DOCUMENT INFORMATION

This Page provides a sequential record of changes for a multi-page drawing.
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HEWLETT PACKARD

FLEX INSTRUCTION SET
Programming Manual

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PREFACE

The following sections have been revised since the last distribution.

All sections have been updated.

1.0 RELATED DOCUMENTS

CS/80 INSTRUCTION SET Programming Manual, Hewlett-Packard, JUL 1982
Beevers, Tim, *HP7937 Firmware Design Outline,* Boise, Idaho, Hewlett-Packard, 1982
Bergquist, EarL *HP7937FL Hardware ERS,* Boise, Idaho, Hewlett-Packard, 1984
Dolkas, Greg, *HPFL Protocol Standard,* Roseville, Callf., Hewlett-Packard
Nelson, Marvin, *HP7937FL Diagnostics,* Boise, Idaho, Hewlett-Packard, 1984
Kazakoff, Jim, *HP7937 Derror Descriptions* Boise, Idaho, Hewlett-Packard, 1987
Spohn, NorRae, *HP7937FL Disc Controller Overview* Boise, Idaho, Hewlett-Packard, 1986
Kazakoff, Jim, *C22OXA Derror Descriptions* Boise, Idaho, Hewlett-Packard, 1989
Peterson, Mark, *225X Derror Descriptions* Boise, Idaho, Hewlett-Packard, 1992

2.0 INTRODUCTION

This document is a FLEX instruction set programming manual, as it applies specifically to Hewlett-Packard disk drives. Please refer to specific device manuals for more information.

3.0 COMMUNICATION SYSTEM MODEL

The descriptions here serve to summarize the function and format of the various messages involved.

In addition, this section introduces device start-up, diagnostic and command pipelining concepts.

3.1 TRANSACTION STRUCTURE

A transaction is a logically complete operation between a system host and the device. A transaction begins with a command received by the device. A report message indicating the transaction passed or failed ends the transaction.

A transaction is split into three possible phases: command, execution, and report. The command and report phases define the transaction. The execution phase transfers data between the host and device only if applicable to the command. Some commands do not transfer data, but they are still executed in the execution phase. If an error occurs during command phase and the data cannot be sent to the host, the device goes to report phase.

3.2 TRANSACTION MESSAGES

There are three message types which occur in a normal transaction: command messages which contain the device operating commands; execution messages which transfer data between the host and device; and reporting message which contain pass or fail status.

A fourth message type, transparent, is used to compensate for different types of channels and differences in operating environments.

3.2.1 Command Messages

Command messages are initiated by a host and always go from the host to a device. The contents of the message may vary in length, typically up to 1Kbytes. A command message is valid only if it occurs during the command phase of a transaction. Command messages contain all device command operation codes (opcodes). See the Device Command section for the specific format of the commands.

3.2.2 Execution Messages

Execution messages contain the data requested by the command. The direction and significance of the message text depends on the command being executed. Possible execution message contents include:

1) Read Data

2) Write Data

3) Utility or Log Information

Execution messages are valid only during the execution phase of a transaction which started with a command which requires an execution message. Some operations (e. g. Spare Block) do not include execution messages.

3.2.3 Reporting Messages

The device initiates reporting messages during the reporting phase of the transaction. All reporting messages consist of at least one byte of status information transmitted from the device to the host. This byte contains the QSTAT pass/fail indication. The QSTAT byte always reflects the information currently contained in the status report.

A QSTAT of zero indicates normal completion. A QSTAT of one indicates an error occurred. The next twelve bytes contain the error information. Please refer to the Status Information Section for error codes.

3.2.4 Transparent Messages

Transparent messages compensate for different types of channels and differences in operating environments. Transparent messages also include interface specific functions or interface testing. Some device specific messages may be required in order to maintain the integrity of the transaction sequence in specific operating environments.

The only transparent message initiated by the device is an Immediate Status Message. (see Channel Implementation Section). This message handles internal device requests, aborted requests, and power recovery. An IMS contains status information which is described in the Status Information paragraph. These messages occur during the report phase.

The transparent messages initiated by the host are described in the Transparent Commands Section.

3.3 DEVICE OPERATION AND TRANSACTION SEQUENCE RELATIONSHIP

In its idle state, the device is in the command-ready state. When a command message is received, it is buffered, parsed, and validated. If the command and its parameters are valid, the device enters the execution state and begins to carry out the command. If not, the device enters the report phase.

In the execution state, the operation requested by the host is performed. If a data transfer is involved, the drive will request an execution message from the host. The execution message is not used for transactions which do not involve a transfer of information. When the requested operation is complete, the device computes the status of the operation and then enters the reporting state.

3.4 POWER-ON SEQUENCE

The device executes the following power on sequence:

1) execute internal diagnostics

2) create status report

3) send IMS indicating power on to all hosts

4) enter an interlock state

When the device enters the interlock state, it will only accept a configure (soft) clear or a reset (hard) clear. Any other commands are aborted with an IMS. This state operates on a individual host basis. The failure of one host to send a clear does not affect the ability of the other hosts to execute commands. If a power on diagnostic failure has occurred, the status information report can be retrieved with a configure (soft) clear. After the soft clear, the diagnostic failure is removed for that host.

The recommended host power on sequence follows.

1) execute an identify on the HPFL subsystem (This command is not executed by the device, so it can be sent before a clear. See Channel Implementation.)

2) send a soft clear to all possible devices on the HPFL

3) execute an extended describe on the devices

3.5 DIAGNOSTIC SEQUENCE (SELF TEST)

The initiate diagnostic command to the controller affects all hosts in the multi-host environment. After the diagnostics complete, the device notifies all hosts of the event. This is necessary as diagnostics are destructive. The following sequence will be executed:

1) The device executes its diagnostics

2) A report message is sent to the issuing host

3) An IMS indicating self test is sent to all non-issuing hosts

4) The device enters an interlock state for non-issuing hosts

The recommended sequence for the non-issuing hosts follows.

1) The host sends a soft clear to the device

2) The host restarts all outstanding commands

3.6 STATUS INFORMATION

The device returns status information by two methods. A status message may be returned in the report message or a level 3 IMS(Immediate Status) message may be returned. The device uses the report message to indicate a problem occurred in the transaction, but the transaction was able to follow a normal sequence. The IMS message is used to indicate a problem that caused the transaction to abort. Both messages use the same basic format and any common errors have the same values.

IMS Message Format

byte 0	byte 1	byte 2	byte 3
0=cancel (used only by the host)			
1=command error	1=illegal opcode		
	2=module addressing		
	3=address bounds		
	4=parameter bounds		
	5=illegal parameter		
	6=message sequence		
2=message length			
3=Reset	1=power on	QSTAT	
	2=initiate sequence	QSTAT	
4=Resource Information	1=device available		
	2=non-responding host		
	3=resource unavailable		
	4=virtual circuit in use		
	6=unable to skip mechanism		
	8=unit available		
5=Hardware Error	1=parity dev to host	device ID	
	2=parity host to dev		
	3=diagnostic failure		derror
	4=unit fault	derror	derror
	5=controller fault	derror	
	7=mechanism fault	mech number	
6=Link Protocol			
7=Port Events	2=pronto protocol error		
8=Access Error	6=too many spares		
	7=upgrade mode		
	8=retransmit		
9=Information Error	6=spindle sync fault		
	A=no self test		

Status Message Format

byte 0	byte 1	byte 2	byte 3	byte 4	byte 5	bytes 6-11
5=Hardware Error	3=diagnostic fault					
	4=unit fault	derror	derror	derror	derror	
	5=controller fault	derror	derror	derror	derror	
	7=mechanism fault	mech number				
	8=Access Error					
	1=no spares available					target addr
	2=defective spare					target addr
	3=unrecoverable data overflow	derror	derror	derror	derror	target addr
	4=unrecoverable data	derror	derror	derror	derror	target addr
	5=end of volume					
	6=too many spares					
	7=upgrade mode					
	9=configuration fault					
9=Information Error	1=almost out of spares					target addr
	2=marginal data	derror	derror	derror	derror	target addr
	3=maintenance track overflow					target addr
	4=autosparing invoked					target addr
	5=XOR parity error					
	6=spindle sync fault	mech number				
	7=skipping mechanism	mech number				

3.7 COMMAND PIPELINING AND SEEK REORDERING

The device will reorder locate and read commands and locate and write commands. The reordering scheme will be based on seek distance and the length of time a command has waited in the queue. No command or host will be starved. All transactions will be overlapped within the device (pipelining). The overlap will be between command and execution phases and between report and execution phases. Some transactions will overlap execution phases.

3.8 RESOURCE LOCKING

Two levels of resource locking will be provided: device and unit.

When a host installs a device lock, the entire device is inaccessible to other hosts until the device lock is removed. If the other hosts try to access the device when a lock is in effect, that message is rejected with UNAVAILABLE RESOURCE status. See the Set/Delete Device Lock command description.

When a host installs a unit lock, that unit is inaccessible to other hosts until the unit lock is removed. If other hosts try to access the unit when a lock is in effect, the message is rejected with UNAVAILABLE RESOURCE status. See the Set/Delete Unit Lock command description.

3.8.1 Event Queuing/Lock Release Notification

A host who had a transaction rejected because of an unavailable resource is notified when the resource is available. The device accomplishes this through an event queue and lock notification routine. Any time a transaction is rejected due to a lock resource, the event is locked in a lock table. When the lock is removed, the host which had a reject message is notified. This notification is an asynchronous IMS indicating RESOURCE AVAILABLE.

3.8.2 Non responding Host Processing (NRH)

If a host becomes inactive during an execution, report or host to host message, the drive would be forced to wait indefinitely for the host to respond. The device resolves this situation with a NRH processing routine, which allows detection of an inactive host. It is implemented using a programmable timeout, which is set independently by each host (see the Set NRH command). When a NRH timeout occurs, the device issues an IMS to the non responding host and removes the active command. The device then goes into the command ready state and is available to other hosts.

3.9 OPTIMAL COMMAND SEQUENCE

In order to minimize controller overhead, an optimal command sequence exists in the device. This sequence is 14 bytes long and consists of set unit, set address, set length and read or write.

3.10 LOGICAL VS PHYSICAL ADDRESSING

There are two different ways to view the device. Logical is the term for the way the host sees the device. Physical is the term for the way the controller sees the device. For example, on the HP7937FL, the host sees 1396 cylinders, 13 heads, and 123 sectors/track on the device. Physically to the controller there are 1404 cylinders, 13 heads, and 124 sectors/track. The host also sees sectors move around the track and continue down the cylinder. Physically these sectors are skewed each time the HP7937FL does a head and cylinder switch. These skews, 40 sectors and 59 sectors, compensate for the delay in head and cylinder switches. This means that cylinder 0, head 1, sector 0 lies up vertically with cylinder 0, head 0, sector 40. So when the drive does a head switch after reading cylinder 0, head 0, sector 122, the next sector it is able to read is cylinder 0, head 1, sector 0. No rotational delay is incurred after a head or cylinder switch. This skewing physically shows the sectors spirally down the cylinders. The preceding example contained data specifically for the HP7937FL. The cylinder, head and sector data information for each disk drive will be different.

3.11 DRIVE STATE DIAGRAM

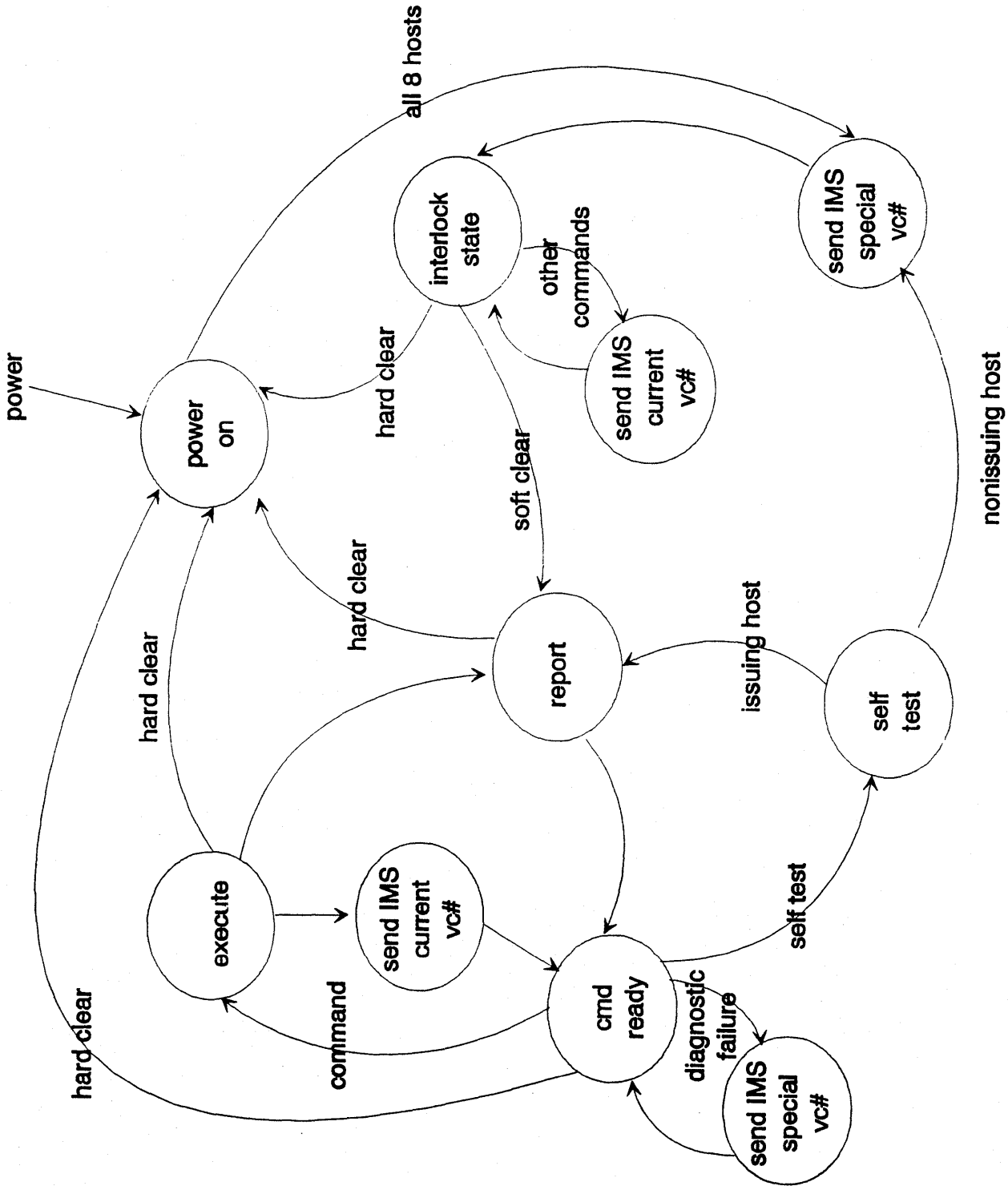


Figure 3.8-1: Drive State Diagram

3.12 MULTIPLE MECHANISM DEVICES

When multiple mechanisms are configured under one product, the following terminology will be used.

Mechanism:	One physical disk drive; synonymous with "drive"
Unit:	One logical disk drive group; may consist of one or more mechanisms
Device:	One complete peripheral product; may consist of one or more units; may consist of one or more mechanisms

4.0 DEVICE COMMANDS

4.1 LOCATE AND READ

FUNCTION

Locates the data indicated by the target address and transmits it to the host.

COMMAND FORMAT

OPCODE (OOH)

DESCRIPTION

The Locate and Read command is validated during the command phase of the transaction, after which the execution phase may begin.

First the device locates the data indicated by the target address. The target address is specified in a Set Address command. Sequential addressing is the default. A failure of any operation up to this point terminates the transaction with an IMS. Once the data is accessible to the host, the device requests an execution message. When an execution message is established, the data transfer begins.

The length of the total data transfer is the number of bytes specified in a Set Length command included in the message with the Locate and Read command. If Set Length is not specified, the power on or last set length value is used.

If a data error is encountered in the course of the transfer, the device is allowed to attempt correction for an interval specified in the Set Retry Time (Complementary) command. If the data is unrecoverable, the device will determine its most accurate reconstruction of the data and return this to the host. The address of the first sector of any bad data will be included with the report message for that transaction.

The transfer always contains the amount of data requested by the host unless the host intervenes or a hardware fault occurs. If a hardware fault occurs, the device will terminate the message and proceed to the report phase.

PRODUCT SPECIFICS

All products support this command.

4.2 LOCATE AND WRITE

FUNCTION

Transfers data from the host to a storage area beginning at the address specified by the target address.

COMMAND FORMAT

OPCODE (O2H)

DESCRIPTION

This command is a means to write data from the host onto the disk media. The opcode is validated during the command phase. The device determines the address and length in the same manner as in the Locate and Read command. If the command is received and decoded correctly, the execution phase commences by locating the area of the media where data is to be written. When device determines it is ready for data, it requests an execution message.

The write may be aborted by hardware problems or host intervention. If the write encountered hardware problems, the data is sunk by the device controller. The device then proceeds to the report phase.

PRODUCT SPECIFICS

All products support this command.

4.3 SET UNIT

FUNCTION

Used to specify a specific unit number with a mass storage device.

COMMAND FORMAT

OPCODE (2XH)

X = Unit Number

DESCRIPTION

The allowable unit numbers are 0H through FH (15). Unit FH always indicates the controller.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:
The device allows only unit 0H and unit FH. Unit FH implies the controller.

