together on one device. The resulting structure could exert enough force on the connector mounting to damage it.

# Chapter 3

## Basic Operating Procedures

### Introduction

This section provides initial power-on and check out procedures for the HP 9133V/XV and discusses flexible disc handling and write protection. The following topics are covered:

Drive Operation	Flexible Disc Procedures
Controls and Indicators	Flexible Disc Description
Initial Power-on and Operating	Write Protection and Initialization
Procedure	Inserting and Removing the Flexible Disc
Initial Checkout	Media Monitor
	Media Wear Indication

### Drive Operation

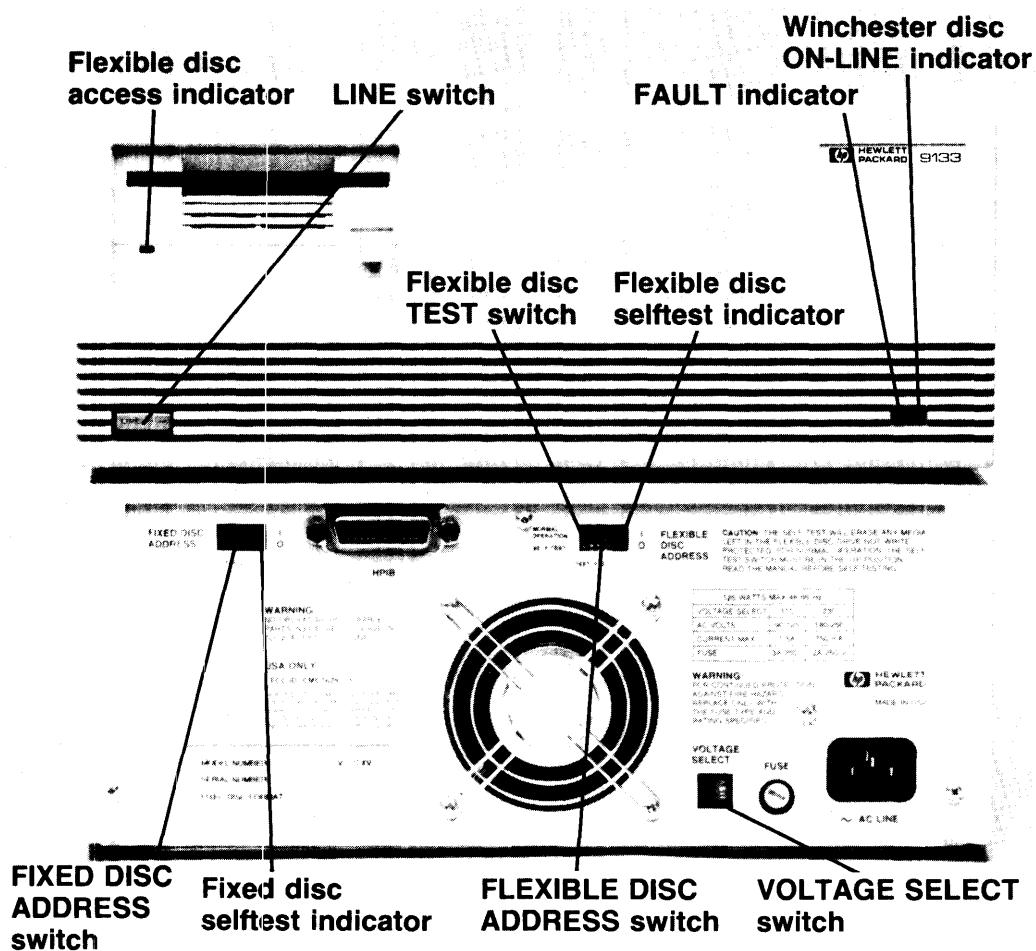
#### Controls and Indicators

The location of all controls and indicators on the disc memory is shown in Figure 3-1. Front panel controls and indicators are a primary power LINE switch, a FAULT indicator, an ON LINE indicator for the Winchester disc drive, and a disc access indicator for the 3 1/2-inch flexible disc drive. Rear panel controls and indicators are a device address switch for each drive and the VOLTAGE SELECT switch. These were discussed in Chapter 2. Also, within the cutout for each device address switch is a selftest indicator. Adjacent to the FLEXIBLE DISC ADDRESS switch segments is a TEST switch permitting a user to initiate selftests.

The LINE switch controls the application of AC power to the disc memory. It is depressed to apply power, and depressed again to remove power.

The FAULT indicator is on whenever the selftest indicator of either disc drive is on. It is normally on during the power-up selftest, selftest initiated by a command from the computer, or when a fault exists in either disc drive. It also indicates the results of the user-confidence selftest initiated by the TEST switch on the rear panel of the disc memory. If the FAULT indicator remains on or flashing for more than one minute after power-up or initiation of a selftest, a fault has been detected in one of the disc drives. (The fault light indication can be followed up by examining the selftest indicator LEDs on the rear of the instrument and consulting the "Selftest Results" section of the Appendix.)

The ON LINE indicator is on whenever the Winchester disc is accessed for data storage or retrieval, and momentarily when the drive is powered up.



**Figure 3-1. 9133V/XV Controls and Indicators**

The flexible disc access indicator is on whenever the flexible disc is accessed for data storage or retrieval and momentarily when the drive is powered up.

