

# Appendix A

## HP 9895A Disc Memory Command Set

### Introduction

The following description of the HP 9895A Flexible Disc Memory command set is HP-IB rather than CPU oriented. It is given in terms of operations (mainly bytes sent) over the HP-IB. Since this level is common to any interface to the 9895A, it is machine independent.

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.

Bus Controller	As used in the manual, is the current HP-IB controller in charge of the HP-IB.
Controller	The 9895A disc controller hardware or firmware.
Unit	One of up to four drives connected to the controller.
Flexible Disc, Disc or Diskette	The coated mylar media used to record data on by the 9895A.
HP Format	The double-density, single- or double-sided, HP standard recording format.
IBM Format	The single-sided IBM standard recording format.
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 the physical track number.
Head	One of the two sets of read, write and erase elements used to record data in the unit.
Track	The area defined by a cylinder and head address.
Cylinder	The recording area accessible by the two heads 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 9895A belongs to a set of command compatible HP-IB interface discs. All of these discs meet the "HP-300 Compatible HP-IB" standards. In addition, 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 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 then 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 from the other discs.

Certain commands used in formatting a disc or for diagnostic purposes are unique to the 9895A. Similarly, certain commands supported by other discs are not supported by the 9895A. An unrecognized command causes an error to be set, but has no detrimental effect on controller operation.

## Command Sequences

Much of the 9895A 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 9895A, the bus controller addresses it 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 9895A, the bus controller addresses it to talk, and then sends a secondary command byte. At this point the device sends back a series of information bytes. In some cases the last information byte will be tagged with an EOI. In cases where the last information byte is not tagged with an EOI, an additional byte tagged with an EOI is made available. The 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 disc memories.

The controller only operates on a single command at any given time; i.e., overlapped operations on multiple drives are not possible.



## Parallel Poll Response

Parallel poll is used as an additional means of communication between the 9895A and the bus controller. If the 9895A 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 9895A 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 9895A. Thus, if the 9895A has parallel poll enabled, and the bus controller is fast enough to send a command sequence and then conduct a parallel poll before the 9895A has disabled the poll, 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) can be issued before other commands.

The exception to the parallel poll response interlock concerns the Clear commands. The DSJ command, unlike the Clear commands, may not be a valid or recognized command in all states of the controller. Thus, the controller may reject or not even see the DSJ command and not disable the parallel poll response. If the bus controller had expected the DSJ to lower the parallel poll in the case where the controller can not accept the DSJ, the bus controller would see the wrong parallel poll after the Clear command.

## Cylinder and Track Numbering

Starting from the outer cylinder, cylinders are numbered sequentially from 0 to 76. These numbers are also the physical track addresses. A track is the intersection of a cylinder and a head. There is also a logical track address associated with each good 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 9895A 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 return for 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 and sector 0 for HP format and 1 for IBM format.

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 without issuing a seek to each sector. This includes updates which cross track or cylinder bounds. The 9895A is always in cylinder mode; that is, the head address will be incremented before the cylinder address.

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.

## HP and IBM Formats

The 9895A can work with discs which use either the HP single- or double-sided formats or the single-sided IBM format. After a disc is inserted in a unit, the first status request for that unit will cause the controller to determine which format is present. This information is available as part of the returned status.

Many details of operation vary slightly for the two formats. These include the allowable range of target address, the updating of target addresses and the effect of the D bit. These differences will be noted in the appropriate command descriptions.

## Loading of the Recording Heads

Control of the position of the heads is done by the controller. Any command received correctly that needs to read or write the disc will load the heads for its operation. In addition, the controller will keep the heads loaded for approximately 2 seconds after the command completes the operation in anticipation of a subsequent command. In multiple drive configurations, the time the heads remain loaded on inactive drives can increase from 2 seconds to approximately 10 seconds, as a function of the operation in progress on some active drive, the interleave of the disc in the active drive and the frequency of the command from the host system. If the host system should malfunction, and leave the controller in a state expecting to receive or send data, the controller will abort the operation in approximately 60 seconds and proceed to its idle loop where the heads could be unloaded. The host system has the ability to lock the access door on any/all of the drives to prevent unwarranted access to the discs; in this case, the doors will not be unlocked if the above error condition should occur.

## Holdoffs

The 9895A will not execute most operations when it enters either of the two states described below. It is very important to know these states and the commands that will remove the holdoffs.

1. DSJ = 2 or Power On State

This state is entered after:

- a. The 9895A is powered up.
- b. After the execution of the Initiate Self-Test command.

As long as DSJ = 2, a value unique to this state, the commands listed below will not be executed. There are, however, three 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,
- c. The Cold Load Read command.

For both DSJ and Clear, the DSJ value becomes 0, the cold load read will override the holdoff and set the DSJ according to the outcome of the read.

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 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 9895A will, however, respond to a Talk command from the above group by sending one byte (of value 1) tagged with an EOI. Also, all data bytes sent to the 9895A as part of the commands listed above will be accepted but ignored. These actions will cause the 9895A not to hang (timeout) the HP-IB until the bus controller is aware of the holdoff.

## 2. First Status State

This state is entered for a particular drive after:

- a. A disc is inserted in the drive during normal operation,
- b. The 9895A is powered up with a disc in the drive,
- c. The 9895A is issued an Initiate Self-Test command, with a disc in the drive.

When this state is entered, a flag in the status 2 word for the drive(s) affected is set. All operations requiring access to the newly inserted disc are disabled until the status of the drive is requested or the Cold Load Read command is issued.

The holdoff ensures that the HP-IB controller is aware that the disc is a newly inserted one before it is actually accessed. In addition, the first request of status for that drive will cause the device to find out the format of the newly-inserted disc, thereby enabling proper use of the disc.

Commands not executed while first status is set are:

- a. Read commands
- b. Write commands
- c. Verify
- d. Initialize
- e. Format
- f. Seek

It should be noted that after a power-on has occurred or after the execution of the Initiate Self-Test command, the DSJ is set to 2 and the first status bit is set for any drive containing a disc. Thus, both holdoffs, DSJ and first status, will be in effect.

Therefore, to enable access to a disc, two command sequences may be used. They are:

- a. A DSJ or Clear followed by a Status command,
- b. A Cold Load Read command.

## Command Execution Checks

In addition to the above holdoffs, the controller will verify other conditions before a particular operation is permitted to execute.

1. Correct number of command bytes.

Obviously, the correct command syntax must be received, or else an I/O program error is defined by the controller.

2. DSJ = 1 and status 1  $\neq$  I/O program error  
DSJ = 1 and status 1  $\neq$  illegal opcode

The above condition exists when the most recent command terminated with an error. The following commands are disabled when this condition exists until the host system requests status and hence is aware of the status of that last operation:

- a. Read commands,
- b. Write commands,
- c. Door lock/unlock.

3. Disc format.

Most commands that operate on the disc will verify that the format is either HP or IBM. If an unknown disc is in the requested drive, these operations will abort with a status 2 error. The commands are:

- a. Seek,
- b. Read commands,
- c. Write commands,
- d. Initialize command.

4. Obviously, the disc must not be write protected when any command that needs to write information on the disc is given. The commands that make this check are:

- a. Write commands,
- b. Initialize command,
- c. Format command.



## Commands

The details of the 9895A HP-IB command set are given in this section. The following conventions are used:

<b> </b>	Byte sent between the bus controller and the 9895A.
<b>P</b>	
<b>P</b>	
<b>D</b>	Parallel poll disabled.
<b>P</b>	
<b>P</b>	
<b>E</b>	Parallel poll enabled.
<b>ADDR</b>	The 9895A's current HP-IB device address.
<b>P</b>	HP-IB parity bit.
<b>ATN</b>	HP-IB bus control signal; this signal indicates that a command is present on the bus.
<b>EOI</b>	End or identify; this signal specifies that the present data byte is the last of the sequence or, if ATN is concurrently asserted, then a parallel poll is being conducted by the bus controller.
<b>UUUU</b>	
<b>or</b>	
<b>UNIT</b>	Unit number ( $0 \leq \text{UUUU} \leq 3$ ).
<b>Stat 1</b>	Status one word: Most significant byte is S1; Least significant byte is unit number.
<b>Stat 2</b>	Status two word.

The bit numbering notation for words is as follows:

<b>15 14 13 12</b>	<b>11 10 9 8</b>	<b>7 6 5 4</b>	<b>3 2 1 0</b>
<b>X X X X</b>	<b>X X X X</b>	<b>X X X X</b>	<b>X X X X</b>

All command sequences are verified for validity when received. This involves testing the secondary command, the command number and the number of data bytes in the command sequence for correctness. An I/O program error is defined whenever there is a problem with a command sequence.