C2201A, C2204A:
The device allows only unit 0H and unit FH. Unit FH implies the controller.
The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.
If the Set Unit command is issued, it must be the first command in the command sequence.
If both the Set Unit command and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.

C225X:
For C225X independent mode, units 0H through EH indicate the logical units, while unit FH indicates the controller.
For C225X striped mode, units 0H through 2H indicate the logical units, while unit FH indicates the controller.
For C225X 2+2 mode, units 0H through 5H indicate the logical units, while unit FH indicates the controller.
The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.

If the Set Unit command is issued, it must be the first command in the command sequence.

If both the Set Unit command and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.

4.4 SET ADDRESS

FUNCTION

Used to set the value of the target address. Specifies single- or three- vector address mode.

COMMAND FORMAT

OPCODE (1XH)	PARAM 1	PARAM 2	PARAM 3
	PARAM 4	PARAM 5	PARAM 6

X=0 implies single-vector mode
Parameters form a single, 6-byte unsigned binary number
X=1 implies three-vector mode
PARAM 1 - PARAM 3 = cylinder address
PARAM 4 = head address
PARAM 5 - PARAM 6 = sector address

DESCRIPTION

The device uses the set address command to set the value of the device's target address. The target address is then used by other commands accessing data on the device. The device sets the target address to 0 at power on.

Upon completion of a transaction which uses the target address, the target address will point to the sector after the last sector accessed during that transaction, whether or not the transaction was successful. The target address can be obtained from the Request Status execution message.

The Target Address is unlike other Complementary parameters in that it is updated by any command which accesses data, and does not revert to a prior value when another accessing command is sent. This allows sequential data accessing.

In three-vector address mode, the 6-byte address specified in a Set Address command is broken into three fields, each of which contains one vector of the three dimensional address. The vectors are three, one, and two bytes in length, respectively. For disk drives, the 3-byte vector indicates cylinder address, the 1-byte vector is the head address, and the 2-byte vector is the sector address.

In single vector (block) address mode, the six byte address field in the Set Address command is treated as one number. The device maps the linear single vector address to an internal cylinder, head, sector address.

If an Address Bounds error occurs during a Set Address command, the target address will be set to zero. The target address is also set to zero any time an End of Volume occurs. The device cheeks for end of volume when a command is decoded.

PRODUCT SPECIFICS

All products support this command.

4.5 SET LENGTH

FUNCTION

Defines the number of bytes in a data transfer.

COMMAND FORMAT

OPCODE (18H)	PARAM 1	PARAM 2	PARAM 3

PARAM 4

Parameters are unsigned binary byte values.

DESCRIPTION

The four bytes following the Set Length opcode contain the byte count of the transfer length. If this field is not included in the command message, the transfer length will be determined by the power on or last set value. A length specification of all 1's (the power on value) implies a transfer size equal to the selected volume. The volume size is determined by the Describe command.

A length specification of all 0's will cause drive to locate the data only (seek). No data is transferred. A Real Time command executed in this manner does not require an execution message. After this type of operation, no verification of the target block address is performed-

PRODUCT SPECIFICS

All products support this command.

4.6 NO OP

FUNCTION

Causes the device to disregard this message byte.

COMMAND FORMAT

OPCODE (34H)

DESCRIPTION

This byte is disregarded if it appears as an opcode in a command message. It may be useful to align messages to word boundaries.

PRODUCT SPECIFICS

All products support this command.

4.7 SET MECHANISM

FUNCTION

Directs a command or utility to a specific mechanism. The appropriate utilities are those requiring specific head data, specific log data or requiring specific mechanism diagnostics.

COMMAND FORMAT

OPCODE (70H)	PARAM 1

PARAM 1 = Mechanism number, values 0 to 255 (decimal)

DESCRIPTION

This command allows appropriate commands or utilities to be directed to a specific mechanism rather than a logical unit.
The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.
If the Set Mechanism command is issued, it must be the first command in the command sequence.
If both the Set Unit command and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.
All commands, except Set Unit, may accompany this command. No reference state exists for this command, therefore, complementary commands must be present in the command sequence as required by the real time, general purpose or diagnostic utility.

PRODUCT SPECIFICS

HP793TFL, HP7936FL:
This command is not supported.

C2201A, C2204A:
This command is supported as described in the general description.
Only mechanism numbers 1 and 2 are allowed.

C225X:
This command is supported as described in the general description.
Only mechanism numbers 00H through 0FH are allowed. Mechanism 0FH indicates the controller.

4.8 EXTENDED DESCRIBE

FUNCTION

Provides the host with information describing the device capabilities.

COMMAND FORMAT

OPCODE (OCH)

DESCRIPTION

The contents of the Extended Describe execution message are formatted into a series of two tables. Each table is prefaced with a six byte table descriptor which provides such information as table type and length, record size and number, and header size (see accompanying diagrams). This information is followed by the header and the specified number of fixed length records.

	MESSAGE LENGTH (2 bytes)
Table type 3	CONTROLLER DESCRIPTION TABLE
Table type 4 or Table type 5 or Table type 6	UNIT/VOLUME DESCRIPTION TABLE (ONE FOR EACH UNIT) (Table type 4) or MECHANISM DESCRIPTION TABLE (ONE FOR MECHANISM SPECIFIED) (Table type 5) or C225X MECHANISM DESCRIPTION TABLE (ONE FOR EACH MECHANISM) (Table type 6)
Table type (FFH)	TABLE LIST TERMINATOR

4.8 EXTENDED DESCRIBE (CONTINUED):

Table type 4 is mutually exclusive with table types 5 or 6. Table type 5 or 6 is only returned when the "Set Mechanism" command accompanies the "Extended Describe" command (and Table type 4 is not returned in this case.) If "Set Mechanism" does not accompany the "Extended Describe" command, then Table type 4 is returned (and Table type 5 is not returned.) Table type 6 is only returned for C225X mech. Table type 5 is returned for all devices other than C225X.

Each table will have the following format:

TS	TYP	HS	RN	RS

Table Descriptor

where,

TS = Table Size
TYP= Table Type
HS = Header Size
RN = Number of Records
RS = Record Size

and,

TS = 6 + HS +(RN * RS)

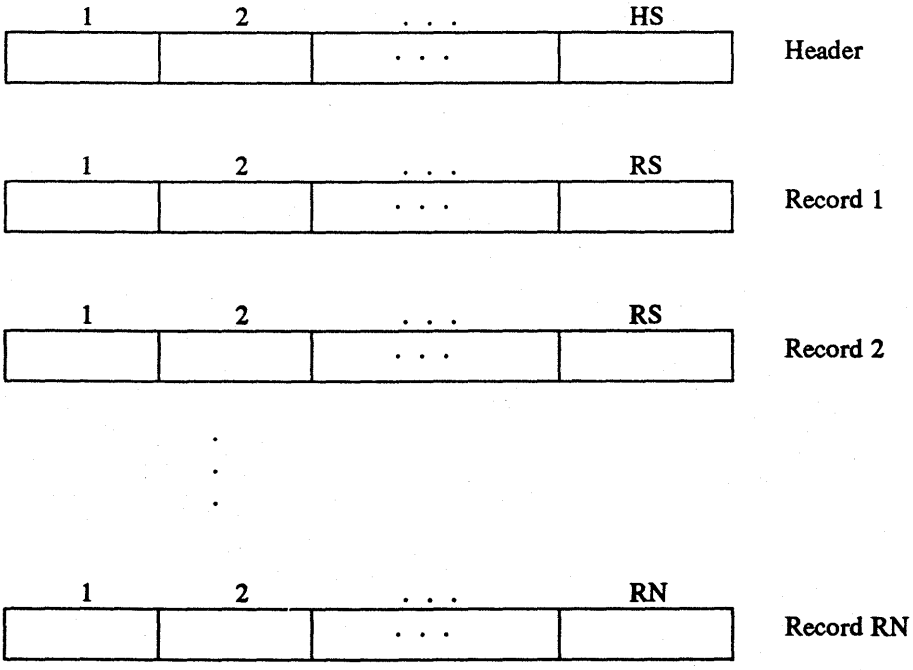


Table Type 3 - Controller Description Table

The first table returned in the describe message is the controller description table (type 3). As shown in the table below, this table has all its information contained in the header; there are no data records. The first five bytes of the header contain the same information included in the controller description field (C I -C 5) of the standard Describe execution. Two additional bytes indicate the ID of the port requesting the message (C6) and the number of host ports on the controller (C7).

Msg Ln C II Header
0,65, 0,22, 3, 16, 0, 0
C1: 128, 1, 19, 136, 4, 0, 8, 7,
2, 37, 0, 96, 0, 245, 176,
255. (0, 38, 4, 18, 1, 14...

CONTROLLER TABLE

TABLE DESCRIPTOR (values in hex format)
FOR HP7937FL, HP7936FL, C2201A, C2204A

Table Size	type	hdr size	# rec	rec size
000E	03	08	00	00

HEADER (eight single byte fields)
FOR HP7937FL, HP7936FL, C2201A, C2204A

C1	C2	C3	C4	C5	C6	C7	C8

FOR C225X

Table Size	type	hdr size	# rec	rec size
0016	03	10	00	00
(dec 22)		(dec 16)		

FOR C225X
HEADER (sixteen single byte fields)

C1	C2	C3	C4	C5	C6	C7	C8

C9	C10	C11	C12	C13	C14	C15	C16

byte fields	Description
C1-C2	Installed Unit byte: 1 bit for each unit (Unit 0 = LSB)

Product	Decimal Values
HP7937FL	1
HP7936FL	1
C2201A	
C2204A	
C225X, striped	-3
C225X, independent	1-32767
C225X, 2+2	1-63

Byte fields	Description
C3-C4	Maximum instantaneous transfer rate in thousands of bytes per second

Product	Decimal Values
HP7937FL	5000
HP7936FL	5000
C2201A	000
C2204A	000
C225X, striped	000
C225X, independent	5000
C225X, 2+2	5000

byte fields	Description
C5	Controller Type 0 = Integrated single-unit controller 1 = Integrated multi-unit controller 2 = Integrated multi-port controller 3 = Integrated multi-port P-Bus only controller 4 = Integrated multi-unit, multi-port controller

Product	Decimal Values
HP7937FL	2
HP7936FL	2
C2201A	2,3
C2204A	2,3
C225X, striped	2,4
C225X, independent	4
C225X, 2+2	4

byte fields	Description
C6	Host Port Id (0-7)

byte fields	Description
C7	Number of host ports provided by controller

Product	Decimal Values
HP7937FL	8
HP7936FL	8
C2201A	8
C2204A	8
C225X, striped	8
C225X, independent	8
C225X, 2+2	8

byte fields	Description
C8	Controller Mode 0 = Single integrated controller/unit 1 = Independent 2 = Two-plus-two 3 = One with parity 4 = Two Striped 5 = Two with parity 6 = Four Striped 7 = Four with parity

Product	Decimal Values
HP7937FL	0
HP7936FL	0
C2201A	0
C2204A	0
C225X, striped	3,4,5,6, or 7
C225X, independent	1
C225X, 2+2	2

byte fields	Description
C9-C11	Controller Number. Represents actual HP product number XX XX XY (2 digits per byte). XXXXX = product number, Y = option

Product	Decimal Values
C225X, striped	022500
C225X, independent	022500
C225X, 2+2	022500

byte fields	Description
C12-C15	Controller Specific Information

Product	Decimal Values
C225X, striped	Contents of board settings, Set at power-on
C225X, independent	Contents of board settings, Set at power-on
225X, 2+2	Contents of board settings, Set at power-on

byte fields	Description
C16	Reserved

Table Type 4 - Unit and Volume Table

Following the controller table is some number of unit/volume description tables (type 4): One unit/volume table is returned for each unit within the device. The unit description is contained in the header of the table and each record in the table describes a volume within that unit. The HP7937FL contains only one volume. This table includes all of the information in the standard Describe message plus an unit number identifier (U1).

UNIT & VOLUME TABLE

TABLE DESCRIPTOR (values in hex format)

Table Size	Type	hdr size	# rec	rec size
0026	04	12	01	0E

HEADER (eighteen single byte fields)

U1	U2	. . .	U18
		. . .	

byte fields — Description

U1 — Unit Number

Product	Decimal Values
HP7937FL	0
HP7936FL	0
C2201A	0
C2204A	0
C225X, striped	0-2
C225X, independent	0-14
C225X, 2+2	0-5

byte fields — Description

U2 — General Device Type
0 = Fixed Disk
1 = Removable disk or combination
2 = Tape, fixed block size, or random access

Product	Decimal Values
HP7937FL	0
HP7936FL	0
C2201A	0
C2204A	0
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

byte fields	Description
U3-U5	Device Number. Represents actual HP product number; XX XX XY (2 digits per byte). XXXXX = product number, Y = option

Product	Decimal Values
HP7937FL	079371
HP7936FL	079361
C2201A	022010
C2204A	022040
C225X, striped	022510
C225X, independent	022510
C225X, 2+2	022510

byte fields	Description
U6-U7	Number of bytes per block

Product	Decimal Values
HP7937FL	256
HP7936FL	256
C2201A	256
C2204A	256
C225X, striped	512, 1024, or 2048
C225X, independent	512
C225X, 2+2	1024

byte fields	Description
U8	Number of blocks that can be buffered

Product	Decimal Values
HP7937FL	128
HP7936FL	128
C2201A	128
C2204A	128
C225X, striped	112
C225X, independent	112
C225X, 2+2	112

byte fields	Description
U9	Recommended burst size (0 burst mode not recommended)

Product	Decimal Values
HP7937FL	0
HP7936FL	0
C2201A	0
C2204A	0
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

byte fields	Description
U10-U11	Block time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
HP7937FL	179
HP7936FL	179
C2201A	130
C2204A	130
C225X, striped	210
C225X, independent	210
C225X, 2+2	210

byte fields	Description
U12-U13	Continues average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
HP7937FL	1800
HP7936FL	1800
C2201A	1434
C2204A	1434
C225X, striped	5000
C225X, independent	1598
C225X, 2+2	3196

byte fields	Description
U14-U15	Optimal retry time in tens of milliseconds

Product	Decimal Values
HP7937FL	80
HP7936FL	80
C2201A	80
C2204A	80
C225X, striped	80
C225X, independent	80
C225X, 2+2	80

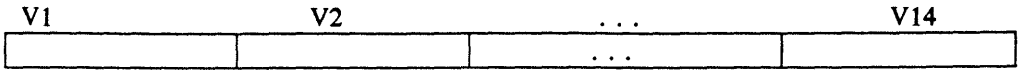
byte fields	Description
U16-U17	Access time parameter in tens of milliseconds. (Maximum time from the end of command message text to RTS data or RTR data. Applies to read and write commands only in single host single command environment)

Product	Decimal Values
HP7937FL	84
HP7936FL	84
C2201A	84
C2204A	84
C225X, striped	84
C225X, independent	84
C225X, 2+2	84

byte fields	Description
U18	Maximum interleave factor

Product	Decimal Values
HP7937FL	1
HP7936FL	1
C2201A	1
C2204A	1
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

RECORD (fourteen single byte fields)



byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
HP7937FL	1395
HP7936FL	1395
C2201A	1448
C2204A	2897
C225X, striped	1934
C225X, independent	1934
C225X, 2+2	1934

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
HP7937FL	12
HP7936FL	6
C2201A	15
C2204A	15
C225X, striped	18
C225X, independent	18
C225X, 2+2	18

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
HP7937FL	122
HP7936FL	122
C2201A	112
C2204A	112
C225X, striped	71
C225X, independent	71
C225X, 2+2	71

V7-V12 Maximum value of single-vector address

Product	Decimal Values
HP7937FL	2232203
HP7936FL	1116101
C2201A	2619791
C2204A	5239583
C225X, striped	2647079
C225X, independent	2647079
C225X, 2+2	2647079

byte fields	Description
V13	Current Interleave factor

Product	Decimal Values
HP7937FL	1
HP7936FL	1
C2201A	1
C2204A	1
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

byte fields	Description
V14	Volume number

Product	Decimal Values
HP7937FL	0
HP7936FL	0
C2201A	0
C2204A	0
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

Table Type 5 - Mechanism Table

Following the controller table is some number of mechanism description tables (type 5): One mechanism table is returned for each mechanism within the device. The mechanism description is contained in the header of the table and each record in the table describes a volume of that mechanism.

The HP7936/37 products do not return this table.

The C2201A and C2204A only return the table for the mechanism specified.