The selftest indicators for the flexible disc drive and the Winchester disc drive are visible through the device address holes on the rear panel, and can be checked to determine which drive is defective if the FAULT indicator is on or flashing.

### Power-On Selftest

A selftest is performed on both the flexible disc drive and the Winchester disc drive when power is applied to the disc memory. The FAULT indicator combines the indication from the flexible disc selftest indicator and the Winchester disc selftest indicator. It will be on continuously during the time the selftests are being performed. If the FAULT indicator is not on after the selftest is completed (about 30 seconds) the test has been completed successfully. The FAULT indicator will remain on or be flashing if the tests have detected a failure in either drive.

## User Confidence Selftest (Flexible Disc Drive)

The extent of the test depends upon whether there is a formatted disc in the flexible disc drive, and, if so, whether or not it is write protected. If there is no disc in the drive, the controller electronics are tested. If the disc in the drive is write protected, the controller, read electronics, and drive are tested. If the disc is not write protected, the controller, read and write electronics, and drive are tested. Details of the User Confidence Selftest are given in the Initial Checkout section below.

## Additional Flexible Disc FAULT Indications

Two other conditions associated with the flexible disc cause the FAULT indicator to come on and stay on until the condition disappears. These conditions are a command sequence-error over the HP-IB (from the host controller) and a data error from the disc. Whenever these conditions occur it is best to retry the last operation. If a retry is successful, the error and error indication are cleared. If the condition remains after several retries remove the flexible disc from the drive and check the disc surface on both sides of the disc for scratches. If any scratches are found, backup the disc immediately. If no scratches are found, the user confidence selftest should be run as described in the Initial Checkout section.

---

### **CAUTION**

THE FLEXIBLE DISC ACCESS LIGHT ON THE FRONT OF THE DRIVE INDICATES USAGE OF THAT DRIVE. DO NOT DEPRESS THE DISC EJECT BUTTON OR REMOVE POWER FROM THE DRIVE WHEN THE ACTIVITY LIGHT IS ON AS THIS MAY CAUSE DATA TO BE LOST.

---

## Initial Power-on and Operating Procedure

---

### **CAUTION**

KEEP THE FRONT AND BACK OF THE DISC MEMORY FREE FROM OBSTRUCTIONS TO AVOID RESTRICTING THE AIR FLOW. FAILURE TO DO SO COULD CAUSE THE UNIT TO OVERHEAT AND RESULT IN DAMAGE TO THE DISC MEMORY.

---

Before turning the disc memory power on, check the setting of the VOLTAGE SELECT switch on the rear panel (see Chapter 2) to ensure that it is correct for your line voltage. If this is the first time the drive has been turned on, make sure the HP-IB cable is not connected and perform the procedures under Initial Checkout. Otherwise, connect the HP-IB cable from the computer to the disc memory and proceed as follows, omitting the Initial Checkout section.

Set the LINE switch on the front panel to the "ON" or "1" position. The FAULT indicator will come on during the power-up selftest and then go off about 30 seconds after the application of power if the selftest of both drives is successful. The FAULT indicator will remain on or be flashing if either drive fails the selftest.

## Initial Checkout

The first time the disc memory is turned on, perform the User Confidence Selftest to assure that the disc has not been damaged in shipment.

### User Confidence Selftest

1. Remove all HP-IB cables from your disc memory.
2. Insert a disc that is not write protected into the flexible disc drive. The disc may be initialized but it is not necessary.

---

#### **CAUTION**

ALL DATA ON THE DISC WILL BE DESTROYED WHEN SELFTEST IS PERFORMED WITH A DISC WHICH IS NOT WRITE PROTECTED.

---

3. Move the TEST switch on the rear panel (Figure 3-1) to SELFTEST (down) position for five seconds and then back to the NORMAL OPERATION (up) position. The switch MUST be in the NORMAL OPERATION position before the disc memory is used.
4. Check the results of the test on the front panel FAULT indicator and on the flexible disc selftest indicator visible through the FLEXIBLE DISC ADDRESS switch cutout on the rear panel. Successful completion of the test is indicated if the FAULT indicator on the front panel and/or the flexible disc selftest indicator flash 10 times and then remain off. Failure of the selftest is indicated if the indicators turn on for 5 seconds and then turn off.