Table A-1. Command Table

	Primary	Secondary	Key <sup>1</sup>	Opcode	Key <sup>2</sup>	# Bytes
Identify	U	ADDRS		—		—
DSJ	T	!10	P	—		1
Read Self-Test	T	!1F	—	—		2
Read Loopback	T	!1E	^	—		1 to 256
Request Status	L	!08	H	!03	C	2
Request Status	L	!0A	J	!03	C	2
Req (Logical) Address	L	!0A	J	!14	T	2
Req (Logical) Address	L	!08	H	!14	T	2
Req (Physical) Address	L	!0C	L	!14	T	2
Send Status or Address	T	!08	H	—		4
Universal Clear	U	—		—		—
Selected Device Clear	L	—		—		—
HP-300 Clear	L	!10	P	—		1
Initiate Self-Test	L	!1F	—	—		2
Write Loopback	L	!1E	^	—		1 to 256
Download Controller	L	!0F	O	—		1 to 256
Door Lock	L	!0C	L	!19	Y	2
Door Unlock	L	!0C	L	!1A	Z	2
HP-IB CRC	T/L	!11	Q	—		—
Seek	L	!08	H	!02	B	6
End	L	!08	H	!15	U	2
Buffered Read	L	!0A	J	!05	E	2
Unbuffered Read	L	!08	H	!05	E	2
Verify	L	!08	H	!07	G	4
Buffered Read Verify	L	!0B	K	!05	E	2
Unbuffered Read Verify	L	!0C	L	!05	E	2
Cold Load Read	L	!08	H	!00	@	2
ID Triggered Read	L	!0B	K	!06	F	2
Send Data	T	!00	@	—		—
Buffered Write	L	!09	I	!08	H	2
Unbuffered Write	L	!08	H	!08	H	2
Initialize	L	!08	H	!0B	K	2
Format	L	!0C	L	!18	X	4
Receive Data	L	!00	@	—		—

<sup>1</sup> To generate the command Secondary, hold the Control key down while pressing the listed key.<sup>2</sup> To generate the command Opcode, hold the Control key down while pressing the listed key.

## Command Table

! - Hexadecimal Number  
T - Talk Primary  
L - Listen Primary  
U - Universal Primary

## Sense Commands

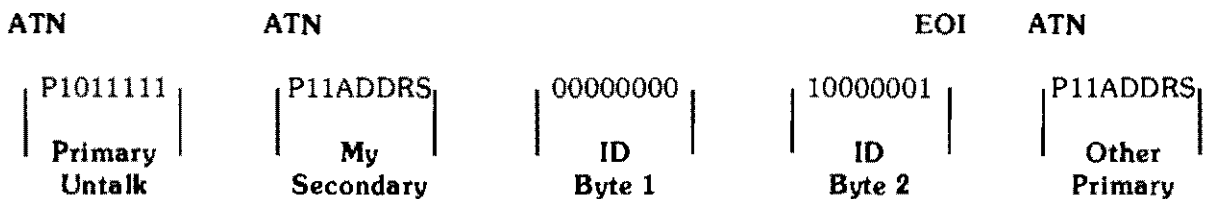
### Identify

**Type:** Sense.

**Purpose:** The 9895A will return a code unique to the disc subsystem to allow for auto-configuration of systems.

**Description:** Upon the reception of the untalk primary followed by the secondary corresponding to the 9895A's current HP-IB address, the 9895A's PHI will respond by sending the ID bytes of 0 and 81 hex, the second byte being tagged with an EOI. These two bytes will continue to be sent until another command is transmitted on the bus.

HP-IB Sequence:



### DSJ

**Type:** Sense.

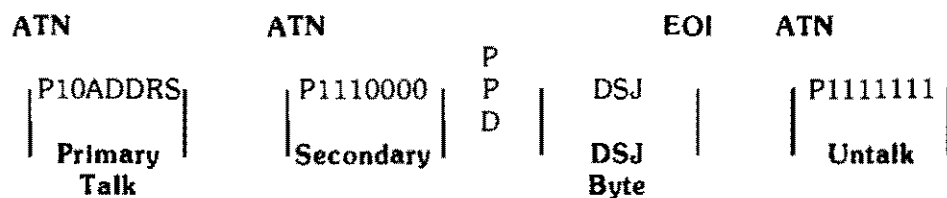
**Purpose:** The 9895A returns a byte indicating if the last operation completed normally or abnormally, or if the power to the 9895A has just been restored, or if a parity error has been detected on the HP-IB. The DSJ command also provides a way to disable the 9895A's parallel poll response.

**Description:** After accepting the DSJ secondary, the 9895A disables its parallel poll response (usually within 100 microseconds) and returns a byte (the DSJ byte) reflecting the status of the controller.

- DSJ = 0 – The 9895A completed its last operation normally.
- DSJ = 1 – The 9895A aborted its last operation abnormally. Status will indicate the current error.
- DSJ = 2 – The 9895A has just completed a power up sequence and is in the DSJ = 2 holdoff state.
- DSJ = 3 – A parity error has occurred on the HP-IB. Repeat the request to receive the pre-parity error DSJ.

## A-12 HP 9895A Disc Memory Command Set

HP-IB Sequence:



Status (Upon Command Completion):

No errors.

S1 - Unchanged

Stat 2 - Unchanged

DSJ - For DSJ = 0 or DSJ = 1 unchanged

- For DSJ = 2 then 0

- For DSJ = 3 then previous DSJ

Parallel Poll:

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

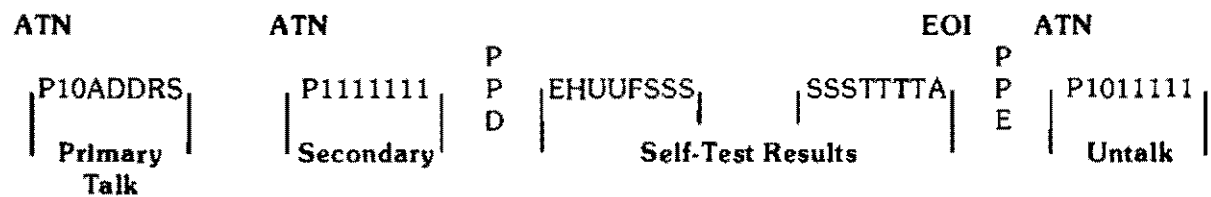
**Read Self-Test Results**

**Type:** Sense.

**Purpose:** The 9895A returns the results of the last self-test it has performed. This is useful after the Initiate Self-Test command or after the 9895A has been powered on (it performs a self-test at power on).

**Description:** After receiving the self-test secondary, the 9895A makes two bytes of the self-test results available. The second byte will be tagged with an EOI.

**HP-IB Sequence:**



Where:

- E – Error bit. If on, then an error has occurred.
- H – Head number. Indicates which head the read or write test failed on.
- UU – Unit number. Indicates which unit was selected when the error occurred.
- F – Format of operation. Indicates if the controller was in IBM (0) or HP (1) operation at the time of failure.
- SSSSSS – Subtest number. Number of the failing subtest.
- TTTT – Test number. Number of the failing test.
- A – “\*” LED. Indicates state of the “\*” LED.

**NOTE**

See page 4-7 for an explanation of self-test results.

**Status:** No errors.

S1 – 0  
Stat 2 – 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 Untalk command.

Read Loopback Record

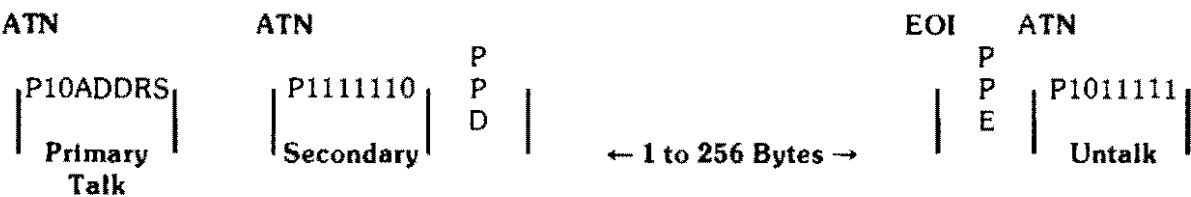
Type: Sense.

Purpose: The 9895A 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 9895A 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 9895A has been untalked,
- 2. It accepts another byte from the HP-IB.

HP-IB Sequence:



Status: No errors.

S1 - 0

Stat 2 - 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 Untalk command.

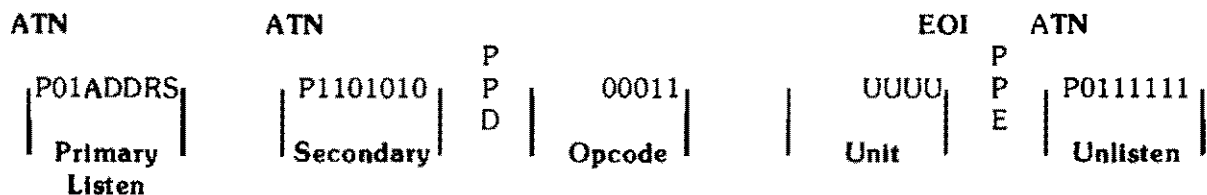
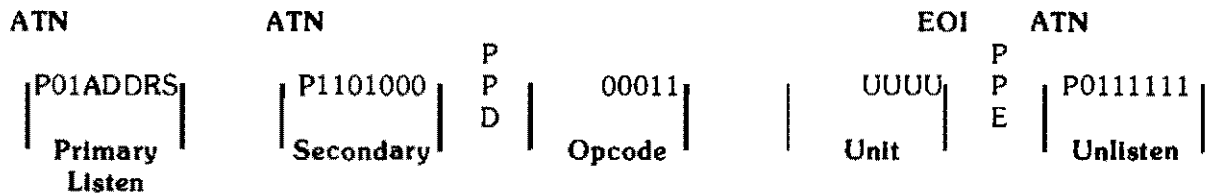
**Request Status**

Type:	Sense.
Purpose:	The device returns four bytes of status information. These status bytes indicate how the last attempted operation completed, which unit was involved and the current status of the unit specified.
Description:	After receiving the Request Status command, parallel poll response is disabled. If the unit's first status bit is set, the 9895A attempts to determine the type and format of the current disc (this may take up to 10 seconds). After the status operation has completed, the parallel poll response is re-enabled.