MECHANISM TABLE

TABLE DESCRIPTOR (values in hex format)
FOR C2201A, C2204A

Table Size	type	hdr size	# rec	rec size
001F	05	0D	01	0C

HEADER (thirteen single byte fields)

U1	U2	. . .	U13
		. . .	

byte fields	Description
U1	Mechanism Number/Address

Product	Decimal Values
C2201A	1
C2204A	1-2

byte fields	Description
U2	General Device Type 0=Fixed disk 1=Removable disk or combination 2=Tape, fixed block size, or random access

Product	Decimal Values
C2201A	0
C2204A	0

byte fields	Description
U3-U5	Device Number. Represents actual HP product number: XX XX XY (BCD coded, 2 digits per byte). XXXXX = product number, Y = option Y = 0 for ESDI; Y = 1 for SCSI

Product	Decimal Values
C2201A	975480
C2204A	975480

byte fields	Description
U6-U7	Number of bytes per block

Product	Decimal Values
C2201A	256
C2204A	256

byte fields	Description
U8	Number of blocks which can be buffered

Product	Decimal Values
C2201A	128
C2204A	128

byte fields	Description
U9	Interface Type 0 = ESDI 1 = SCSI

Product	Decimal Values
C2201A	0
C2204A	0

byte fields	Description
U10	Block time in microseconds (Time is from beginning of one block to beginning of next

Product	Decimal Values
C2201A	130
C2204A	130

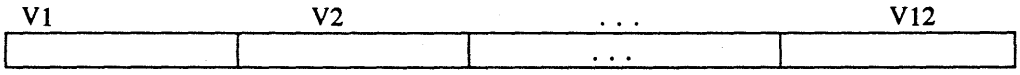
byte fields	Description
U11-U12	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C2201A	1434
C2204A	1434

byte fields	Description
U13	Maximum interleave factor

Product	Decimal Values
C2201A	1
C2204A	1

RECORD (twelve single byte fields)



byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C2201A	1448
C2204A	1448

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C2201A	15
C2204A	15

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C2201A	112
C2204A	112

byte fields	Description
V7-V12	Maximum Value of single-vector address

Product	Decimal Values
C2201A	2619791
C2204A	2619791

Table Type 6 - Mechanism Table

TABLE DESCRIPTOR (values in hex format)
FOR C225X

Table Size	type	hdr size	# rec	rec size
0021	06	0F	01	0C

HEADER (thirteen single byte fields)

U1	U2	. . .	U15
		. . .	

byte fields — Description

U1 — Mechanism Number/Address

Product	Decimal Values
C225X, striped	0-14
C225X, independent	0-14
C225X, 2+2	0-3,5-8,10-13

byte fields — Description

U2 — General Device Type
0=Fixed disk
1=Removable disk or combination
2=Tape, fixed block size, or random access

Product	Decimal Values
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

byte fields — Description

U3-U5 — Device Number. Represents actual HP product number;
XX XX XY (BCD coded, 2 digits per byte
XXXXX=product number, Y=option
Y=0 for ESDI; Y=1 for SCSI

Product	Decimal Values
C225X, striped	022511
C225X, independent	022511
C225X, 2+2	022511

byte fields	Description
U6-U7	Number of bytes per block

Product	Decimal Values
C225X, striped	512
C225X, independent	512
C225X, 2+2	512

byte fields	Description
U8	Number of blocks which can be buffered

Product	Decimal Values
C225X, striped	112
C225X, independent	112
C225X, 2+2	112

byte fields	Description
U9	Interface Type 0=ESDI 1=SCSI

Product	Decimal Values
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

byte fields	Description
U10-U11	Block time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
C225X, striped	210
C225X, independent	210
C225X, 2+2	210

byte fields	Description
U12-U13	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C225X, striped	5000
C225X, independent	1598
C225X, 2+2	3196

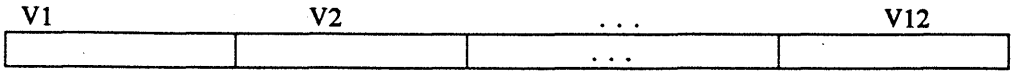
byte fields	Description
U14	Maximum interleave factor

Product	Decimal Values
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

byte fields	Description
U15	Mechanism status 0=Good 1=being rebuilt 2=non-operational 3=Unassigned (not broken, but not a member of a logical unit)

Product	Decimal Values
C225X, striped	Set at power-on
C225X, independent	Set at power-on
C225X, 2+2	Set at power-on

RECORD (twelve single byte fields)



byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C225X, striped	1934
C225X, independent	1934
C225X, 2+2	1934

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C225X, striped	18
C225X, independent	18
C225X, 2+2	18

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C225X, striped	71
C225X, independent	71
C225X, 2+2	71

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
C225X, striped	2647079
C225X, independent	2647079
C225X, 2+2	2647079

Table Type FFH - Table Terminator

A table type parameter value of FF(hex) indicates the end of the describe data.

TABLE TERMINATOR

TABLE DESCRIPTOR (values in hex format)

Table Size	type	hdr size	# rec	rec size
0006	FF	0	0	00

4.9 INITIALIZE MEDIA

FUNCTION

Instructs the device to overwrite all data on the media.

CAUTION

Execution of the Initialize Media command will destroy all user data on the selected unit.

COMMAND FORMAT

OPCODE (37H)	PARAM 1	PARAM 2

Parameter format:

PARAM 1 = OOH
Initialize retaining all factory and field spares

PARAM 1 = 01H
Initialize retaining only factory spares

PARAM 1= 02H
Initialize maintenane tracks only

PARAM 1 = ANY OTHER VALUE
Invailid command

PARAM 2 = Block interleave byte (unsigned binary number)

DESCRIPTION

The initialize options define which spares will be retained during the initialize operation. No previously defined information in the data fields is retained.

The option to initialize retaining no spares (PARAM 1 = 3) is provided for factory or CE use only.

A "0" interleave factor has the same value as a factor of " 1 ". If a block interleave factor greater than the maximum allowable (as defined by the Describe command) is specified, the interleave value defaults to maximum interleave. No error is generated by this process.

This operation takes several minutes to complete.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is implemented as described in the general description.

C2201A, C2204A:

When the unit number is set to 00H then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

C225X:

The 02H PARAM 1 value is not allowed.

When the unit number is set to OOH through OEH then this command operates on the selected unit. This command is not valid for logical unit OFH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

4.10 SPARE BLOCK

FUNCTION

Instructs the device to replace a section of media with a spare section of media.

COMMAND FORMAT

OPCODE (O6H)	PARAM 1

Parameter format:

PARAM 1 = OOH
Retain data on reformatted track with ERT

PARAM 1 = 01H
Retain no data on reformatted track

PARAM 1 = 04H
Retain data on reformatted track without ERT

DESCRIPTION

Once sparing has been initiated in a given area, it must be completed before processing any new host commands. When the host issues a Spare Block command to the device, it is necessary to reformat the entire data track on which the defective block resides.

If the option to retain no data is specified (PARAM 1 = 1), the sparing operation will be performed but none of the data will be retained. The format pattern is used in place of the data. When the host reads this format pattern, no error is returned.

If the option to retain data is specified (PARAM 1 = 0 or 4), then all good data on the track is retained during the sparing operation. Any sector on the track, including the target address, reporting uncorrectable data will retain its current data. That sector will still report uncorrectable data to the host. If the current uncorrectable data can not be read, then the format pattern will be used, and the sector will report uncorrectable data.

If the option to spare with ERT (PARAM 1=0) is specified, then an error rate test is ran on the target address. The device then spares the address only if the error rate test discovers an error. If no error is discovered, the address is not spared, and the operation finishes. If the option to spare without ERT (PARAM 1 = 4) is specified, then the device always spares the target address.

It is recommended that the host use the option to retain data with ERT during normal conditions. A diagram outlining the possible conditions is included in the Host State Diagram section.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is implemented as described in the general description.

C2201A, C2204A:

When the unit number is set to 00H then this command operates on the selected unit. This command is not valid for logical unit OFH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

C225X:

This command is not valid for the controller.

C225X independent mode:

This command is implemented as described in the general description.

C225X striped mode and 2+2 mode:

When a Set Unit 00H through 0EH is issued, and an unrecoverable read was previously detected, the Spare Block command will spare the individual mechanism that reported the unrecoverable read.

When a Set Unit 00H through 0EH is issued, and no unrecoverable read has been detected, the Spare Block command will spare all the mechanisms in the unit.

When a Set Mechanism 00H through 0EH is issued, the individual mechanism is spared.

C225X parity mode:

When a Set Unit 00H through 0EH is issued, and an unrecoverable read was previously detected, the Spare Block command will spare the individual mechanism that reported the unrecoverable read. Following the spare, C225X will recover the data for the individual mechanism that was spared. In order to recover the mechanism data, no skip drive can exist.

When a Set Unit 00H through 0EH is issued, and no unrecoverable read his been detected, the Spare Block command will spare all the mechanisms in the unit.

When a Set Mechanism 00H through 0EH is issued, the individual mechanism is spared.

4.11 LOCATE AND VERIFY

FUNCTION

Instructs the device to perform an internal verification of a section of data to ensure that it can be read.

COMMAND FORMAT

OPCODE (04H)

DESCRIPTION

None of this data is transferred to the host so no execution message is required. The Set Length and Set Address (Complementary) commands are used as described earlier.

The verification starts at the target address and continues for the amount of data (in bytes) specified in a Set Length command (or the existing length or power on value). If this byte count length is not an integral multiple of the number of bytes per block the count will be rounded up to verify the entire block.

During verification all correctable data errors are counted and logged into the error log. Verification will terminate immediately with an unrecoverable error. Read retries are not attempted during a Locate and Verify.

PRODUCT SPECIFICS

All products support this command.

4.12 INITIATE UTILITY

FUNCTION

Directs the device to perform one utility routine.

COMMAND FORMAT

OPCODE (3XH)	PARAM 1	PARAM 2	PARAM 3
	PARAM 4	PARAM 5	PARAM 6
	PARAM 7	PARAM 8	PARAM 9

Opcode format:

X = 0: no execution message
X = 1: drive will receive execution message
X = 2: drive will send execution message

Parameter format: PARAM 1 = Utility number (drive specific)

PARAM 2 - PARAM 9 = Any parameters required by the utility.

DESCRIPTION

The utility number following the Initiate Utility opcode indicates which utility is to be performed. Depending on the utility selected, a predefined (by the drive) number of parameter bytes may be expected to follow the utility number. Please refer to the utilities section for specific details.

PRODUCT SPECIFICS

All products support this command.

4.13 INITIATE DIAGNOSTIC

FUNCTION

Directs the device to perform one internally defined diagnostic routine.

COMMAND FORMAT

OPCODE (33H)	PARAM 1	PARAM 2	PARAM 3

Parameter format: PARAM 1 - PARAM 2 = Loop parameter

PARAM 3 = Diagnostic section number

DESCRIPTION

This command instructs the device to perform one internally defined diagnostic routine.

Parameter byte PARAM 3 (diagnostic section number) defines which internal diagnostic the drive will perform. (The value of this parameter is device dependent.) Parameter bytes PARAM 1 and PARAM 2 (loop control) determine how many times the diagnostic will be performed.

As diagnostics to the controller cause the drive to go off-line, all other hosts will receive an IMS indicating reset - initiate diagnostics.

Currently, the only supported diagnostic is self-test, Diagnostic section number zero (0).

PRODUCT SPECIFICS

HP7937FL, HP7936FL

This command must be directed to the device's controller (unit 15).

C2201A, C2204A:

This command must be directed to the device's controller (unit 15).

C225X:

This command is allowed for all units (0- 14) and for the controller (unit 15).

Diagnostics issued to the controller (unit 15) perform as described. Diagnostics issued to units 0-14 perform mechanism self-tests to each mechanism of the unit.

Diagnostics issued to the controller (unit 15) on the link device is not allowed.

4.14 REQUEST STATUS

FUNCTION
Instructs the device to execute the equivalent of a zero length write, and to return (in an execution message) the status report.

COMMAND FORMAT

OPCODE (0DH)

DESCRIPTION
The Request Status command executes a zero length write and returns a 12-byte status report (in an execution message) indicating the status of the transaction. This is the same status format as the status returned in the report phase of every command that has a non-zero QSTAT.

Status Message Format

byte 0	byte 1	byte 2	byte 3	byte 4	byte 5	bytes 6-11
5=Hardware Error	3=diagnostic fault					
	4=unit fault	derror	derror	derror	derror	
	5=controller fault	derror	derror	derror	derror	
	7=mechanism fault	mech numb				
8=Access Error	1=no spares available					target addr
	2=defective spare					target addr
	3=unrecoverable data overflow	derror	derror	derror	derror	target addr
	4=unrecoverable data	derror	derror	derror	derror	target addr
	5=end of volume					
	6=too many spares					
	7=upgrade mode					
	9=configuration fault					
9=Information	1=almost out of spares					target addr
	2=marginal data	derror	derror	derror	derror	target addr
	3=maintenance track overflow					target addr
	4=autosparing invoked					target addr
	5=XOR parity error					
	6=spindle sync fault	mech number				
	7=skipping mechanism	mech number				

PRODUCT SPECIFIC
All products support this command.

4.15 SET DEVICE LOCK

FUNCTION

Locks the entire device for exclusive access by the host issuing the command.

COMMAND FORMAT

OPCODE (63H)

DESCRIPTION

This command allows a host to gain exclusive access to the entire device for as long as it wishes. The other hosts are excluded from all access to the device until the lock is removed; any attempt by an excluded host to access the device will fail with an UNAVAILABLE RESOURCE IMS.

PRODUCT SPECIFICS

HP793TFL, HP7936FL:

This command is implemented as described in the general description.

C2201A, C2204A:

This command is implemented as described in the general description.

C225X:

This command is implemented as described in the general description. Additionally, this command is considered an invalid request if any Unit Lock exists.

4.16 DELETE DEVICE LOCK

FUNCTION

Removes a currently installed device lock.

COMMAND FORMAT

OPCODE (6BH)

DESCRIPTION

This command deletes a device lock, thus freeing the device for access by the other hosts. Any host can unlock the device.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is implemented as described in the general description.

C2201A, C2204A:

This command is implemented as described in the general description.

C225X:

This command is implemented as described in the general description. Additionally, this command is considered an invalid request if any Unit Lock exists.

4.17 SET UNIT LOCK

FUNCTION

Lock a unit for exclusive access by the host issuing the command.

COMMAND FORMAT

OPCODE (73H)

DESCRIPTION

This command allows a host to gain exclusive access to an unit for as long as it wishes. The other hosts are excluded from all access to the unit until the lock is removed; any attempt by an excluded host to access the unit will fall with an UNAVAILABLE RESOURCE IMS.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

This command is implemented as described in the general description. Additionally, this command is considered an invalid request if any Device Lock exists.

4.18 DELETE UNIT LOCK

FUNCTION

Remove a currently installed unit lock.

COMMAND FORMAT

OPCODE (7BH)

DESCRIPTION

This command deletes a unit lock, thus freeing the unit for access by other hosts. Any host can unlock the unit.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

This command is implemented as described in the general description. Additionally, this command is considered an invalid request if any Device Lock exists.

4.19 SET NONRESPONDING HOST (NRH) TIMEOUT

FUNCTION

Defines the length of time (in seconds) the controller must wait for the host to respond to the device after the device initiates the transfer of execution data.

COMMAND FORMAT

OPCODE (67H)	PARAM 1	PARAM 2

Parameter format: PARAM 1 - PARAM 2 = timeout value in tens of milliseconds
(16 bit, unsigned)

DESCRIPTION

This command establishes the length of time the controller must wait in NRH processing for the host response. The time specified applies only to the host issuing the command. If the host does not respond within the specified time limit, the controller frees the space in the drive for that execution message and sends an IMS to the offending host.

The value of the timeout parameter bytes (P1 -P2) defines how long (in tens of milliseconds) the device will wait for the host to respond. The maximum timeout value is 65,534 (10.92 minutes). A value of 0 represents the minimum time during which the controller can execute the NRH processing; this minimum time depends on any system overhead involved.

The default timeout value is 65534.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is implemented as described in the general description.

C2201A, C2204A:

This command is implemented as described in the general description.

C225X:

The device uses the NRH timeout command to set the longest time allotted for any command. If the NRH timeout command is not included in the command message, the value will be determined by the power-on or last set value. The power-on value is 65534 (10.92 minutes). The maximum value is 65535, indicating 60 minutes.

When this command is included in the command message of a Real Time command, only the Real Time command will be affected by the NRH timeout value issued.

4.20 SET HOST TO HOST (HTH) TIMEOUT

FUNCTION

Defines the length of time (in seconds) the controller must wait for the host to respond to the device after the device initiates a host-to-host message.

COMMAND FORMAT

OPCODE (69H)	PARAM 1	PARAM 2

Parameter format: PARAM 1 - PARAM 2 = timeout value in tens of milliseconds
(16 bit, unsigned)

DESCRIPTION

This command establishes the length of time the controller must wait in HTH processing for the host response. The time specified applies only to the host receiving the command. If the host does not respond within the specified time limit, the controller frees the spare in the drive for that execution message and sends an IMS to the host issuing the command.

The value of the timeout parameter bytes (P1 -P2) defines how long (in tens of milliseconds) the device will wait for the host to respond. The maximum timeout value is 65,534 (10.92 minutes). A value of 0 represents the minimum time during which the controller can execute the NRH processing; this minimum time depends on any system overhead involved.

The default timeout value is 65534.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is implemented as described in the general description.

C225X:

The device uses the HTH timeout command to set the longest time allotted for any HTH command. If the HTH timeout command is not included in the command message, the value will be determined by the power-on or last set value. The power-on value is 65534(10.92 minutes). The maximum value is 65535, indicating 60 minutes.

When this command is included in the command message of a Real Time command, only the Real Time command will be affected by the HTH timeout value issued.

4.21 LOCATE AND FILL

FUNCTION

Transfers the parameter byte pattern to a storage area beginning at the address specified by the target address.

COMMAND FORMAT

OPCODE (05H)	PARAM 1

PARAM 1 = byte pattern to transfer

DESCRIPTION

This command performs a write on the media without execution data being sent. The parameter byte is written to every byte of the current length.

