



MANUAL UPDATE 5957-6584

UPDATE FOR THE 3 1/2-INCH FLEXIBLE DISC DRIVE SERVICE MANUAL (PART NUMBER 09121-90030)

This update is for the tabbed section of the manual labeled 9123D. The update covers information on the HP 9123D product.

To update your manual, remove the old tab and text from the manual and replace it with this update.

The updated section contains a revision date below the page numbers.

Introduction

The HP 9123D Disc Drive (Figure 1-1) is a random-access data storage device containing two 3 1/2-inch double-sided disc drives with a storage capacity of 710 Kbytes per drive. The DC power for the unit is supplied by the host system. The unit was designed for use with the Touchscreen II only, and uses the SUBSET 80 command set.

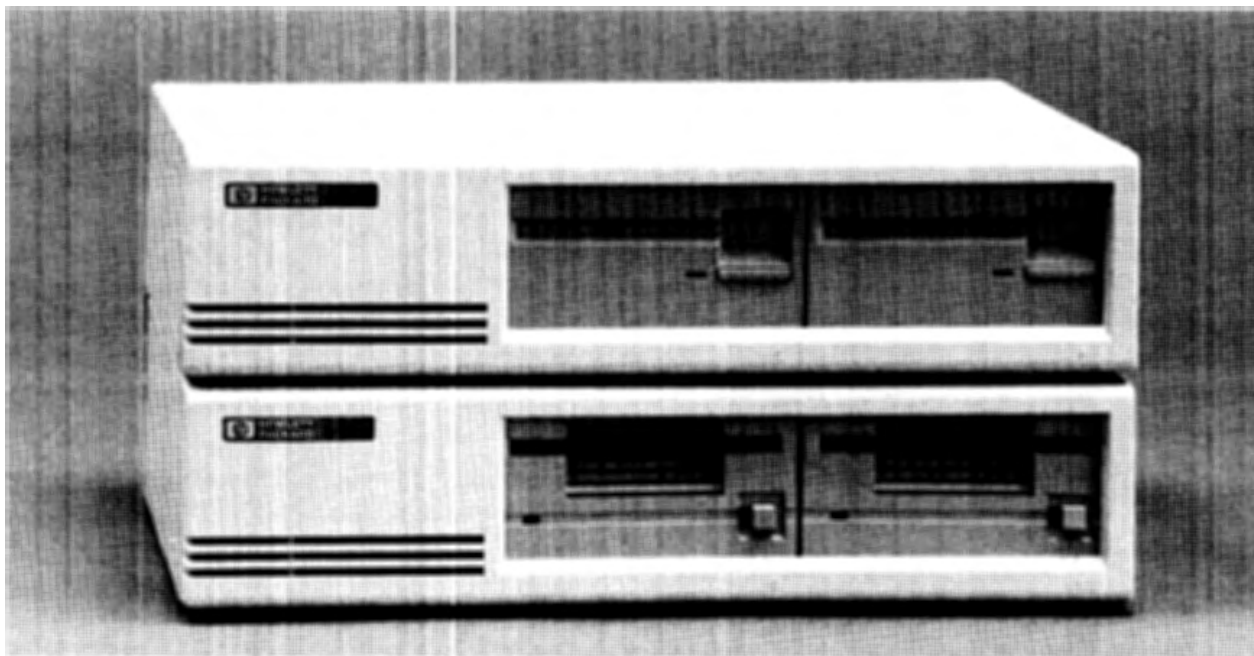


Figure 1-1. HP 9123D Disc Drive.

Part Number 5957-6584

Specifications

Physical Characteristics

Number of drives	2
Net Weight	
Height	76mm(2.99 in.)
Depth	285mm(11.1 in.)
Width	325mm(12.8 in.)

Interface	HP-IB
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Performance Characteristics

HP Double-Density Format

Encoding	MFM
Rotational speed	600 RPM
Bit density @ 600 RPM	Track 79 (inside track) 8717 BPI
Track density	135 tracks per inch
Tracks per surface	80
Surfaces used per disc	2

Capacity

Bytes/sector	512
Sectors/track	9
Tracks	80
Bytes/drive (Formatted)	709.632 Kbytes (154 tracks used for data)

Access Time

Track-to-track seek	15 ms/track, plus 28 ms settling
Maximum track-to-track seek (80 tracks)	1213 ms
Average track-to-track	433 ms
Maximum rotational latency	100 ms
Average rotational latency	50 ms
Spindle motor ON time	400 ms
Maximum data access time (seek plus latency plus motor ON time)	1.713 s
Average data access time	483 ms

NOTE

All of HP's computers spare 4 complete tracks. This reduces the usable user space to $512 \times 9 \times 154$ (bytes/sector times sector/track times unsparred tracks). This total equals 709.632 Kbytes. The remaining two tracks are for system use.

Power Requirements

	Serial number prefix 2528A and below	Serial number prefix 2536A and above
Voltage (must be supplied by host computer)	+12 VDC + 5 VDC	+12 VDC + 5 VDC
Current Requirements	+12 VDC 3.0 A max. (250ms) .6 A average + 5 VDC 2.2 A max.	+12 VDC (.6 A max) + 5 VDC (.8 A max)

Environmental Specifications**Operating Limits**

Temperature	10 to 40°C (50 to 104°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 to 60°C (-40 to 140°F)
Altitude	-304 to 15240 m (-1000 to 50,000 ft)

NOTE

The flexible disc in the HP 9123D Disc Drive 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 disc life to be drastically reduced.

GENERAL INFORMATION

A package of ten discs, product number 92192A, is available and may be ordered from the Direct Marketing Division (DMK).

CAUTION

The disc drive 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.

When moving the disc unit, care must be taken to prevent excessive shock. Install the shipping disc (P/N 1535-4881) and the rubber wedge (P/N 9223-0648) before moving it to another location. If you do not have the parts mentioned, they may be purchased from Hewlett Packard.

Cleaning the Case

The disc drive case is made from a white plastic material and is not painted. The rear panel has a durable, non-toxic label.

Before cleaning the case, disconnect the power cable and HP-IB cables. Make sure that any disc is removed from the drives. Dampen a clean, soft, lint-free cloth in a solution of clean water and mild soap. Wipe the soiled areas of the case, making sure that no cleaning solution gets inside the case. For cleaning more heavily soiled areas, a solution of 80% clean water and 20% isopropyl alcohol may be used. Dry the areas that had cleaning solution applied with another clean, soft, lint-free cloth. A non-abrasive eraser may be used to remove pen and pencil marks.

CAUTION

Chemical spray-on cleaners used for appliances and other household and industrial applications may damage the case finish. Do not use detergents that contain ammonia, benzenes, chlorides, or abrasives.

Introduction

Refer to the Touchscreen II operator manual for installation of the HP 9123D disc drives.

Disc Compatibility

Figure 2-1 shows the recommended usage of single-sided and double-sided flexible discs with the HP 9123D. Words used in the table are defined as follows:

* "Exchange only" means that the disc should be used only for exchanging data and programs with single-sided disc drives, and should not be used on a daily basis.

* "OK" means that the disc may be used on a daily basis.

Single-sided HP disc	exchange only
Double-sided HP media in single-sided format	OK
Double-sided HP media in double-sided format	OK
HP software	OK

Figure 2-1. Usage of Single- and Double-sided Flexible Discs.

Controls and Indicators

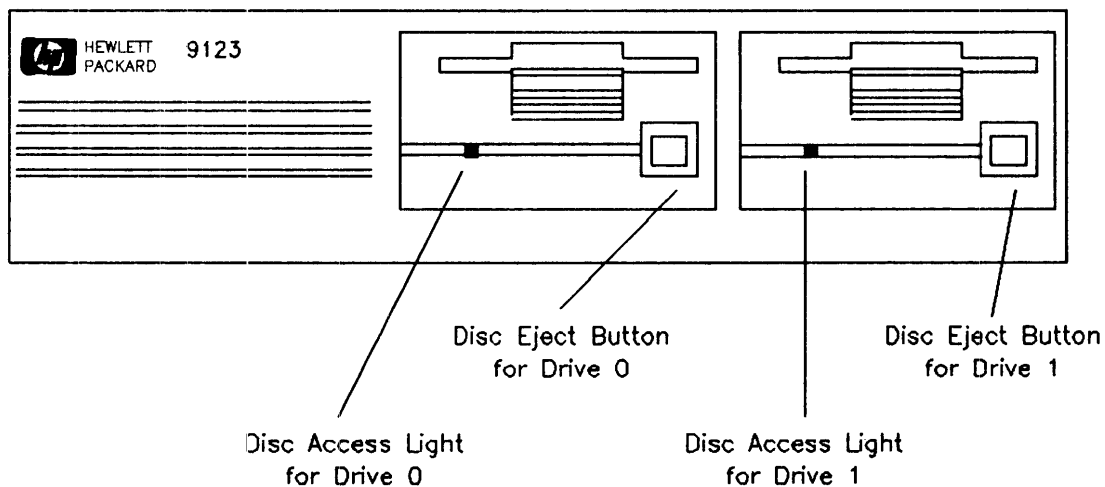


Figure 2-1. Front Panel 9123D (Serial number prefix 2528A and below).

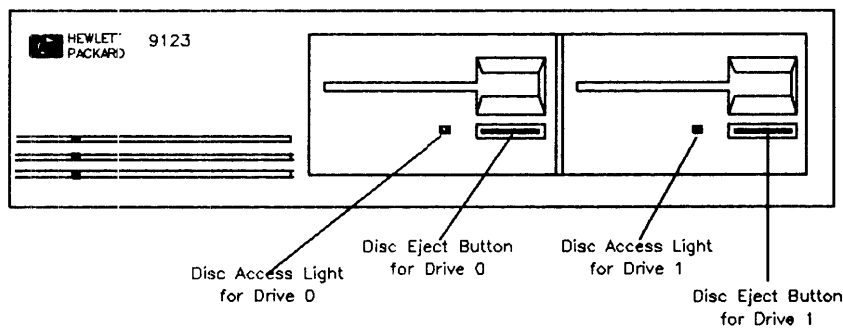


Figure 2-2. Front Panel 9123D (Serial number prefix 2536A and above).

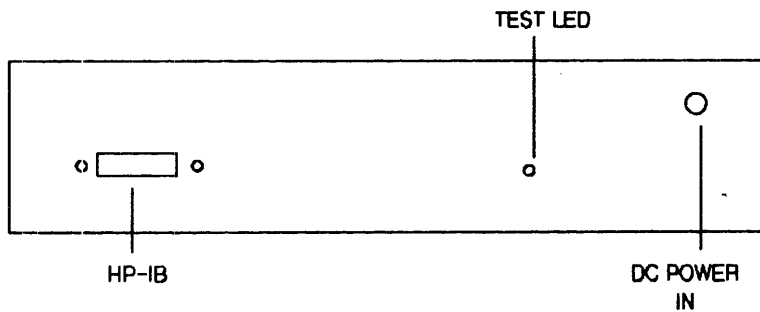


Figure 2-2 Rear Panel 9123D

Media Monitor

Through a feature called Media Monitor, the disc drive automatically monitors the cumulative use of each individual disc. When the usage of a disc is approaching a level at which there is a risk of loss of data through normal disc wear, the disc access light on the front panel blinks and a clicking sound is heard. The disc drive will continue to execute commands from the computer but after a command has been performed the drive immediately resumes the warning indication.

When the Media Monitor warning occurs, immediately copy the disc. If you continue to use this disc, the disc drive will eventually automatically write protect the disc. After that time, you will only be able to read data from the disc or copy the disc.

Power-on Selftest

A power-on selftest is performed automatically when you turn on the disc drive. The selftest first checks the HP-IB, FDC, RAM, ROM, and PIA chip followed by a WRITE/READ test (if an initialized, non write-protected disc is inserted). When a WRITE test is performed, it is done on a reserved area of the disc and no user data is at risk. The disc access LED acts as a pass/fail selftest indicator.

The basic (passing) selftest lasts approximately 8 seconds, as indicated by the disc-access LED. When an initialized, unprotected disc is inserted; read, write, and motor-speed tests are performed. A write-protected disc will not allow the read and write tests to run. If the disc access light stays on after the normal testing time, an error within the disc drive has been detected. If an error occurs, refer to Chapter 4 for troubleshooting procedures.

Write Protect Error on Initialization

A motor speed check is performed when a disc is inserted into the drive. If the motor speed is on either side of the tolerance allowed, a Write Protect Error is generated and the disc cannot be initialized or used. At this point, insert another disc. If a write protect error is generated again, refer to Chapter 4 for troubleshooting procedures. If no write protect error occurs with the second disc, then the first disc used is bad and should be discarded.

HP-IB Interface

Installation

The disc drive is connected to the computer using the cable provided with the Touchscreen II (part # 45849-60002). Refer to the Touchscreen II Operator's Manual for system-specific interconnects.

HP-IB Interface Restrictions

1. All the AC line switches (of the host system) must be turned "OFF" when connecting (and disconnecting) devices to the 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 considered 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 a 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.

CAUTION

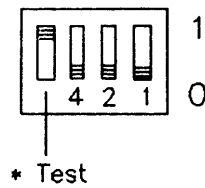
Never turn the disc drive off or remove the disc from the drive when the disc access light is on; doing so can cause loss of data.

Selecting the HP-IB Address

The HP-IB address select switch is located on the Controller PCA and is not accessible through the rear of the chassis. To gain access to the switch, the top cover must be removed. Refer to Chapter 5 for information on the removal of the top cover.

The address switch must be set to address 0 if the HP 9123D is to be used as the system boot device. If it is necessary to set the HP 9123D to another address, the following procedure should be used:

1. Turn off the Touchscreen II power
2. Disconnect power cable between the HP 9123 and the Touchscreen II
3. Remove the top cover of the HP 9123D (Refer to Chapter 5).
4. Set the address switch to the desired address.



Switches 1,2,and 4 are shown in the proper position for the HP 9123D to be the boot device, address 0, with the Touchscreen II.

*

This switch segment is used only when selecting a selftest.

Figure 3-1. HP-IB/Selftest Select Switch.

Troubleshooting

CHAPTER

4

Repair Philosophy

The 3 1/2-inch disc drive assembly is serviced on the exchange program. The assembly includes the drive and drive electronics board.

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

Exchange Assemblies

PART NUMBER	DESCRIPTION
09123-69511	Controller Board
09114-69511	3 1/2-inch Drive
09123-69101	3 1/2-inch drive (Serial number prefix 2536A and above)

Non-Exchange Assemblies

PART NUMBER	DESCRIPTION	S/N PREFIX 2528A and BELOW	S/N PREFIX 2536A and ABOVE
09121-61611	Ribbon Cable Assembly	X	
09123-61611	Ribbon Cable Assembly		X
09123-61602	DC Power Cable	X	
09123-61604	DC Power Cable		X

Setup

If the Touchscreen II is not available to power the HP 9123D Disc Drive unit, a DC power cable (Part #09123-61603) and a power supply capable of providing +5 VDC @ 2.2 A and +12 VDC @ 3.0 A max. (250ms), .6 A average, may be used. Figure 4-6 shows the interconnection for the disc drive, cable, and power supply.

The +5 VDC supply must be adjusted to +4.88 VDC \pm 0.03 VDC at the Controller PCA. Use the +5 VDC test point on TS1 (See Figure 4-1).

Controller Electronics Assembly

Figure 4-1 represents the controller electronics printed circuit assembly. Along with key components, the test points are also labeled.