**NOTE**

There is also an unbuffered status request which uses a different secondary whose operation is identical.

After the send status secondary, the 9895A sends four bytes of status information. The first two bytes (known as Stat 1) includes information about the last operation which the device performed. The Stat 1 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:****Request Status (Buffered)****Request Status (Unbuffered)**



**Where:**

**Where:**

<b>S1 Binary (Decimal)</b>	<b>Meaning</b>
00000 (0)	Normal completion. The operations completed without error, or the controller has just been cleared or powered up.
00001 (1)	Illegal opcode. The last command contained an opcode which is not recognized by the 9895A.
00111 (7)	Cylinder compare error. The target cylinder has one or more sectors in which the track number does not correspond with the track number of the remainder of the sectors. The controller will automatically re-try the read/write operation once if this is encountered.
01000 (8)	Uncorrectable data error. The disc read or verify operation was terminated because a CRC error was detected in the data field. The data is still transmitted for the bad sector.



**S1**  
**Binary (Decimal)**

**Meaning**

01001 (9)

Sector compare error. The target sector cannot be found in the current track. Up to two passes of the track are made before this status is set. In this case, a CRC error exists in the preamble of the requested sector, or the subsequent data field cannot be found.

01010 (10)

I/O program error. This error is defined when:

1. An illegal secondary is received.
2. An improper number of data bytes are received.

This status can only be set if the previous S1 was zero.

10001 (17)

Defective track or sector. During an HP write, read, read verify or verify, a set D bit was encountered.

10010 (18)

Re-tryable hardware error. An internal hardware timing error occurred during a data transfer or seek. The operation should be re-tried.

10011 (19)

Stat 2 error. Some condition in Stat 2 prevented the drive-related operation from completing normally. These conditions include:

1. Specified unit is between 0 and 3, but that drive is not connected to the controller.
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 drive's first status bit is set.
7. IBM format requested on a double-sided disc.
8. ID triggered read attempted on an IBM disc.

10111 (23)

Unit unavailable. A command included a request for a unit number greater than 3.

11111 (31)

Drive attention. The indicated drive is requesting attention because:

1. A seek completed normally.
2. A Seek command failed due to:
  - a. Drive fault,
  - b. Out of bounds target cylinder or sector,
  - c. The controller cannot find the target address.
3. Following an End command, a change in drive status was detected, including:
  - a. Inserting a disc,
  - b. Removing a disc.

Stat 2	Bit #	Meaning
*	15	Stat 2 error. This bit is set if one or more of the following bits are set in stat 2: <ol style="list-style-type: none"> <li>1. Drive fault,</li> <li>2. Seek check,</li> <li>3. Any drive not ready error.</li> </ol> (See code 10011 in S1 table for list of possible causes.)
TTTT	12-9	Disc type. These four bits indicate the type and format of the disc currently present in the selected drive as follows: <p>0000 – Empty drive  0001 – Blank or unknown format, single-sided  0010 – HP format, single-sided  0101 – Blank or unknown format, double-sided  0110 – HP format, double-sided  1000 – IBM format, single-sided</p>
A	7	Attention. This bit is set when a seek completes (successfully or unsuccessfully), or following an End command when stat 2 changes. It is cleared after the status is read.
W	6	Write protected. The disc in the selected drive has the write protect notch present.
E	4	Drive fault. This bit is set after the following occurs: <ol style="list-style-type: none"> <li>1. Drive goes not ready after End command,</li> <li>2. Drive goes not ready during data transfer,</li> <li>3. Hardware failure.</li> </ol> Drive fault is cleared after the status is read.
F	3	First status bit. This bit is set when a disc is present in the selected drive after: <ol style="list-style-type: none"> <li>1. Power on,</li> <li>2. The door is closed,</li> <li>3. Self-test completion.</li> </ol> First status is cleared after the status is read.
C	2	Seek check. This bit is set when a seek fails for one or more of the following reasons: <ol style="list-style-type: none"> <li>1. An out-of-bounds target sector was specified,</li> <li>2. An attempt was made to access a non-existent physical track,</li> <li>3. The seek algorithm could not find the target logical track.</li> </ol>

Stat 2	Bit #	Meaning
SS	1, 0	<p>The seek check bit is cleared after the status is read.</p> <p>Drive (not) ready. These two bits indicate the state of the selected drive as follows:</p> <p>00 – Drive ready</p> <p>01 – Undefined</p> <p>10 – No drive connected to controller (this condition is established at power on and will not change if a new drive is added while the controller is operating normally)</p> <p>11 – No disc in drive</p>
Status:		<p>No errors.</p> <p>S1 – 0</p> <p>Stat 2 – Bits A, E, F and C are cleared</p> <p>DSJ – 0</p>
Parallel Poll:		<p>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 Untalk command.</p> <p>An extra byte (the value of 1) tagged with an EOI will be sent if the controller requests more than the specified number of bytes.</p>

Request (Logical) Disc Address

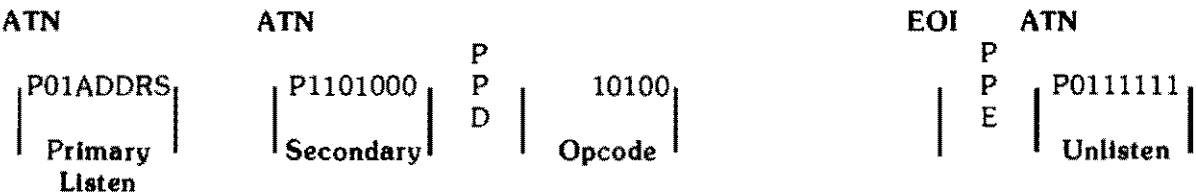
Type: Sense.

Purpose: The 9895A 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.

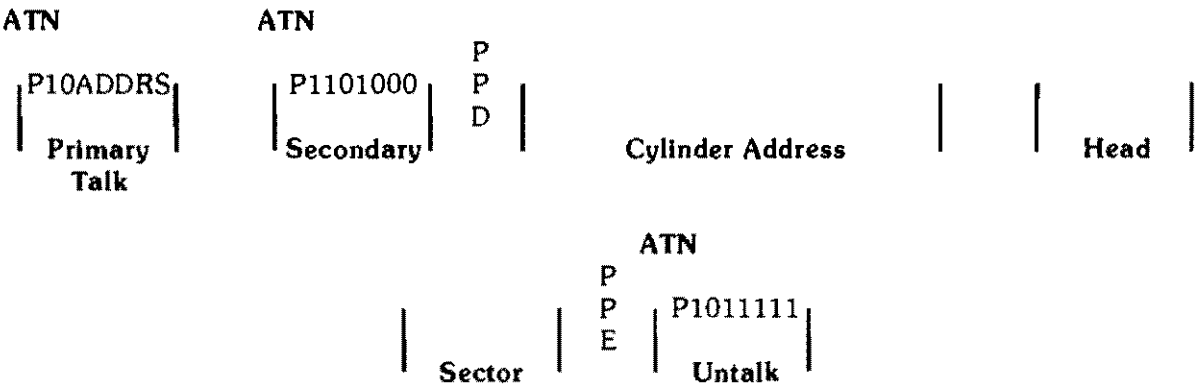
Description: Following reception of the appropriate command sequence, the 9895A returns four bytes indicating the current target sector. This includes two bytes of target cylinder address, one byte of target head address and one byte of target sector address.

HP-IB Sequence:

Request (Logical) Disc Address



Send Address Command



Status: No errors.

S1 - 0  
Stat 2 - Unchanged  
DSJ - 0

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 Untalk command.

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

## Request (Physical) Disc Address

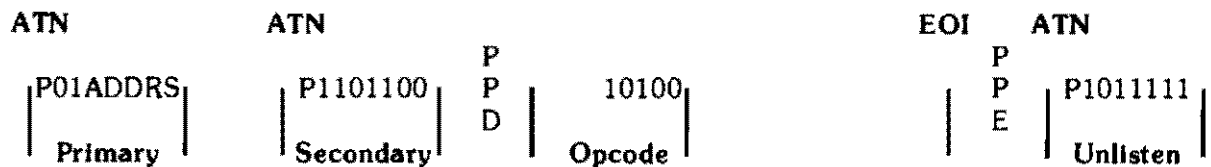
Type: Sense.

Purpose: The 9895A 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.