The opcode is validated during the command phase. The device determines the address and length in the same manner as in the Locate and Read command. If the command is received and decoded correctly, the execution phase commences by locating the area on the media where data is to be written. The device then commences writing the parameter byte to the disk.

The write may be aborted by hardware problems or host intervention. If the write encountered hardware problems, the execution phase terminates and the device proceeds to report phase.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is implemented as described in the general description.

C225X:

This command is implemented as described in the general description.

4.22 DIRECTED POST

FUNCTION

Reads the data from this unit and writes the data to an alternate unit

COMMAND FORMAT

OPCODE (5207H)

DESCRIPTION

This command allows one unit to write some of its data to a different unit. The recipient of this command is the unit from which data is read. There are six complementary commands used when processing this command. The complementaries are: Set Unit, Set Address, Set Length, Directed Bus Id, Directed Unit and Directed Address. The Set Unit, Set Address and Set Length complementary commands specify the current position of the data. The Directed Bus ID, Directed Unit and Directed Address complementary commands specify the destination position of the data. (For certain devices, the additional complementary commands Set Volume and Directed Volume may be necessary.) For this command, the current and destination units must reside on the same Bus. The current and destination units may reside within the same device.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

The Set Volume and Directed Volume complementary commands cannot be used to describe the C225X device.

Data transfers are not allowed within the same unit. Data transfers are not allowed within the same module.

4.23 DIRECTED FETCH

FUNCTION

Gets data from an alternate unit and writes the data to this unit.

COMMAND FORMAT

OPCODE (5208H)

DESCRIPTION

This command reads data from a unit and writes it to this unit. The recipient of this command is the unit where the data will be written. There are six complementary commands used when processing this command. The complementaries are: Set Unit, Set Address, Set Length, Directed Bus Id, Directed Unit and Directed Address. The Directed Bus ID, Directed Unit and Directed Address complementary commands specify where to read the data from. The Set Unit, Set Address and Set Length complementary commands specify where to write the data on this unit. (For certain devices, the additional complementary commands Set Volume and Directed Volume may be necessary.) For this command, the current and destination units must reside on the same Bus. The current and destination units may reside within the same device.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported

C225X:

The Set Volume and Directed Volume complementary commands cannot be used to describe the C225X device.

Data transfers are not allowed within the same unit. Data transfers are not allowed within the same module.

4.24 DIRECTED BUS ID

FUNCTION

Used to set the value of the Bus ID of the directed unit for directed operations.

COMMAND FORMAT

OPCODE (5215H)	PARAM 1

PARAM 1 = Directed Bus ID

DESCRIPTION

This command allows Bus ID values of 0 through 7.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

This command is supported as described in the general description.

4.25 DIRECTED UNIT

FUNCTION

Used to specify the directed unit number for a directed command

COMMAND FORMAT

OPCODE (522XH)

X = Directed Unit Number

DESCRIPTION

This command designates the alternate unit for the data transfer in directed operations. For a Directed Post command, the Directed Unit command indicates which unit the data will be written. For a Directed Fetch command, the Directed Unit command indicates from which unit the data is read.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported

C225X:

This command is supported as described in the general description.

4.26 DIRECTED VOLUME

FUNCTION

Used to specify the directed volume for a directed command.

COMMAND FORMAT

OPCODE (524XH)	PARAM 1

X = Directed Surface Number

PARAM 1 = Media number

DESCRIPTION

This command designates the alternate volume for the data transfer in a directed operation. For a Directed Post command, the Directed Volume command indicates which volume the data will be written. For a Directed Fetch command, the Directed Volume command indicates from which volume the data is read.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

The Direct Volume cannot be used to indicate a C225X device.

4.27 DIRECTED ADDRESS

FUNCTION

Used to specify the directed address for directed commands.

COMMAND FORMAT

OPCODE (521XH)	PARAM 1	PARAM 2	PARAM 3
	PARAM 4	PARAM 5	PARAM 6

X=O implies single-vector mode.
Parameters form a single, 6-byte unsigned binary number.

X=1 implies three-vector mode.
PARAM 1 - PARAM 3 = cylinder address
PARAM 4 = head address
PARAM 5 - PARAM 6 = sector address

DESCRIPTION

This command designates the alternate address for the data transfer in directed operations. For a Directed Post command, the Direct Address command indicates which address the data will be written. For a Directed Fetch command, the Directed Address command indicates from which address the data is read.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

This command is supported as described in the general description.

4.28 REBUILD

FUNCTION

Begin rebuilding data.

COMMAND FORMAT

OPCODE (50H)

DESCRIPTION

This command regenerates data for a specific mechanism.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This Command is not supported.

C225X:

The C225X must recognize a drive missing from a parity set.

The command validates the mechanism can be rebuilt when the Set Mechanism command is employed.

This command validates the unit has a mechanism that can be rebuilt when the Set Unit command is employed.
The default unit is used when neither a Set Mechanism or Set Unit command accompanies this command. This command validates the default unit has a mechanism that can be rebuilt.

There is no execution message with the Rebuild command. An immediate report is issued. To determine when a Rebuild has completed, the Rebuild Status utility in conjunction with Extended Describe must be used.

4.29 SKIP DRIVE

FUNCTION

Remove a mechanism from participation within a unit.

COMMAND FORMAT

OPCODE (71H)

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

A Set Mechanism Command must be sent in the command sequence of this command.

Once a skip drive is set, it can only be accessed via Set Mechanism commands.

A skip drive is only allowed in a parity configuration. Only one skip drive is allowed per unit.

5.0 TRANSPARENT COMMANDS

Transparent commands compensate for different types of channels and different operating environments. As a result the transparent messages supported on each system will differ from those supported on other link implementations. Some of these commands are delivered as level 4 commands (FLEX), while others are delivered as level 3 commands. More information on the specifics of the level 3 implementation can be found in the Channel Implementation Section.

5.1 REMOTE HOST RESET

FUNCTION

Causes a Remote Link Reset (RLR) on the indicated host. This is a FLEX level 4 command.

COMMAND FORMAT

OPCODE (10H)	PARAM 1

Parameter Format: Host port number

DESCRIPTION

This command causes the device to assert the RLR line that goes to the indicated host (see HPFL manual for RLR line description). Parameter one indicates the host that will receive the reset.

5.2 TRANSPARENT STATUS (TSTAT)

FUNCTION

Returns the current status of the device in the report message. Completion of the command indicates the device is still alive. This may be useful during long transactions. This is a FLEX Ievel 4 command.

COMMAND FORMAT

OPCODE (40H)

DESCRIPTION

This transparent command returns the same report message format as a normal command. After this command, the current status of the device for the host is cleared.

5.3 CONFIGURE CLEAR

FUNCTION

Brings the device into a known software state for the host issuing the command. This is implemented as a level 3 command.

DESCRIPTION

This command returns a report message the same as tstat or other normal commands. The command causes the following operations to be performed on the device.

1) Abort the current operation at the earliest opportunity such that no data corruption can take place.

2) Flush all queued commands for the issuing host.

3) Reset all command parameters to their Power on values for the issuing host.

4) Generate the status report.

5) Set the Qstat value to indicate whether the status is being returned.

6) Clears the interlock state for the issuing host.

7) Enters the report state for the issuing host.

After this command, the current status is cleared.

5.4 LOOPBACK

FUNCTION

Sends data to the device's buffer and back. This is a level 3 command.

DESCRIPTION

The data is sent to the device. The data goes into the device RAM buffer and is then returned to the host.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

A maximum of 32K bytes of data may be sent to the device.

C225X:

A maximum of 32K bytes of data may be sent to the device.

C2201A, C2204A:

A maximum of 32K bytes of data may be sent to the device.

5.5 CANCEL

FUNCTION

Cancels an outstanding transaction. This is a level 3 command. The device will cancel the transaction by either removing it from the queue, stopping the disk command, or stopping the execution message going out the channel.

5.6 IDENTIFY

FUNCTION

Returns the type of device connected to the link. This is a level 3 command. For specific information see the Channel Implementation Section.

5.7 RESET CLEAR

FUNCTION

Resets the drive hardware and software. This is a level 3 command.

DESCRIPTION

The reset clear performs the following operations.

1) Abort the current operation without damaging the mechanism.

2) Flush all queued commands.

3) Clear all clearable device or interface conditions.

4) Reset all command parameters to their power on values.

5) Reset the reference status.

6) Execute a power on self test to acquire status conditions.

7) Set the Qstat to indicate whether status information is being returned.

8) Send an IMS indicating power on to all hosts.

9) Enter the interlock state.

6.0 HOST STATE DIAGRAMS

The following diagrams are recommended procedures for the host to follow when communicating with the disk. Please note in the timeout diagram if a transparent status (Tstat) fails, the correct action is to send a Hard Clear not a Soft Clear. This is because a Soft Clear takes the same path as the transparent status which failed. Please also note the terms Hard Clear and Soft Clear correspond to Reset Clear and Configure Clear.