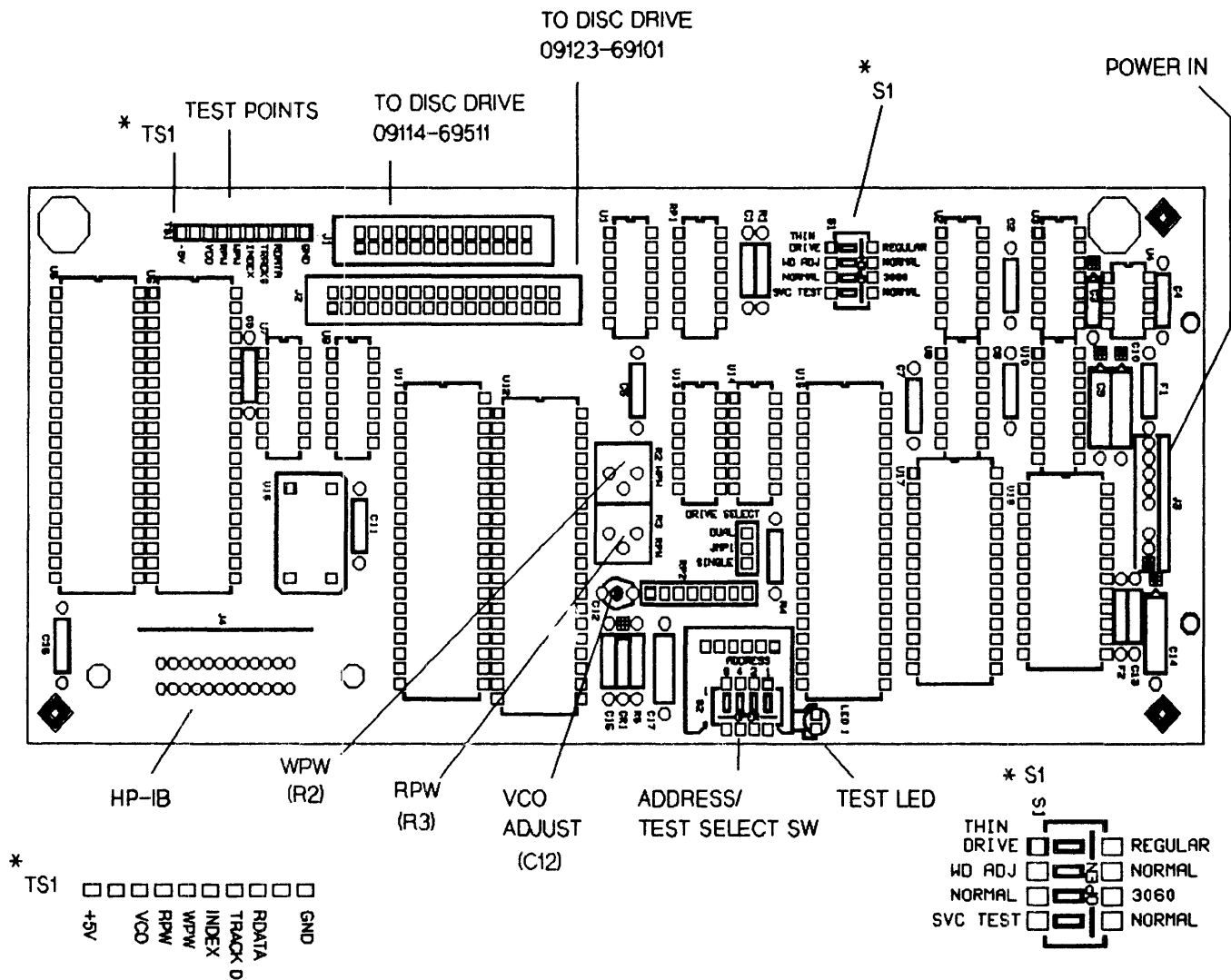


Figure 4-1. Controller PCA.

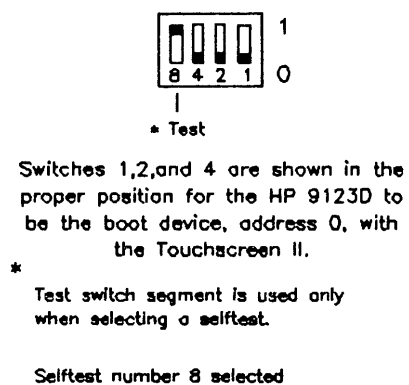


Figure 4-2. HP-IB/Selftest Select Switch.

Selftest

The selftest diagnostic capability of the HP 9123D can be initiated in three ways: Power-on, service initiated, and I/O bus initiated. The HP 9123D power-on selftest tests the RAM, ROM, FDC, HP-IB and PIA chip. In addition, a write/read, and seek test will be performed when formatted, unprotected discs are inserted before powering the unit on.

The service diagnostic testing function allows selection and looping of any of the test choices in the following table.

To initiate a test, perform the following:

1. To gain access to the HP-IB/Selftest switch, the top cover must be removed. Refer to the Top Cover Removal information in Chapter 5 for the removal information.
2. Apply power to the unit and allow the power-on selftest to complete.
3. Install formatted, unprotected discs if tests 6 through 13 are to be performed. (Note: Scratch discs should be used, as some tests destroy the data and format)
4. Set the HP-IB ADDRESS switch to the desired test number (see Figure 4-2).
5. Select the "SVC TEST" position of switch S1 to start the test. To loop on a selected test, leave switch in the "SVC TEST" position. Reselect the "NORMAL" position to run the test only once.

The fault LED will blink once at the beginning of the test, followed by either a:

--Test pass indication Fault LED blinks 5 times

Test results are displayed for 5 seconds followed by a complete power-up sequence.

OR

--Test fail indication Fault LED stays on

NOTE

To reset the unit after a test has failed, select the "NORMAL" and then the "SVC TEST" position of switch S1. Turning the computer system off, and then on again, will also reset the unit. Once reset, and if switch S1 is in the "SVC TEST" position, the test which was selected will be run.

When looping on a test, the following occurs:

1. A power-up sequence; indicated by the blinking LED
2. Test execution; indicated as follows
 - A. The test passes; LED blinks (number of blinks depends on test number). The test is repeated until switch S1 is returned to the "NORMAL" position.

TROUBLESHOOTING

B. The test fails; LED stays on. The test is not repeated.

NOTE

A disc must be in the drives to perform test 6 through 13. Ensure that the discs are not write protected and that they are initialized scratch discs.

Available Tests

		Test Time	
0	RAM	2s	all patterns are written in all locations of RAM
1	ROM	2s	a checksum calculation is performed
2	HP-IB chip	2s	two of the registers are written and their content verified.
3	FDC chip	2s	two of the registers are written and their content verified.
4	Drive 0 Seek	3s	commands are given to the FDC to move the head on and off of track 0. The track 0 indicator is checked to see that movement occurred.
5	Drive 1 seek	3s	same as above but on drive 1.
6	Motor 0 speed	3s	the head is stepped to track 35 and loaded. The period of the index pulse is measured and compared against the specification. No test if no disc in drive.
7	Motor 1 speed	3s	same as above but on drive 1.
8	Write/verify disc 0	80s	writes on every sector of the disc and verifies the data written.
9	Write/verify disc 1	80s	same as above but on drive 1.
10	Verify disc 0	35s	all sectors in the data area of the disc are checked for CRC errors.
11	Verify disc 1	40s	same as above but on drive 1.
12	Format disc 0	75s	the disc is re-initialized with a 011 data pattern.
13	Format disc 1	75s	same as above but on drive 1.

14 PIA test

1s the registers in the PIA chip are written to and their content verified.

Additional Hints

The power-on selftest can be used to isolate the PCA or the drive in the following manner:

- With no disc installed, apply power to the unit. If the selftest fails (the TEST LED stays on) the controller PCA or drive cable (flat ribbon) is the cause of the failure.
- If the preceding test passed, power down the unit and insert an initialized scratch disc and power up the unit. The selftest will now attempt to do a write and then a read from the disc. If it fails at this point, you should attempt to use another new initialized scratch disc and repeat the test. If it still fails then use the available selftest described on the previous page to further isolate the problem.
- If you have one drive which continually fails the selftest, you can swap the LOGICAL position (exchange disc drive addresses) of the drives by doing the following:
 1. Using Figure 4-4 or 4-5 as a reference, take the disc drive select switch of PHYSICAL drive 0 and set it to position 1.
 2. Set PHYSICAL drive 1 disc drive select switch to position 4.
- Power on the unit, with discs installed in each drive, and see if the problem follows the logical position of the drive. If it does, then the controller PCA or the drive cable is the problem.
- If the problem does not follow the drive, then the drive you were originally having the problem with is at fault.

Return the drive select switch of each drive to its original position (refer to Figure 4-4 or 4-5 for original positions).

NOTE

If you have problems reading discs written on by other systems or other systems have problems reading your discs, proceed to the Adjustments section that follows only after you have verified that a known-good formatted disc presents the same symptoms. This type of problem may mean that the PLL has drifted out of tolerance.

Adjustments

The Phase Lock Loop (PLL), Read Pulse Width (RPW), and Write Pulse Width (WPW) adjustments are performed as follows. The PLL adjustment should be performed when the unit exhibits read/verify errors. The RPW and WPW adjustments are not recommended as they rarely drift. If you are experiencing read errors, the Read Pulse Width (RPW) may have drifted out of specification. Refer to the RPW and WPW Adjustment section for the adjustment procedure.

NOTE

When using a external power supply, ensure that the +5 volt supply is adjusted for +4.88 volts \pm .03 volts at the controller PCA. Use the +5 volt test point on TS1 (Refer to Figure 4-1).

PLL Adjustment

Perform the following procedures at an ambient temperature of 25° C (77° F) in the order specified.

Use Figure 4-1 for locating test points.

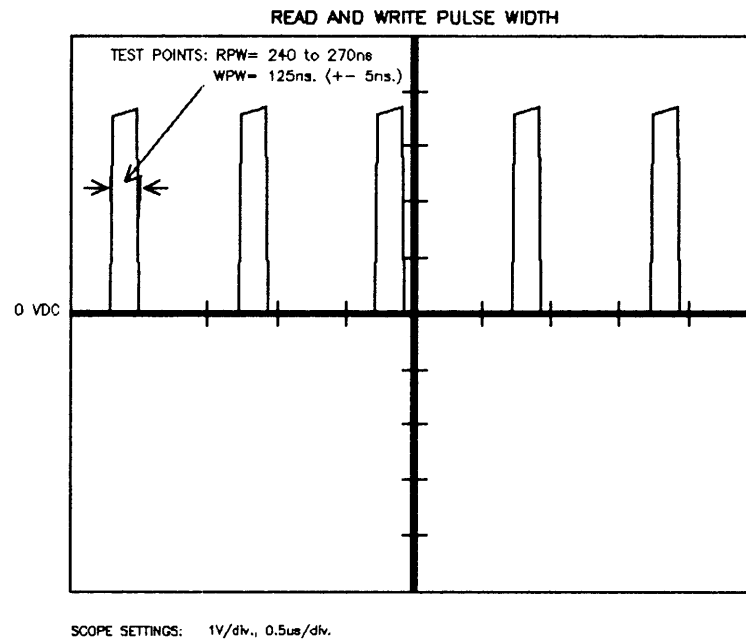
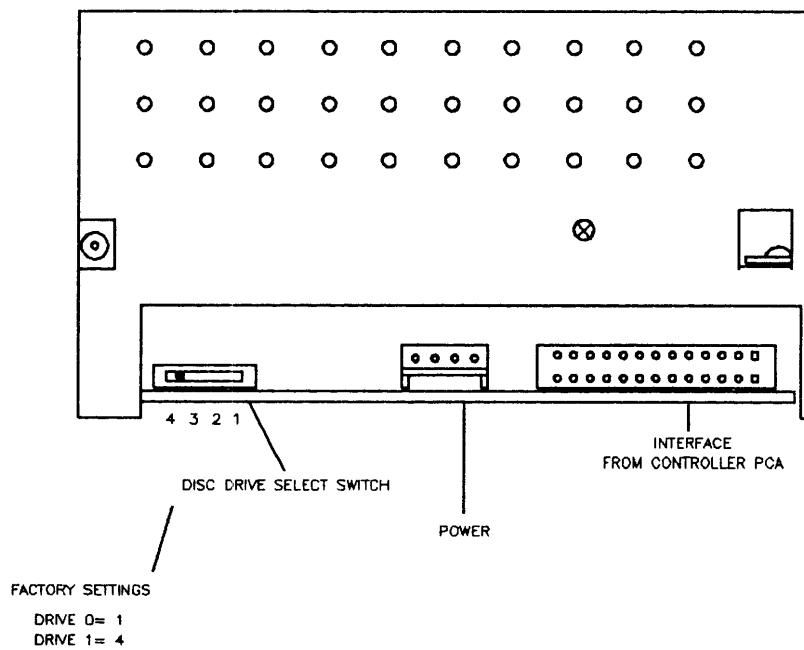
1. Power on the unit, and allow the power-on selftest to finish.
2. Select the WD ADJ position on switch S1. This enables the FDC adjust mode.
3. After a 2 minute warmup, attach the frequency counter test leads to the VCO test point. The frequency should be 500 KHz \pm 5%. If adjustment is necessary, adjust the variable capacitor C12 for a frequency of 500 KHz \pm .2% (\pm 1 KHz).
4. Return the WD ADJ/NORMAL switch of S1 to the "NORMAL" position.
6. Verify disc operation.

RPW and WPW Adjustment

Use Figure 4-1 for locating test points.

1. Perform the preceding power-on and warm-up procedure (Steps 1 and 2)
2. Attach the oscilloscope test lead to the RPW test point.
3. Observe the waveform pulse-width (see Figure 4-3). The pulse width should be between 230 and 270ns. measured at the 50% voltage point. If the pulsewidth is on either side of the specification just given, replace the controller PCA.
4. Attach the test lead to the WPW test point and observe the pulse width. The width should be 125 ns \pm 5ns. If not, adjust resistor R2.
5. The RPW and WPW adjustments are rarely necessary. Perform only if the adjustments were inadvertently altered or in the case of excessive read errors, the RPW should be adjusted.
6. Return the "WD ADJ" switch of S1 to the "NORMAL" position.

7. Verify disc operation.

**Figure 4-3. Read/Write Pulse Width.****Figure 4-4. Disc Drive Select Switch (09114-69511).**

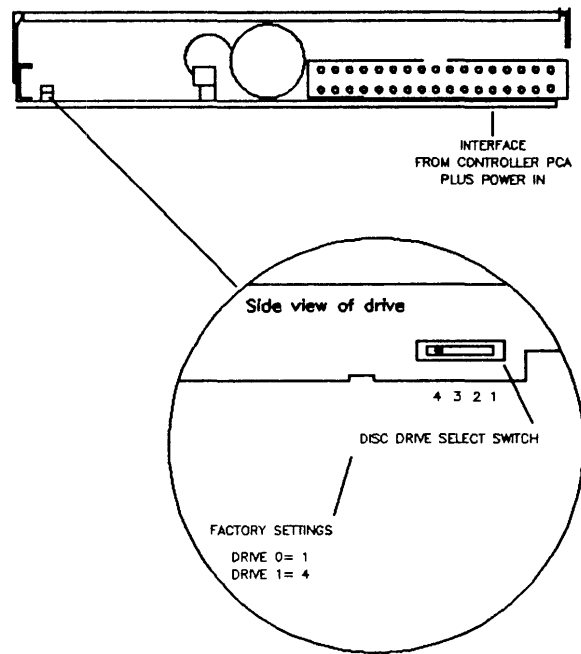


Figure 4-5. Disc Drive Select Switch (09123-69101).

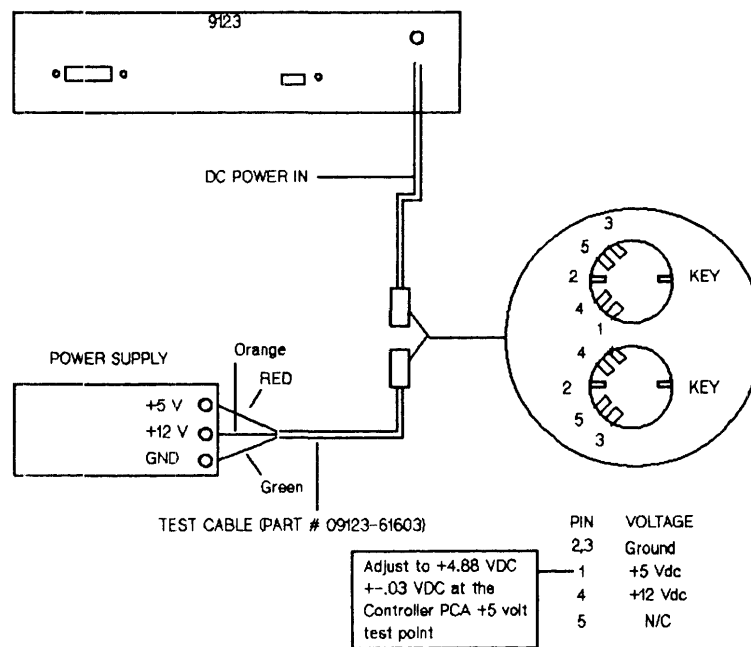


Figure 4-6. External Power Supply Interconnect.

Top Cover Removal

To remove the top cover perform the following steps.

- Remove the cable cover at the rear of the unit by pushing the two tabs, located on sides of the cable cover, towards the center of the unit and pulling the cover straight back.
- Remove the two cover securing screws on the rear of the unit.
- Tilt the rear of the cover upwards, and carefully remove the cover in a foreward direction.
- Assembly is performed in the reverse order.

Controller Board Removal

To remove the printed circuit assembly (PCA) complete the following steps.

- Remove the two screws that attach the HP-IB connector to the chassis.
- Remove the DC power connector J3 and disc drive cable J1 from the PCA.
- Pull the PCA upwards to remove it from the two plastic lock-pins.
- Tilt the PCA upwards enough to clear the disc drives and lift the PCA from the chassis.
- To assemble, reverse the above process. (There is one lanced board guide on the rear of the chassis; be sure that one edge of the PCA is placed in the board guide when installing the PCA.)

Disc Drive Removal

Disc drive removal for products having a serial number prefix of 2528A and below.

- Remove the flat ribbon and power cables from drive "0" and "1".
- To remove drive "0", remove the three screws located on the bottom of the chassis.
- To remove drive "1", remove the two screws located on the bottom of the chassis and one screw located in the middle of the chassis side.
- To assemble, reverse the above process. Ensure that the drive select switch is set to the proper position. Refer to Figure 4-4, Chapter 4 of this Manual, for location and proper setting of the switch.

Disc drive removal for products having a serial number prefix of 2536A and above.