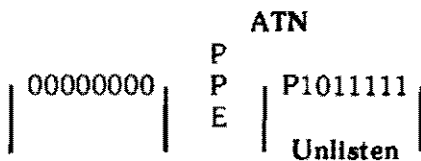
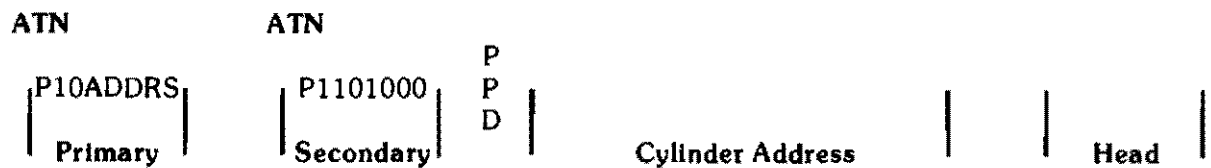
Description: After receiving the request (physical), the 9895A returns two bytes containing the physical cylinder address, one byte containing the head address and one byte of zeros.

HP-IB Sequence:

### Request (Physical) Disc Address



### Send Address



Status: See Request (Logical) Address.

Parallel Poll: See Request (Logical) Address.

## Control Commands

### Universal or Selected Device Clear

Type: Control.

Purpose: A clear places the 9895A 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. Since a clear updates the device's HP-IB address, it is useful if the system is being re-configured.

Description: Upon reception of either a universal or selected device Clear command, the 9895A stops handshaking with the HP-IB, parallel poll response is disabled and the following are performed:

1. The PHI is reset,
2. HP-IB is updated from the device address on the controller board,
3. Stat 1 is cleared,
4. Stat 2 is updated appropriately,
5. DSJ set to 0,
6. All drives are re-calibrated to physical track 0,
7. The target address is set to cylinder 0, head 0, sector 0/1 for HP/IBM format,
8. Disable HP-IB parity checking.

HP-IB Sequence:

#### Universal Device Clear

ATN

	P	P
P0010100	P	P
Universal	D	E

#### Selected Device Clear

ATN

P01ADDRS
Primary

ATN

P0000100	P	P
Selected	P	P
Device	D	E



Status:

No errors.

S1 - 0

Stat 2 - All bits cleared, then bits E and SS are set, if appropriate.

DSJ - 0

Parallel Poll:

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

## Clear

Type:

Control.

Purpose:

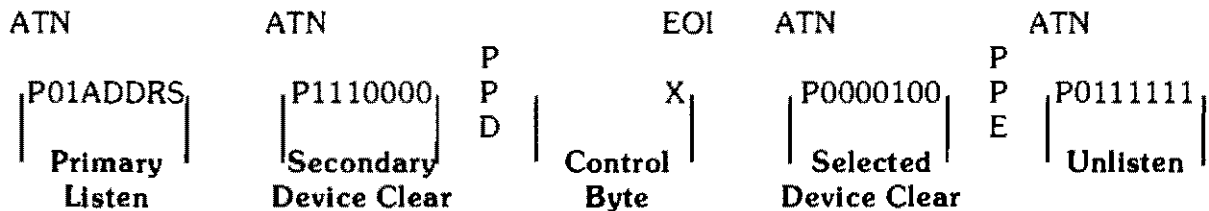
This command gives the user the capability to place the 9895A controller in a known state and to programatically enable or disable the HP-IB parity check logic.

Description:

After reception of the HP-300 clear secondary, the data byte and the device clear, the controller sets or clears the HP-IB parity enable in the PHI.

HP-IB Sequence:

### HP-300 Device Clear



Where: X - HP-IB parity check bit:

0 - Disable parity check,

1 - Enable parity check.

Status:

No errors.

S1 - 0

Stat 2 - All bits cleared, then E and SS set, if appropriate.

DSJ - 0

Parallel Poll:

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

Initiate Self-Test

Type: Control.

Purpose: This command gives the user the capability to remotely initiate the 9895A self-test. The self-test results may then be read back using the Read Self-Test Results command. Self-test takes approximately 7 seconds to complete.

Description: Two bytes are sent following the self-test secondary and contain the following information:

The first byte contains the cylinder to be tested and is only pertinent if the W bit is set in the second byte of the command. The W bit is interpreted as follows:

- 0 – No write/read test performed,
- 1 – The write/read test is performed on the designated cylinder.

If the write/read test is selected, a double-sided disc is required and all data on both sides of the selected cylinder will be lost.

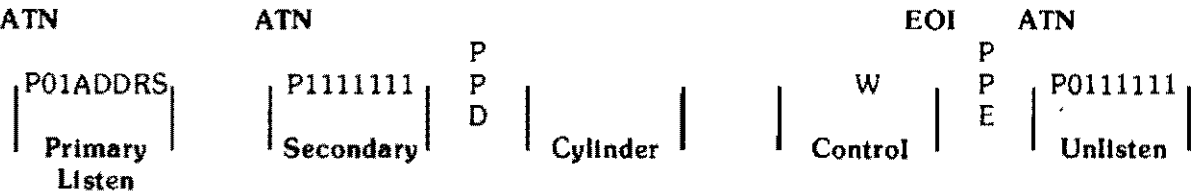
After the execution of the self-test, the controller will be in the same state as a power on condition would leave it.

NOTE

The self-test write test will re-format the selected test cylinder. This re-formatting will destroy data on the selected cylinder and change the sector interleave and offset so that it may no longer be optimal for the host system. After the write test is performed, the disc should be re-formatted by the Format command.

HP-IB Sequence:

Initiate Self-Test





Status: No errors.

S1 - 0  
Stat 2 - Cleared, the bits E, F, C and \* set, if appropriate.  
DSJ - 2  
Illegal cylinder number.  
S1 - Drive attention  
Stat2 - Bit C and \* are set.

DSJ - 1

Parallel Poll: The parallel poll response is re-enabled after the operation is completed, normally or abnormally. If additional commands are sent before the controller is ready and while self-test is in progress, they will be lost.

**Write Loopback Record**

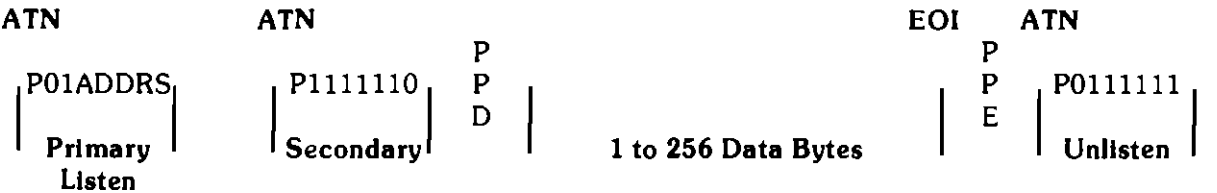
Type: Control.

Purpose: The 9895A stores up to 256 bytes in its internal buffer. A diagnostic could use the command, along with the read loopback record, 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 sent, the last byte must be tagged with an EOI.

HP-IB Sequence:

**Write Loopback Record**



Status: No errors.

S1 - Unchanged  
Stat 2 - 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 Untalk command.

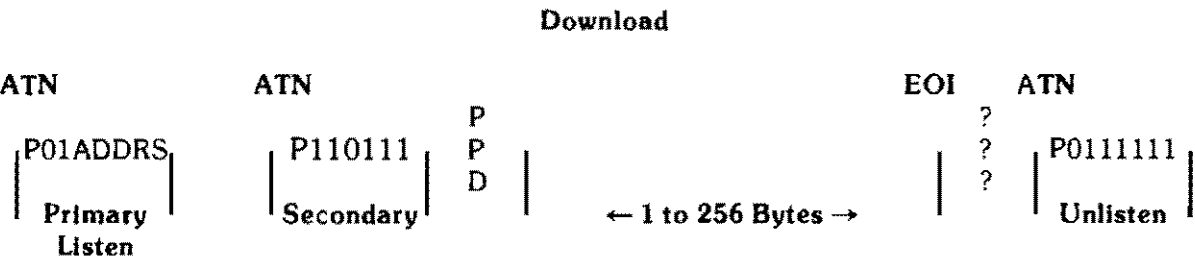
Download

Type: Control.

Purpose: This command allows the downloading and execution of MCC or Z80 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 memory. Following the reception of the last byte, the code will be executed starting at the first byte if the controller processor is an MCC, or starting at the third byte if the controller processor is a Z80.

HP-IB Sequence:



---

**NOTE**

Updating of status and the operation of parallel poll is dependent upon downloaded code.

---

**Seek**

Type:

Control.