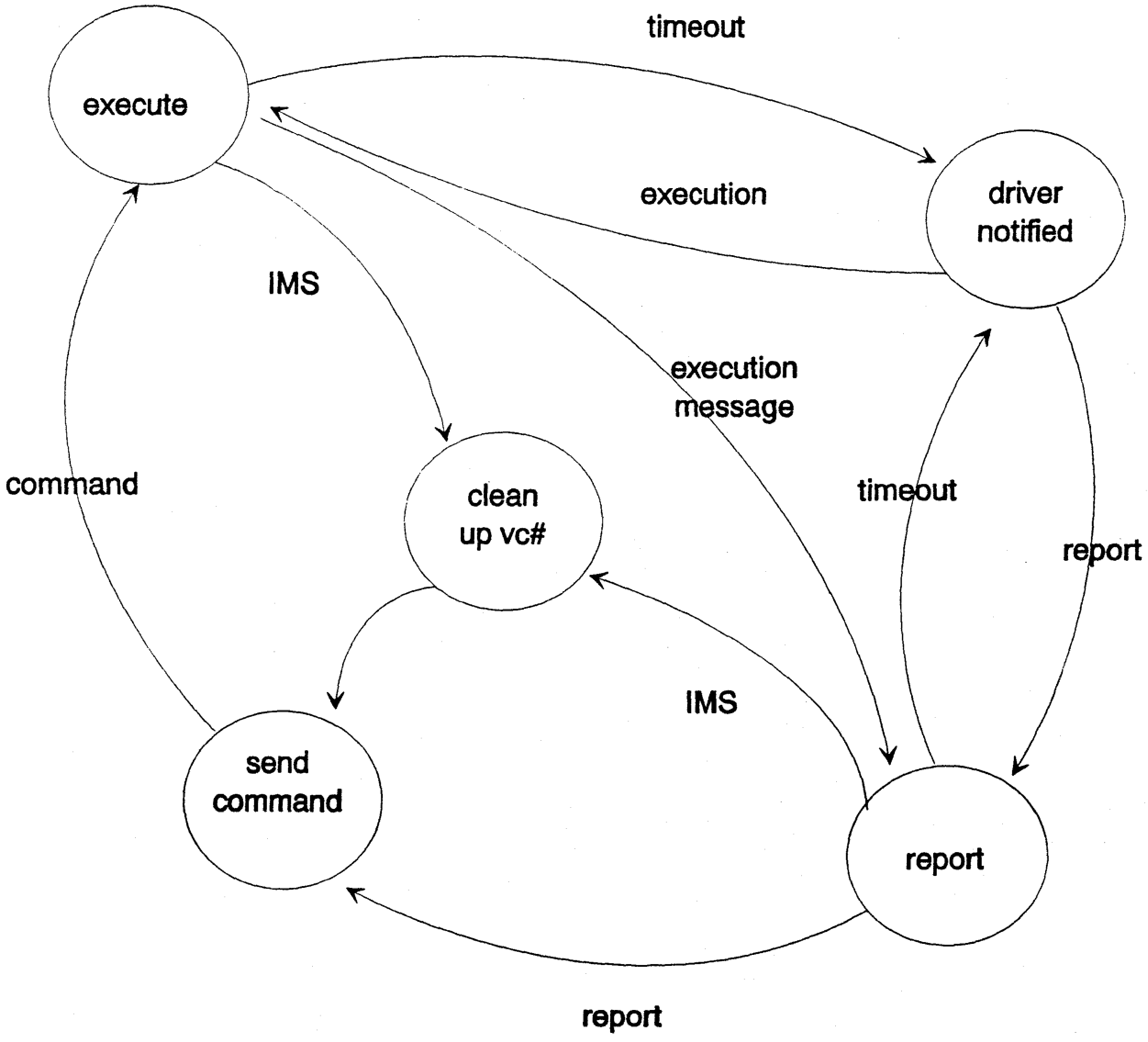


Figure 3.10-1: Host State Diagram for Normal Transactions

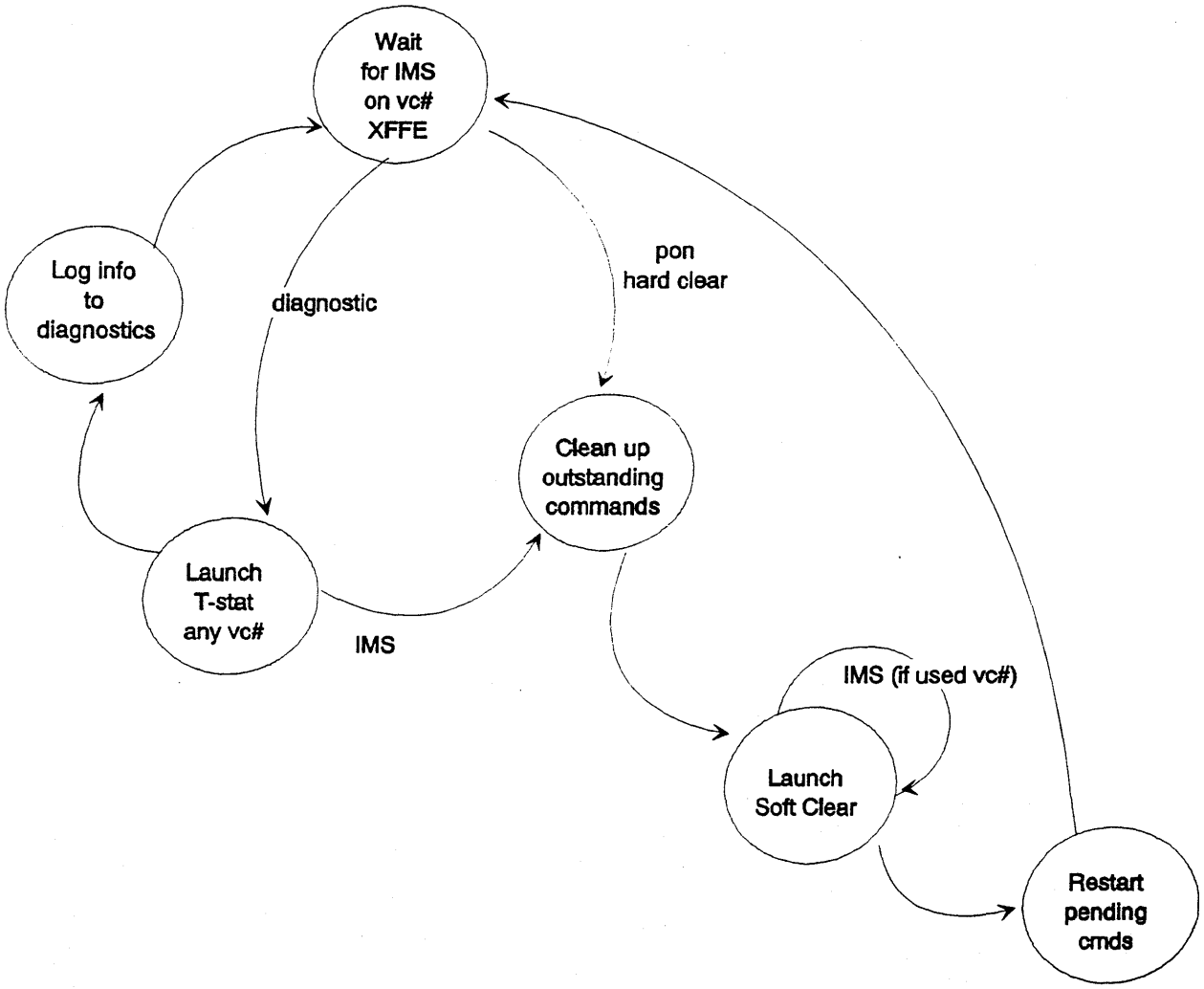


Figure 3.10-2: Host State Diagram for Asynchronous IMS

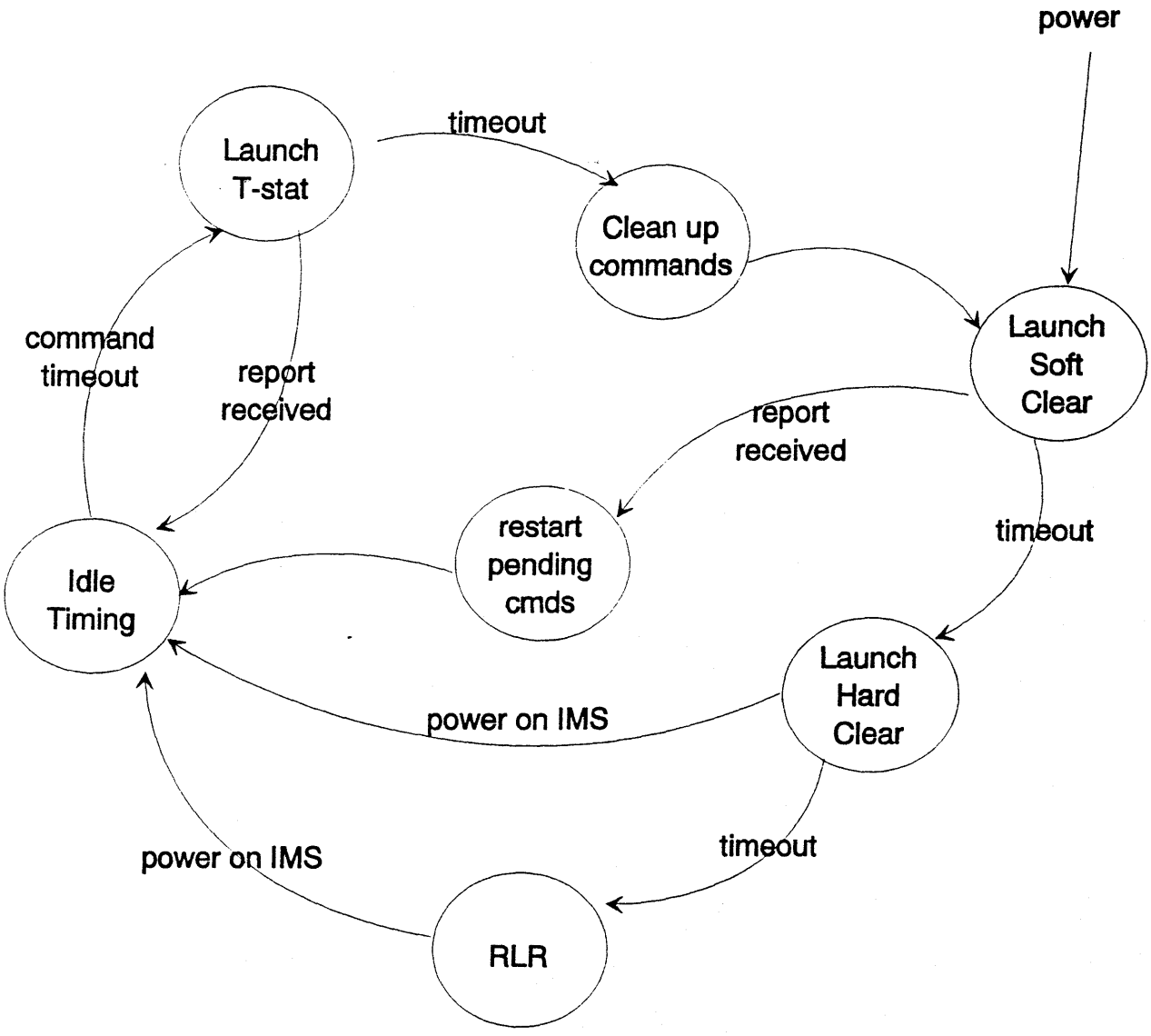


Figure 3.10-3: Host State Diagram for Timeouts

7.0 CHANNEL IMPLEMENTATION

7.1 INTRODUCTION

This section provides an overview of the HPFL and discusses the protocol and syntax for channel interactions between the host and a device.

The FLEX protocol can be used on an optical communication link. A transaction and its message parts (command, execution, and report,) remain similar to CS80 despite the differences in communication links used to transport it from host to peripheral device. The major change from link to link is the mechanism and channel protocol used to transport messages.

Protocol is defined as the rules for conducting communications on a given channel. Protocol is channel-specific/device-independent and includes the addressing requirements, handshake sequences, and channel management operations.

Syntax is defined as the systematic arrangement of communication elements (bytes, commands, etc.) to form intelligent messages.

7.2 HPFL OVERVIEW

The HPFL interface is a 5.0 megabyte/sec optical interface link. It enables process to process information transfer and will support higher level protocols such as FLEX, however, no specific higher level protocol is implied.

The HPFL was designed in the framework of the international Standards Organizations (ISO) Open Systems Interconnection (OSI) reference model. The various levels of protocol are defined as follows.

LEVEL 0 - The Medium Layer Standard defines the actual medium used to move data. There are two main level 0 standards used in the HPFL device:

FIBER LINK: The optical cable medium is a 100/140 micron duplex glass fiber. This cable is the connection from the host computer system to a cluster of fiber optic link devices. For more details refer to the "HPFL Protocol Standard" (Roseville Networks Division).

PBus: The wire medium is a 64 wire differential cable. These cables are the connections between fiber optic link devices in a cluster. For more details, refer to the "HP7937FL PBus ERS" (Disc Memory Division).

LEVEL 1 - The Physical Layer Standard defines the transmission of raw data over a medium. There are two main level 1 standards used in the HPFL device:

FIBER LINK: The optical components encode a 5 bit (one bit of control or data flag and 4 bits of data) parallel stream into a 6 bit serial stream. The transmitter converts this electrical signal into a photon stream passed across the optical cable. The decode process is the reverse of the above process. For more details, refer to the "HPFL Protocol Standard" (Roseville Networks Division).

PBus: The PBus passes data in 16 bit words with synchronous control lines. Each byte is parity protected during transmission. For more information, refer to the "HP7937FL PBus ERS" (Disc Memory Division).

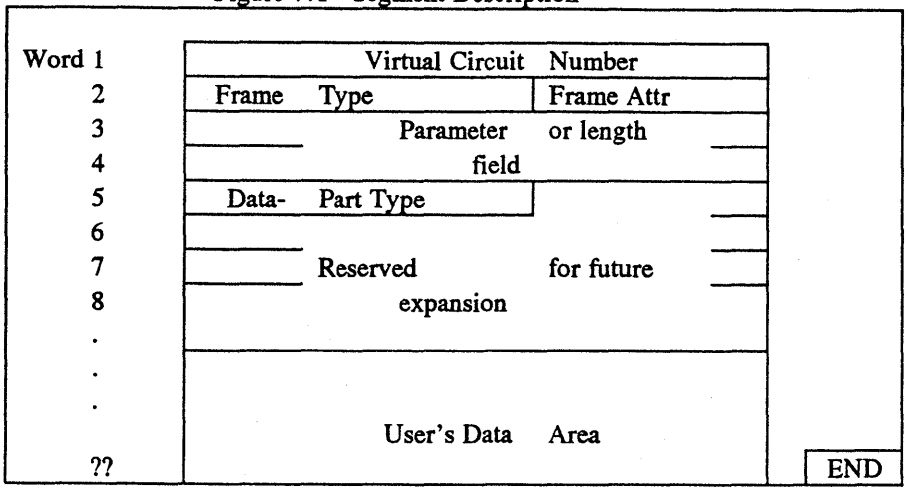
LEVEL 2 - The Data Layer Standard defines the framing of data to transform the raw transmission facility into a errorless transmission facility. There are two main level 2 standards used in the HPFL device:

FIBER LINK: The optical transmission uses a sliding window protocol and 16 byte frame groups to control flow. The acknowledge/non acknowledge of these frames controls the necessary re transmission of problem frames. If any error is detected, the frame is re transmitted without any external intervention (level 3). Every frame must be acknowledged by the receiver before the sender may overwrite the information in that frame. This link protocol is essentially invisible to the level 3 network layer, as such it will also be invisible in our discussion of the channel implementation (level 3) for HPFL. For more information, refer to the "HPFL Protocol Standard" (Roseville Networks Division).

PBus: The PBus uses parity and various other control handshakes to frame data. A source selection process is performed to arbitrate for the bus. The selection is round robin among host connections followed by a round robin among device connections. The following destination selection is accomplished via a PBus ID which the source provides. Once the source and destination is selected, data is passed one word (parity protected) at a time. The data frame is terminated by the assertion of EOS. For more information, refer to the "HP7937FL PBus ERS" (Disc Memory Division).

LEVEL 3 - The Network Layer Standard consists of headers (16 byte preambles) followed by optional data segments. These headers control the movement of level 4 data. This will be further explained in the remainder of this chapter. Below is a brief generalization of this protocol layer.

Figure 7.1 - Segment Description



At the channel protocol level (level 3), HPFL data is sent in segments of 8192 bytes with a 16 byte header (figure 7.1). All segments of a message except the last must have a full 8192 bytes of data. The last segment before the end of the message may be any number of bytes up to the maximum of 8192 bytes.

The first field in the segment header is the virtual circuit. This 16 bit number provides the capability of addressing data to a specific process. Each segment on the channel contains a virtual circuit. This number causes a segment to be directed to the process that is assigned to handle that particular segment.

The frame type field defines the type of the frame:

0 = Data (DAT)
1 = Ready to Send (RTS)
2 = Ready to Receive (RTR)
3 = No Op (NOP)
4 = Request to Send (RQS)
5 = Permission to Send (PTS)
6 = Immediate Status (IMS)
7 = Loopback Data (LDA)
8 = Request Identify (RQI)
9 = Identify (IDY)
10 = Request Loopback (RQL)
11 = Permission to Loopback (PTL)
12 = Returned Loopback Data (RLD)
13 = Acknowledge IMS (IMA)
14 = Reset (RST)
15 = Good Report (RPT)
16 = Link Status (LS)
17 - 254 = not assigned
255 = reserved for expansion

The next field contains the frame attributes which are modifiers to the frame type field. The individual bits of this field are defined as follows:

bit 0 = End of Message
bit 1 = First Bit

bit 2 = Length field present
bits 3 - 7 are not used

The "End of Message" indicator is used to flag the completion of each negotiation phase between the host and the device. The "First Bit" is used to indicate the first frame that each side sends on a given virtual circuit for a individual transaction. The "length field present" bit indicates that there is a valid length (counted in bytes) present in the parameter/length field.

The data type code field indicates what sort of data is to be transferred. It is either the type of the data which is included in this DATA segment, or it is the type of the data which is being negotiated for. The RTS and RTR frames are examples of the "type" that is being negotiated for.
The meaning of the parameter or length field is dependent on the frame type and frame attribute. When the length field present bit in the frame attribute is set, this field indicates the length (in bytes) of the data which is included in this DATA segment, or the length of the data which is being negotiated between two processes. In other cases this field serves as a parameter to the frame type. For example, in the case of an IMS, this field contains an explanation of why the immediate status was generated.

The segment header is followed by the user's data area. To contain data the segment must be of frame type DATA, LDA, RLD or a quick command (RTS followed by data). All other segments consist of headers only. The user's data area contains 8192 bytes of data unless the segment is the last one in a message. In the last segment, the user's data area may have any number of bytes up to a maximum of 8192 bytes.

7.3 FLEX SPECIFIC IMPLEMENTATION

Link management is accomplished by the segment headers. Each message in a FLEX transaction is sent across the link in segments. An entire message may be contained in a single segment or a single message may take several segments. Each segment header contains information by which the link can be managed.

7.3.1 HPFL Header Format

In the process of link management, portions of the general HPFL header perform implementation specific functions.

The first four bits of the virtual circuit field contain the device ID. This ID is the address of the device which is to receive or is sending the segment, depending on which direction the segment is being sent across the link. The remaining 12 bits of the virtual circuit identify the host process which is sending or receiving the segment. The map of usable virtual circuits is as follows:
(X represents the fiber optic link device address - i.e. 0 through 7, Y represents the port (link) address - i.e. 8 through 15)

HEX Virtual Circuit - Uses

X000 through XFFF - general transaction vc's with the following exceptions:
- XFF0 - Reserved for future control
- XFF1 - Reserved for future control
- - Reserved for future control
- - Reserved for future control
- XFFB - Reserved for future control
- XFFC - HPFL Device Loopback
- XFFD - Host To Host Return Virtual Circuit
- XFFE - Asynchronous Virtual Circuit
- XFFF - Reserved for future control

Y000 through YFFF Available for Direct Host to Host messages
with the following exceptions-.
FFFF - Universal Virtual Circuit

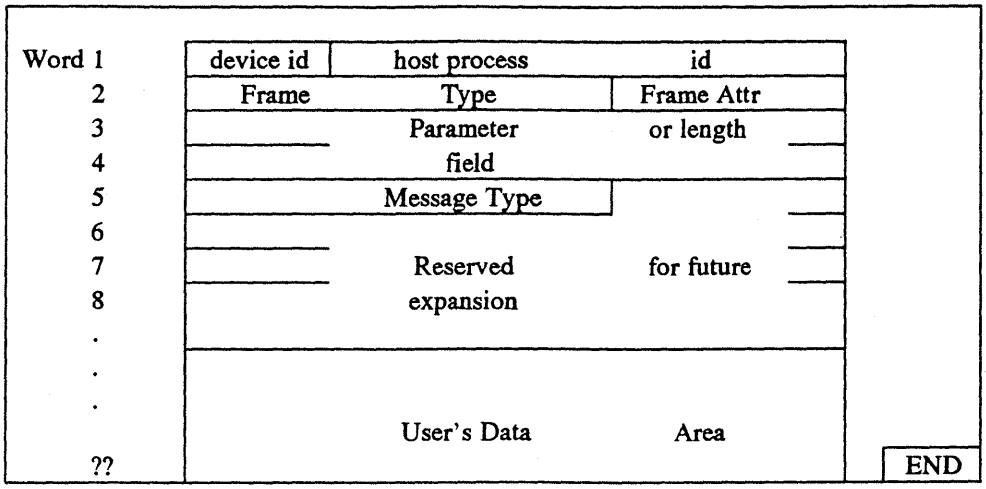


Figure 7.2 FLEX Specific Segment Description

The message type (data-part type) code field indicates the general type of the segment.

0 = command message
1 = execution message
2 = report message
3 = transparent message
4 = host to host message
5 - configure clear
6-254 = not assigned
255 = reserved

In the case of multi-segment messages the data-part type code of each segment will contain the same message type. For example, in the case of an execution message where the host is reading 16K bytes of data from a device, the data will come from the device in two DATA segments and the message type of both segments will be execution message.The frame type, frame attributes, parameter/length, and user data fields function as described in section 7.2, HPFL Overview.

7.3.2 Command Message

A command message is initiated by the host sending an Ready To Send (RTS) segment to the device. The virtual circuit in the segment header contains the device ID which addresses the receiving device, as well as an identifier for the host process which is sending the RTS segment. The message type is set to 0 to indicate the message being negotiated for is a command message. Bit 1 in the attributes field will be set to indicate that this is the first frame being sent by this host on this virtual circuit for this transaction. The parameter/length field is not used.

When the device is ready to receive the command message from the host, it sends a Ready to Receive (RTR) segment. It uses the virtual circuit number that was received in the host's RTS segment, along with a message type of 0 to indicate a ready to receive command message. The parameter/length field is not used and the user data field is empty. Again Bit 1 of the attributes field will be set to indicate that this is the first frame being sent by this device on this virtual circuit for this transaction.

Upon receiving the RTR from the device, the host responds with a DATA segment, continuing to use the same virtual circuit number used in the RTS and RTR segments. Again the message type of 0 is used to indicate command message. The user's data field contains the actual FLEX command message, for

example, a Set Unit, Set Length, Set Address. Bit 0 of the frame attribute is also set to indicate End Of Message (EOM), since command messages longer than one segment are not supported.

A quick version of the above command process is also supported. The host attaches a copy for the FLEX command (i.e. using the data area) to the initial command RTS. If the fiber optic link device has buffer spare available for the command, it will be brought in, thus completing the command message. Due to the operation of HPFL and fiber optic link device, a majority of the time there will be space to accommodate the attached data.

If the command can not be accommodated, the device will bit bucket the attached data. At some later time, the device will request the host to reset the FLEX command by issuing an RTR just like the above command process. Whenever the RTR message is sent, the HP7937FL guarantees that there is space for the FLEX data when it arrives. The host will respond to the RTR by sending a DATA frame with the FLEX command attached, exactly as above.

7.3.3 Execution Message

The source of the execution message, the host in the case of write execution and the device in the case of a read execution, starts the execution message by sending a Ready To Send (RTS) segment. The virtual circuit containing the device ID and the host process is the same as the virtual circuit used in command message corresponding to this execution message. The message type is set to 1 to indicate the message being negotiated for is an execution message. Bit 2 of the frame attribute field is set to indicate the length field is present. The parameter/length field contains the total length or a portion of the length of the execution message that the source is ready to send.

The destination of the execution message then responds with an Ready To Receive (RTR) segment when it is prepared to receive the execution messages. It uses the same virtual circuit it received in the RTS segment. The message type is set to 1 to indicate ready to receive execution message. The length field present bit (2) of the frame attributes is set and the parameter/length field contains the number of bytes the destination is ready to receive.

Next, the source of the execution message sends a DATA segment, continuing to use the same virtual circuit used in the RTS and RTR segments. Again the message type is set to 1, indicating this segment is part of an execution message. The user's data area contains the actual execution message data. If the execution message is larger than one segment then additional DATA segments, having virtual circuits and messages types as described, are sent. The RTS/RTR pair from above can align an agreement for many 8K DATA segments. Each DATA segment except for the last one in a message must contain 8192 data bytes. The final DATA segment in a message need not contain all 8192 bytes. Bit 2 of the frame attributes will be set indicating the length field is present and the parameter/length field will have the number of data bytes in the segment. This last segment will also have bit 0 of the frame attributes set to indicate End Of Message (EOM).