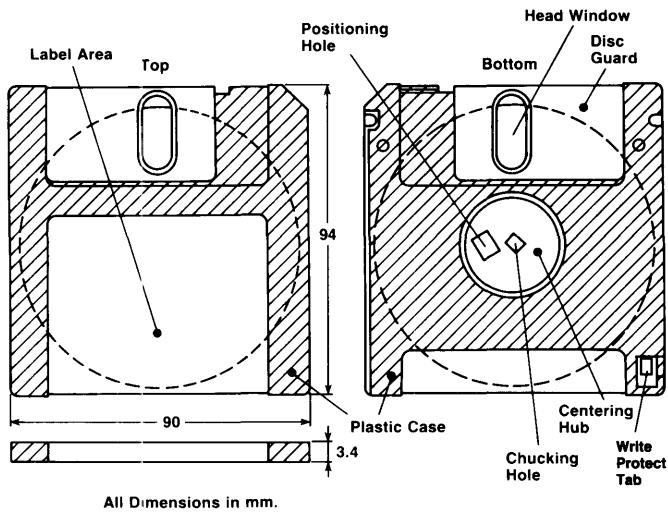
## Flexible Disc Procedures

### Flexible Disc Description and Write Protection

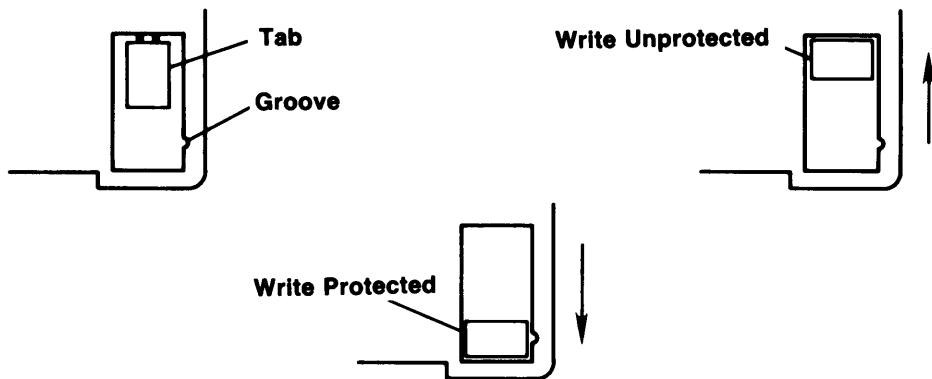
The 3 1/2-inch flexible disc is enclosed in a rigid plastic shell for extra protection and reduced disc-to-case friction (see Figure 3-2). A metal centering hub ensures rapid and accurate positioning when the disc is inserted in the drive. The disc shutter, which automatically opens the head access window when the disc is in the drive and then closes the window when the disc is removed from the drive, protects the recording surface from foreign object contamination.

A micro-flexible Disc is not write protected when received. Prepare the disc for write protected operation as follows (see Figure 3-3):

1. Lift the free end of the write protect tab and break it off.
2. Align the protrusion on the tab with the slot in the disc.
3. Depress the tab into the groove - tab should fit snugly.
4. Slide the tab away from the center of the disc to complete the write protection procedure.



**Figure 3-2. The 3 1/2-inch Flexible Disc**



**Figure 3-3. 3 1/2-inch Flexible Disc Write Protection**

### Write Protect Error on Initialization

A motor speed check is performed when a disc is inserted to be initialized. If the motor speed is on either side of the tolerance allowed, a Write Protect Error is generated and the disc is not initialized. If this error should occur, check the flexible disc to ensure that it is not write protected. (See the preceding section). If the disc is not write protected, then try to initialize another flexible disc which is not write protected. If the second disc initializes correctly, the first disc was defective and should be discarded. If the second disc also fails to initialize, perform the user confidence selftest (described in the Initial Checkout section of this manual) to check the disc drive.

### Inserting and Removing the Flexible Disc

To insert and remove flexible discs:

1. Do not insert the disc into the drive without power applied.
2. Insert the disc with the metal shutter toward the drive and the metal centering hub down. Carefully slide the disc into the drive until you feel it contact the rear of the drive.

- Continue pressing the disc until it is pulled down into the drive.
3. Remove the disc by depressing the disc eject button and pulling the disc straight out. Make sure the shutter is closed before storing the disc.

---

**NOTE**

There is no write protect capability on the Winchester drive. Caution must be used to avoid writing over data stored on the Winchester disc.

---

### **Media Monitor**

The proper time to discard each disc which you have been using is normally indicated by the Media Monitor in the flexible disc memory. When the disc is approaching the end of its useful life but before becoming so badly worn that data is actually lost the Media Monitor will continuously make a clicking sound and blink the flexible disc access light. This warning indication will continue until you remove the disc from the drive and reinsert it, or your computer sends a command to the drive. If the disc is removed and reinserted, the warning indication will resume after another 1 minute 40 seconds of head loaded operation has occurred. If a command is received from the computer the drive will accept and perform the command and then immediately resume the warning indication.

You should immediately copy everything on your disc to a new disc and discard the old one when the Media Monitor warning occurs. Continued use of the old disc after the initial warning will result in eventual automatic write protection of the disc by the drive controller.

### **Media Wear Indication**

Checking for wear is a simple visual inspection of the disc surface before you insert the disc into the drive. When viewing the disc surface you should look for any signs of deep circular scratches . This is done by sliding open the disc guard, revealing the disc surface. If you see any sign of deep circular scratches on either side of the exposed surface, the disc should be immediately copied and discarded. Circular scratches on the upper (label side) surface of the disc indicate load pad wear. The load pad should be checked by a qualified service person and replaced if necessary.

# **Chapter 4**

# **Troubleshooting**

## **Introduction**

This chapter provides the physical location of key components, and a list of replaceable parts.

The following topics are discussed in this chapter:

Repair Philosophy  
Exchange Assemblies  
Support Packages Contents Lists  
Product Support Package (PSP)

Field Support Inventory Package (FSI)  
Recommended Field Support Inventory  
Controller Assembly

## **Repair Philosophy**

The 3 1/2-inch Disc Drive assemblies are serviced on the exchange program. The assembly includes the drive and drive electronics board (the PC board attached to the lower side of the drive).