- Remove the flat ribbon cables from drive "0" and "1".
- To remove the drives, remove the screws (three per drive), located on the bottom of the chassis.
- To assemble, reverse the above process. Ensure that the drive select switch is set to the proper position. Refer to Figure 4-5, Chapter 4 of this Manual, for location and proper setting of the switch.

NOTE

Some of the early 09123-69101 disc drives have tape on the metal portion of the drives case near the front bezel. This tape is for ESD protection and is necessary only where the drives are adjacent to each other in the HP 9123D. IF the tape is missing on either drive in this location, remove the tape from the outside location and install on the adjacent side(s).

9123D PARTS LIST

LEVEL	REFERENCE DESIGNATOR	PART NUMBER	DESCRIPTION
CONTROLLER PCA			
1		09123-66501	CONTROLLER BOARD
.2	C12	0121-0552	7-60PF VARIABLE CAPACITOR
.2	C4,13	0160-3335	470 PF 10% CAPACITOR
.2	C1,2,5-8,11,15,16	0160-4571	.1UF + 80 CAPACITOR
.2	C17	0160-4835	.1UF 10% 50V CAPACITOR
.2	C9	0180-0228	22UF 15V CAPACITOR
.2	C10,14	0180-0229	33UF 10V CAPACITOR
.2	C3	0180-0291	1UF 35V 10% CAPACITOR
.2	R1	0683-1015	100 OHM .05
.2	R5	0757-0280	1K 1% .125W
.2	U17	09123-89900	CONTROLLER EPROM
.2	U17	09123-89901	" " (S/N prefix 2536A and above)
.2	EPROM SOCKET	1200-0861	28 PIN SOCKET
.2	TEST POINTS	1251-5238	CONNECTOR 10 PIN
.2	J4	1251-7651	CONNECTOR
.2	J1	1251-8248	SQUARE POST
.2	RP1	1810-0162	4.7K RESISTOR NETWORK
.2	RP2	1810-0205	4.7K RESISTOR NETWORK
.2	U7	1813-0194	XTAL-CLOCK-OSCILLATOR
.2	U18	1818-1611	IC-STATIC RAM
.2	U1,8	1820-0471	IC-SN7406N
.2	U9	1820-0681	IC-SN74S00N
.2	U13	1820-1112	IC SN74LS74AN
.2	U2	1820-1208	IC-74LS32
.2	U10	1820-1216	IC-SN74LS138
.2	U3	1820-1416	IC SN74LS14N
.2	U14	1820-1433	IC SN74LS164N
.2	U7	1820-2096	IC SN74LS393N
.2	U6	1820-2549	IC-8291AP
.2	U15	1820-2624	IC-68B09
.2	U11	1820-2983	IC 68B21
.2	U12	1820-3659	WD-2793-02 FDC
.2	U4	1826-1273	IC TL7705CP-8
.2	CR1	1901-0050	DIODE, SWITCHING
.2	LED1	1990-0450	LED-LMP
.2	U5	1LH4-0001	TRANSCEIVER
.2	R2,R3	2100-3210	10K TRIMMER RESISTOR
.2	F1,F2	2110-0447	FUSE 3A 125V
.2	SW1,2	3101-2063	SWITCH

CASE PARTS

Drive Mounting Hardware

1		0515-1038	SCREW (S/N PREFIX 2536A AND ABOVE)
1	(5 EACH)	0515-1025	SCREW (S/N PREFIX 2536A AND ABOVE)
1		0624-0583	SCREW (S/N PREFIX 2528A AND BELOW)

Top Cover Hardware

1		0590-0681	U-CLIP
1		09123-44401	COVER, PLASTIC
1		2360-0117	MACHINE SCREW 6-32

HP-IB Mounting Hardware

1		0380-1717	STANDOFF-HEX
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Miscellaneous Parts

1		0403-0427	BUMPER FOOT
1		0460-0043	TAPE-INDL 3 IN
1		0460-0050	TAPE-INDL .75 IN
1		0515-0076	MACHINE SCREW 3X.5 6MM
1		0515-0922	MACHINE SCREW
1		0515-1079	SCREW CAP M3X.5 8MM
1		09121-61611	RIBBON CABLE ASSY (S/N PREFIX 2528A AND BELOW)
1		09123-61611	" " " (S/N prefix 2536A AND ABOVE)
1		09123-44402	PANEL, CABLE COVER
1		09123-61602	DC POWER CABLE (S/N PREFIX 2528A AND BELOW)
1		09123-61604	" " " (S/N PREFIX 2536A AND ABOVE)
1		09123-84301	NAMEPLATE
1		09123-84302	LABEL, REAR PANEL
1		2190-0008	LOCK WASHER EXT T#6
1		2190-0409	LOCK WASHER INTL #8
1		5180-0001	LABEL- UL

MECHANICAL PARTS

1		09114-69511	FLEXIBLE DISC DRIVE(S/N PREFIX 2528A AND BELOW)
1		09123-69101	" " " (S/N PREFIX 2536A AND ABOVE)
1		7101-0783	FRONT BEZEL FOR 09123-69101 DRIVE

EXCHANGE ASSEMBLIES

1	09114-69511	FLEXIBLE DISC DRIVE(S/N PREFIX 2528A AND BELOW)
1	09123-69101	" " " (S/N PREFIX 2536A AND ABOVE)
1	09123-69511	CONTROLLER PCA

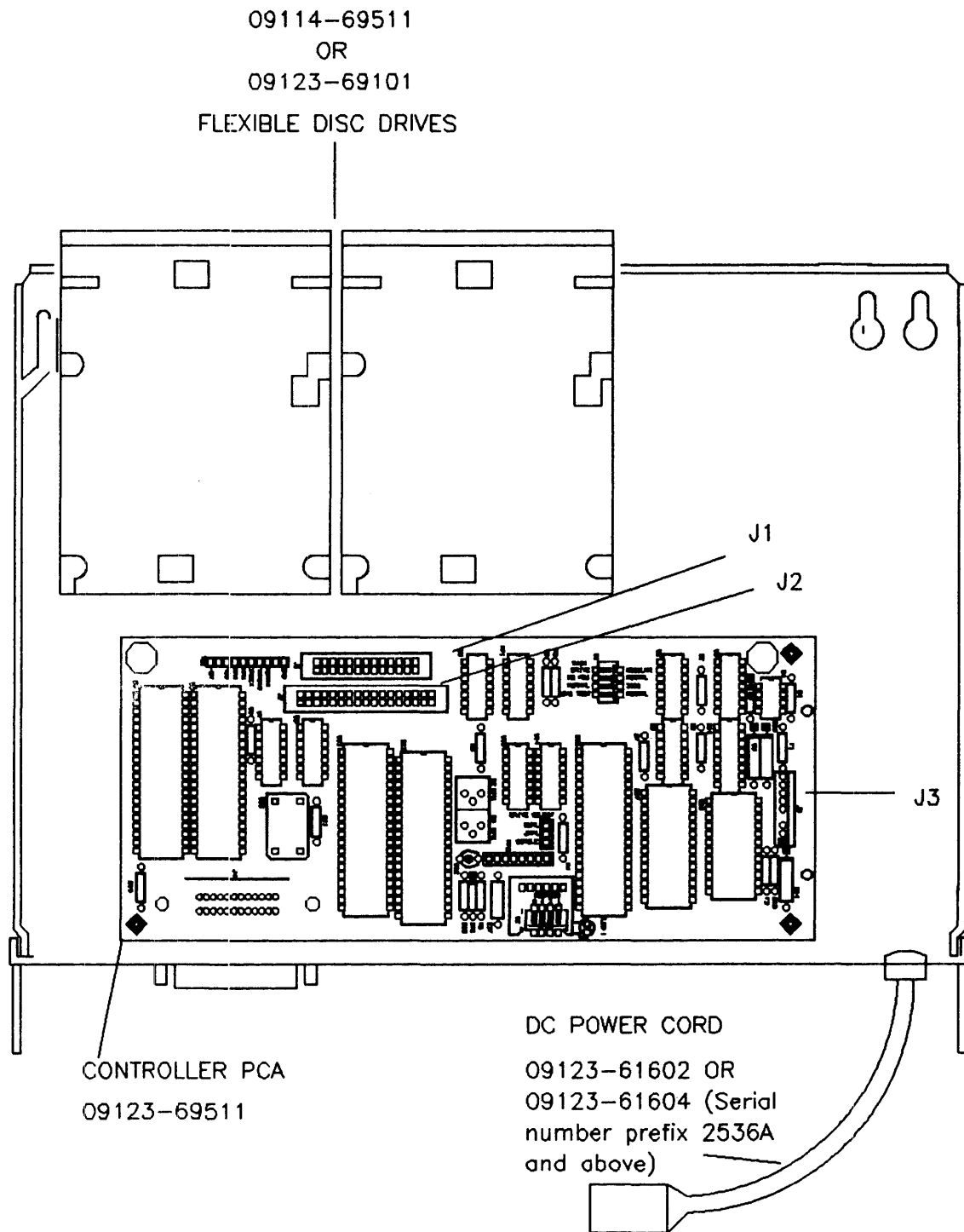


Figure 5-1 Field Replaceable Assemblies (FRA)

Appendix A

HP Flexible Disc Drive Command Set

Introduction

The following description of the Disc Drive command set is HP-IB rather than CPU oriented. It is given in terms of operations (mainly bytes sent) over the HP-IB. All host computers interfacing to the 9121D/S and the 9133 will use these commands. For the rest of this section where the 9121D/S is referenced, please keep in mind that the implementation is the same for the flexible disc portion of the 9133.

A basic knowledge of the HP-IB operation including primary commands, secondary commands, and parallel poll operation is assumed. An HP publication "Condensed Description of the Hewlett-Packard Interface Bus", Part No. 59401-90030, is available for background information. HP-IB is an implementation of IEEE Standard 488-1978.

HP Flexible Disc Drive	the HP family of flexible disc drives: 82901M, 82902M, 9895M, 9135, 9133, and 9121D/S.
Bus Controller	the current HP-IB controller in charge of the HP-IB.
Controller	micro-flexible disc drive controller hardware or firmware.
Unit	one of two drives connected to the controller.
Flexible Disc, Disc or Diskette	the coated mylar media on which data is recorded by the disc drive.
HP Format	the double density single sided HP standard recording format as defined by this document.
Physical Track Number	the track number relative to the outer most track on the disc.
Logical Track Number	the track number recorded on the disc at a physical track. Logical track numbers may or may not be the same as physical track numbers.
Head	the device used to record or read data on the micro-flexible disc. Even though the 3 1/2-inch drives have only one head, the addressing will mimic the 8290x which has two heads per drive.
Track	the area defined by a cylinder and head address.
Cylinder	the recording area accessible by the head without moving the head actuator.
Sector	the smallest block of data that can be read or written from the disc.
Host System	the system which contains the Bus Controller.

Command Compatibility

The 9121D/S and the 9133 belong to a set of command compatible HP-IB interface disc drives. All of these disc drives meet the “HP-300 compatible HP-IB” standards. The same sequence of HP-IB operations can be used to transfer data to and from any of these discs.

There are some subtle differences between HP-300 Compatible HP-IB and IEEE Standard 488-1978.

- (1) An identify code sequence by the host, used to determine what class of devices and which device is connected, is not supported by IEEE 488-1978.
- (2) Disc read and write operations cannot be suspended and resumed; i.e., an Untalk or Unlisten command terminates command operation. This is not consistent with IEEE 488-1978.

Since the capacity and organization of a flexible disc is different from other HP-IB compatible discs, the allowable range of certain parameters is also different than the other discs. The 9121D/S and 9133 have been configured to appear exactly as a HP8290x.

Certain commands used in formatting a flexible disc or for diagnostic purposes are unique to the 8290x/9121D/S. Similarly, certain commands supported by other discs are not supported by the 8290x and/or the 9121D/S. An unrecognized command causes an error to be set, but has no detrimental effect on controller operation.

9121D/S and HP 82901/2 Compatibility

The 9121D/S is designed to operate using existing host mass storage drivers for the HP 82901/2. THE 9121D/S's response to commands for a HP 82901/2 will be the same as the response of the HP 82901/2. All necessary transformations of addresses will occur within 9121D/S, so that from host driver standpoint, the 9121D/S will have 35 cylinders, 2 heads, 16 sectors per track, with 256 bytes in each data field, same as the HP 82901/2. The two bytes returned in response to the Identify command from the host will identify the 9121D/S as an HP 82901/2.

To provide extra performance, many commands have been added to the 9121D/S command set that are unsupported by the 8290X. In addition to these new commands, a way to distinguish between the 9121D/S and 8290X is provided in the Request Status command.

Command Sequences

Much of the Flexible Disc Drive command set shown in this section is made up from two basic types of HP-IB sequences.

To send information (commands or data) to the Flexible Disc Drive, the Bus Controller addresses the Flexible Disc Drive to Listen, and then sends a secondary command byte followed by a series of information bytes. The last information byte sent must be tagged with an EOI. Finally the Bus Controller sends an Unlisten command, and the sequence is complete.

To receive information (status or data) from the 9121D/S, the Bus Controller addresses the 9121D/S to Talk, and then sends a secondary command byte. At this point the device sends back a series of bytes. In some cases the last byte will be tagged with EOI. In cases where the last byte is not tagged with EOI, an additional byte tagged with EOI is made available. This extra byte may be used to detect that a byte was dropped on the HP-IB, or it can be used to determine the end of a transfer without maintaining a byte count. Finally the Bus Controller issues an Untalk and the sequence is complete.

Sequences other than the ones shown may in some cases work, but, there is no guarantee that they will be compatible with other HP-IB discs, or with future HP Flexible Disc Drive's.

Parallel Poll Response

Parallel poll is used as an additional means of communication between the 9121D/S and the Bus Controller. If the 9121D/S is ready to accept the next part of a command sequence, it will respond to the parallel poll conducted by the Bus Controller.

After accepting most secondary command bytes the micro-flexible disc drive disables the parallel poll response. This indicates that the device is busy processing the current part of the command sequence. The actual disabling of parallel poll response may occur up to 100 microseconds after the secondary is accepted by the micro-flexible disc drive. Thus, if the drive has the parallel poll enabled, the Bus Controller is fast enough to send a command sequence and then conduct a parallel poll before the 9121D/S has disabled the poll response, the Bus Controller would see the wrong parallel poll response. To solve this problem an intentional delay can be introduced, or a DSJ command (this disables parallel poll response) can be issued before other commands.

The use of the DSJ command as a parallel poll response interlock does not apply in one case. A DSJ cannot be used to disable the poll response which occurs in the middle of certain data transfer command sequences. (For example, in the Buffered Write and Initialize commands, the transfer of data bytes normally provides an interlock.)

Cylinder and Track Numbering

Starting from the outer track, the tracks are numbered sequentially from 0 to 69. These numbers are the PHYSICAL track addresses. A track is the intersection of a cylinder and a head. All addressing is done using a cylinder and head address. The track address is calculated by cylinder times 2 + head. The 9121D/S performs all the necessary conversions and is addressed as an 8290X. There is also a LOGICAL track address associated with each "good" (i.e. non-invisible) track. If a disc has no bad tracks, the logical address of a track is the same as the physical address.

A disc with bad tracks can be made to look like a slightly smaller disc with no bad tracks. To do this, the bad tracks are specially marked to indicate that they have no logical address. A track marked in this way is referred to as an invisible track. The remaining good tracks are sequentially assigned logical track numbers. Logical track 0 is the outer-most good track (it may or may not be physical track 0).

During normal operations the user need be concerned only with logical addresses. The Flexible Disc Drive controller will take care of finding the proper physical address.

Target Addressing

Each unit has a target address associated with it. This is the logical address of the next sector which will be accessed by a Data Transfer command or returned by an address request. This sector is referred to as the target sector. It is uniquely determined by a target cylinder address, a target head address, and a target sector address.

Following a power up or a Clear command the target address will be set to cylinder 0, head 0, sector 0.

A seek command sets the target address to the cylinder, head, and sector indicated in the command sequence.

During a data transfer, the target address is automatically updated so the successive logical sectors can be read or written without issuing a seek to each sector. This includes updates which cross track or cylinder bounds. The 9121D/S, like the HP8290x, is always in cylinder mode, that is, the head address will be incremented before the cylinder address.

As an example of the incrementing of the target address...

Cylinder	Head	Sector
0	0	14
0	0	15
0	1	0
...		
0	1	15
1	0	0

If a data transfer terminates abnormally, the target address is left pointing at the sector which caused the termination.

The D Bit

Each sector has a flag called the D Bit. It is used to indicate that a track is defective (which is different than invisible). The D Bit can be set or cleared using the Initialize command. A set D Bit affects the Read, Write and Format commands and is indicated in the returned status.

The Format command is used to convert all tracks flagged with the D Bit into invisible tracks.

Holdoffs

The 9121D/S does not execute most operations when it enters the DSJ = 2 state (power on state). It is very important to know how this state is entered and the commands that will remove the holdoff.

1) DSJ = 2 or Power on State

This state is entered after:

- a. The 9121D/S is powered up,
- b. After the execution of the Initiate Selftest command,
- c. After the execution of the manual selftests.

As long as DSJ = 2, the commands listed below will not be executed. There are, however, two commands which may be executed either to change the DSJ or override its holdoff. These commands are:

- a. The DSJ command,
- b. The CLEAR commands.