In most cases all the DATA segments associated with an execution message will be sent after a single RTS/RTR pair has been exchanged, however, all the DATA segments of an execution message need not be sent at one time. The number of DATA segments is negotiated between the source and destination using the parameter/length field in the RTS and RTR segments. The source and destination may agree to send only part of the message at a given time. For example, the host wants to read 34K of data from the device. The device, since it is the source of the data, initiates the execution message by sending an RTS execution segment to the host with a length field of 32K. The host responds with an RTR execution segment that has a length field of 32K. The devise then begins sending DATA segments, each DATA segment will have 8192 bytes of data. A total of 4 DATA segments will be sent. The last segment will not have the EOM bit set since the end of message will not be reached until 34K bytes of data has been transferred. When the device is ready to send the remaining 2K of execution data it sends an RTS

execution with a length field of 2K to the host. The host responds with a RTR execution with a length field of 2K. Then the device sends one DATA segments, the last segment having the EOM bit set to indicate end of execution message.

The destination of an execution message may send a Ready To Receive (RTR), segment to indicate it is prepared to accept the execution message prior to the source sending the RTS to indicate it is ready to send the execution message. In this case the source of the execution message then responds with DATA segment(s) whenever it is ready to send the execution message, rather than sending an RTS to initiate negotiation for an execution message. This process allows for an abbreviated negotiation for the execution message by preempting the RTS segment sent from the source of the message. This shortened protocol form should only be used if the destination is willing to commit its resource to receive the execution message knowing that the source of the message may not yet be ready to send that message.

It is possible that the source of the execution message might send an RTS segment, in the standard message negotiation fashion, at the same time the destination sends out the RTR segment using the shortened protocol. In this case the destination of the execution message will receive an RTS segment for an execution message after it has already indicated it is ready to receive that same message. The destination need only accept the RT'S segment from the source and wait for the source to start sending DATA segments @ce the source of the execution will have received its RTR segment and therefore know the destination is ready for data.

7.3.4 Report Message

A report message is initiated by the device sending a Ready To Send (RTS), segment to the host. The virtual circuit in the segment header indicating the device id and the host process is the same as the virtual circuit used in the command message corresponding to this report message. The message type is set to 2 to indicate the message being negotiated for is a report message. The "length field present" bit in the attribute field will be set and the parameter/length field will contain the length of the data that will be sent in the DATA report message.

When the host is ready to receive the report message from the device it sends a Ready To Receive (RTR), segment. It uses the virtual circuit number that was received in the device's RTS segment, along with a message type of 2 to indicate ready to receive report message. The parameter/length field must contain a valid length and the "length field present" bit must be set.

Upon receiving the RTR from the host the device responds with a DATA segment, continuing to use the same virtual circuit number used in the RTS and RTR segments. Again the message type of 2 is used to indicate a report message. The user's data field contains the FLEX device report. Bit 2 of the frame attribute field is set to indicate the length field is present. Thus, the length of the report message, in bytes, is found in the parameter/length field. Bit 0 of the frame attribute is also set to indicate End of Message (EOM), since report messages longer than one segment are not supported.

A quick version of the report process is also supported. If the fiber optic link device has successfully completed the command and execution phases, and a good report (0 Qstat) is to be sent, a single header message can be used. The device will send a good report (RPT) frame on the same virtual circuit number used in the command message corresponding to this report. The attributes field will have the EOM bit set. A message type of 2 will be used to indicate a report phase message. No data is sourced with this frame. The host receiving this message translates this to a 0 Qstat.

7.3.5 Asynchronous IMS

Asynchronous events occur when the device wishes to report an event that did not occur as the result of a particular transaction. For example, power on or background diagnostic failure.

IMS segments are used to report all asynchronous events. The virtual circuit number of the IMS contains the device ID of the device reporting the event and a host process ID of "XFFE". This host process ID is reserved for the reporting of asynchronous events and the host should not use it for any other transactions.

The parameter/length field of the IMS is used to indicate the cause of the asynchronous event. The field is defined as follows:

byte 0	byte 1	byte 2	byte 3
3=Reset	1=power on	OSTAT	
	2=initiate diagnostics	OSTAT	
4=Resource Information	1=resource available		
	2=non-responding host		
	B=unit available		
5=Hardware Error	1=parity dev to host	device ID	
	7=mechanism fault	mech number	
7=Port Events	2=pronto protocol error		

7.3.6 Loopback

A loopback message is initiated by the host sending a request Loopback (RQL) segment to the device. The virtual circuit in the segment header contains a device ID which addresses the receiving device, as well as an identifier for the host process which is sending the RQL segment. The parameter/length field will contain the requested length of the loopback. Bit 2 of the frame attributes field is be set to indicate that the length field is present. Bit 1 of the attribute field is set to indicate that this is the first frame from the host for this transaction. The message type field is not used.

When the device is ready to receive the loopback data it sends a Permission To Loopback (PTL) segment to the host. It uses the same virtual circuit as the one received in the RQL segment. The parameter/length field indicates the number of loopback data bytes the device is willing to accept. Bit 2 of the frame attributes field is set to indicate the length field is present. Bit 1 is also set to indicate that this is the first frame from this device for this transaction. The message type field is not used.

Upon receiving the PTL from the device, the host responds with a Loopback DATA (LDA) segment continuing to use the same virtual circuit number used in the RQL and PTL segments. The user's data field contains the loopback data. If the loopback data is longer than one segment then additional LDA segments are sent. Each LDA segment except for the last will contain 8192 bytes of data. The last LDA segment will have bit 2 of the frame attributes set to indicate length field present and the parameter/length field will contain the number of bytes in the user's data field. Bit 0 of the frame attributes will also be set to signal end of message (EOM). The message type field is not used.

After accepting the LDA segment(s) from the host, the device responds with its own Returned Loopback Data (RLD) segment. If the loopback data does not fit in one segment, then multiple RLD segments are sent. Each RLD segment uses the same virtual circuit used in the other loopback segments and has loopback data in the user's data field. The last RLD segment sent has bit 2 of the frame attributes set indicating length field present and the parameter/length field contains the number of bytes in the user's data field. Bit 0 of the frame attributes will also be set to signal end of message (EOM). The message type field is not used.

The virtual circuit number of all ones has been reserved as the "Universal Virtual Circuit". A RQL on this virtual circuit number will always receive a PTL assuming that the hardware is operating. This feature will aid the diagnostics. The maximum loopback length supported on a fiber optic link device Universal Virtual Circuit is 256 bytes.

7.3.7 Cancel (Frame Type 6)

The host can cancel a transaction by sending an Immediate Status (IMS) segment to the device. The virtual circuit number it uses is the virtual circuit number that is associated with the transaction to be canceled; for example, the same one that was used in the RTS, RTR, and DATA segments that made up the command message. The parameter/length field contains a 0 byte indicating a cancel request. The message type field is not used.

The device answers by sending an Acknowledge IMS with the same virtual circuit number. The message type and parameter/length fields are not used.

Canceling a transaction causes the device to enter the command ready phase. If the host cancels a non-active virtual circuit, the device will respond with the Acknowledge IMS, just as it normally would. The device will not flag this occurrence, and will continue normal operation.

7.3.8 Identify

Identify is used to determine the type of device connected to the link. If more than one device is connected to a link in some multipoint configuration, the identify can also be used to identify each individual device.

An identify is initiated by sending a Request Identify (RQI) segment. The response to the RQI is an Identify (IDY) segment. The parameter/length field of the IDY contains the identify information. The IDY header and the 4 byte parameter/length field is formatted as follows:

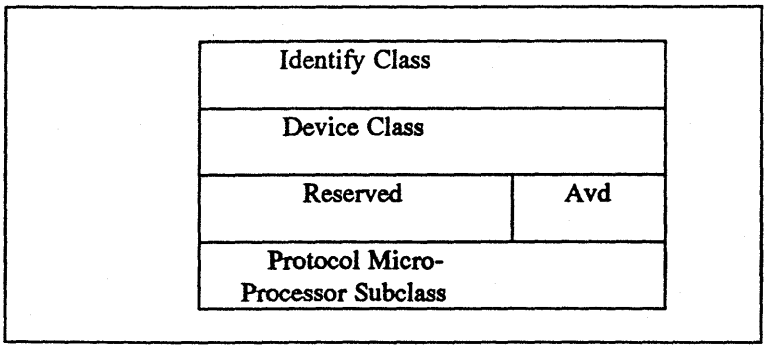


Figure 7.4

Identity Classes currently defined are:

0 = HPFL Host SPU interface
1 = HPFL multiplexer

Device Class codes are currently defined as:

0 = Class Unknown
1 = Pseudo Device
2 = FLEX

The Avd field gives the deadlock avoidance scheme used. This allows the receiving end to configure itself correctly, or report any incorrect configuration to the host. This field is defined as follows.

0 0 None; full duplex device
0 1 Half duplex master device
1 0 Half duplex slave device
1 1 not defined

The Protocol Microprocessor Subclass indicates the firmware revision code number of the fiber optic link device protocol control unit. This code may differ from the revision code of the fiber optic link controller (read revision number utility).

7.3.8.1 Universal Virtual Circuit Identifies

The virtual circuit number of all ones has been reserved as the "Universal Virtual Circuit". An RQI on this virtual circuit will always receive an IDY response as long as the fiber-optic connection is working correctly. This is usually the first communication that is sent on the optical cable. The response will confirm the communication path as well as identify the type(s) of device on the other end.

The following is an example of an identify sequence on an HP7937FL To begin an identify sequence, the host sends an RQI segment on the Universal Virtual Circuit. The response will be an IDY on the same virtual circuit number with a parameter/length field of:

Identity Class	= 1		HPFL multiplexer
Device Class	= 1		Pseudo device
Avd field	= 0	1	Half duplex master

At this point the host knows it is talking to a HPFL multiplexer. Because of the bus structure associated with the HP7937FL, the host also knows that the top four bits of the virtual circuit number is used for a device ID.

Universal Virtual Circuit IDYs have some additional information about the device directly connected to the link. Byte number 10 (10th byte) contains the LER (Link Error Counter) status when the IDY was sent. Following the IDY message, the LER counter will be reset to zero. Byte number 12 (12th byte) will contain the port ID (8-15) of the link. This information would be useful for a remote diagnostic process that is unable to visually determine the port address of the link and is unable to talk to any of the FLEX devices on the Pbus.

7.3.8.2 Device Identifies

If the host wishes to know about an individual device, it sends an RQI segment to the device using a virtual circuit number which contains that device's ID number. If no functional device with the chosen device ID exists, no response will be returned. If the device does exist, the device will respond with an IDY on the same virtual circuit number with a parameter field of:

Identity Class	= 1		HPFL multiplexer
Device Class	= 2		FLEX
Avd field	= 0	1	Half duplex master

Additional information about the device can be obtained by using the FLEX Extended Describe command (section 4.7).

7.3.9 Transparent Message

The source of a transparent message, which can be a host or a device, initiates the message by sending a Ready To Send (RTS) segment. A message type of 3 is used to indicate transparent message. The virtual circuit contains the device ID and the host process ID. The parameter/length field is not used.

When the destination is prepared to accept the transparent message, it responds with an RTR, Ready To Receive, segment with the same virtual circuit it received in the RTS segment The message type is 3 to indicate transparent message. The parameter/length field is not used.

Next, the source of the transparent message sends a DATA segment containing the transparent message in the user's data field. The virtual circuit is the same as the one used in the RTS and RTR segments and the message type is 3 for transparent message. Bit 0 of the frame attributes will be set to indicate End Of Message (EOM), since transparent message must fit in one segment. If the source knows the length of the data being sent then bit 2 of the frame attributes should also be set to indicate length field present and the parameter/length field should contain the length of the data in bytes.

7.3.10 Remote Link Reset

The remote link reset (RLR) is a physical hardware reset line that the host can activate. This function will reset all devices on the Pbus, both hardware and software. This type of clear may take several seconds and will disrupt all hosts connected to this Pbus.

To initiate this type of clear, the host requests the HPFL to perform Request 6, Sub function 3. Each device will perform basically the same function as defined in the following "reset clear".

7.3.11 Reset Clear

Reset clear is a hard clear which resets all device hardware and software associated with a single device. This type of clear may take several seconds to recalibrate heads, run self-test, basically do whatever is necessary to bring the drive to a fully functional on-line, known state. Reset should be used to recover a device when operation of the device is suspect, such as timeout situations.

To initiate a reset clear the host sends a Reset segment to the device, using a virtual circuit number which contains that device's ID number. The parameter/length and message type fields are not used.

The sequence of operations performed by a reset clear is as follows:

1) Abort the current operation without damaging the mechanism.

2) Flush all queued commands.

3) Clear all clearable device or interface conditions.

4) Reset all command parameters to their power on values.

5) Reset the reference status.

6) Execute a power on self test to acquire status conditions.

7) Set the Qstat to indicate whether status information is being returned.

8) Send an M indicating power on to all hosts.

9) Enter the interlock state.

7.3.12 Configure Clear

A configure clear brings the device into a known software state for only the host sending the configure clear.

Configure clear is a soft clear which brings device software into a known state. This type of clear does not take very much time and is a useful mechanism for setting the state of the device, such as during a cold load sequence.

The sequence for a configure clear is the same as the sequence for a transparent message, except a message type of configure clear is used instead of the message type being transparent.

The host initiates a Configure clear by sending an RTS segment, with the message type set to configure clear. Any virtual circuit that contains the appropriate device ID and is not already in use is acceptable. The parameter/length field and the frame attributes are not used.

The device then responds with an RTR segment, using the same virtual circuit number and a configure clear message type.

The host then responds with a DATA segment, using the configure clear message type and the virtual circuit used in the RTS/RTR segments. The parameter/length field will be set to 0, and the frame attributes will have the EOM bit set. This null data message is used because the devices only supports one type of configure clear. It is possible that, future devices may support more than one type of configure clear and would therefore make use of the data portion of the segment.

The sequence of operations performed by a configuration clear is as follows:

1) Abort the current operation at the earliest opportunity such that no data corruption can take place.

2) Flush all queued commands for the issuing host.

3) Reset all command parameters to their power on values for the issuing host.

4) Generate the status report.

5) Set the Qstat value to indicate whether the status is being returned.

6) Clear the interlock state for the issuing host.

7) Enter the report state for the issuing host.

After this command, the current status is cleared.

7.4 SAMPLE READ SEQUENCE

FLEX transactions consist of three phases, command, execution, and report. Each of these phases require that a message be transmitted across the link.

The read transaction is initiated by the host transmitting an RTS segment to the device with the message type field containing a command message indicator. When the device is able to accept a command message it responds with an RTR segment with the message type field holding a command message indicator. The host then sends a data message with the message type field set to command message and the user's data area containing the read command. The device decodes and executes the read command.

When the device is ready to send the read data, it sends an RTS segment to the host. The message type field indicates execution message, the parameter/length field contains the byte length of the execution message, and the length field present bit is set in the frame attributes.

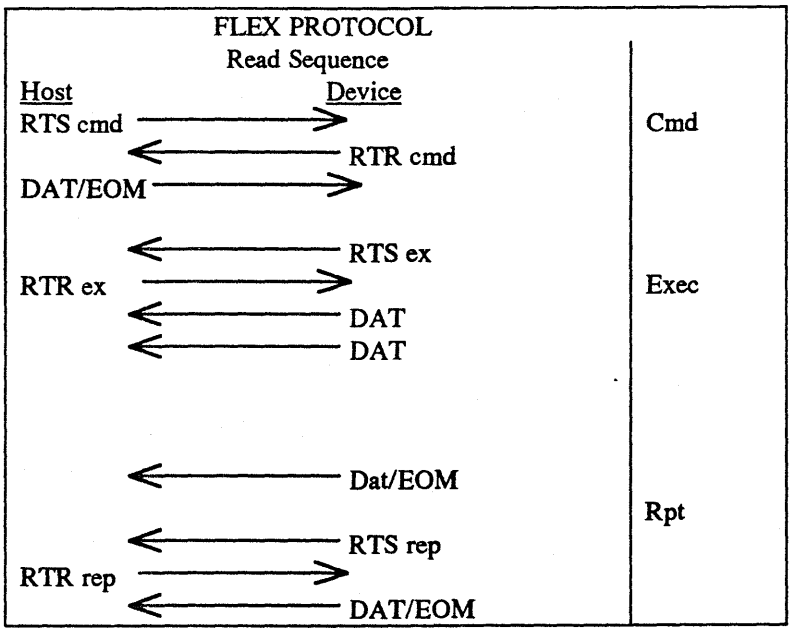


Figure 7. 5

When the host is ready to receive the execution message, it sends an RTR segment with the message type field holding an execution message indicator, the parameter/length field containing the byte length of the execution message, and the length field present bit is set in the frame attributes. The device sends a data message with the message type field set to execution message and the User's data area containing the read data. If the data message is longer than 8192 bytes, the data is broken into as many data segments as necessary. The EOM flag is set in the data header of the last segment sent to the host.

Upon completion of the execution phase the device sends an RTS segment to the host with the message type field holding a report message indicator, the parameter/length field containing the byte length of the report message, and the length field present bit is set in the frame attributes. When the host is ready for the report, it sends an RTR segment to the device with the message type field set to report message, the parameter/length field set to the byte length of the report message, and the length field present bit set. The device sends a data message with the message type field set to report message, and the device's report in the User's data area. This completes a read transaction. (see figure 7. 5)

7.5 SAMPLE WRITE SEQUENCE

The write transaction is initiated by the host in the same way as the read sequence is. The host sends a write command in command message phase rather than a read command. The device decodes and executes the write command.