## **Exchange Assemblies**

The following assemblies are exchange assemblies for the 3 1/2-inch drive portion of the 9133 Disc Memory:

3 1/2-inch Flexible Disc Drive -- 09121-69501  
Controller Assembly -- 09133-69509

## **Support Packages Contents Lists**

The following packages lists are the contents for the PSP and the FSI.

### **Product Support Package (PSP) -- 09121-67100**

09121-88810 -- Pad Weight  
09121-89400 -- Disc, Alignment  
09121-89401 -- Disc, Level  
09121-89405 -- Disc, Cleaning  
8750-0051 -- Gauge, Tension  
5061-2808 -- HP-85 Test Package  
09121-90030 -- Manual, Service

## Field Inventory Parts Package (FSI) -- 09121-67197

09133-66500 -- Controller Assembly-9133  
09133-69509 -- 3 1/2-inch Controller Assembly  
09121-69501 -- 3 1/2-inch Flexible Disc Drive  
09121-68501 -- Fan Assembly  
09121-88811 -- Pad, Head Load  
2110-0587 -- Fuse, 2A

## Recommended Field Service Inventory

The following list of parts and assemblies is recommended for building your Field Service Inventory (FSI).

09121-69501 -- 3 1/2-inch Flexible Disc Drive  
09133-69509 -- 3 1/2-inch Controller Assembly

## Controller Assembly

The 3 1/2-inch controller electronics assembly with test points indicated is shown in Figure 4-1.

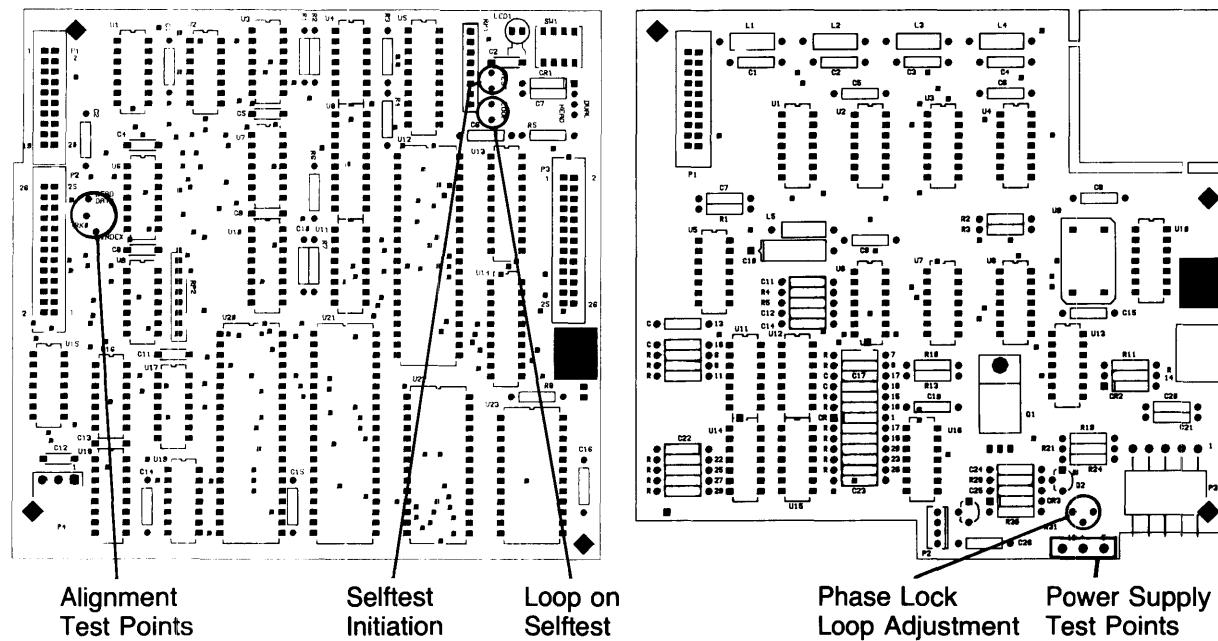


Figure 4-1. Controller Assembly Test Points

# Chapter 5

## Assembly Access

### Introduction

This chapter describes access to 9133V/XV Disc Memories and removal of the 3 1/2-inch disc drive and the printed circuit assemblies (PCAs) controlling it. Information about the Winchester drive and about the power supply for the 9133V/XV is contained in the Winchester drive service manual.

The following topics are discussed in this chapter:

Safety Considerations

3 1/2-inch Drive Removal

Top Cover Assembly Removal

Controller PCA Removal

Front Panel Assembly Removal

### Safety considerations

#### General

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

#### Safety Symbols



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.



Indicates hazardous voltages.



Indicates earth (ground) terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

#### **WARNING**

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

**CAUTION**

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly performed, could result in damage to, or destruction of, part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

### Safety Earth Ground

This is a safety class I product and is provided with a protective earthing terminal. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

### Before Applying Power

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual, and that the correct primary fuse rating is installed.

If this product is to be energized via an auto-transformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the main power source.

### Servicing

Any servicing, adjustment, maintenance or repair of this product must be performed only by service-trained personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when the product is disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow) are to be used for replacement.

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**NOTE**

Disassembly instructions are written as if viewing the disc device from the front. That is, right = the viewer's right; left = the viewer's left; "front" = the front of the device; and "rear" = the rear of the device.