For both DSJ and Clear the DSJ value will change from 2 to 0.

The only way for the Bus Controller to realize that the device was in the power on state is by sending the DSJ command (which clears the state).

The purpose of this holdoff state is to withhold all operations that may occur during normal 9121D/S usage until the Bus Controller can become aware that the power has been interrupted.

The following is a list of the commands not executed while in the DSJ = 2 state:

- a. All Read commands.
- b. All Write commands,
- c. Verify,
- d. Initialize,
- e. Format,
- f. Seek,
- g. End,
- h. Request Status,
- i. Request Disc Address commands.

The 9121D/S will, however, respond to a primary Talk command from the above group by sending one byte (of value 1) tagged with EOI. Also, all data bytes sent to the 9121D/S as part of the commands listed above will be accepted but ignored. These actions will cause the 9121D/S not to hang (timeout) the HP-IB until the Bus Controller is aware of the holdoff.

Commands

The details of the Disc Drive HP-IB command set are given below. The following conventions are used:

XXXXXXXX Byte sent between the bus controller and the Disc Drive.

P	}	Parallel Poll response disabled.
P		
D		
P	}	Parallel Poll response enabled.
P		
E		
ADDR	The 9121's current HP-IB address (set by 3 switches on back panel).	
P	HP-IB parity bit, ignored by 9121D/S.	
UUUU	Unit number ($0 \leq \text{UUUU} \leq 3$).	
S1	Status one.	
S2	Status two.	

Command Table

8290X Compatible Commands

	T/L	Secondary	Opcode	Data Bytes	Hold off for DSJ = 2
Identify		ADDRS	---	-	NO
DSJ	T	10H	---	1	NO
Read Selftest	T	1FH	---	2	NO
Request Status	L	08H	03H	2	YES
Req Logical Address	L	08H	14H	2	YES
Req Physical Address	L	0CH	14H	2	YES
Send Status or Address	T	08H	---	4	YES
Universal Clear	U	---	---	-	NO
HP-300 Clear	L	10H	---	1	NO
Initiate Selftest	L	1FH	---	2	NO
Seek	L	08H	02H	6	YES
End	L	08H	15H	2	YES
Buffered Read	L	0AH	05H	2	YES
Verify	L	08H	07H	4	YES
Send Data	T	00H	---	-	YES
Buffered Write	L	09H	08H	2	YES
Initialize	L	08H	0BH	2	YES
Format	L	0CH	18H	4	YES
Receive Data	L	00H	---	-	NO

Additional Commands Not On 8290X

Read Loopback Record	T	1EH	---	1-256	NO
Send Wear	L	0CH	16H	3	YES
Write Loopback Record	L	1EH	---	1-256	NO
Download	L	0FH	---	1-256	NO
HP-IB CRC	L/T	11H	---	-	NO
Buffered Read Verify	L	0BH	05H	2	YES
Unbuffered Read Verify	L	0CH	05H	2	YES
Cold Load Read	L	08H	00H	2	NO

Command Table:

H – Hexadecimal number, T – Talk Primary

L – Listen Primary, U – Universal Primary

Sense Commands**Identify**

Type: Sense

Purpose: 9121D/S returns a code unique to the flexible disc subsystem to allow for auto configuration of systems. These ID bytes are identical to those of the 8290X.

Description: Upon the reception of a Talk 31 (same as UNTALK) followed by the secondary corresponding to the 9121's current HP-IB address, the 9121D/S will respond by sending the ID bytes of 01 and 04 Hex, the second byte being tagged with EOT.

HP-IB Sequence:

ATN	ATN		EOI	ATN
P1011111	P11ADDRS	00000001	00000100	P11ADDRS
Primary Untalk	My Secondary	ID Byte 1	ID Byte 2	Other Primary or Secondary

NOTE

Even though the 9121D/S and 8290X return the same Identify bytes, distinction between the two is possible using the Request Status command.

DSJ

Type: Sense

Purpose: The 9121D/S returns a byte indicating if the last operation completed normally or abnormally, or if the power to the 9121D/S has just been restored. The DSJ command also provides a way to disable the drives's parallel poll response.

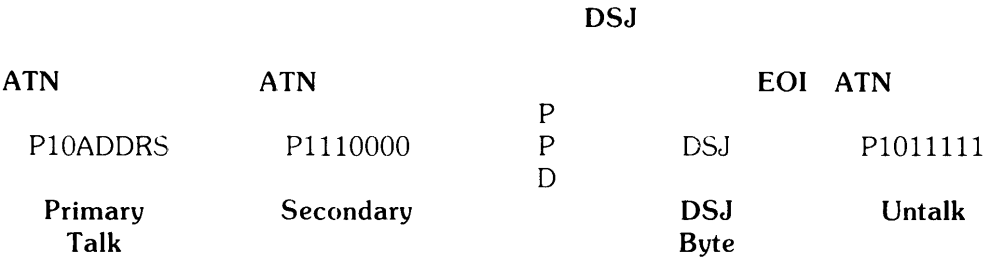
Description: After accepting the DSJ secondary, the 9121D/S disables its parallel poll response (within 100 microseconds) and returns a byte (the DSJ byte) reflecting the status of the controller.

DSJ = 0 - The 9121D/S completed its last operation normally.

DSJ = 1 - The 9121D/S aborted its last operation abnormally. Status will indicate the current error. Use the Request Status command to find the cause and clear the DSJ = 1 condition.

DSJ = 2 - The 9121D/S has just completed a power up sequence or selftest and is in the DSJ = 2 holdoff state.

HP-IB Sequence:



Status (upon command completion):

No errors

S1 - Unchanged

S2 - Unchanged

DSJ - For DSJ = 0 or DSJ = 1 unchanged

- For DSJ = 2 then 0

Illegal secondary

S1 - I/O program error

S2 - Unchanged

DSJ - 1

Parallel Poll: Parallel Poll is disabled after the reception of the the secondary and is not re-enabled after the completion of the command.

Read Selftest Results

Type: Sense

Purpose: The 9121D/S returns the results of the last selftest it has performed. This is useful after the Initiate Selftest command or after the 9121D/S has been powered on (the 9121D/S performs a minimal selftest at power on).

Description: After receiving the selftest secondary, the 9121D/S makes two bytes of selftest results available.
The second byte will be tagged with EOI.

HP-IB Sequence:

ATN	ATN		EOI	ATN
P10ADDRS	P1111111	P P D	EHUU1000	000TTTTA
				P P E
Primary Talk	Secondary		Selftest results	Untalk

Where: E - Error Bit. Set if an error has occurred.

H - Head Number. Always 0.

UU - Unit Number. Indicates which unit was selected when the error occurred.

TTTT - Test Number. Number of the failing test.

0001 - RAM test failure

0010 - ROM test failure

0100 - Flexible disc controller chip test failure

0101 - Motor speed error

0111 - Format test error

1000 - Verify test error

0110 - Seek test failure

A - ATTENTION - a test failed

Status: No errors

S1 - 0

S2 - Unchanged

DSJ - Unchanged

Illegal Secondary

S1 - I/O program error

S2 - Unchanged

Parallel Poll: If only one of the specified number of bytes is accepted by the HP-IB Controller, the parallel poll response is assured to be re-enabled upon the reception by the 9121D/S of the Untalk command.

Read Loopback Record

Type: Sense

Purpose:	The 9121D/S sends up to 256 bytes (see Write Loopback Record) from its internal data buffer over the HP-IB. This is used by diagnostics to test the HP-IB data path.
----------	--

Description: Upon accepting the loopback secondary, the 9121D/S sends the bytes stored in its internal buffer. The most significant byte of the first word is transferred first. The 256th byte will be tagged with an EOI and the transfer terminated. If fewer than 256 bytes are requested, the device will realize that the transfer is complete when:

1. The 9121D/S has been untalked.
2. It accepts another byte from the HP-IB.

HP-IB Sequence:

Read Loopback Record

ATN	ATN				EOI		ATN
P10ADDRS	P11111110	P				P	P10111111
		P				P	
		D				E	
Primary Talk	Secondary		1 to 256	Data Bytes			Untalk

Status: No errors

S1 - 0
S2 - Unchanged
DSJ - Unchanged

Parallel Poll: If **less than** the specified number of bytes is accepted by the HP-IB Controller, the parallel poll response is assured to be re-enabled upon the reception by the device of the Untalk command.

Request Status

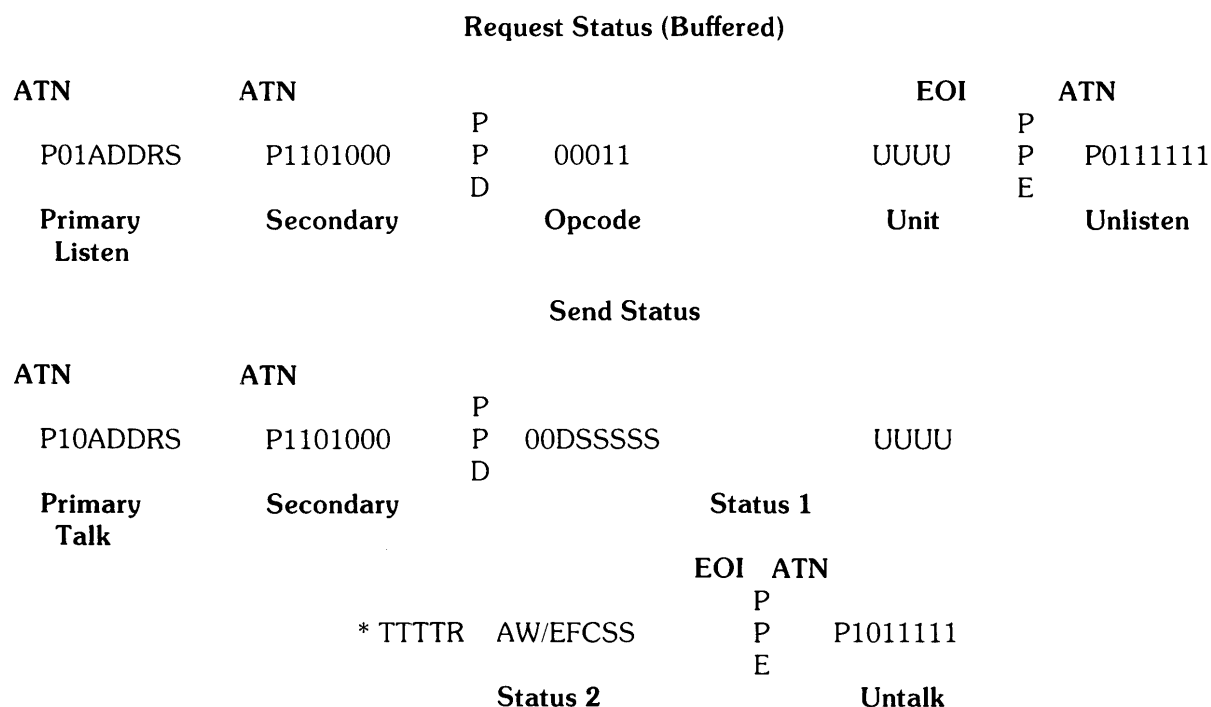
Type: Sense

Purpose: The 9121D/S returns four bytes of status information. These status bytes indicate how the last attempted operation was completed, which unit was involved, and the current status of the unit specified.

Description:	After receiving the Request Status command, the parallel poll response is disabled. If the unit specified is not the unit used in the last disc operation where an error occurred, the 9121D/S attempts to determine the type and format of the disc in the selected unit. After the status operation has completed the parallel poll response is re-enabled. The Bus Controller should now send the Send Status command.
--------------	---

After the Send Status secondary, the 9121D/S sends four bytes of status information. The first two bytes (known as Status 1) includes information about the last operation which the device performed. The Status 1 (S1) Unit field indicates which drive was involved in the operation. The D Bit is set if a D bit was encountered during the operation.

HP-IB Sequence:



Where: D -- D Bit

SSSSS -- Status 1 (See following explanation)

UUUU -- Unit number

* -- Set if one or more starred bits in Status 2 is set

TTTT -- Disc type

R -- The 9121D/S will set this bit to 1. The 8290X sets this bit to 0.

A -- Drive attention

W -- Disc write protected

E * -- Drive fault

F -- First status bit

C * -- Seek check

SS * -- Drive ready status

Status 1	Meaning
00000	Normal Completion. The operations completed without error, or the controller has just been cleared, or powered up.
00001	Illegal Opcode. The last command contained an opcode which is not recognized by the 9121D/S.
00111	Cylinder Compare Error. The target cylinder was not found.
01000	Uncorrectable Data Error. The disc read or verify operation was terminated because a data error was detected. This is the CRC error.
01001	Sector Compare Error. The target sector cannot be found in the current track. Up to five passes of the track are made before this status is set.
01010	I/O Program Error. An illegal HP-IB secondary or command sequence has been received by the controller. This status can only be set if the previous S1 was zero.
10001	Defective Track or Sector. During a write, read, or verify, a set D Bit was encountered.
10010	Retryable Hardware Error. An internal hardware timing error occurred during a data transfer or seek. The operation should be retried once.
10011	Status 2 Error. Some condition indicated in Status 2 prevented the drive related operation from completing normally. These conditions include: <ol style="list-style-type: none"> 1. Specified unit is between 0 and 3 but that drive is not connected to the controller. (The 9121D/S has only units 0 and 1.) 2. There is no disc in the drive. 3. A hardware problem is detected in the drive. 4. The disc is unformatted or has an unknown format. 5. The disc is write protected (error only during a disc write operation). 6. The selected drives First Status Bit is set.
10111	Unit Unavailable. A command included a request for a unit number greater than 3.
11111	Drive Attention. The indicated drive is requesting attention because: <ol style="list-style-type: none"> 1. A seek completed normally. 2. A seek command failed due to: <ol style="list-style-type: none"> a. Drive fault, b. Out of bounds target cylinder or sector, c. The controller cannot find the target address.
Status 2	Meaning
*	Status 2 Error. This bit is set if one or more of the following bits are set in Status 2: <ol style="list-style-type: none"> a. Drive Fault b. Seek Check

	c. Any drive Not Ready error
TTTT	Disc Type. These four bits indicate the type and format of the disc currently present in the selected drive as follows: 0000 - Empty drive or drive not present 0101 - Blank or Unknown format 0110 - HP format
A	Attention. This bit is set when a seek completes (successfully or unsuccessfully). It is cleared after the status is read.
W	Write Protected. The disc in the selected drive has the write protect tab in the edge-most position, or the disc has exceeded the allowed wear for a disc, or the spindle speed of this disc is out of specification at Format time.
E	Drive Fault. This bit is set if a drive hardware failure is detected. Drive Fault is cleared after the status is read.
F	First Status Bit. This bit is set when a disc is present in the selected drive after: a. Power on, b. Self test completion. First Status is cleared after the status is read. Because of hardware limitations imposed by the drives, this function is not available at this time. This bit is always 0.
C	Seek Check. This bit is set when a seek fails for one or more of the following reasons: a. An out of bounds target sector was specified b. An attempt was made to access a non-existent physical track, c. The seek algorithm could not find the target logical track. The Seek Check bit is cleared after the status is read.
SS	Drive (NOT) Ready. These two bits indicate the status of the selected drive as follows: 00 -- Drive Ready 11 -- No disc in drive or no drive connected

NOTE

If DSJ = 1, then the bits in the Status 2 word will not necessarily be set correctly. The R bit always reflects whether the device is a 9121D/S or 8290X.

Status: No errors

S1 - 0
S2 - the A, E, F, and C bits are cleared
DSJ - 0

Illegal secondary, Illegal command length, Illegal command opcode

- S1 - I/O program error
- S2 - Unchanged
- DSJ - 1

Parallel Poll: If less than the specified number of bytes is accepted by the HP-IB Controller, the parallel poll response is assured to be re-enabled upon the reception by the 9121D/S of the Untalk command.

An extra byte (the value of 1) tagged with EOI will be sent if the controller requests more than four bytes.