When the device is ready for the write data, the device sends to an RTR segment with the message type field holding a execution message indicator, the parameter/length field containing the byte length of the execution message, and the length field present bit is set in the frame attributes. The host sends a data message with the message type field set to execution message and the User's data area containing the write data. If the data message is longer than 8192 bytes, the data is broken into as many data segments as necessary. The EOM flag is set in the data header of the last segment sent to the device.

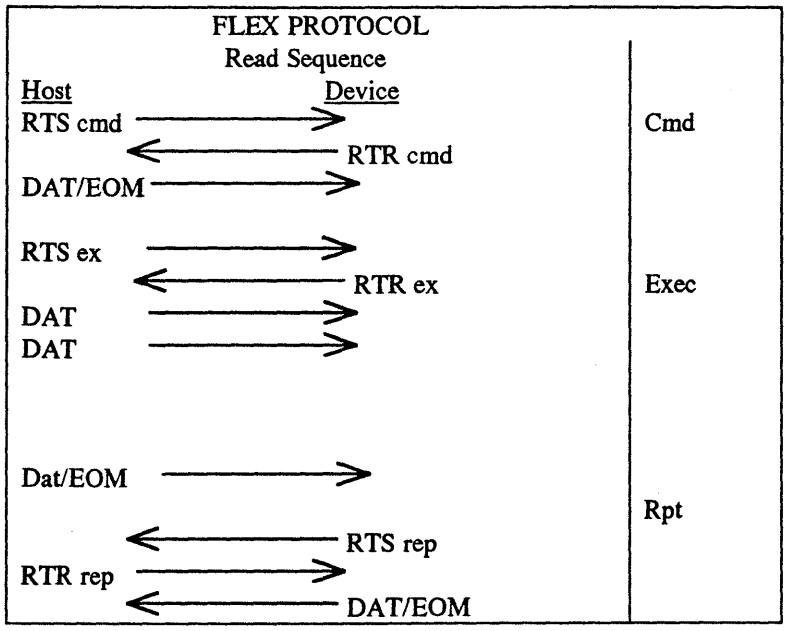


Figure 7.6

Upon completion of the execution phase the device will conclude the transaction in the same way as the read transaction This completes a write transaction. (see figure 7.6)

8.0 HOST TO HOST COMMUNICATION

Fiber optic link devices allow hosts to send messages to other hosts. These messages will pass through the device's controller buffer as a store and forward operation. The objective is to allow an inexpensive means of communication among the hosts without interfering with the device. This is accomplished by reserving a specific area of the controller's buffer for host to host communication and allowing the device reserving a specific area to route the message by interpreting only one byte of the message.

8.1 DIRECT HOST TO HOST COMMUNICATION

The direct host to host communications allow small messages to be directly routed to one other host. These messages are typically 32 bytes or less. The messages are buffered by the receiving host. This will offer quick host to host communication. The basic protocol will appear as follows:

host 1 host 2

DAT (host to host) 

VC = (destination host address
(0-7) + 8H) * 1000H +
any VC number

In this example of sending to host #2 the VC A000H would work.

8.2 BROADCAST HOST TO HOST COMMUNICATION

Sending a host to host message is similar to sending a FLEX command. The host can choose any device to echo the host to host message. These host to host messages are slower than "Direct Host to Host" messages and do consume drive resources. The response time for Broadcast host to host messages to one other host is typically 5ms to 20ms (256 bytes to 32K bytes). Transactions less than or equal to 1K bytes in length will have less impact on drive resources than do transactions greater than 1K bytes. Transactions between 1K + 1 byte and 32K bytes will interfere with the progression of disk IO (I.e. reads and writes).

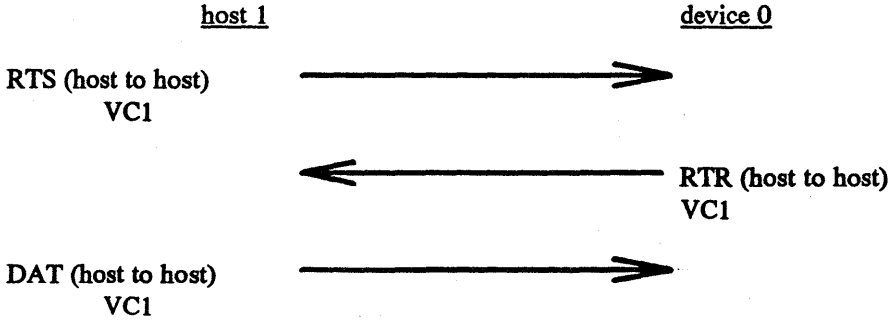
host #	7	6	5	4	3	2	1	0

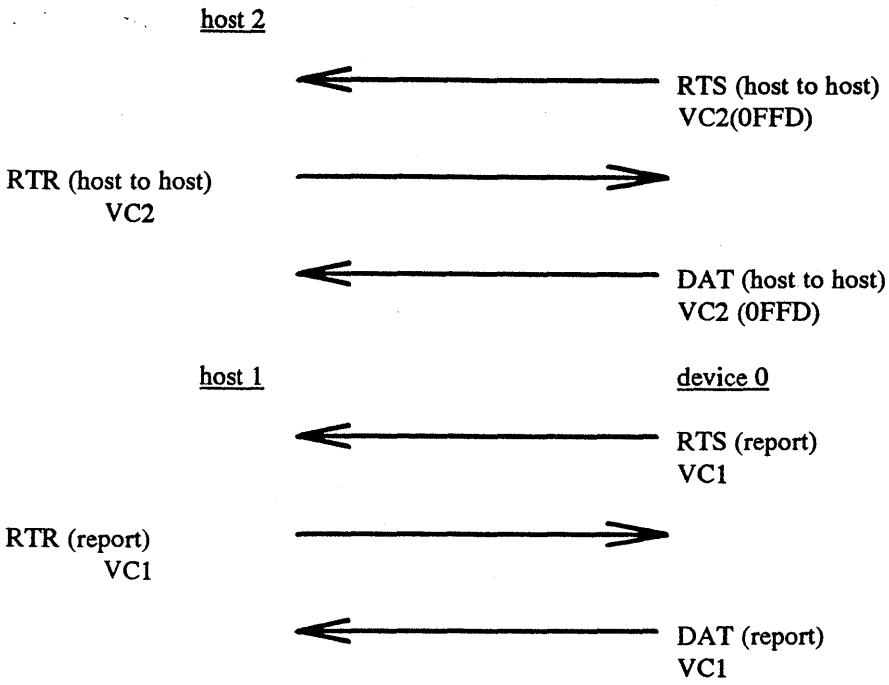
If a host sets his own bit, he will receive the message also. This completes the command phase of the broadcast host to host.

The device will now echo the desired host to host message including the bit map to each host that is to receive this message. The message is sent one at a time to each corresponding host. The device will send an RTS frame with the host to host message tag set on virtual circuit "Drive Address", FFDH. The host will respond with an RTR on that same virtual circuit. (NOTE: Since any device can send this phase of the host to host message, the host needs to "wait" on 8 virtual circuits for host to host messages. Namely, 0FFDH through 7FFDH. Alternatively, the host can agree to only send Broadcast host to host messages through a certain set of devices thus reducing the number of virtual circuits that they must wait on.) The device will then send a DATA frame and the data for that host to host message. This exact process will be repeated for each host that is to receive the message. This concludes the execution phase of the host to host command.

The drive will then source a RTS frame with the report message tag set on the original virtual circuit number chosen by the initiating host. The initiating host will then send an RTR report frame on the original virtual circuit. The device will then send a DATA frame report message to the original host. The report consists of one byte, whose format is the same as the destination bitmap of the message. A one in a host's position in the bitmap indicates the host did not accept the message. The report is sent to the sending host when all the designated receiving hosts have had an opportunity to get the message. A timer is used in case a host is not accepting the message.

The specific flow of a host to host command is illustrated below. VCI is any unassigned non-reserved virtual circuit number.





NOTE - This facility gives the host a basic broadcast facility. The reported bitmap does not confirm that the host actually received the DATA frame of the host to host message (similar to the direct host to host facility.) A confirmation phase of the execution phase can be added, but only if someone is interested in a low level confirmation. At present the host can confirm a host to host message any way they choose.

8.3 WHO'S WHO IN HOST TO HOST COMMUNICATION

How does a host find out what his host address is? When a host does an extended describe to any amux device, it will return the hosts address in header byte C6 (port ID value 0-7). This will also tell the host exactly which device he is physically connected to. If the host address is 0, then it's physically connected to device 0. If the host address is 1, then it is physically connected to device 1, etc.

Additionally, any host can find out if there are other hosts on the amux system by sending a broadcast message to all hosts. T he returned status will indicate what other hosts retrieved the broadcast message. This will then tell the driver which other hosts existed at the time of the broadcast message.

8.4 MESSAGE

An RTS host to host command requires the length field to be set. In the DATA message the first byte must contain the destination address. This byte is a bit map of the hosts that are destinations. This allows the sending host to broadcast the command. The destination byte format is

host #	7	6	5	4	3	2	1	0

If a host sets his own bit, he will receive the message also.

8.5 REPORT

The report consists of one byte, whose format is the same as the destination byte of the message. A one in a host's position in the byte indicates the host did not accept the message. The report is sent to the sending host when all the designated receiving hosts have had an opportunity to get the message. The Nonresponding Host Timeout is used in case a host is not accepting the message (see Device Commands).

9.0 UTILITIES

Below are the available utilities, their micro-opcode number, and a brief description.

Micro-Opcode	Utility Name	Brief Description of Utility
0C4H	Read Drive Tables	The host receives a copy of the device table specified in the parameter.
0C5H	Read Run-Time Log	The host receives a copy of the run-time data errors, sector count and recoverable error count logged during device operation for the specified head.
0C6H	Read Error Rate Log	The host receives a copy of the correctable and uncorrectable data errors logged during previous error rate tests.
0C7H	Read Fault Log	The host receives a copy of all device faults except data errors logged during device operation.
0CDH	Clear Logs	Clears the specified logs in the device.
0C8H	Pattern Error Rate Test	This test performs incremental writes using selected data across the selected test area, followed by incremental reads.
0C9H	Read Only Error Rate Test	This test performs incremental reads across the selected test area.
0CBH	Random Error Rate Test	This test performs random length writes and then reads using selectable data at random locations.
0CCH	Random Read Only Error Rate Test	This test performs random length reads at random locations.
0B1H	Butterfly Seek	This servo test performs all possible length seeks completed in both directions.
0CEH	Preset Drive	This utility forces logging of any run-time data errors and device faults.
0A3H	Read Full Sector	Seeks to the current host address, reads a full sector with no verify and returns the data.
0C3H	Read Revision Number	The host receives the firmware ROM revision numbers.

0D3H	Diagnostic Read	The host can read the maximum number of bytes of data from a reserved area
0D4H	Diagnostic Write	The host can write the maximum number of, bytes of data to a reserved area
0D5H	Rebuild Status	This utility reports the percentage completion of the rebuild in progress, or cancels the rebuild in progress.
0E0H	Firmware Upgrade	Instructs the device to receive new firmware.
0E1H	Reserved	

General format of Execute Utility Commands:

001100XX	XXXXXXXX		. . .	
Initiate Utility Opcode	Micro Opcode	Parameter bytes (0-6)		

The specific command determines the number of parameter bytes. The INITIATE UTILITY opcode takes three forms.

XX = 00 Initiate Utility with No execution message

XX = 01 Initiate Utility, the device will receive an execution message

XX = 10 Initiate Utility, the device will send an execution message

Below is a list of the utilities with the type of options available.

Option	Name
10	Read Spare Track Table
10	Read Run-Time Log
10	Read Error Rate Log
10	Read Fault Log
00	Clear Logs
00/10	Pattern ERT
00/10	Read Only ERT
00/10	Random ERT
00/10	Random Read Only ERT
10	Locate and Read Full Sector
00	Butterfly Seek
00	Preset Drive
10	Read Full Sector
10	Read Revision Number
10	Diagnostic Read

Option	Name
01	Diagnostic Write
00/10	Rebuild Status
01	Firmware Upgrade

9.1 READ DRIVE TABLES UTILITY

FUNCTION

Returns the contents of the specified table within the selected unit.

DESCRIPTION

Tables containing information relevant to the operation and configuration of the storage unit and controller are present.

Table Number	Table Name
0	Unused
1	Spare Track Table
2	Head Value Table
3	Configuration Table
4	Dual Port Table
5	Servo Adaptation Table
6	Runout Table
7	Unused
8	Unused
9	Unused
10	Manufacturer's Block Table
11	Spare Block Table
12	Copy Data Disk Address Table
13	Unused
14	Unused
15	Unused

A parameter bounds error occurs if table numbers which are not present are used.

SPARE TRACK TABLE:

The Read Spare Track Table relates the spared logical tracks to the actual physical tracks currently in the device. The scalar number associated with each cylinder address in the returned table determines the mapping of that spared logical track to a physical track. The routine returns the spare track information for all heads beginning with head 0.

The number of spare tracks used represents the number of physical spare tracks assigned to logical tracks on a particular head. The number of logical spared tracks represent the number of logical tracks on a particular head that were spared to another physical location. The number of logical spared tracks may be less than or equal to the number of spared tracks used depending on whether

the same logical track was spared several times or only once. If no logical tracks were spared on a particular head, only the header will be returned.

The log header for each head is: (This is repeated for each head)

Head number	1 byte
Number of spare operations	2 bytes (always zero)
Number of spare tracks used	1 byte
Number of logical tracks spared	1 byte

The record format is: (This is repeated for each logical track spared within each head)

Cylinder address high byte	1 byte
Cylinder address low byte	1 byte
Scalar spare number	1 byte

COMMAND FORMAT

The Initiate Utility opcode for the Read Drive Tables Utility is 32H, since the device returns an execution message containing the spare track table. The Read Drive Tables micro-opcode is C4H. One parameter, the table number, follows the micro-opcode.

00110010	11000100	0000TTTT
Initiate Utility Opcode	Micro Opcode (C4H)	TTTT = Table Number

PRODUCT SPECIFICS

HP7937FL, HP7936FL:
The HP7937 implements only the Spare Track table in the Read Drive Tables Utility. A parameter bounds error occurs if other table numbers are sent. The HP7937 uses the same log format as previous CS80 devices, but always returns zero for the number of secondary spare operations. The HP7937 returns zero because the spare track table is not on the maintenance track and the spare count would be lost at each power cycle. The maximum number of spares for the HP7937 is 78 tracks. Individual heads do not have a set number of spares. The maximum message length for the HP7937 is 299 bytes (78* 3) + (5* 13 heads). The MSB of the scalar spare number will be set if the spare was a factory spare.

C2201A, C2204A:
The C2201A and C2204A implement only the Spare Track table in the Read Drive Tables Utility. A Parameter bounds error occurs if other table numbers are sent.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

C225X:
The C225X implements only the Spare Track table in the Read Drive Tables Utility. A parameter bounds error occurs if other table numbers are sent.

When the unit number is set to 00H through 0EH then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

The Scalar Spare number is always zero (0).

9.2 READ RUN-TIME LOG UTILITY

DESCRIPTION

The Read Run-Time Log Utility provides run-time data errors for a specified head. The device initial! ,ogs run-time data errors in a RAM area.

COMMAND FORMAT

The Initiate Utility opcode for the Read Run-Time Log is 32H, since the device returns an execution message containing the log. The Read Run-Time Log micro-opcode is C5H. One parameter, the head number, follows the micro-opcode.

00110010	11000101	0000XXXX
Initiate Utility Opcode (C5H)	Micro Opcode	Head Number (0 to 12)

FORMAT OF EXECUTION MESSAGE

Below is the log format.

The log header for each head is:
Number of log entries 1 byte
Number of sectors read 5 bytes
Number of correctable data errors (1 retry) 2 bytes
Number of uncorrectable data errors 1 byte

The record format is:

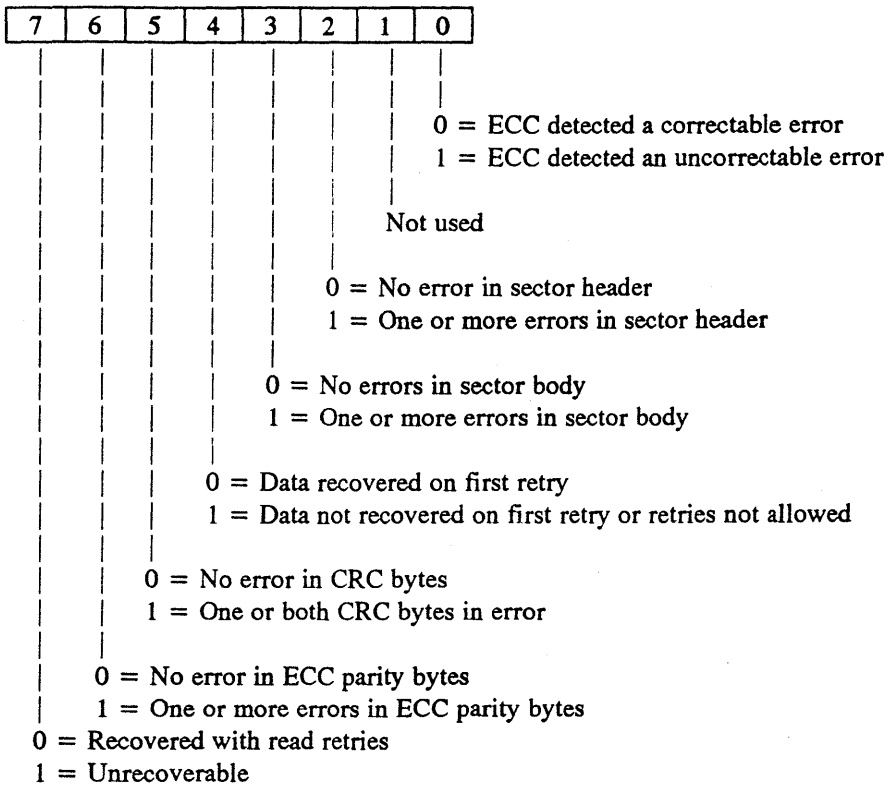
Current physical cylinder address	2 bytes
Current physical head address	1 byte
Current physical sector address	1 byte
Current logical cylinder address	2 bytes
Current logical head address	1 byte
Current logical sector address	1 byte
Error byte	1 byte
Occurrence count	1 byte

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

A maximum of 5 entries are allowed in the RAM area. The HP7937FL writes the information out to the device as soon as possible. Any more than five entries without device update causes the fifth entry to be replaced. The permanent log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The HP7937 uses the same log format as previous CS80 devices. The definition of the error byte is different. Below is the log format.