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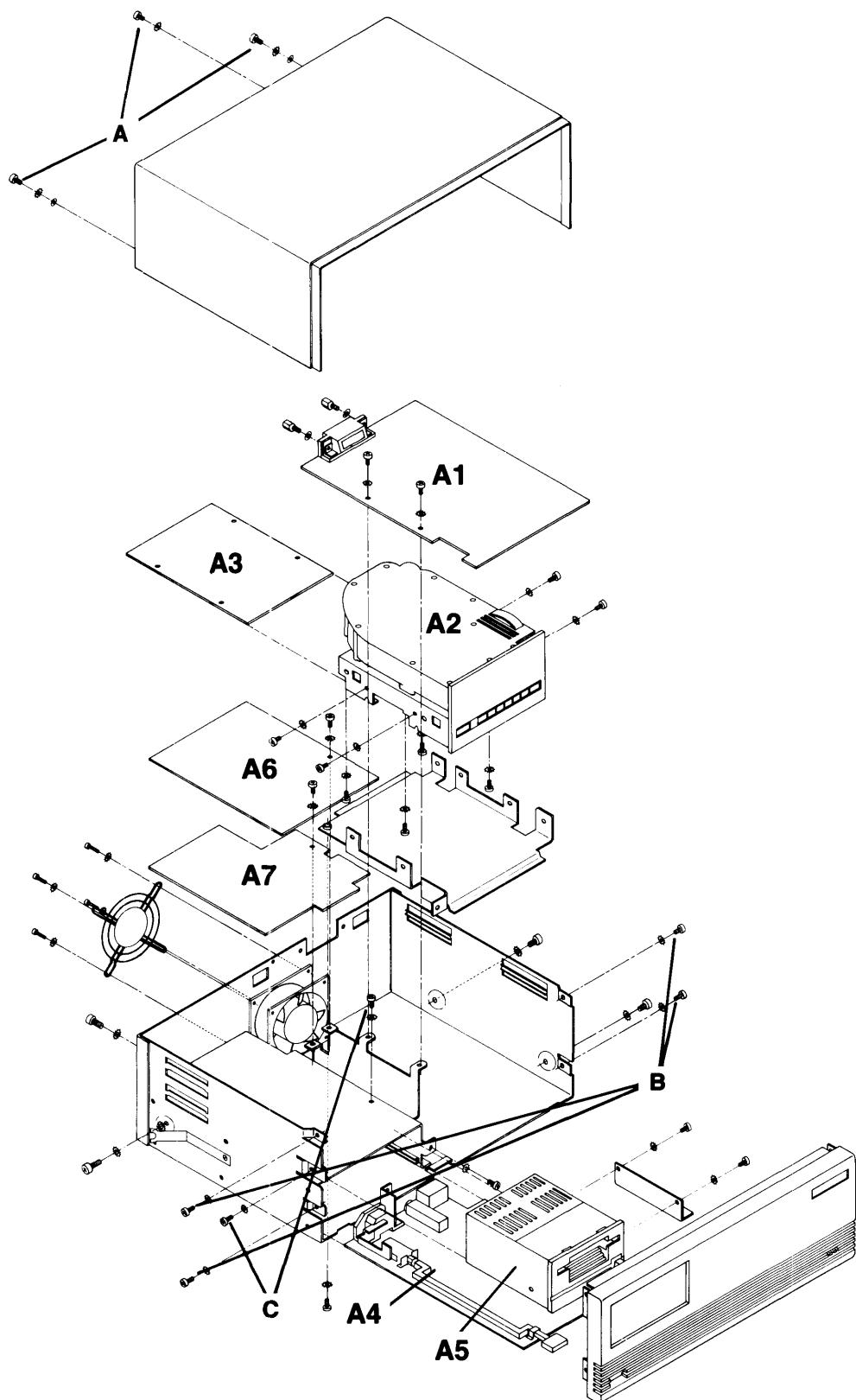


Figure 5-1. The 9133V/XV Exploded View

## Assembly Designations

The following assembly numbers are used to designate cable connections:

A1	Winchester Controller PCA (09133-69508)
A2	Winchester Drive
A3	Winchester Drive Electronics PCA
A4	Power Supply
A5	3 1/2-inch Drive
A6	3 1/2-inch Drive Controller, Upper Board (09133-69506)
A7	3 1/2-inch Drive Controller, Lower Board (09133-69507)

## Top Cover Assembly Removal

The Top Cover Assembly consists of an injection molded plastic shroud and a steel shield shroud. To remove the assembly, remove three screws on the rear of the instrument (marked "A" in Figure 5-1.)

DO NOT LIFT THE COVER. Instead, slide the cover assembly to the rear until it is clear of the front panel and the HP-IB connector nuts. Then lift the cover assembly from the instrument. See Figure 5-2.