Purpose:

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

It is important to note that the 9895A 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 device 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:

	HP		IBM
	Single	Double	Single
Cylinder address:	$0 \leq C \leq 76$	$0 \leq C \leq 76$	$0 \leq C \leq 76$
Head address:	$H = 0$	$0 \leq H \leq 1$	$H = 0$
Sector address:	$0 \leq S \leq 29$	$0 \leq S \leq 29$	$1 \leq S \leq 26$

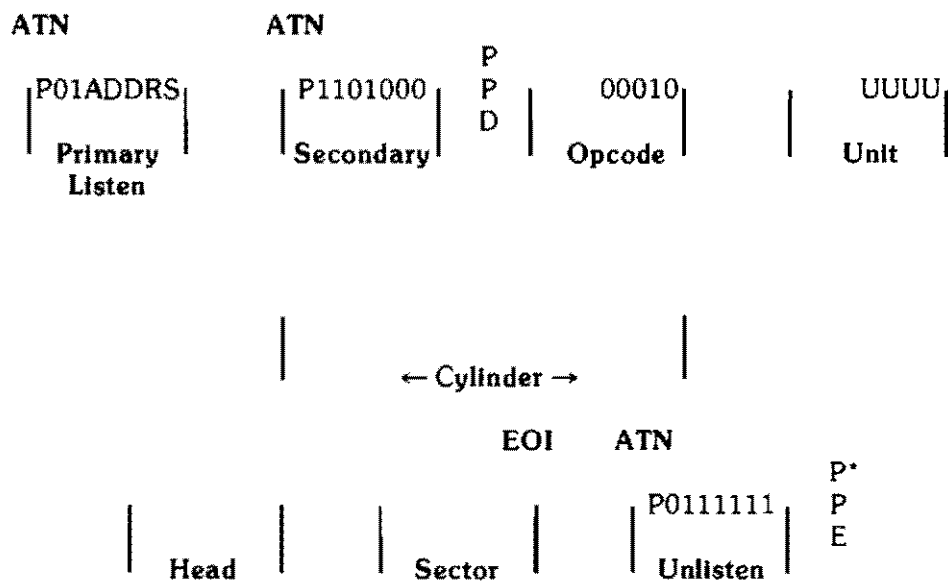
If any of these tests fail, the status is updated and the Seek command is aborted with a "Seek Check" indication.

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

1. Determine if present logical track is the same as that requested. If they are, then seek is complete. Otherwise, proceed with step 2.
2. Read current cylinder location from disc.
3. If current address is not the location expected, then do physical seek to cylinder 0.
4. Estimate the direction and number of steps to the target cylinder.
5. Step actuator to target and read current head position.
6. If not at target cylinder address, repeat steps 3 and 4 until target found or re-try exhausted.

## A-28 HP 9895A Disc Memory Command Set

HP-IB Sequence:



\* On seek completion.

Status:

Successful seek.

S1 – Drive attention  
Stat 2 – Bit A set (drive attention)  
DSJ – 0

Unsuccessful seek.

1. Illegal seek parameter, target track not found, off end of disc.

S1 – Drive attention  
Stat 2 – Bits A and C set (see check)  
DSJ – 1

2. Drive not ready during seek, track 0 indicator not found when expected.

S1 – Drive attention  
Stat 2 – Bits A and E set (drive fault)  
DSJ – 1

No disc, disc not ready, first status bit holdoff, disc not formatted, unknown format.

S1 – Status 2 error  
Stat 2 – Unchanged  
DSJ – 1

Parallel Poll:

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

**End**

Type:

Control.

Purpose:

The End command serves a dual purpose as follows:

1. It causes the 9895A to cease responding to a parallel poll and puts the controller and drives in a "Stand By" state, and,
2. In case of a status change in any of the drives, the 9895A immediately re-activates its parallel poll response which can serve as a pseudo-interrupt facility to the bus controller.

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 9895A upon reception of an End command:

1. S1     – 0  
   Stat 2 – Unchanged  
   DSJ    – 0
2. Disable parallel poll response.
3. Wait for change in drive status.

The 9895A will continue to check the status of all drives and will, at the same time, remain ready to execute any new HP-IB command. However, if no new command has been issued to the 9895A, and the state of a drive changes since the last time status was requested, the following is performed by the device:

1. Disc removed  
   S1     – Drive attention  
   Stat 2 – Bit A  
   DSJ    – 1
2. Disc inserted  
   S1     – Drive attention  
   Stat 2 – Bits A and F set (first status)  
   DSJ    – 1
3. Parallel poll is enabled on the HP-IB.

HP-IB Sequence:

**End Command**

ATN

ATN

EOI

ATN

P01ADDRS
Primary

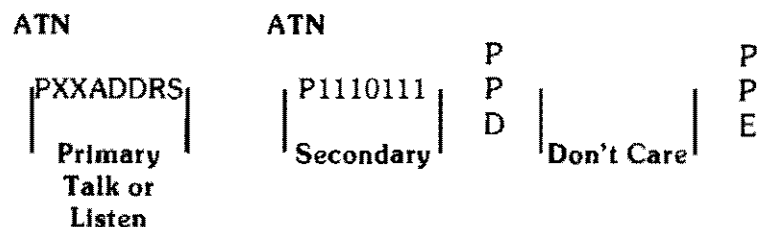
P1101000
Secondary

P	10101
P	
D	Opcode

P0111111
Unlisten

## HP-IB CRC Secondary

Type:	Control.
Purpose:	The HP-IB CRC secondary is part of the 9895A command set to be compatible with future HP-IB devices which use the CRC data tests of the future HP-IB control chips. The 9895A will ignore this command; that is, not set I/O program error when it is received.
Description:	The 9895A can be addressed to talk or listen. If addressed to listen, any number of data bytes may be sent; if addressed to talk, an EOI will be sent over the HP-IB.
HP-IB Sequence:	



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

## Door Lock

Type:	Control.
Purpose:	This command will lock the disc access door on the selected drive.

### NOTE

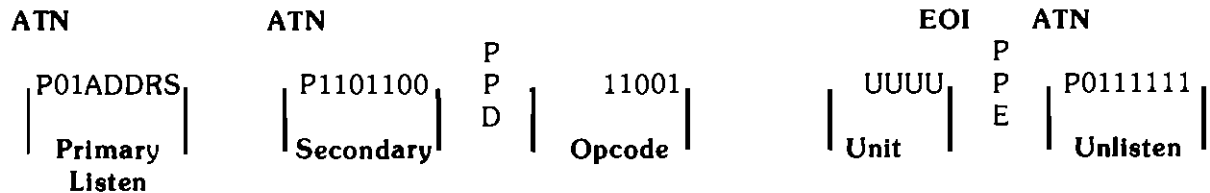
Normal operation of the 9895A will lock the access door whenever a drive is selected for an operation.

When the door is locked, the heads are also loaded. The heads loaded position represents the maximum wear condition for the disc.

Description:	<p>After sending the secondary, the opcode and the unit number, the 9895A will issue a command to the selected drive to lock the door. The door will remain locked and the heads loaded until one of the following conditions occur:</p> <ol style="list-style-type: none"> <li>1. A Door Unlock command,</li> <li>2. A Clear command,</li> <li>3. An Initiate Self-Test command.</li> </ol>
--------------	--

HP-IB Sequence:

### Door Lock Request



Status: No errors.

S1 - 0  
Stat 2 - Unchanged  
DSJ - 0

### Door Unlock

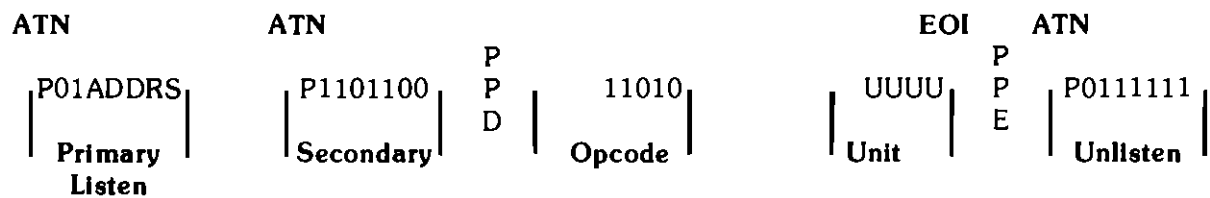
Type: Control.

Purpose: This command is used to unlock the disc access door. It is useful after the Door Lock command is given (see Door Lock).

Description: After the reception of the secondary, opcode and unit number, the 9895A will issue a command to the selected drive to unlock the access door. This command has no effect if the door was not previously locked.

HP-IB Sequence:

### Door Unlock



Status: (See Door Lock)

## Disc Read Commands

### Buffered Read

Type:

Disc read.

Purpose:

Data is transferred through an internal buffer in 9895A 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 190K bytes 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, parallel poll response is disabled and the status of the specified unit is checked. If the unit can be accessed, then the current cylinder number is read and compared with the target cylinder address. If they differ, a seek to the target cylinder is performed. This may occur if the actuator has slipped or if an auto-increment to the next cylinder is required.

If an HP format disc is being used, then the target sector's 256 bytes are read into the controller's 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 a D bit is encountered, the target address is not incremented.

If an IBM disc is present, then the target sector's 128 bytes are read into the controller's buffer. If the read completes successfully, then the target address is incremented by one. If the target sector is not found, a CRC error is indicated, or the D bit is encountered, then 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 9895A again disables parallel poll.

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 an EOI tagged byte and enabling parallel poll response.

If there was no error, the sector's worth of data is made available. The bus controller can take any number of bytes up to a sector's length. If more than one sector is requested, the 9895A will send a byte tagged with an EOI. The number of bytes taken has no effect on the updating of the target address.