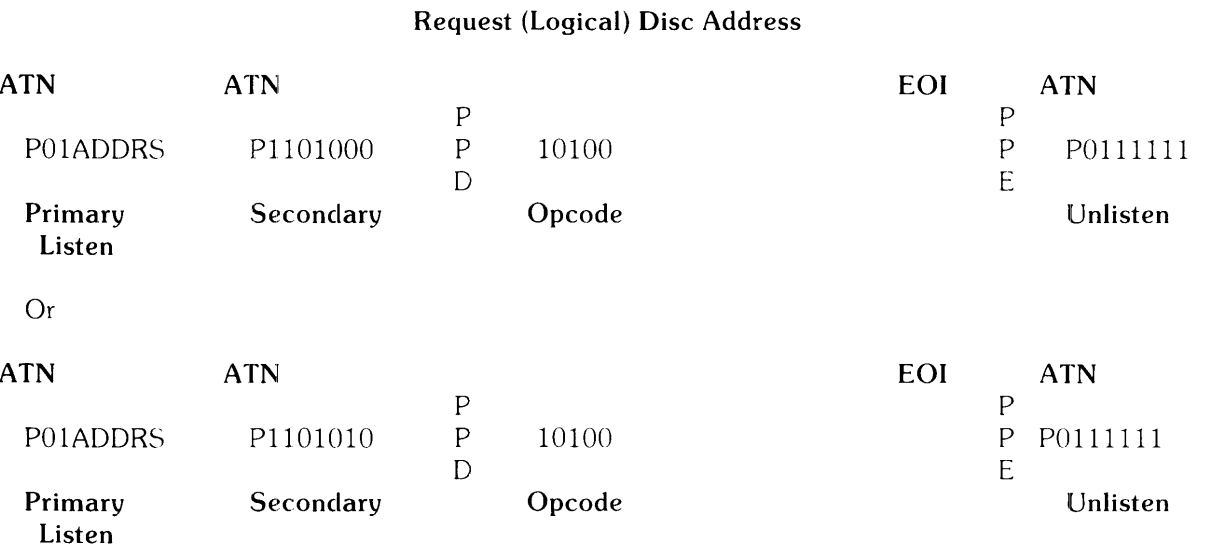
Request (Logical) Disc Address

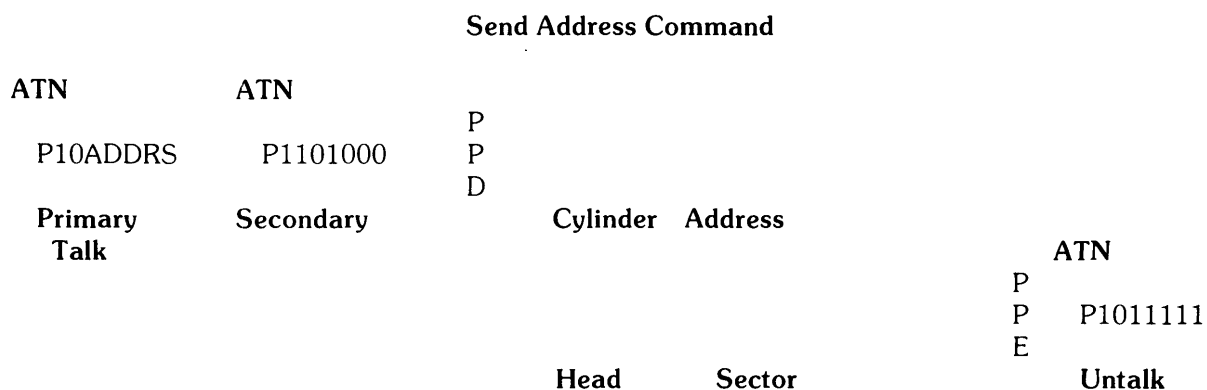
Type: Sense

Purpose: The 9121D/S returns bytes indicating the current Target address. This command is used to determine the address of the offending sector after a data error has occurred.

Description: Following reception of the appropriate command sequence the 9121D/S returns four bytes indicating the current target sector. This includes two bytes of target cylinder address, one byte of target head address, and one byte of target sector address.

HP-IB Sequence:





Status: No errors
 S1 - 0
 S2 - Unchanged
 DSJ - 0

Illegal secondary, Illegal command sequence, Illegal byte count

 S1 - I/O Program error
 S2 - Unchanged
 DSJ - 1

Illegal opcode S1 - Illegal opcode
 S2 - Unchanged
 DSJ - 1

Parallel Poll: If less than the specified number of bytes is accepted by the HP-IB Controller, the parallel poll response is assured to be re-enabled upon the reception by the device of the Untalk command.

An extra byte (the value of 1) tagged with EOI will be sent if the controller requests more than 4 bytes. However, this request is not necessary for normal operations.

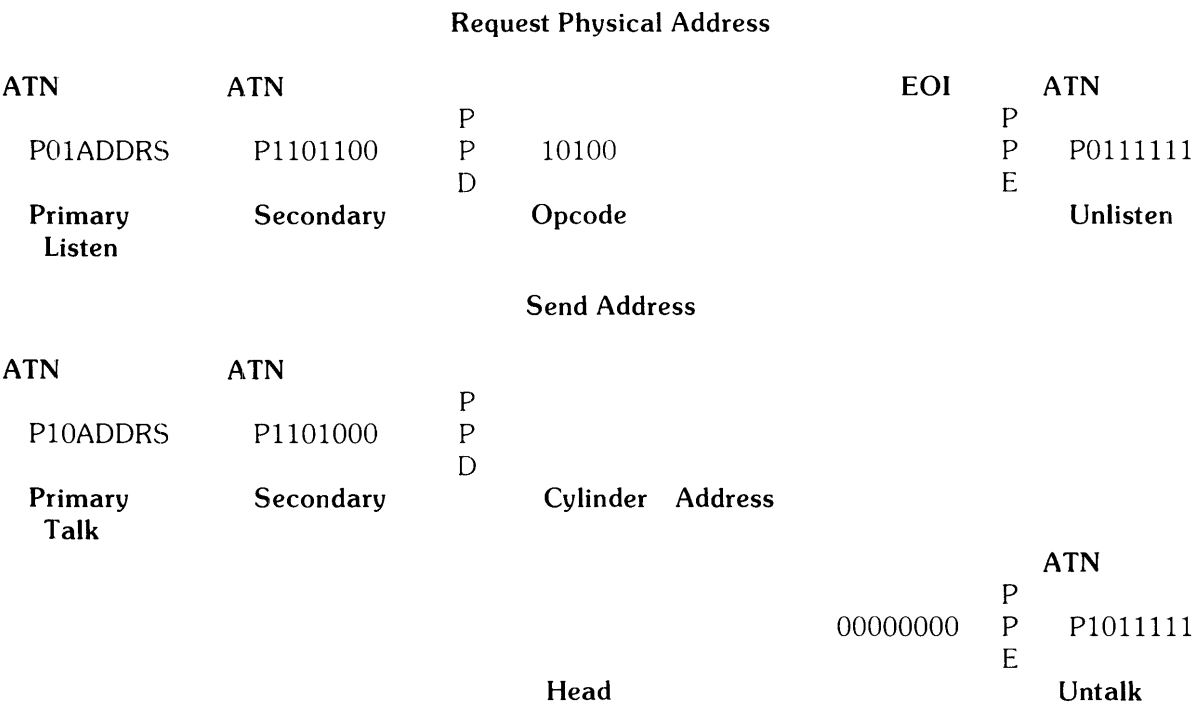
Request (Physical) Disc Address

Type: Sense

Purpose: The 9121D/S returns bytes indicating the physical cylinder on which the head actuator is positioned. This is useful for calculating the number of invisible tracks between the outer most track and the current track. This is done by subtracting the physical cylinder address from the target cylinder address.

Description: After receiving the Request Physical Address secondary and opcode, the 9121D/S returns two bytes containing the physical cylinder address, one byte containing the head address and one byte of zeros.

HP-IB Sequence:



Status: (See Request Logical Address)
Parallel Poll: (See Request Logical Address)

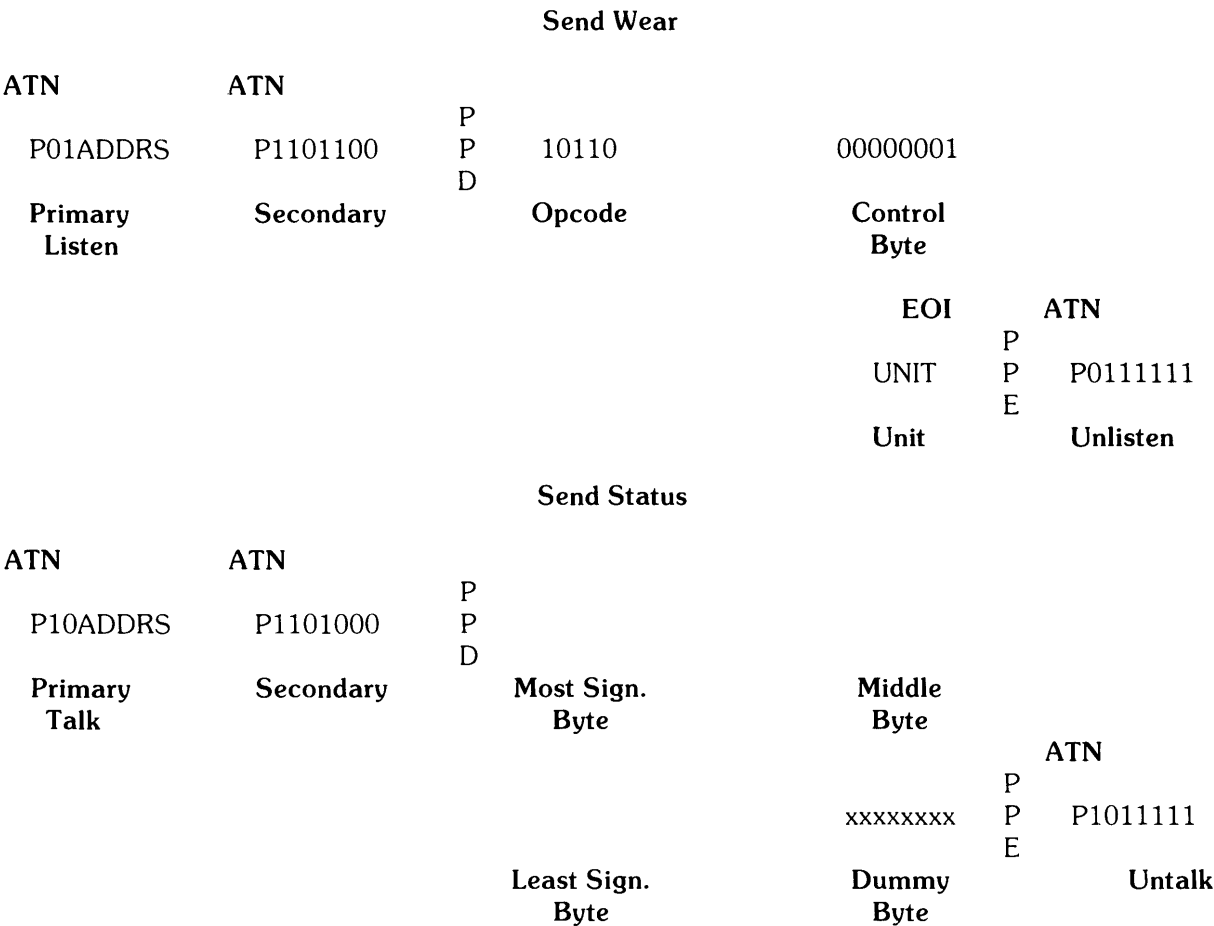
Send Wear

Type: Sense

Purpose: The 9121D/S returns bytes indicating the number of revolutions which the disc has accumulated with a loaded head. This command may be used by a host system to warn a user of impending disc wear (and the blinking light indicator).

Description: After receiving the Send Wear secondary and opcode and the Send Status command, the 9121D/S returns four bytes containing the number of revolutions recorded on the disc.

HP-IB Sequence:



Status: (See Request Logical Address)
Parallel Poll: (See Request Logical Address)

Control Commands

Universal Device Clear

Type: Control

Purpose: A Clear places the 9121D/S in a known state. Thus it is useful when initializing a system on power up or after a host system crash. The Clear also allows a power up DSJ of 2 to be cleared by sending a single byte. This is useful if the system is being reconfigured.

Description: Upon reception of a Universal Device Clear command, the 9121D/S stops handshaking with the HP-IB, parallel poll response is disabled and the following are performed:

- a. The P8291A is reset,
- b. Status 1 is cleared,
- c. Status 2 is updated appropriately,
- d. DSJ set to 0,

- e. All drives are recalibrated to physical track 0,
- f. The Target address is set to cylinder 0, head 0, sector 0
- g. The unit is set to 0, the head is unloaded and the motor is turned off.

This command may take several seconds to complete.

HP-IB Sequence:

Universal Device Clear

ATN	
	P P
P0010100	P P
	D E
Universal	

Status: No errors
S1 - 0
S2 - All bits cleared, then the E and SS bits are set if appropriate.
DSJ - 0

Parallel Poll: The parallel poll response is re-enabled after the operation is completed, normally or abnormally.

HP-300 Clear

Type: Control

Purpose: This command gives the user the capability to place the 9121D/S controller in a known state.

Description: After reception of the HP-300 Clear secondary, the data byte, and the Selected Device Clear Universal, the controller performs the actions described above under Universal Device Clear. This command may take several seconds to complete.

HP-IB Sequence:

HP-300 Device Clear

ATN	ATN		EOI	ATN	ATN
		P			P
P01ADDRS	P1110000	P		P0000100	P P0111111
		D			E
Primary Listen	Secondary	Dummy Byte		Selected Device Clear	Unlisten

Status: No errors
S1 - 0
S2 - All bits cleared, then the E and SS bits are set if appropriate.
DSJ - 0

Illegal secondary, No data byte, Data not tagged with EOI

S1 - I/O Program error
S2 - Unchanged
DSJ - 1

Parallel Poll: The Parallel Poll response is re-enabled after the operation is completed, normally or abnormally.

Initiate Selftest

Type: Control

Purpose: This command gives the user the capability to remotely initiate the 9121D/S selftest. The selftest results may then be read back using the Read Selftest Results command.

Description: Two bytes are sent following the selftest secondary and contain the following information:

The first byte is ignored by the 9121D/S. The W bit in the second byte is interpreted as follows:

- 0 -- No format test is performed.
- 1 -- The format test is performed.

If the format test is selected, a disc is required in all drives and all data on the disc(s) will be lost.

After the execution of the selftest the controller will be in the same state as a power on condition would leave it.

HP-IB Sequence:

Initiate Selftest					
ATN	ATN		EOI	ATN	
P01ADDRS	P1111111	P	W	P	P0111111
Primary Listen	Secondary	D	Control	E	Unlisten
		Dummy			

Status: No errors
S1 - 0
S2 - Cleared, then the E, F, and SS bits are set if appropriate.
DSJ - 2

Parallel Poll: The parallel poll response is re-enabled after the operation is completed, normally or abnormally.

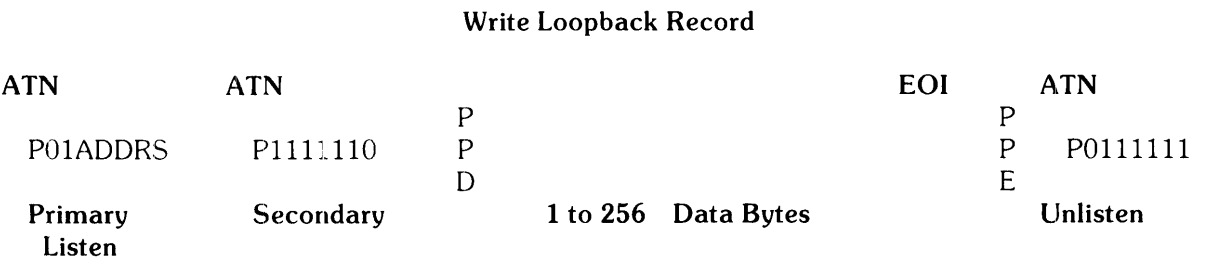
Write Loopback Record

Type: Control

Purpose: The 9121D/S stores up to 256 bytes in its internal buffer. A diagnostic could use the command, along with the Read Loopback Record command, to test the operation of the HP-IB link.

Description: After receiving the Write Loopback Record secondary, the controller will store up to 256 bytes in the internal buffers. If less than 256 bytes are send, the last byte must be tagged with an EOI.

HP-IB Sequence:



Status: No errors.
S1 - Unchanged
Stat2 - Unchanged
DSJ - Unchanged

Parallel Poll: If less than the specified number of bytes is accepted by the HP-IB controller, the parallel poll response will be re-enabled by the Unlisten command.

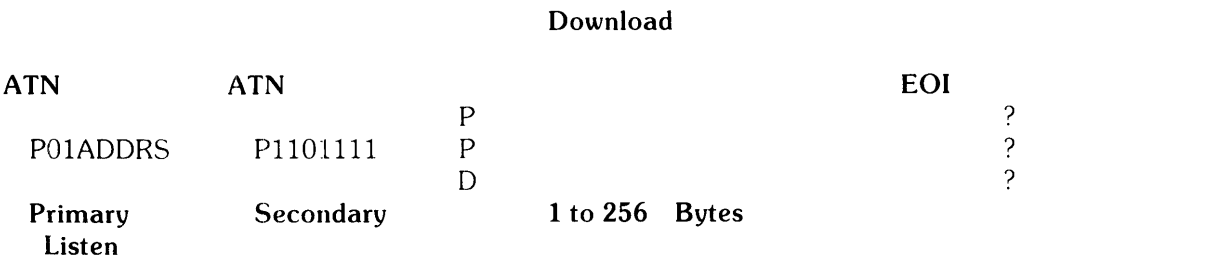
Download

Type: Control

Purpose: This command allows the downloading and execution of 6809 code into the controller's internal (RAM) memory. It is intended for diagnostic purposes only, and as such should be used with care.

Description: After receiving the Download secondary, up to 256 bytes are stored in the controller's RAM. Following the reception of the last byte, the code will be executed starting at the first byte.

HP-IB Sequence:



Status: Dependent upon the downloaded code
 Parallel Poll: Dependent upon the downloaded code.