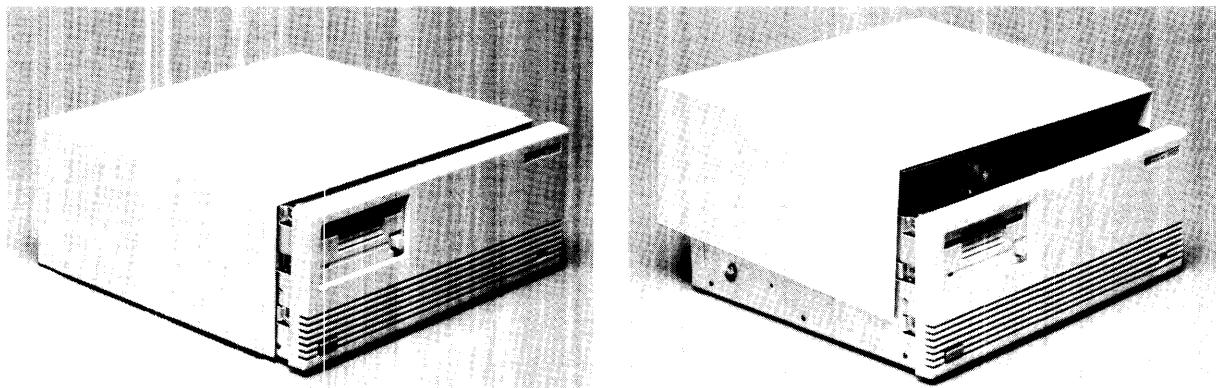


Figure 5-2. Top Cover Assembly Removal

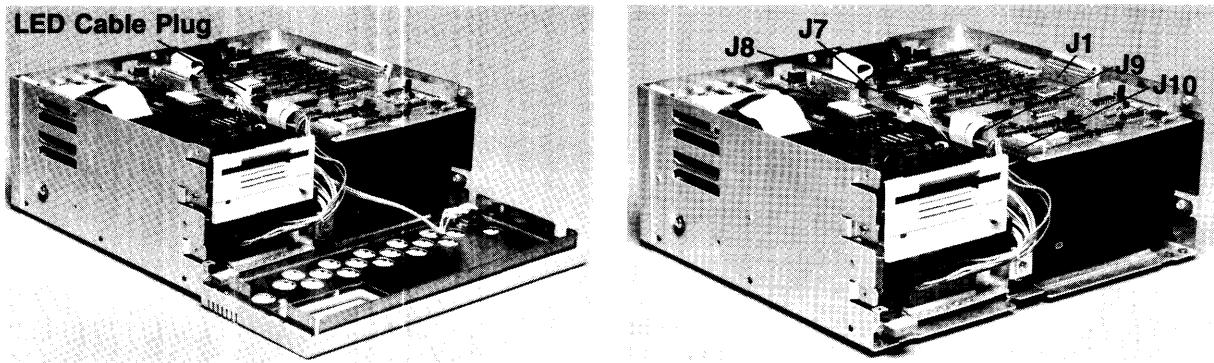
## Front Panel Assembly Removal

The Front Panel Assembly must be removed for access to the 3 1/2-inch Drive. The controller boards (09133-69506 and 09133- 69507) can be removed without removing the Front Panel Assembly.

The Front Panel assembly consists of an injection molded plastic panel and a steel shield.

Remove the assembly as follows:

1. Remove the four-pin LED cable plug from A1J8. See Figure 5-3.
2. Remove four screws marked "B", two on each side of the instrument.
3. Slide the panel to the front, clear of the instrument.



**Figure 5-3. Front Panel Assembly Removal**

## Controller PCA Removal

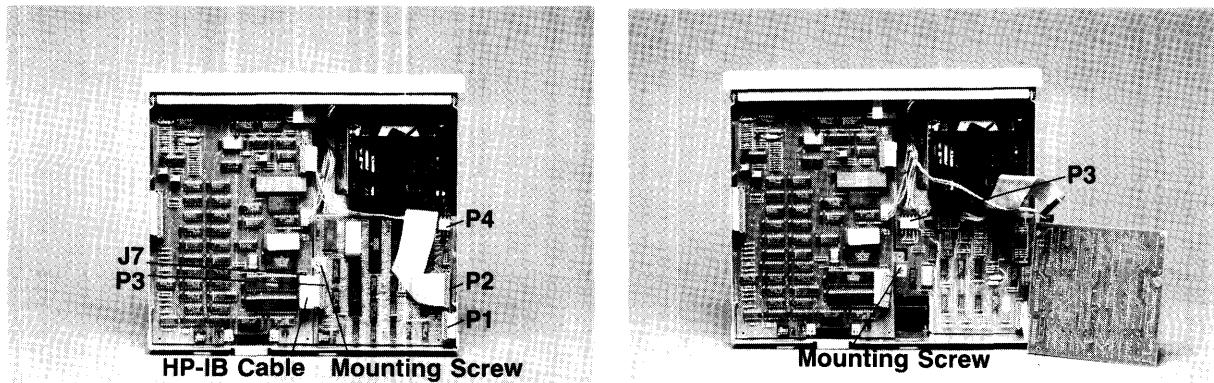
The controller PCA in 9133V/XV products consists of two boards, 09133-69506 and 09133-69507, located immediately behind the 3 1/2-inch drive. These boards can be removed without removing the drive itself.

To remove the upper board (09133-69506) proceed as follows:

1. Detach the HP-IB cable from A1J7. Leave the cable attached to the upper board (A6).
2. Detach the Board Interface cable from A6P1 and the drive controller cable from A6P2.
3. Remove the mounting screw from the right side of the board.
4. Lift the board clear of the chassis and flexible disc drive. Remove the three pin power connector from A6P4.