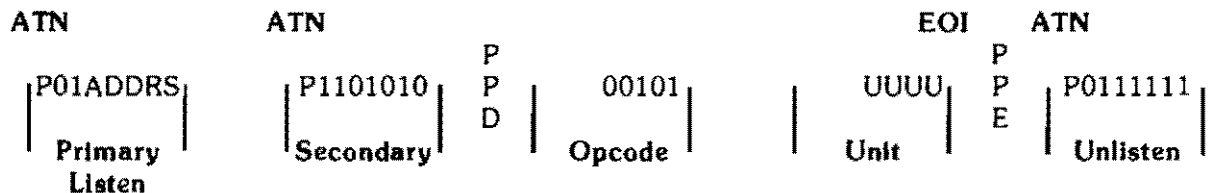
If the D bit or CRC error occurs, the corresponding data may be invalid.

Parallel poll response will be enabled after sending the last byte, sending another secondary to the 9895A or by un-talking the 9895A.

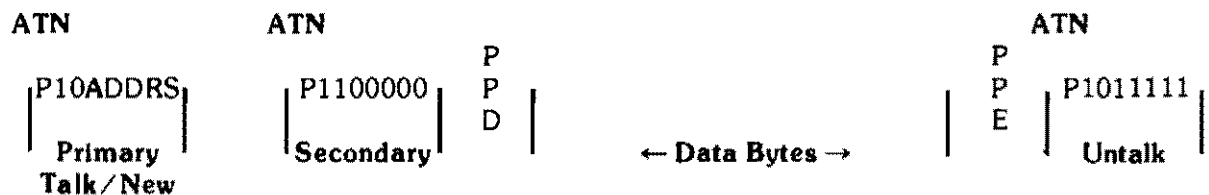
If more than one sector is to be transferred, then any number of buffered reads can be used in succession. If an error is encountered, all following reads will be held off due to a bad DSJ, so there is no chance of an error in the middle of a long read going unreported. However, error detection will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

### HP-IB Sequence:

#### Buffered Read Request



#### Send Data Request



Status:

No errors.

S1 - 0

Stat 2 - Unchanged

DSJ - 0

Unsuccessful read.

S1 - Error

Stat 2 - Bits A, E and C set, if appropriate.

DSJ - 1

### Requirements for Execution:

1. Unit  $0 \leq U \leq 3$
2. DSJ  $\neq 2$
3. Disc present and ready
4. Not first status
5. Stat 1 = Normal completion,  
I/O program error, or,  
Illegal opcode error.
6. Disc format is HP or IBM.

**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 will be re-enabled by the Untalk command.

An extra byte (the value of 1) tagged with an EOI will be sent if the controller requests more than the specified number of 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, parallel poll response is disabled and the status of the selected unit is checked. If the unit can be accessed (requirements for execution), the internal buffer is filled with a sector of data from the disc, just as in the buffered read. Now the 9895A 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 9895A then reads the next sector into the internal buffer and sends it to the bus controller. This process continues until a termination condition is reached:

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.

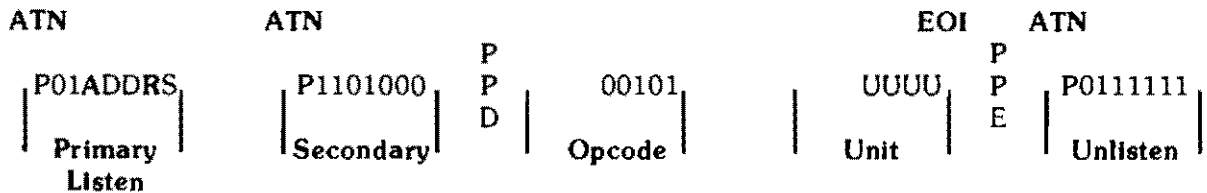
If at any time during the operation the device notices that it has been untalked or that the bus controller has sent a byte, the process is stopped.

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.

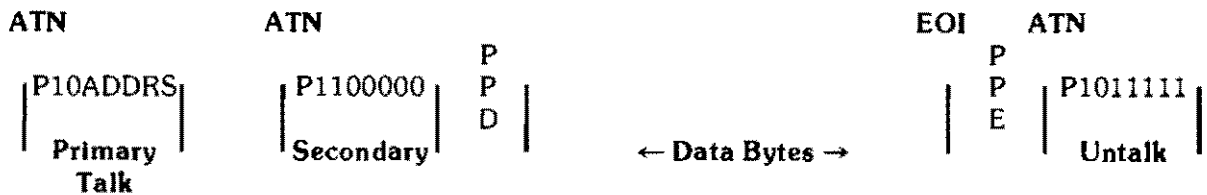
As has been seen, the unbuffered read actually uses the internal buffer to store the data. However, the protocol used is unbuffered in that the parallel poll response is not used to indicate when data is available. Thus, there is a pause in data flow to the HP-IB each time the buffer is re-filled from 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 160 milliseconds long.

HP-IB Sequence:

#### Unbuffered Read Request



#### Send Data Request



Status:

No errors.

S1 - 0  
Stat 2 - Unchanged  
DSJ - 0

Unsuccessful read.

S1 - Error  
Stat 2 - Bits A, E and C set, if appropriate.  
DSJ - 1

Requirement 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 will be re-enabled by the Untalk command.

## Verify

Type:

Disc read.

Purpose:

The Verify command is a read with reduced margins 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:

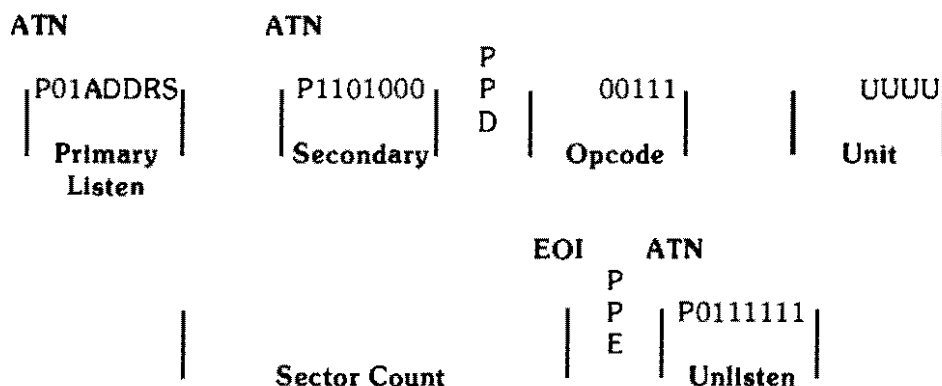
As with other read commands, parallel poll is disabled, the availability of the unit is checked, and the target sector is sought. Starting with the target sector, consecutive sectors are read using reduced margins until any of the following occurs:

1. Unable to begin verify operation,
2. Sector count given in the command expires,
3. A seek or read error occurs,
4. A sector marked defective is detected,
5. The end of the disc is reached.

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:

### Verify Request



Status:

No errors.

S1 - 0

Stat 2 - Unchanged

DSJ - 0

Verify error.

S1 - Error

Stat 2 - Bits A, E and C set, if appropriate.

DSJ - 1

**Requirements for Execution:**

1.  $0 \leq \text{Unit} \leq 3$
2.  $\text{DSJ} \neq 2$
3. Disc present and ready
4. Not first status bit
5. Sector count  $\geq 0$
6. Disc of known format.

**Parallel Poll:**

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

## Buffered Read Verify

**Type:**

Disc read.

**Purpose:**

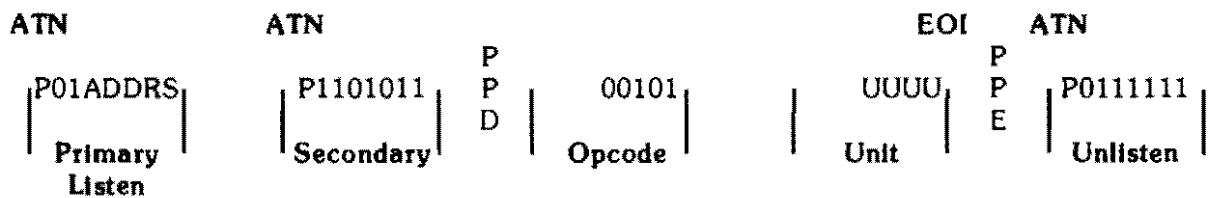
The buffered read verify is identical to the Buffered Read command except that the margins for good data are reduced. This command gives a high confidence that the data on the disc is recoverable.

**Description:**

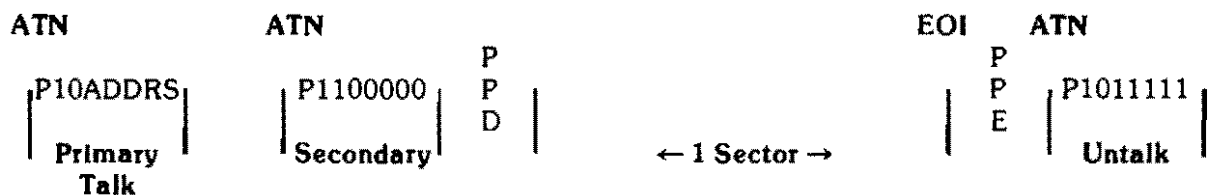
See Buffered Read.

**HP-IB Sequence:**

### Request Buffered Read Verify



### Send Data


**Status:**

See Buffered Read.

**Requirements for Execution:**

See Buffered Read.