Seek

Type: Control

Purpose: The Seek command updates a unit's target address and moves the head to the new target track. A seek usually precedes a data transfer operation or a series of consecutive data transfers.

It is important to note that the 9121D/S controller is totally dedicated to the selected drive during any drive related operation (e.g., the Seek command). This disallows any overlapped seek operation between multiple drives.

Description: The 9121D/S receives 6 bytes, including the seek opcode, the unit number, and the target cylinder, head and sector address. Checks are made to assure that the specified drive is available, that the entire command has been received, and that the new target address lies within the following bounds:

Cylinder Address: $0 \leq C \leq 34$

Head Address: $0 \leq H \leq 1$

Sector Address: $0 \leq S \leq 16$

NOTE

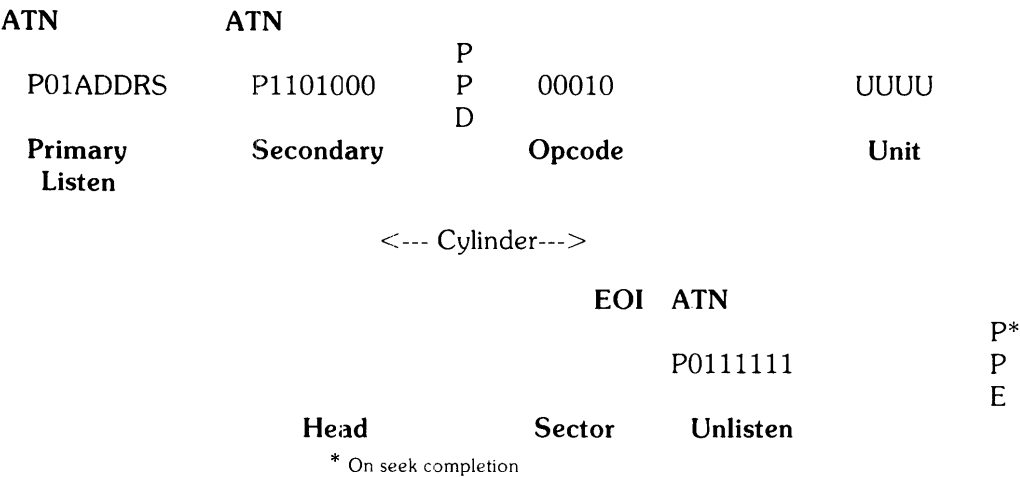
The 9121D/S allows a sector of address 16 to be accessed. This is included for possible future non-HP format compatability. The target address is still incremented from sector 15 to 0.

If any of these test fail, the status is updated and the seek command is aborted with a "Seek check" indication.

The following algorithm is used to locate a logical target track during the seek operation:

- a. Determine if present logical track is the same as that requested. If they are, then seek is complete, else proceed with step b.
 - b. Estimate the direction and number of steps to the target cylinder,
 - c. Step actuator to target, and read current head position,
 - d. If not at target cylinder address, repeat steps (b) and (c) until target found or retry exhausted.
-

HP-IB Sequence:



- Status:
- Successful Seek
 - S1 - Drive Attention
 - S2 - The A bit is set (Drive Attention)
 - DSJ - 0
 - Unsuccessful Seek
 - a. Illegal seek parameter, Target track not found, Off end of disc.
 - S1 - Drive Attention
 - S2 - The A and C (Seek check) bits are set
 - DSJ - 1
 - b. Track 0 indicator not found when expected.
 - S1 - Drive Attention
 - S2 - The A and E (drive fault) bits are set
 - DSJ - 1
 - Illegal command length
 - S1 - I/O Program Error
 - S2 - Unchanged
 - DSJ - 1
 - Illegal unit specification
 - S1 - Unit Unavailable
 - S2 - Unchanged
 - DSJ - 1
 - DSJ = 2 Holdoff
 - S1 - Unchanged
 - S2 - Unchanged
 - DSJ - 2

No disc or not ready, 1st Status Bit holdoff, Disc not formatted or of unknown format

- S1 - Status 2 Error
- S2 - Unchanged
- DSJ - 1

Parallel Poll: The parallel poll response is re-enabled after the operation is completed, normally or abnormally. Normal completion is when the target cylinder is reached.

End
Type: Control
Purpose: The End command causes the disc system to cease responding to a parallel poll and puts the controller and drives in a “stand by” state.
Description: The End command should be issued after a series of commands to a single unit have been completed. The following is performed by the 9121D/S upon reception of an End command:
a. S1 - 0
S2 - Unchanged
DSJ - 0
b. Disable Parallel Poll response.

HP-IB Sequence:

End Command				
ATN	ATN	P	EOI	ATN
P01ADDRS	P1101000	P 10101		P0111111
Primary Listen	Secondary	D Opcode		Unlisten

HP-IB CRC Secondary
Type: Control
Purpose: The HP-IB CRC secondary is part of the 9121D/S command set for compatability with existing and future drivers. This command does nothing. It is accepted by the 9121D/S and then forgotten.
Description: The 9121D/S can be addressed to talk or listen. If addressed to listen, any number of data bytes may be sent. If addressed to talk, and EOI will be sent over the HP-IB.

HP-IB Sequence:

HP-IB CRC Secondary				
ATN	ATN	P		P
PXXADDRS	P1110001	P		P
Primary Talk or Listen	Secondary	D	Don't Care	E

Parallel Poll: The parallel poll response is re-enabled after the operation is completed, normally or abnormally.

Disc Read Commands

Buffered Read

Type: Disc Read

Purpose: Data is transferred through an internal buffer in the 9121D/S before being sent to the HP-IB. This allows HP-IB data transfers to be asynchronous with the disc, and to vary from an arbitrarily low rate to about 82 Kbytes per second. The maximum number of bytes to be transferred in a buffered read is 256 (1 sector), the read request must be repeated for each additional sector transferred.

Description: Following reception of the read command, the parallel poll response is disabled, and the status of the specified unit is checked. If the Unit can be accessed, then the target sector's 256 bytes are read into the controllers buffer. If the read completes successfully, then the target address is incremented by one sector. If the sector is not found, a CRC error is indicated, or if a D Bit is encountered, the target address is not incremented.

After the data has been buffered into the controller the parallel poll response is re-enabled, indicating that the device has data ready to transmit. The Bus Controller should request the data by issuing the Send Data secondary. Upon receiving the secondary the 9121D/S again disables parallel poll response.

If the read was terminated before data was loaded into the buffer (i.e., any error except CRC or D Bit on), the device will respond by sending EOI tagged byte, and enabling parallel poll response.

If there was no error, or the a CRC error or D Bit was encountered, the sector's worth of data is made available. The Bus Controller can take any number of bytes up to a sectors length. If more than 1 sector is requested, the 9121D/S will send a byte tagged with EOI. The number of bytes taken has no effect on the updating of the target address.

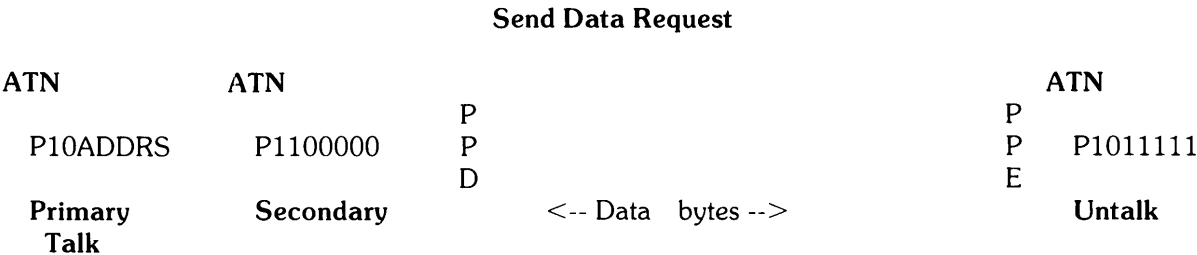
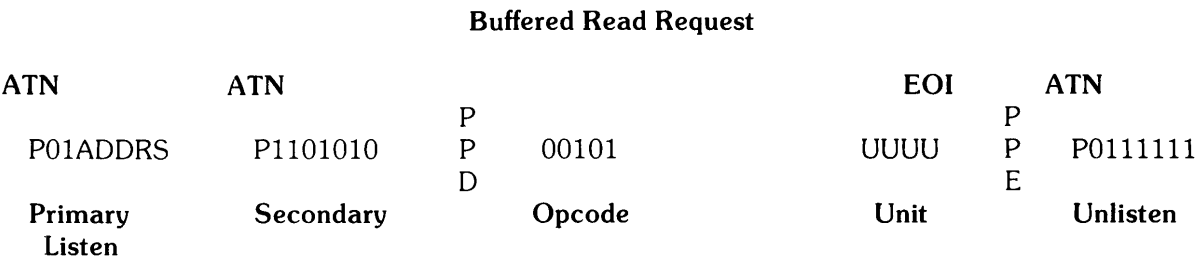
If the D Bit or CRC error occurs, the corresponding data may be invalid.

The parallel poll response will be enabled after sending the last byte, sending another secondary to the 9121D/S or by untalking the 9121D/S.

If more than 1 sector is to be transferred, any number of buffered reads can be used in succession. If an error is encountered, all following reads will be held off due to a bad DSJ, so there is no chance of an error in the middle of a long read going unreported. However, error detection will be quickened if:

- A DSJ is used after each read
- The reception of an EOI is used to indicate an error

HP-IB Sequence:



Status:

No errors
S1 - 0
S2 - Unchanged
DSJ - 0

Unsuccessful Read
S1 - Error
S2 - the A, E, and C bits are set if appropriate
DSJ - 1

Requirements for execution:

- a. 2 data bytes received in command
- b. Unit 0 ≤ U ≤ 3
- c. DSJ <> 2
- d. Disc present and ready
- e. Not First Status
- f. Status 1 = Normal completion,
I/O program error, or,
Illegal opcode error.

Parallel Poll:

The Parallel Poll response is re-enabled after the operation is completed, normally or abnormally.

If less than the specified number of bytes is accepted by the HP-IB Controller, the parallel poll response is assured to be re-enabled upon the reception of the Untalk command by the 9121D/S.

An extra byte (the value of 1) tagged with EOI will be sent if the controller request more than 256 bytes. However, this request is not necessary for normal operations.

Unbuffered Read

Type:

Disc Read

Purpose:

The unbuffered read allows more than one sector to be transferred from the disc to the bus controller using a single command.

Description:

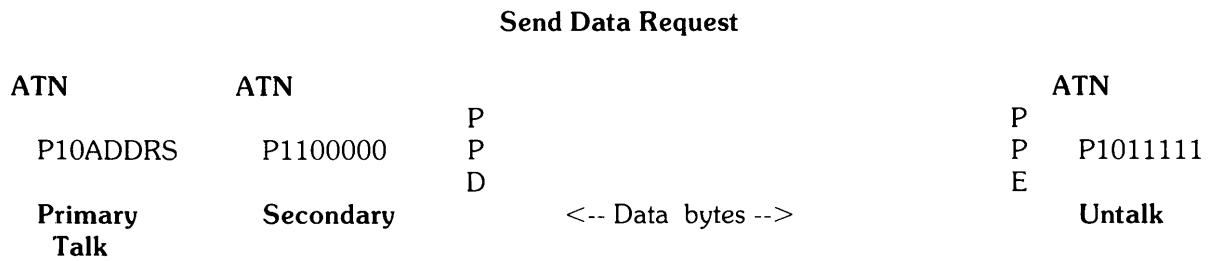
Following reception of the read command, the parallel poll response is disabled, and the status of the specified unit is checked. If the unit can be accessed (see the requirements for execution), the internal buffer is filled with a sector of data from the disc, just as in a Buffered Read. At this time, the 9121D/S waits for the Send Data command, then begins sending data to the bus controller. When all the bytes from the sector have been sent, the 9121D/S reads the next sector into the internal buffer and sends it to the bus controller. This process continues until a termination condition is reached:

1. If the unit becomes unavailable, or a sector cannot be found when the buffer is empty, or if a CRC error or D bit is encountered, the sector in the buffer is sent followed by an EOI.
2. If at any time during the operation the 9121D/S notices that it has been untalked or that the bus controller has sent a byte on the HP-IB, the process is stopped.

Following any of the above terminations, status is updated and parallel poll response is re-enabled. If there was an error in reading the data from the disc, the target address is left pointing to the sector in which the error occurred. Otherwise, the target address points to the sector following the last sector read from the disc. Occurrence of the error will cause a dummy byte tagged with EOI to be transmitted to the host system, thereby terminating the read process.

As has been seen, the Unbuffered Read actually uses the internal buffer to store the data. However, the protocol used is unbuffered in that the parallel poll response is not used to indicate when data is available. Thus, there is a pause in data flow to the HP-IB each time the buffer is refilled from the disc. This pause occurs at the beginning of the read and after every sector has been transferred. Depending on when the read is started and the sector interleaving, this pause may be up to 200 milliseconds long.

HP-IB Sequence:



Status:

No errors
 S1 - 0
 S2 - Unchanged
 DSJ - 0
 Unsuccessful Read
 S1 - Error
 S2 - the A, E, and C bits are set if appropriate
 DSJ - 1

Requirements for execution: See Buffered Read.

Parallel Poll: The Parallel Poll response is re-enabled after the operation is completed, normally or abnormally.

If less than the specified number of bytes is accepted by the HP-IB Controller, the parallel poll response is assured to be re-enabled upon the reception of the Untalk command by the 9121D/S.

Verify

Type: Disc Read

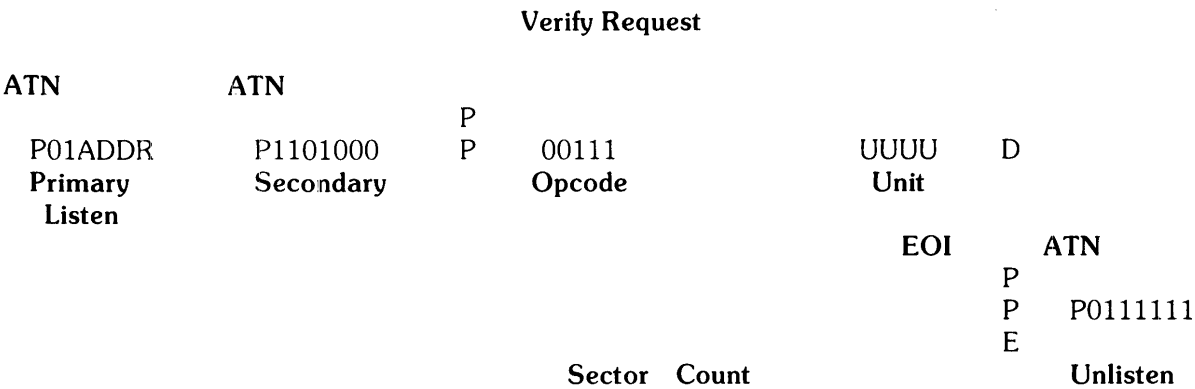
Purpose: The Verify command is a read which does not transfer data to the HP-IB. This is useful for performing a surface analysis of the disc or checking the integrity of the data on the disc.

Description: As with other read commands, parallel poll is disabled, and the availability of the unit is checked. Starting with the target sector, consecutive sectors are read until any of the following occurs:

- a. Unable to begin verify operation,
- b. Sector count given in the command expires,
- c. A seek or read error occurs,
- d. A sector marked defective is detected,
- e. The end of the disc is reached.
- f. A track marked invisible is detected

Parallel poll response is re-enabled upon completion of the verify. If an error was detected, the target address points to the sector in which the error occurred. Otherwise, the target address points to the sector following the last sector read.

HP-IB Sequence:



Status:

No errors

S1 - 0

S2 - Unchanged

DSJ - 0

Verify error

S1 - Error

S2 - The A, E, and C bits are set if appropriate

DSJ - 1

- Requirements for execution:
- a. 4 data bytes in command
 - b. 0 <= Unit <= 3
 - c. DSJ <> 2
 - d. Disc present and ready
 - e. Not First Status Bit
 - f. Sector Count >= 0

Parallel Poll: The parallel poll response is re-enabled after the operation is completed, normally or abnormally.