To remove the lower controller board (09133-69507), proceed as follows:

1. Remove the mounting screw from the right side of the board.
2. Remove the power connector from A7P3.



**Figure 5-4. Controller PCA Removal**

During reassembly, note that both boards slide into lanced board guides on the left side of the chassis.

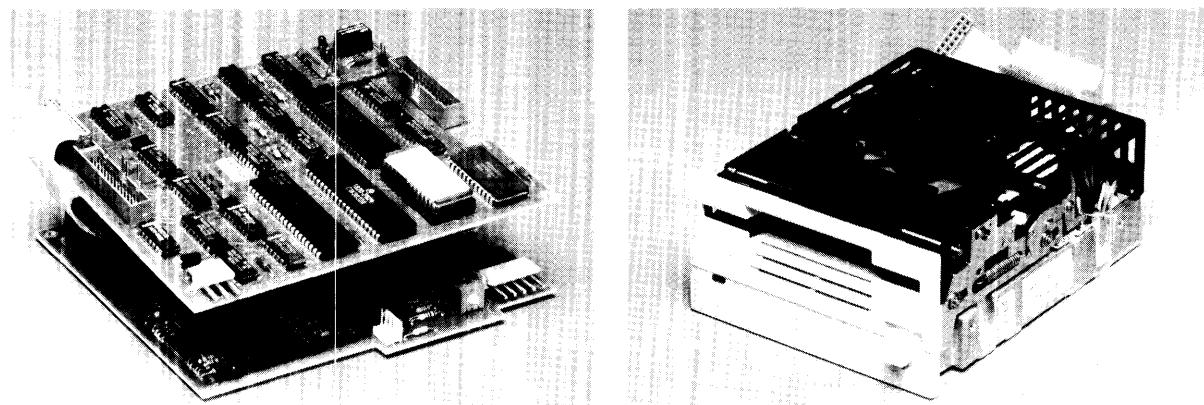
## 3 1/2-inch Drive Removal

To remove the flexible disc drive assembly, it is necessary first to remove the Top Cover Assembly and the Front Panel Assembly.

With this done, proceed as follows:

1. Detach the drive controller cable from A6P2. (See Figure 5-4)
2. Remove two mounting screws marked "C" on Figure 5-1. One screw is located on the front left side of the chassis; the other connects the L-shaped bracket on the right side of the drive to the power shield.
3. Slide the drive assembly forward and remove the four-pin white connector from the rear of the drive.
4. Slide the drive assembly to the front and free of the instrument.

If a defective drive is to be returned for replacement, remove the L-shaped bracket on the right side of the drive assembly and reconnect it to the power shield until the replacement drive is received. This bracket is not part of the replaceable assembly. See Figure 6-5.



**Figure 5-5. Replaceable Assemblies**

## Field Replaceable Units

The field replaceable units for the 3 1/2-inch section of the disc memory are as follows:

- a) 09121-695111 flexible disc drive
- b) 09133-69509 3 1/2-inch controller assembly
- c) 5061-3144 power supply

## Parts List

This section contains the parts list for the Disc Memory. The check digit (CD) is required when a part is ordered from HP, so please include this information with your order.

<b>Level</b>	<b>Reference Designator</b>	<b>HP Part No.</b>	<b>CD</b>	<b>Description</b>
<b>Case Parts</b>				
1		0403-0427	1	BUMPER FOOT
1		0510-1237	0	FASTNER
1		07940-00026	7	FAN GUARD
1		07940-40062	5	SHAFT SWITCH
1		09121-48301	4	BUTTON, PUSH
1		09121-48303	6	FOOT-MOLDED
1		09133-00602	2	FRT SHIELD-33
1		09133-01201	9	BRKT,FLPY
1		09133-20101	8	CHASSIS - 9133
1		09133-40201	1	FRT PNL- 9133
1		09133-88865	3	SHIELD/SHROUD ASSY
1		09133-84304	7	FRT PNL LABEL-33
1		09144-45404	9	GUARD, POWER
<b>Electrical Assemblies</b>				
1		09133-42501	8	LIGHT PIPE
1		09133-61601	9	POWER HARNESS
1		09133-61602	0	DISC CTLR CABLE
1		09133-61604	2	HPIB CABLE
1		09133-61606	4	LED/PWR CABLE
1		09133-61609	7	FLOPPY CTLR CBL
.2		09133-61610	0	FDC INTER CABLE
1		09133-61611	1	FLPY POWER CBL
1		09133-68501	2	FAN ASSEMBLY
1		5061-3144	4	POWER SUPPLY
1		8120-1378	1	CABLE-POWER
<b>Fuses</b>				
1		2110-0003	0	FUSE-3AMPS NB
1		2110-0002	9	FUSE 2A 250V
<b>Exchange Assemblies</b>				
1	<b>A5</b>	<b>09121-69511</b>	<b>2</b>	<b>FLEXIBLE DISC DRIVE</b>
1		<b>09133-69509</b>	<b>2</b>	<b>3 1/2-INCH CONT. ASSY</b>
.2		<b>09133-61610</b>	<b>0</b>	<b>FDC INTER CABLE</b>
.2	<b>A6</b>	<b>09133-66506</b>	<b>9</b>	<b>FLPY CTLR BD-I</b>
.3	C1,3,6,7,14-16	0160-4832	4	C-F .01UF 10%
.3	C2,4,5,8,9,11-13	0160-5332	1	C-F .1UF 20% 50V
.3	C10	0160-5349	0	C-F 200PF 5%
.3	TRKO.TEST LOOP. INDEX.READ DATA	0360-0124	3	STUD-TERM
.3	R5	0683-1015	7	R-F 100 OHM .05
.3	R3,4,6,8	0683-1025	9	R-F 1K 5% .25W
.3	R7	0757-0430	5	RES 2.21K 1%
.3	R1,2	0757-0442	9	R-F 10.0K 1/8W
.3	U22	1200-0861	8	SKT-IC 28-CONT
.3	DUAL HEAD	1251-5380	3	CONN 2 PIN M
.3	P1	1251-8681	3	20 PIN CONNECTOR
.3	P2,3	1251-8682	4	CONNECTOR,26 PIN
.3	P4	1251-8693	7	RT ANGL POST HDR
.3	RP1,2	1810-0204	6	NTWK-R 7X1K SIP
.3	U23	1818-1178	1	IC MK 4118AN-3
.3	U7,15	1820-0471	0	IC SN7406N
.3	U17	1820-1112	8	IC 74LS74
.3	U3,6,19	1820-1197	9	IC 74LS00