Unbuffered Read Verify

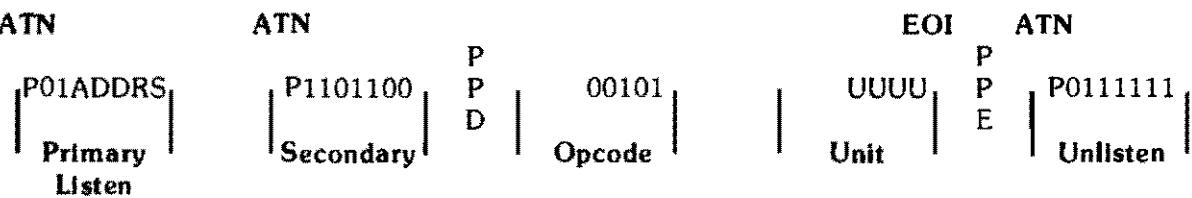
Type: Disc read.

Purpose: The unbuffered ready verify is identical to the Unbuffered Read command except that the margins for good data are reduced. This command gives a high confidence that the data on the disc is recoverable.

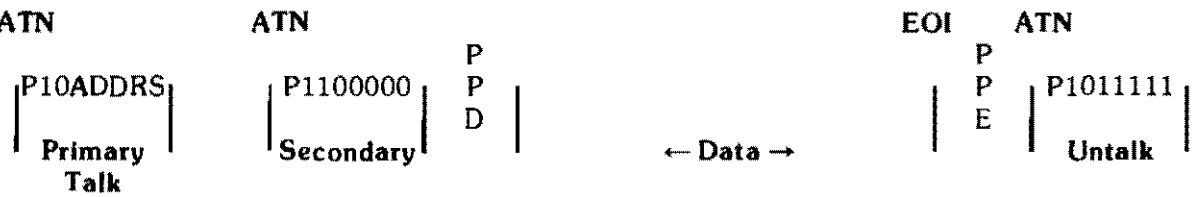
Description: See Unbuffered Read.

HP-IB Sequence:

Request Unbuffered Read Verify



Send Data



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 is disabled, the DSJ cleared and the first status bit checked. If first status is set, the format of the disc is determined and the first status bit cleared. If the unit can be accessed, the 9895A performs a seek to cylinder 0, reads the specified sector into the internal buffer, then asserts parallel poll waiting for the send data secondary. After the send data secondary is received, parallel poll 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 terminating conditions occurs:

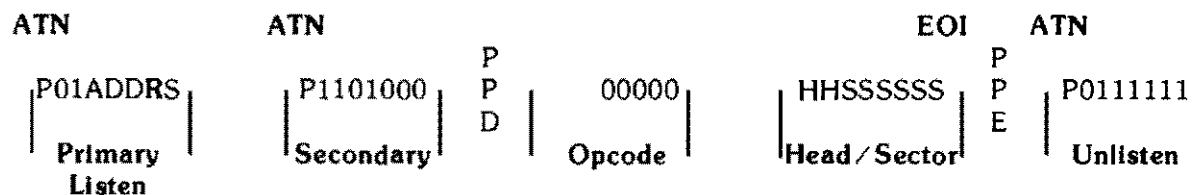
1. If the unit becomes unavailable or a sector cannot be found when the buffer is empty, a byte tagged with EOI is sent.
2. If a CRC error or D bit is encountered, the sector is sent followed by a byte tagged with an EOI.
3. If at any time during the operation the device notices that it has been untalked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

Following any of the above terminations, status is updated and 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 re-filled 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 160 milliseconds long.

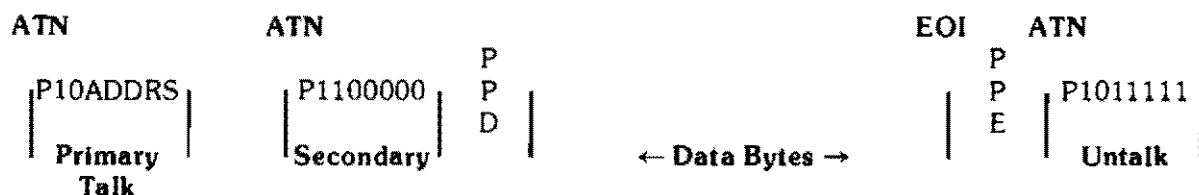
**HP-IB Sequence:**

**Cold Load Read Request**



Where: HH – Head address  
SSSSSS – Sector address

**Send Data**



Status:

No errors.

S1 – 0

Stat 2 – Type field updated.

DSJ – 0

Unsuccessful read.

S1 – Error

Stat 2 – Bits A, E and C set, if appropriate.

DSJ – 0

Requirements for Execution:

1. Unit available,
2. Disc ready,
3. Disc of known format,
4. 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 will be re-enabled by the Untalk command.



## ID Triggered Read

Type:

Disc read.

Purpose:

ID triggered read is used to read a sector of which the ID field cannot be found or read correctly. As an example, if the status from a read indicates that the target address sector is not found, the ID triggered read would be used to locate and trigger off of the previous sector's ID field to read the target sector. The host processor must be aware of the sector interleaving to request the correct sector to trigger from (see Format).

---

### NOTE

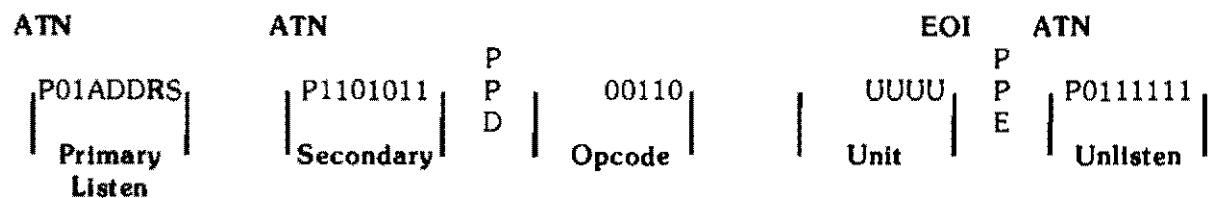
ID triggered read is only supported for HP format and uses buffered protocol.

---

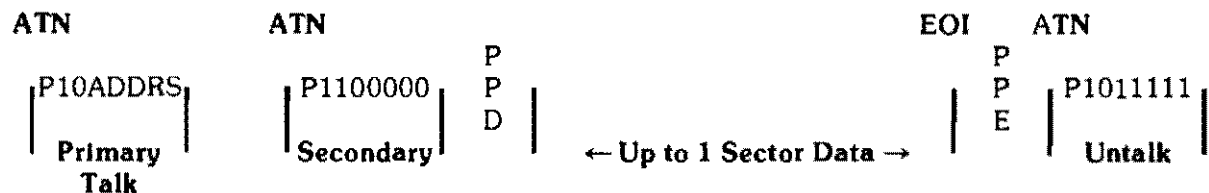
Description:

HP-IB Sequence:

#### Request ID Triggered Read



#### Send Data



Status:

See Buffered Read.

Requirements for Execution:

Disc must be in HP format. See Buffered Read.

## Disc Write Commands

### Buffered Write

Type:	Disc write.
Purpose:	The disc controller takes data transmitted on 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 190K bytes per second. The maximum HP-IB data rate is faster than the data rate to the disc, thus less time is used to transfer one sector over the HP-IB than it takes to write that sector. During the remaining time the HP-IB is free to be used by other devices on the bus.
Description:	<p>Following reception of the Write command, parallel poll response is disabled, 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 one sector of data bytes. After seeing the receive data secondary, the 9895A will disable parallel poll response and begin placing data bytes in its buffer. The 9895A will stop accepting bytes after:</p> <ol style="list-style-type: none"><li>1. It receives a byte tagged with an EOI,</li><li>2. It has accepted one sector.</li></ol>

---

#### NOTE

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

---

After the buffer has been accepted by the controller, the current address is checked with the target address. If they differ, a seek to the target cylinder is performed. This may occur if the actuator has slipped or if an auto-increment to the next cylinder is required.

If an HP format disc is being used, the 9895A attempts 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.

If an IBM format disc is being used, only 128 bytes from the buffer are written to the disc. If the write completes successfully, the target address is incremented by one sector. If the target sector is not found, the sector is not written and the target address not updated.

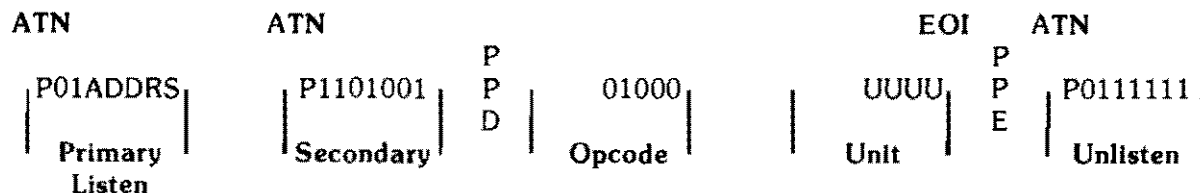
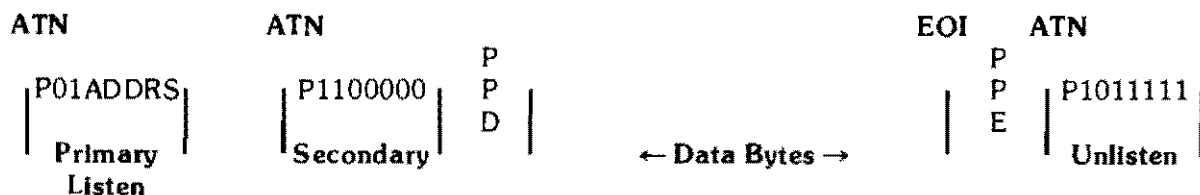
**NOTE**

In IBM format, writing to a sector which has the D bit on clears the D bit.