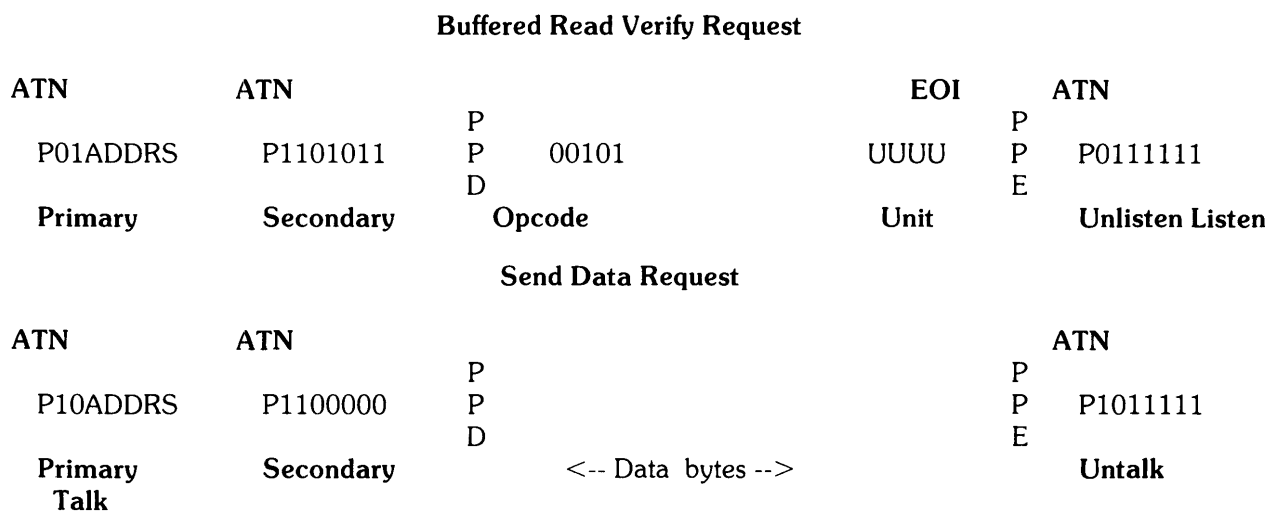
Buffered Read Verify

Type: Disc Read

Purpose: The Buffered Read Verify is identical to the Buffered Read command. No reduced margin read is done.

Description: See Buffered Read.

HP-IB Sequence:



Status: See Buffered Read

Requirements for execution: See Buffered Read

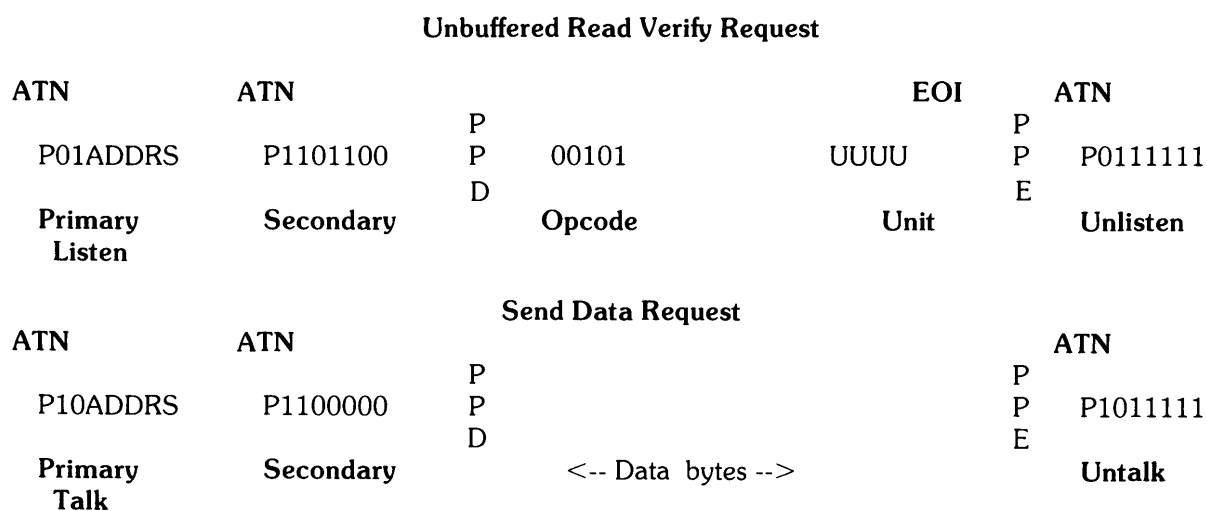
Unbuffered Read Verify

Type: Disc Read

Purpose: The Unbuffered Read Verify is identical to the Unbuffered Read command. No reduced margin read is done.

Description: See Unbuffered Read.

HP-IB Sequence:



Status: See Unbuffered Read

Requirements for execution:

See Unbuffered Read

Cold Load Read

Type:

Disc Read

Purpose:

The Cold Load Read is a command to read from unit 0, cylinder 0 at a specified head and sector address. This command consists of a seek to cylinder 0 followed by a read operation starting at the specified head and sector. Consecutive sectors are read until the bus controller stops the read.

Description:

Following reception of the Read command, parallel poll response is disabled, and the DSJ is cleared. If the Unit can be accessed, the 9121D/S performs a seek to cylinder 0, reads the specified sector into the internal buffer, then re-enables its parallel poll response waiting for the send data secondary. After the Send Data secondary is received, the parallel poll response is disabled and the buffered sector is sent to the bus controller. When the sector has been sent, the controller fills the buffer with the next sector from the disc and then sends it to the bus controller. This process is repeated until one of the termination conditions occurs:

1. If the unit becomes unavailable or a sector cannot be found when the buffer is empty, a byte tagged with EOI is sent.
2. If a CRC error or D bit is encountered, the sector is sent followed by a byte tagged with an EOI.
3. If at any time during the operation the device notices that it has been untalked or that the bus controller has sent a byte, the transfer will be stopped.

Following any of the above terminations, status is updated and the parallel poll response is re-enabled. If there was an error in reading data from the disc, the target address is left pointing to the sector in which the error occurred. Otherwise, the target sector points to the sector following the last sector read from the disc.

The Cold Load Read uses unbuffered HP-IB protocol, although all sector transfers take place through the buffer. Thus, there is a pause in data flow to the HP-IB each time the buffer is refilled from the disc. This pause occurs at the beginning of the read and after every sector is transferred. Depending on when the read is started and the staggering of the sectors (see the Format command), this inter-sector pause may be up to 200 milliseconds long.

HP-IB Sequence:

Cold Load Read Request

ATN	ATN		EOI	ATN
P01ADDRS	P1101000	P P D	00000 HHSSSSSS	P P E P0111111
Primary Listen	Secondary	Opcode	Head/Sector	Unlisten

where: HH - Head address
SSSSSS - Sector address

Send Data Request

ATN	ATN		EOI	ATN
P10ADDRS	P1100000	P P D		P P E P1011111
Primary Talk	Secondary	<-- Data bytes -->		Untalk

Status:

- No errors
 - S1 - 0
 - S2 - Type field updated
 - DSJ - 0
- Unsuccessful Read
 - S1 - Error
 - S2 - the A, E, and C bits are set if appropriate
 - DSJ - 1

Requirements for execution:

- a. Unit available,
- b. Disc ready,
- c. Disc of known format,
- d. Valid head and sector number.

Parallel Poll: If less than the specified number of bytes is accepted by the HP-IB Controller, the parallel poll response is assured to be re-enabled upon the reception of the Untalk command by the 9121D/S.

Disc Write Commands

Buffered Write

Type: Disc Write

Purpose:	The disc controller takes data transmitted over the HP-IB and stores it in an internal buffer before writing it on the disc. This buffering allows the host system to transmit asynchronously from an arbitrarily slow rate to about 69 Kbytes per second.
Description:	<p>Following reception of the write command, the parallel poll response is disabled, and status of the specified unit is checked, and the parallel poll response is re-enabled.</p> <p>At this time, the Bus Controller should send the Receive Data secondary followed by up to 256 bytes of data. After seeing the Receive Data secondary, the 9121D/S will disable its parallel poll response, and begin placing data bytes in its buffer. The 9121D/S will stop accepting bytes after:</p> <ul style="list-style-type: none">a. it receives a byte tagged with EOI,b. it has accepted 1 sector (256 bytes).

NOTE

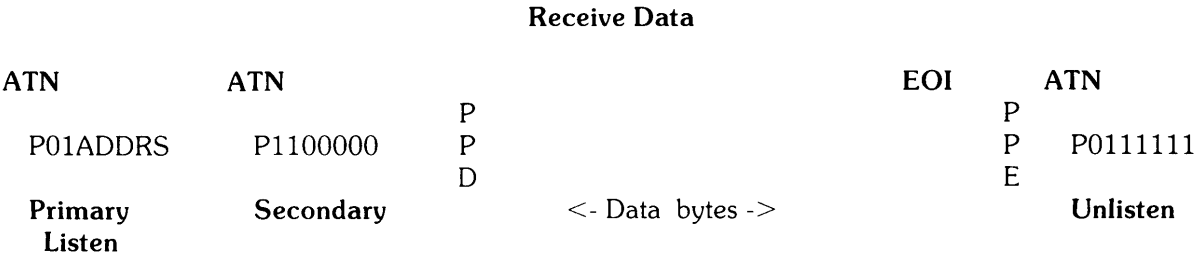
If less than 1 sector is sent the sector will be filled with data in the buffer from previous operations.

The 9121D/S will attempt to write the 256 bytes in the buffer to the target sector. If the write completes successfully the target address is incremented by one sector. If the target sector cannot be found, or a D Bit is encountered, the sector is not written and the target track is not incremented. The parallel poll is re-enabled after the write completes or aborts.

If more than 1 sector is to be written, any number of write commands can be used in succession. The 9121D/S will update the target address automatically. A write will fail if it follows another write which failed, so there is no chance of an error in the middle of a long transfer going unreported. However, error detection will be quickened if a DSJ is used after each write sequence is completed.

HP-IB Sequence:

Buffered Write Request					
ATN	ATN			EOI	ATN
P01ADDRS	P1101001	P P D	01000	UUUU	P P E P0111111
Primary Listen	Secondary		Opcode	Unit	Unlisten



Status:

No errors
S1 - 0
S2 - Unchanged
DSJ - 0

Unsuccessful Write
S1 - Error
S2 - the A, E and C bits are set if appropriate
DSJ - 1

- Requirements for Execution:
- a. 2 data bytes in command
 - b. $0 \leq \text{UNIT} \leq 3$
 - c. $\text{DSJ} \neq 2$
 - d. Disc present and ready
 - e. First Status Bit not set
 - f. Status 1 = Normal completion,
I/O program error, or, Illegal opcode error.
 - g. Disc not write protected

Parallel Poll: The Parallel Poll response is re-enabled after the operation is completed, normally or abnormally.

Initialize

Type: Disc Write

Purpose: The initialize command is used to set or reset D Bits. It is similar to the buffered write with the following exception:

All D Bits on the target track will be set or reset, before the target sector is written.

The Initialize command is especially useful when used with the Format command to make invisible tracks.

Description: Following reception of the initialize command, parallel poll response is disabled, and the status of the selected unit is checked.

The entire target track is re-formatted, with the D Bit in all sectors set or reset according to the D Bit specified in the opcode byte of the command. This re-formatting has several results:

- a. All data on the target track is lost,

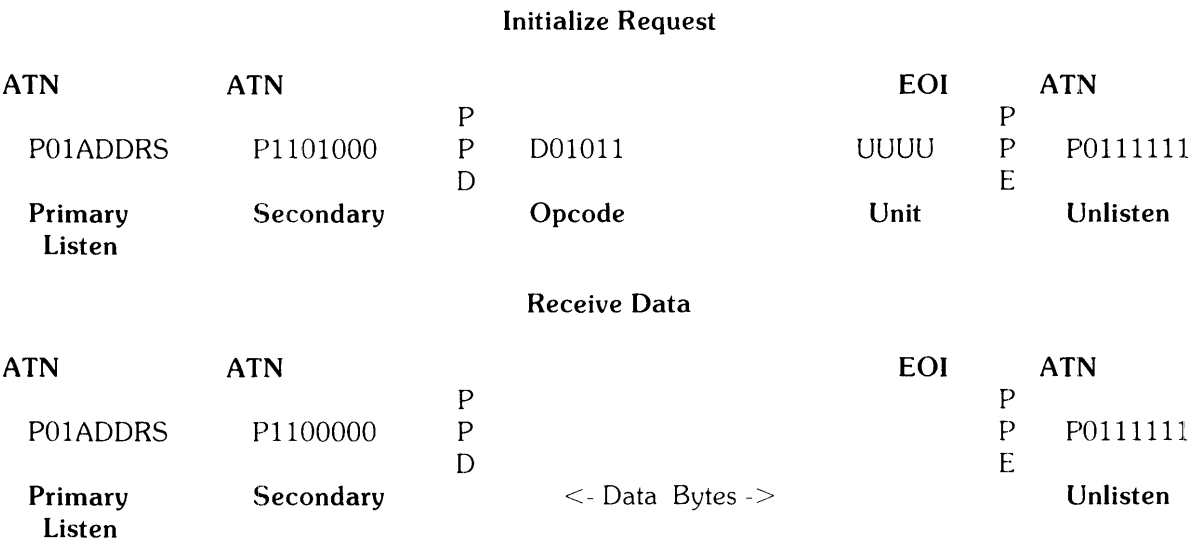
- b. The sector interleave of the track is changed to type 2 (every other sector),
- c. The spiral offset of the target track may no longer be optimal.

After the Initialize request is sent, the command accepts data in a manner identical to the buffered write command. The last data byte received is written into the data field of every sector on the target track (256 times per sector).

NOTE

If track 0 is initialized to set the D bits to 1, and then the Format without overwrite is done, the disc will be unusable. Track 0 must not be spared.

HP-IB Sequence:



Status:

No errors

S1 - 0

S2 - Unchanged

DSJ - 0

Unsuccessful

S1 - Error

S2 - the A, E, and C bits are set is appropriate

DSJ - 1

Requirements for Execution:

(See Buffered Write requirement)

Parallel Poll:

The parallel poll response is re-enabled after the operation is completed, normally or abnormally.

Format

Type:

Disc Write

Purpose:

The Format command is a part of the sequence of commands which takes a disc which is unformatted or has the wrong format into a disc with a usable format. The formatting operation also can make tracks marked with the D Bit into invisible tracks.

The Format sequence was designed to allow the disc controller to do as much of the work of formatting as possible, but still allow the host system to set its own criteria for:

- a. Bad track detection,
- b. Sector interleave,
- c. Format data byte.

Description:

After receiving the format command, Parallel Poll is disabled, and the status of the specified unit is checked. If the unit can be used, the motor speed is checked. If the speed is not within specification, the Format command will fail with a write protect error. The disc is formatted according to the type, Old Format Override, interleave, and selected data byte as specified in the command data bytes.

If the disc is of a different format than the Format command requests, or the Override Old Format Bit is set, the entire disc will be formatted without invisible tracks.

If the disc is the same type as that requested by the Format command, and the Override Old Format Bit is not set, Flexible Disc Drive will attempt to read from each track before it is formatted and make that track invisible if:

- a. The track is already invisible,
- b. A sector with a D Bit set is found,
- c. The track has no readable sectors.

NOTE

If track 0 is made invisible, the disc will seem as if it has been worn out, i.e., the user alert system (blinking and clicking) will be activated. This means that the disc will be write protected.

The Interleave parameter determines the order in which the sectors occur on a track. Host systems that accept data slower than the disc rate operate more efficiently if the ordering of the sectors is non-sequential. Non-sequential sectors ordering allows for sectors to be arranged on the disc by logical use instead of by physical location.

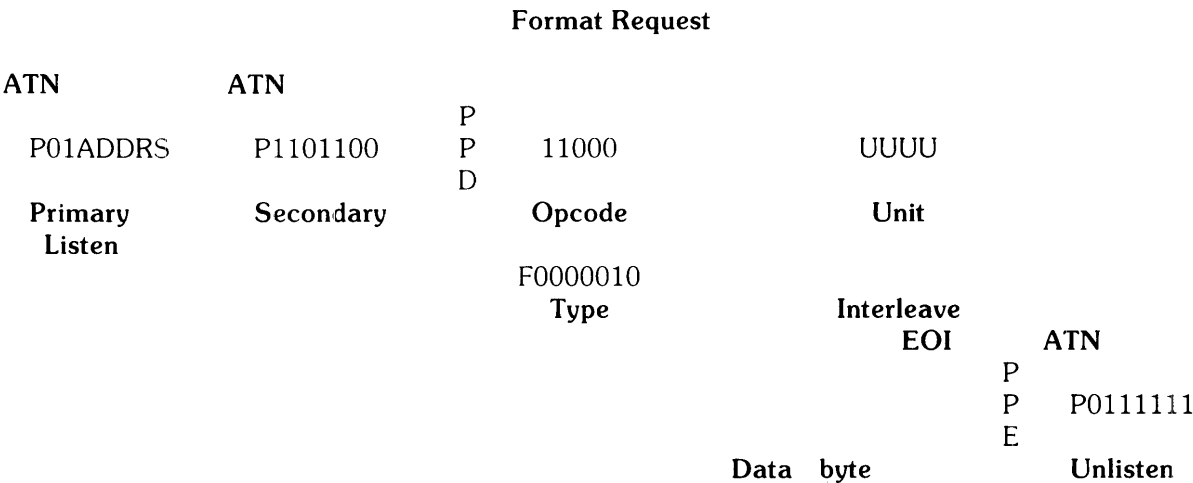
In general, the Interleave parameter indicates the number of disc revolutions required to send or receive one tracks worth of data. For example, an interleave value of 5 would indicate that the sectors would be arranged on the disc in a manner that would require 5 revolutions to read 1 track. Note: At the present time an Interleave parameter value of 2 (2 revolutions per track) generates the sector sequence with the minimum time required to transfer one track.

HP format also uses the Interleave parameter to determine the inter-track spiral offset. This offset minimizes the effect of track to track seeks by physically arranging sector 15 of one track and sector 0 of the next to make the the track seek time either as short as possible, or transparent (the track seek time is less than the interleave latency time in this case).