Level	Reference Designator	HP Part No.	CD	Description
.3	U1,16	1820-1199	1	IC 74LS04
.3	U4	1820-1201	6	IC SN74LS08N
.3	U2	1820-1202	7	IC 74LS10N
.3	U11	1820-1216	3	IC SN74LS138
.3	U18	1820-1300	6	IC SN74LS195N
.3	U9	1820-1416	5	TTL TRGR 74LS14N
.3	U10	1820-1437	0	IC SN74LS221
.3	U8	1820-1730	6	IC SN74LS273N
.3	U5	1820-2024	3	IC SN74LS244
.3	U14	1820-2483	8	IC SN75161N
.3	U13	1820-2485	0	IC SN75160N
.3	U12	1820-2549	7	IC 8291AP
.3	U21	1820-2624	9	IC 68B09
.3	U20	1820-3006	3	IC MB8876A CTLR
.3	CR1	1901-0050	3	DIO SWITCHING
.3	LED1	1990-0450	4	LED-LMP
.3	SW1	3101-2264	1	SW-RKR 4-1A
.3	U22	09121-15510	8	SONY CTRL E PROM
.2	<b>A7</b>	<b>09133-66507</b>	<b>0</b>	<b>FLPY CTLR BD-II</b>
.3	C11,13,14,20,21,24-26	0160-4571	8	C-F .1UF + 80
.3	C23	0160-4574	1	C-F 1000PF 10%
.3	C17	0160-4805	1	C-F 47PF 5% 100V
.3	C18	0160-4830	2	C-F 2200PF 10%
.3	C5-9,15,19	0160-4832	4	C-F .01UF 10%
.3	C1-4,16,22	0160-5349	0	C-F 200PF 5%
.3	C10	0180-1746	5	C-F 15UF 20V
.3	R1-3,7,16,30	0683-1025	9	R-F 1K 5% .25W
.3	R11,13-15,19,21,24,28	0683-1035	1	R-F 10K .05 1/4W
.3	R5	0698-3132	4	R-F 261 OHM .01
.3	R9,29	0698-3154	0	R-F 4.22K 1%
.3	R10,26	0698-3442	9	R-F 237 OHM 1%
.3	R17,20,22,25	0698-3445	2	R-F 348 OHM 1%
.3	R18,23	0757-0280	3	RES 1.00K 1/8W
.3	R4,6,8	0757-0417	8	R-F 562 OHM 1%
.3	R12,27	0757-0442	9	R-F 10.0K 1/8W
.3	P2	1251-7018	8	CONN POST TO HDR
.3	P3	1251-7862	0	CONN-POST-TP-HDR
.3	P1	1251-8681	3	20 PIN CONNECTOR
.3	U9	1813-0194	9	XTAL-CLK-OSC
.3	U13,16	1820-0471	0	IC SN7406N
.3	U8	1820-1112	8	IC 74LS74
.3	U3	1820-1197	9	IC 74LS00
.3	U4	1820-1201	6	IC SN74LS08N
.3	U10	1820-1202	7	IC 74LS10N
.3	U2	1820-1416	5	TTL TRGR 74LS14N
.3	U5	1820-1433	6	IC SN74LS164N
.3	U1,7	1820-2096	9	IC SN74LS393N
.3	U12,15	1821-0001	4	XSTR-ARRAYCA3046
.3	U6	1826-0210	7	IC LM361
.3	U11,14	1858-0058	8	XSTR ARY MPQ3906
.3	Q2,3	1854-0215	1	XSTR-2N3904
.3	Q1	1855-0548	5	XSTR-MOSFET 12A
.3	CR2,3	1901-0050	3	DIO SWITCHING
.3	CR1	1901-0518	8	DIO- SM-SIG-S
.3	R31	2100-3351	6	RES-TRMR 500 10%
.3		2200-0521	8	SCR-MACH 4-40
.3		2260-0002	6	NUT-HEX 4-40
.3	L5	9100-0539	3	IDCTR (MSIC)
.3	L1-4	9140-0183	7	IDCTR 20UH 10%