Parallel poll is re-enabled after the write completes or aborts.

If more than one sector is to be written, any number of write commands can be used in succession. The 9895A 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****Receive Data**

Status:

No errors.

S1 - 0

Stat 2 - Unchanged

DSJ - 0

Unsuccessful write.

S1 - Error

Stat 2 - Bits A, E and C set, if appropriate.

DSJ - 1

- Requirements for Execution:
1. 2 data bytes in command
  2.  $0 \leq \text{Unit} \leq 3$
  3.  $\text{DSJ} \neq 2$
  4. Disc present and ready
  5. First status bit not set
  6. Stat 1 = Normal completion,  
I/O program error or illegal opcode error
  7. Disc not write protected

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

## **Unbuffered Write**

Type: Disc write.

Purpose: The unbuffered write allows more than one sector to be transferred from the bus controller to the disc using a single HP-IB command sequence. Due to the inability to share the HP-IB during the transfer, the unbuffered write is not the preferred mode when HP-IB performance is desired.

Description: Following reception of the Write command, parallel poll response is disabled and status of the specified unit is checked. The 9895A now waits for the receive data secondary and then fills its internal buffer with one sector from the bus controller. When the buffer is full, the 9895A searches for the target sector and writes the buffer to it. When the buffer has been emptied, the 9895A accepts another sector from the HP-IB and in turn writes it to the next sector of the disc. This process continues until a byte tagged with an EOI is received or an error occurs. The buffer containing the byte tagged with the EOI is written to the disc before the write completes.

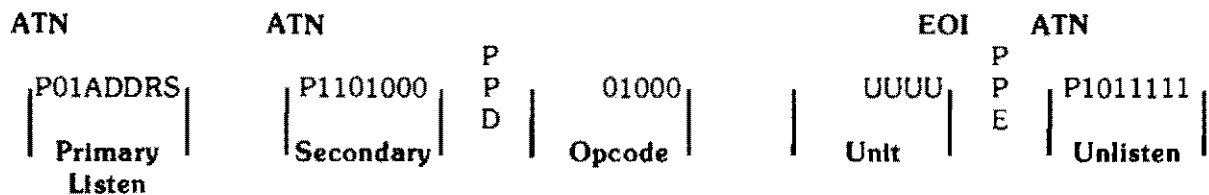
If an error occurs (i.e., drive goes not ready, an HP format D bit is encountered, the sector can't be found, etc.), writing to the disc will stop, but the 9895A will continue accepting bytes until an EOI tagged byte is received.

If an error occurs, the target address will point to the sector in which it occurred. Otherwise, the target address will point to the sector following the last sector written. When writing has been completed, parallel poll response will be re-enabled.

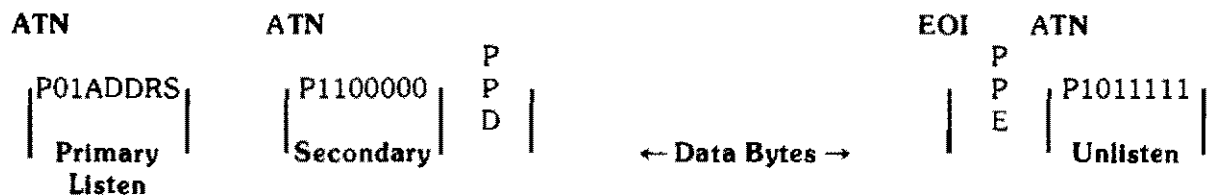
As in the unbuffered read, unbuffered write actually uses the internal buffer of the controller. However, the protocol used is unbuffered in that parallel poll is not used to indicate when data may be sent to the 9895A. Like unbuffered read, there is a pause in the data flow to the 9895A each time the buffer is written to the disc. The pause occurs after each sector is transferred. Depending on when the write starts and the staggering of the sectors (see the Format command), this pause may be up to 160 milliseconds long.

HP-IB Sequence:

#### Unbuffered Write Request



#### Receive Data



Status:

No errors.

S1 - 0

Stat 2 - Unchanged

DSJ - 0

Unsuccessful write.

S1 - Error

Stat 2 - Bits A, E and C set, if appropriate.

DSJ - 1

Requirements for Execution:

See Buffered Write Command.

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 re-set D bits. It is similar to the buffered write with the following exception:

1. For HP format discs, all D bits on the target track will be set or re-set before the target sector is written.
2. For IBM format discs, the D bits of the target sector are set or re-set as the 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 is disabled and the status of the selected unit is checked.

If an HP format disc is present, the entire target track is re-formatted, with the D bit in all sectors set or re-set according to the D bit specified in the opcode byte of the command. This re-formatting has several results:

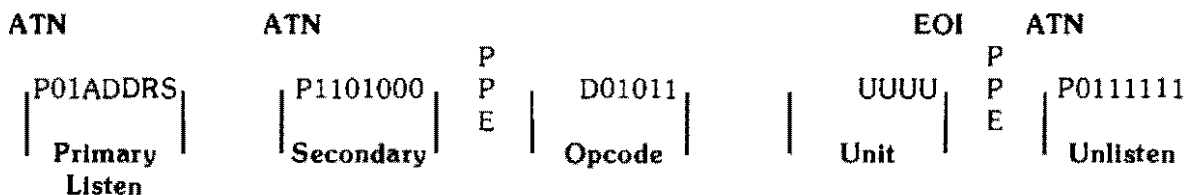
1. All data on the target track is lost,
2. The sector interleave of the track is changed to 2 (every other sector),
3. The spiral offset of the target track may no longer be optimal.

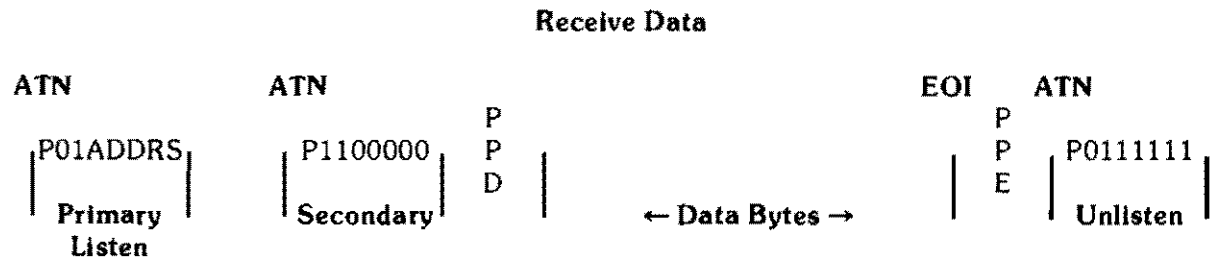
If an IBM format disc is present, the D bit is set or re-set according to the D bit specified in the opcode data byte as each sector is written. The initialization of an IBM sector does not affect the format or data of the remaining sectors of the target track, as does an HP format.

After the initialize request is sent, the command accepts and writes data in a manner identical to the Buffered Write command.

HP-IB Sequence:

### Initialize Request





Status: No errors.

S1 - 0

Stat 2 - Unchanged

DSJ - 0

Unsuccessful.

S1 - Error

Stat 2 - Bits A, E and C set, if 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 changes a disc which is unformatted or has the wrong format into a disc with a usable format. The 9895A supports three types of formats: HP double density, single- or double-sided and single-sided standard IBM format disc. 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:

1. Format type,
2. Bad track detection,
3. Sector interleave,
4. Spiral offset,
5. 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 disc is formatted according to the type, old format override, interleave and selected data byte.

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, 9895A will attempt to read from each track before it is formatted and make that track invisible if:

1. The track is already invisible,
2. A sector with a D bit set is found,
3. The track has no readable sectors.

---

### NOTE

The 9895A looks at the D bit of a random sector to decide whether or not to make that track invisible. HP format requires that the D bit of all the sectors be set so there is no problem. But, IBM format allows a mixture of set and cleared D bits on one track. Therefore, before formatting an IBM disc, all D bits on a good track should be cleared and all D bits on a bad track set.

---



If the type parameter is set to 2, the disc will be given HP format. Double-sided discs will automatically be formatted on both sides, and single-sided disc only on head 0. If the type parameter is set to 8, the disc will be formatted IBM. Double-sided discs are not supported in IBM format. Single-sided discs will be formatted on head 0 only (IBM standard). Other values of type will cause an I/O program error.

The interleave parameter determines the order in which the sectors occur on a track. Data transfers which use the internal buffer on the 9895A, or 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 track's 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 five revolutions to read one track.

---

**NOTE**

An interleave parameter value of 2 (two 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 29 of one track and sector 0 of the next to make the track seek time approximately the same as the rotational latency.