NOTE

The 9121D/S resets the physical and logical address to 0,0,0, while the 8290X leaves these pointing to past the end of the media.

HP-IB Sequence:



Where: ADDRS - Flexible Disc Drive
 HP-IB address
 F - Override Old Format Bit
Interleave - 1 to 15

NOTE

The data byte must never be 0F5H, 0F6H, or 0F7H.

Status:	No errors S1 - 0 S2 - Unchanged DSJ - 0
	Unsuccessful S1 - Error S2 - the A, E and C bits are set if appropriate DSJ - 1
Parallel Poll:	The parallel poll response is re-enabled after the operation is completed, normally or abnormally.

DISC CHANGE INDICATION

At the beginning of each microfloppy access, the peripheral checks to see if a new disc has been inserted into the current unit's drive. If a new disc is indicated, QSTAT will be 2 and the Power Fail error bit will be set. At the next command at which the format of the disc needs to be known (Describe, Locate and Verify, etc.), the disc will be accessed (if present) to determine its size, and the Describe fields pertaining to these characteristics will be updated.

Commands that can cause the QSTAT of 2 and Power Fail status bit indication are:

- Locate and Read
- Locate and Write
- Describe
- Initialize Media
- Locate and Verify
- Spare Block
- Initiate Diagnostic

RETRIES

There is never any reason to retry a command since the peripheral always does its best to get the data. If an Unrecoverable Data error does occur, you may retry, but the peripheral has already done about 30 retries for you already.

If the Recoverable Data or Media Wear status bits are set, don't retry. The data has been obtained; it just took a retry to get it, or the media is wearing out. The integrity of the data the peripheral passes to the host does not need to be questioned in this case.

TIMEOUTS

The head will be loaded and the motor turned on only before those operations that access the disc. The head will be unloaded if no further microfloppy commands have been given by the host within 1 second of the end of the last operation. The motor will be turned off after 1 minute of microfloppy inactivity.

If a command is given to unit 15 (the controller), the heads are unloaded on the drives. These operations affect the transfer rate because when the heads are re-loaded, the head load time is incurred before any data is transferred.

NOTE

PLEASE REFER TO CS/80 INSTRUCTION SET PROGRAMING
MANUAL (5955-3442) FOR THE DETAILS OF THE COMMAND
SET AND ITS OPERATION

SUBSET/80 COMMAND TABLE

COMMAND	PAGE
Universal Device Clear	B-4
Amigo Clear	B-4
Cancel	B-4
Channel Independent Clear	B-4
Describe	B-5
Identify	B-6
HP-IB Parity Checking	B-6
Download	B-6
Initialize Media	B-7
Initiate Diagnostic	B-8
Locate and Read	B-9
Locate and Write	B-10
Locate and Verify	B-10
No Op	B-11
Loopback	B-11
Request Status	B-11
Set Address	B-12
Set Format Options	B-12
Set Length	B-13
Set Mask	B-13
Set RPS	B-13
Set Release	B-13
Set Unit	B-13
Set Volume	B-14
Spare Block	B-14

APPENDIX B

CLEARs

There are three mechanisms available to clear the HP 9122: the HP-IB Universal Clear command, the AMIGO Clear, and the Channel Independent Clear. Depending on which clear is given to the peripheral, all or one of the units will be affected, and the clear can be "HARD" or "SOFT".

Hard Clear

A HARD clear to the microfloppy units (0 or 1) will cause the following events to occur:

1. The heads of the drive are repositioned to track 0
2. The status bits, P1-P10, and QSTAT are cleared (except that if the Diagnostic Result bit is set, only the Power Fail status bit will be cleared. The QSTAT will be 1 for the unit in this case).
3. The status mask is cleared
4. The length is set to all ones
5. The target address is set to zero
6. The format used for initializing will be reset to the default format (256 byte sectors on both sides).

Soft Clear

A SOFT clear is identical to the HARD clear except that the heads of the unit are not moved.

AMIGO CLEAR, UNIVERSAL CLEAR, CHANNEL INDEPENDENT CLEAR TO UNIT 15

Description: All the units (drives 0 and 1 and the controller, unit 15) are cleared. Units 0 and 1 do HARD clears. The unit will be set to 0 after completion of this command.

CHANNEL INDEPENDENT CLEAR TO UNIT 0 OR UNIT 1

Description: The selected unit will do a SOFT clear. No other units are affected.

CANCEL

Description: This command causes a graceful termination of the Initialize Media command, leaving the HP 9122 in the reporting phase. Cancel will not cause an immediate response usually, but eventually it will be seen as acted upon.

The Cancel command suppresses message length and message sequence errors.

DESCRIBE

Description: The control fields returned for the HP 9122 are:

C1,C2 = installed unit byte. C1 will always be 80H,
C2 will be 1 or 3, corresponding to 1 or 2
drives.
C3,C4 = 100, maximum instantaneous transfer rate in
thousands of bytes per seconds.
C5 = 4 if only one unit (drive) connected or 5 if more than
one unit is connected.

The unit description field will be:

U1 = Generic device type 1, floppy
U2-U4 = 091220H, product number
U5-U6 = bytes per block (usually 256)
U7 = 1, number of blocks which can be buffered
U8 = 0, burst mode not recommended
U9-U10 = microseconds per sector (16 microseconds
per byte)
U11-U12 = 45 kbytes/s maximum continuous average
transfer rate (as if it could do interleave
of 1) (the actual maximum is 15 Kbytes/s
for interleave of 2)
U13-U14 = 4500,45 seconds read retry time
U15-U16 = 8400,84 seconds maximum access time
U17 = maximum interleave factor
U18 = 0, no fixed volumes
U19 = 1, one removable volume

The Volume Description Field is:

V1-V3 = address of maximum track usable for data
storage
V4 = 1, maximum head address for double-sided, 0
for single-sided discs
V5-V6 = maximum sector address (assuming that the
sectors are numbered consecutively starting
with 0)
V7-V12 = 2463 for HP double-sided with 256 byte
sectors, 1385 for HP double-sided with 512 byte
sectors, 769 for HP double-sided with 1024 byte
sectors, 1055 for HP single-sided, 0 for no media
V13 = current interleave factor or minimum usable
if the current interleave is unknown

The describe fields will reflect the format of the disc in the drive. If no disc is in the drive, V1-V6 will reflect the format of the last disc, but the address field, V7-V12, will be zero. If the disc has been changed since the last disc access, the Describe will take place with the fields reflecting the characteristics of the new disc and the Power Fail bit will be set (and QSTAT = 2).

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DOWNLOAD

Description: This command is used to download code into the RAM of the HP 9122, which will then be executed. This command is used for special service routines and diagnostics only.

HP-IB PARITY CHECKING

Description: This command can be used to turn on and off the SRQ from the HP 9122. Parity checking is not supported on the HP 9122.

IDENTIFY

Description: Identify is a special-case HP-IB command used by the host at power-on to identify the devices connected to the bus. The HP 9122 will return 02, 22H.

INITIALIZE MEDIA

Description: Before the actual formatting procedure starts, the rotational speed of the disc is measured. If out of spec, the Initialize Media command will end with a write protect error. Additionally, if the wear monitor counter has reached the topmost wear level, the command will end with a write protect error, along with the media wear status bit.

This command will initialize a disc, one track at a time. The procedure includes writing and verifying a worst case pattern. All necessary sparing is performed at this time. None of the spares present on the disc at the beginning of the format procedure are saved. If a track is truly defective, it will be spared again by this procedure.

None of the spares present on the disc at format time are saved. If a track is truly defective, it will be spared again by the Initialize Media procedure.

Initialize Media Procedure.

There are up to two spare tracks on each side of the double-sided disc. If more tracks need to be spared than provided for by these set-aside tracks, the command will end with a No Spare Available error.

The disc can be formatted with an interleave from 0 to the maximum allowed (the maximum is the number of sectors on a track minus one). An interleave of 0 is the same as an interleave of 1 except that no spiral offset is used. If the interleave parameter passed is greater than the maximum, the maximum will be used.

Periodically during the execution of the Initialize Media command, the HP-IB will be scanned. If a clear or Cancel command is recognized, the Initialize Format command will be terminated with no errors. However, the disc may not be usable (recognizable) as is.

To initialize a disc with a format different from the default HP double-sided one, use the Set Format Options command before the Initialize Media command.

After a successful Initialize Media, the data fields are all set to 0.

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Some Possible Status Errors:

35 = Not Ready	No disc in drive
36 = Write Protect	Disc is write protected
34 = No Spares Available	Ran out of spare tracks
55 = Auto Sparing Invoked	At least one track was spared

INITIATE DIAGNOSTIC

Description: This command instructs the HP 9122 to perform its diagnostic routine. This routine is similar to the one performed at power-on.

The TEST LED will go on for the duration of the diagnostic test. If all the test performed complete successfully, the LED will go off. The LED will stay on if one of the test fail.

If the medium has been changed since the last disc access, the Power Fail status bit will be set, with QSTAT = 2, and the diagnostics will be performed.

The individual tests are performed in the following order:

FDC test -- reads/writes to registers
Seek test -- steps the head in and out.

If no disc is in the drive, the test is complete,

otherwise,

Index period test -- measured.

If the disc in the drive is not of a HP double-sided format, then the testing is complete, else if the disc is write protected, then only a read test is performed. A write, read, compare test is performed if the disc is not write protected. All writing is done in non-data areas. No customer data is at risk.

As soon as the first test failure occurs, the rest of the Diagnostic routine is aborted.

If the diagnostic fails, the parameter bytes P1 through P6 will contain one of the following error codes:

meaning	P1	P2	P3	P4
FDC failure --	00	00	00	01
Seek test failure --	00	00	00	02
Index test failure --	A---	A	00	03
Write test failure --	XX	B	00	04
Read test failure, hd 0	xx	B	00	06

```

Read test failure, hd 1  xx  B  00 07
Read compare error, hd 0  C---C  00 08
Read compare error, hd 1  C---C  00 09
Read test failure, hd 0  xx  B  00 10
Read test failure, hd 1  xx  B  00 11

```

where $A * 9.1875 \text{ microseconds} + 90 \text{ ms}$ is the index period,

B reflects the FDC status as follows:

```

1xxx xxxx -- no disc in drive
xlxx xxxx -- write protected
xxx1 xxxx -- ID read error
xxxx 1xxx -- CRC error
xxxx xlxx -- hardware failure,

```

C is the address of the bad data.

X means there is no meaningful data in that field.

P5, P6 will always be set to the unit that failed.
As soon as the first test failure occurs, the rest of the Diagnostic routine is aborted.

LOCATE AND READ

Description: This command finds the data at the target address and transmits it to the host.

If the present location of the read/write head is not at the target track, the head is stepped to the proper cylinder and an ID is read to verify the location of the head. If any error occurs up to this point, the proper status bits are set up, QSTAT is set to 1, and the reporting phase is entered, skipping the execution phase.

Once the proper track is located, the execution message is requested, unless the current length is 0, in which case no execution message is requested.

Data is read from the disc one sector at a time. After reading a sector data is passed to the host. The cycle of reading a sector of data and then passing it to the host over the HP-IB will continue until the number of bytes as set by the current length parameter is passed.

If the correct sector for a read cannot be found a restore to track 0 followed by a seek for the correct track is performed. Re-seeking will be performed up to five times.

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If the data is read with a CRC error, up to two retries will be performed before the read ends in error. In all cases, all the data requested as defined by the length parameter will be passed to the host.

Some Possible Status Errors:

35 = Not Ready	No disc in drive
33 = Uninitialized Media	Blank or unreadable disc
44 = End of Volume	Reads extend to end of disc
41 = Unrecoverable Data	Seek fails or data error
40 = Unrecov. Data Overflow	More than one error 41
59 = Recoverable Data	Seek or read succeeds after retries
52 = Latency Induced	"
57 = Recov. Data Overflow	More than one error 59

LOCATE AND VERIFY

Description: This command instructs the device to perform an internal verification of a section of data to ensure that it can be read.

This command is basically the same as a Locate and Read except that 1) the data is not made available to the host, 2) retries on reading the data are not performed.

Some Possible Status Errors:

35 = Not Ready	No disc in drive
33 = Uninitialized Media	Unformatted disc
44 = End of Volume	Verify went to end of disc
41 = Unrecoverable Data	Seek fails or data error
40 = Unrec. Data Overflow	more than one error 41

LOCATE AND WRITE

Description: This command transfers data from the host to the microfloppy, starting at the target address.

If the present location of the read/write head is not at the target track, the head is stepped to the proper cylinder and an ID is read to verify the location of the head. If any error occurs up to this point, the proper status bits are set up, QSTAT is set to 1, and the reporting phase is entered, skipping the execution phase.

Once the proper track is located, the execution message is requested, unless the current length is 0, in which case no execution message is requested.

The actual writing of the data occurs once the sector buffer is filled with data from the host. This cycle of filling the buffer and then transferring the data to the microfloppy will continue until the number of bytes as specified in the length parameter is written on the microfloppy. If only a portion of a sector's worth of data is passed by the host, the remainder of the sector is filled with arbitrary data.

Some Possible Status Errors:

35 = Not Ready	No disc in drive
33 = Uninitialized Media	Unformatted disc present
36 = Write Protect	Disc is write protected
44 = End of Volume	Reads extend to end of disc
41 = Unrecoverable Data	Seek fails or data error
40 = Unrecov. Data Overflow	More than one error 41
59 = Recoverable Data	Seek succeeds after retries
52 = Latency Induced	"
57 = Recov. Data Overflow	More than one error 59

LOOPBACK

Description: This command initiates a sequence to test channel integrity.

NO OP

Description: This command is ignored.

REQUEST STATUS

Description: This command instructs the HP 9122 to return the status report.

There are certain status bits that can be set by all the commands. These are:

- 5 = Illegal Opcode
- 9 = Illegal Parameter
- 10 = Message Sequence
- 12 = Message Length
- 19 = Controller Fault

22 = Unit Fault
30 = Power Fail.

The Power Fail status may indicate that a new disc has been inserted into the drive.

If the media in a drive has been used for an extended period of time, the Media Wear status bit, number 51, will be set. This bit indicates that the data on the disc should be backed up, and then the disc should be discarded.

Concurrent with the setting of the Media Wear bit, the media alert signal of repeatedly loading and unloading the heads on the drive with the worn disc in it will begin. Additional use of the disc after this state has been reached is possible (though not recommended). After more use, not only will the Media Wear bit be set, but write operations (Initialize Media, Locate and Write) will fail, with the Write Protect bit being set. The Media Wear bit will be set once for every 2 minutes or so of disc usage.

SET ADDRESS

Description: This command sets the value of the single vector target address.

The target address is incremented after each read, whether it was successful or not and will point to the block after the one just read. If a Locate and Write fails, the target address is not incremented past the block that failed.

Some Possible Status Errors:

7 = Address Bounds Address passed is too large

SET FORMAT OPTIONS

Description: This command will set up the HP 9122 to initialize discs in a format different than the default one.

The execution message contains a single option byte that selects which of the format options to use when executing a subsequent Initialize Media command.

Byte Meaning

- 0 product default, 256 byte sectors, double-sided HP format
- 1 same as 0, 256 byte sectors, double-sided HP format
- 2 512 byte sectors, HP double-sided format
- 3 1024 byte sectors, HP double-sided format
- 4 HP single-sided format (HP 9121 compatible)
- FFH this is ignore (signifies that options are available in the HP 9122)

After power-up or a clear, the default format is again set up and used by subsequent Initialize Media commands.

SET LENGTH

Description: This command defines the number of bytes in a data transfer.

A length of all ones will specify the entire disc.

SET STATUS MASK

Description: This command allows masking of error conditions reported by the Request Status command. The 8 bytes following the command opcode indicate which error bits are to be masked. At power-on, no bits are masked.

The masked error bits will not be reported by either Request Status or QSTAT. If an error bit is not masked, it reports a hard error (QSTAT=1) when set. The only exception to this is the Power Fail error bit. This bit reports a power-on status (QSTAT=2) when set.

Some Possible Status Errors:

8 = Parameter Bounds Trying to mask an unmaskable bit

SET RELEASE

Description: This is a NO OP to the HP 9122.

SET RPS

Description: This sets time-to-target and window-size time intervals for RPS data transfers. The HP 9122 will treat this command as a No Op. No RPS is enabled.

SET UNIT

Description: This command is used to specify a specific unit within the HP 9122. The controller is always unit 15. A HP 9122 may have 1 or 2 drives, at units 0 and 1.

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Some Possible Status Errors:

6 = Module Addressing Illegal unit number

SET VOLUME

Description: Use this command to specify the desired storage volume of a specified mass storage device.

In the case of the HP 9122, each unit has only one volume, so the only valid volume number is 0.

Some Possible Status Errors:

6 = Module Addressing Volume <> 0

SPARE BLOCK

Description: This command tries to instruct the HP 9122 to spare out the track indicated by the target address.

Some Possible Status Errors:

34 = No spares available.

No autosparing is done during normal use; sparing is only done during an Initialize Media command. Any data that can't be read will cause an Unrecoverable Data error. At no time will the Marginal Data status bit be set (as that would indicate to the host that a Spare Block command should be given).