The error byte definition is:



C2201A, C2204A:

When the unit number is set to 00H then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current physical addresses and the Current logical addresses reflect the address space of the logical unit Thus, the Current physical addresses reflect the physical addresses of the logical unit; the Current logical addresses reflect the logical addresses of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current physical addresses and the Current logical addresses reflect the address space of the individual mechanism. Thus, the Current physical address reflect the physical addresses of the individual mechanism, the Current logical address reflect the logical addresses of the individual mechanism.

C225X:

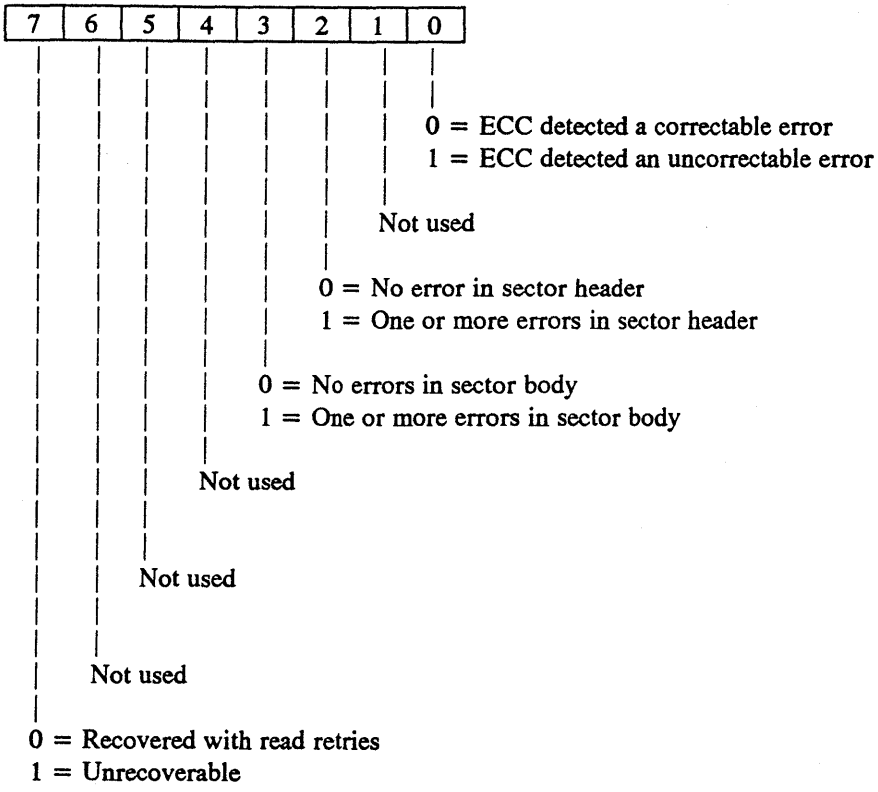
This command is allowed for units 0-14 and for mechanisms 0-14. This command is not allowed for the controller (unit 15).

The Number of Sectors Read is not head specific. Instead, the Number of Sectors Read indicates the total number of sectors read on a mechanism.

The Number of correctable errors and the Number of uncorrectable errors are head specific, but their value indicates a summation of all mechanisms of the unit.

The Physical Cylinder, Physical Head and Physical Sector values are actually Logical values.

The error byte definition is:



9.3 READ ERT LOG UTILITY

DESCRIPTION

The Read ERT Log Utility provides ERT test data errors for a specified head. The device initially logs ERT data errors in the RAM area reserved for run-time.

COMMAND FORMAT

The initiate Utility opcode for the Read ERT Log is 32K since the device returns an execution message containing the log. The Read ERT Log micro-opcode is C6H. One parameter, the head number, follows the micro-opcode.

00110010	11000110	0000XXXX
Initiate Utility Opcode	Micro Opcode (C5H)	Head Number (0 to 12)

FORMAT OF EXECUTION MESSAGE

Below is the log format.

The log header for each head is:

Number of log entries	1 byte
Number of sectors read	5 bytes
Number of correctable data errors (1 retry)	2 bytes
Number of uncorrectable data errors	1 byte

The record format is:

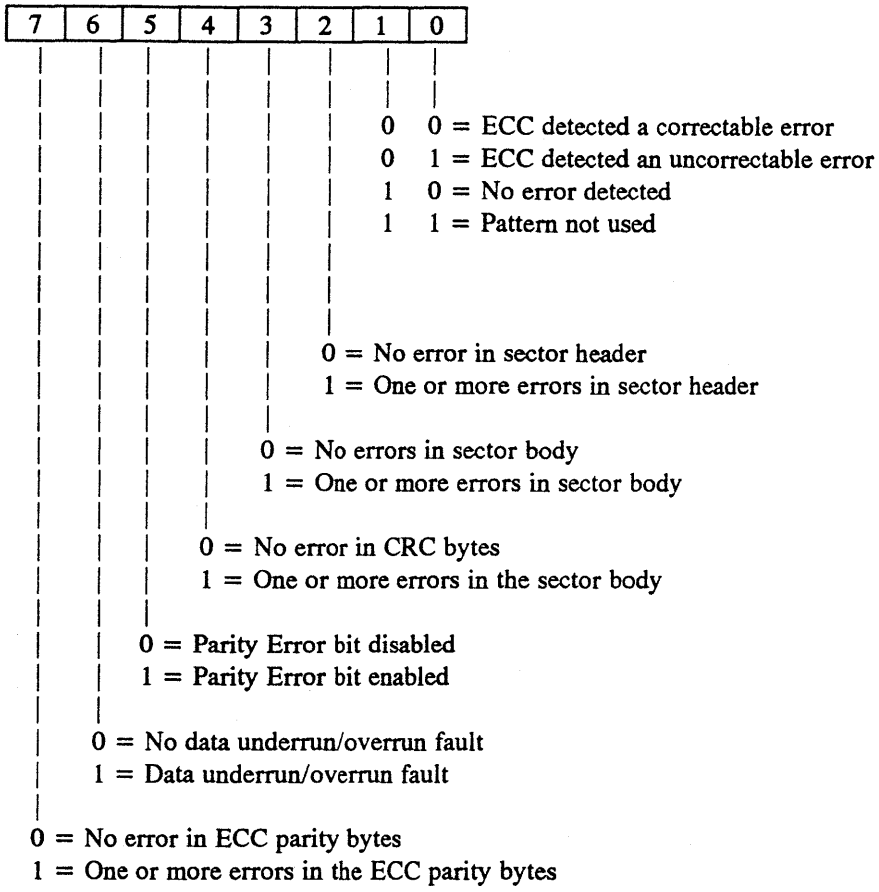
Current physical cylinder address	2 bytes
Current physical head address	1 byte
Current physical sector address	1 byte
Current logical cylinder address	2 bytes
Current logical head address	1 byte
Current logical sector address	1 byte
Error byte	1 byte
Occurrence count	1 byte

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

After 5 entries are in the RAM area the device moves the entries to the disk. The permanent disk log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The HP7937FL uses the same log format as the run-time log. The error byte definition is different from the run-time log and is shown below. The number of correctable data errors in the log header for ERT's is a count of all correctables (not recoverable on first retry like the Run-Time log).

The error byte definition is:



C2201A, C2204A:

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current physical addresses and the Current logical addresses reflect the address spare of the logical unit. Thus, the Current physical addresses reflect the physical addresses of the logical unit; the Current logical addresses reflect the logical addresses of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current physical addresses and the Current logical addresses reflect the address spare of the individual mechanism. Thus, the Current physical address reflect the physical addresses of the individual mechanism; the Current logical address reflect the logical addresses of the individual mechanism.

After 5 entries are in the RAM area the device moves the entries to the disk. The permanent disk log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The C2201A and C2204A use the same log format as the run-time log. The error byte definition is different from the run-time log and is shown below. The number of correctable data errors in the log header for ERT's is a count of all correctables (not recoverable on first retry like the Run-Time log).

bit 0	=	Spindle Speed Error bit	(Servo)
bit 1	=	Servo Timing Error bit	(Servo)
bit 2	=	Off Track bit	(Servo)
bit 3	=	AGC Error bit	(Servo)
bit 4	=	Data Overrun bit	(Endecon)
bit 5	=	Undefined	
bit 6	=	Undefined	
bit 7	=	Undefined	

The last byte, error type, indicates whether an error is a Derror, Terror, event or fault by setting/clearing the last two bits of the 2ND nibble. The first nibble is the activity indicator. The activity indicator gives a number which represents the number of seeks within a range that occurred between faults. The ranges are shown below.

A	A	A	A	0	0	T	L

T (Type)
0 = Event
1 = Fault

L (Location)
0 = Derror
1 = Terror

AAAA

0000 = no seeks
0001 = 1 seek
0010 = 2 seeks
0011 = 3 seeks
0100 = 4 seeks
0101 = 5 to 7 seeks
0110 = 8 to 200 seeks
0111 = 201 to 2,000 seeks
1000 = 2,001 to 12,000 seeks
1001 = 12,001 to 25,000 seeks
1010 = 25,001 to 150,000 seeks
1011 = 150,001 to 600,000 seeks
1100 = 600,001 to 4,000,000 seeks
1101 = 4,000,001 to 16,000,000 seeks
1110 = 16,000,001 to 1,000,000,000 seeks
1111 = > 1,000,000,000 seeks

C2201A, C2204A:

Below is the log format.

The log header is (number of records):	1 byte
The record format is:	
Current logical cylinder address	2 bytes
Current logical head address	1 byte
Current logical sector address	1 byte

Target logical cylinder address	2 bytes
Target logical head address	1 byte
Target logical sector address	1 byte
Status of internal registers	1 byte
Error byte	1 byte
Error type and activity indicator	1 byte

Two fields in the record format hold special meanings. For the Current Logical Cylinder Address and the Target Logical Cylinder Address, if the upper bit is set to 1, then the value is a physical address rather than a logical address.
When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current logical addresses and the Target logical addresses reflect the address space of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current logical addresses and the Target logical addresses reflect the logical address space of the individual mechanism.

The device initially logs faults and related events in a RAM area. The RAM holds a maximum of 30 entries. The C2201A and C2204A post the entries to the device after the command completes. The permanent fault log on the device holds a maximum of 44 entries. Thus, the C2201A can return a maximum of 74 entries to the host while the C2204A can return a maximum of 148 entries to the host.

The C2201A and C2204A use the same log format as previous CS80 devices. The status definitions of the internal registers error and error type are different. The status of internal registers byte is a collection of bits from the servo register and the endecon register. The purpose of this register is to provide additional information about the Servo and R/W systems when a fault in the data path occurs. If a channel fault occurs, this byte is zero. The bit definitions are shown below.

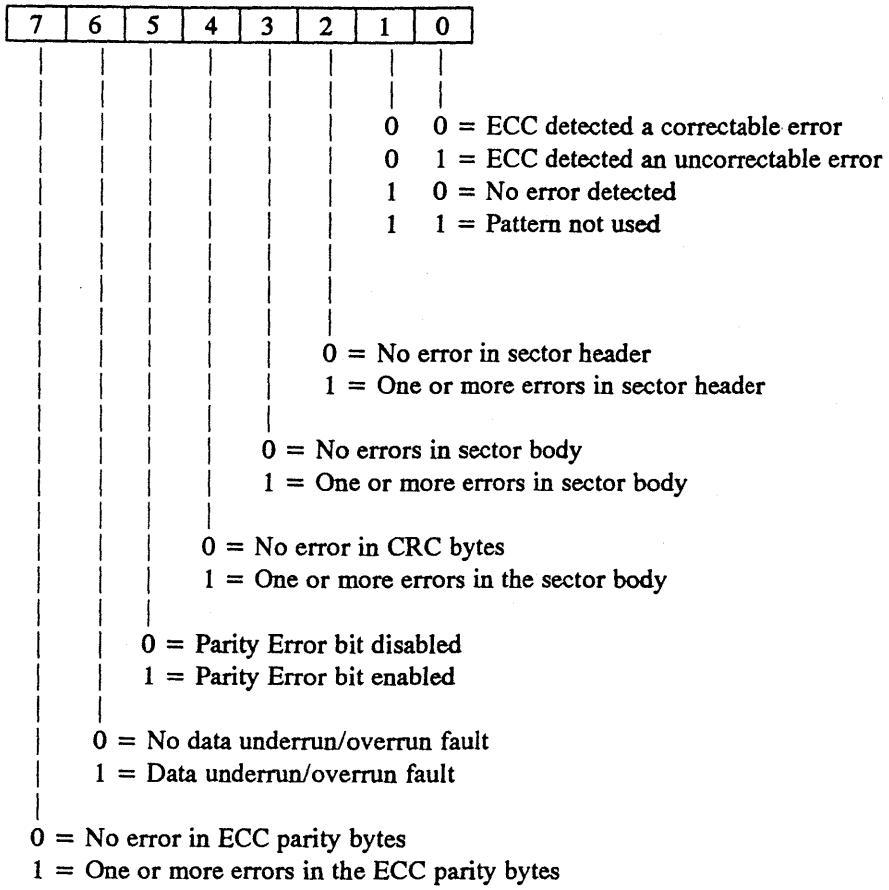
bit 0	= Spindle Stopped	(ESDI)
bit 1	= Data Path Fault	(CTRL)
bit 2	= Seek Fault	(ESDI)
bit 3	= Write Protect	(ESDI)
bit 4	= Write Fault	(ESDI)
bit 5	= Com/Stat ESDI Fault	(ESDI)
bit 6	= Com/Stat Ctrl Fault	(CTRL)
bit 7	= Data Clock Fault	(CTRL)

The conditions under which each bit is set is described below:

Spindle Stopped	:The spindle motor is not up to speed
Data Path Fault	:Power Fail or Write Hold Off
Seek Fault	:Seek failure or drive lost spindle lock
Write Protect	:Write Protected, Fixed Media
Write Fault	:See ESDI standard status documentation
Com/Stat ESDI Fault	:Interface Fault or Frame Error or Illegal Command
Com/Stat CTRL Fault	:Port Fault or Frame Error or Command Abort
Data Clock Fault	:TFault or Disk Error (from DMA) No other bits shall be set in this register at the time TFault or Disk Error are set

The last byte, error type, indicates whether an error is a Derror, Terror, event or fault by setting/clearing the last two bits of the 2ND nibble. The first nibble is the activity indicator. The activity indicator gives a

The error byte definition is:



C225X:

This command is not supported.

9.4 READ FAULT LOG UTILITY

DESCRIPTION

The Read Fault Log Utility provides information useful in diagnosing a device problem. A fault is an event (abnormal control flow) causing termination of a transaction or an event indicating an incorrect transaction. The fault log includes all faults and any related events. A related event is an event that occurs in the same transaction as a fault. The device initially logs faults and related events in a RAM area.

COMMAND FORMAT

The Initiate Utility opcode for the Read Fault Log Utility is 32H, since the device returns an execution message containing the fault log. The Read Fault Log micro-opcode is C7H. There are no parameters following the micro-opcode.

00110010	11000111
Initiate Utility Opcode	Micro Opcode (C7H)

FORMAT OF EXECUTION MESSAGE

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

Below is the log format.

The log header is (number of records):	1 byte
The record format is:	
Current logical cylinder address	2 bytes
Current logical head address	1 byte
Current logical sector address	1 byte
Target logical cylinder address	2 bytes
Target logical head address	1 byte
Target logical sector address	1 byte
Status of internal registers	1 byte
Error byte	1 byte
Error type and activity indicator	1 byte

The device initially logs faults and related events in a RAM area. The RAM holds a maximum of 30 entries. The HP7937FL posts the entries to the device after the command completes. The permanent fault log on the device holds a maximum of 44 entries. Thus, a maximum of 74 entries can be returned to the host. The HP7937 uses the same log format as previous CS80 devices. The status definitions of the internal registers error and error type are different. The status of internal registers byte is a collection of bits from the servo register and the endecon register. The purpose of this register is to provide additional information about the Servo and R/W systems when a fault in the data path occurs. If a channel fault occurs, this byte is zero. The bit definitions are shown below.

number which represents the number of seeks within a range that occurred between faults. The ranges are shown below.

T (Type)
0 = Event
1 = Fault
L (Location)
0 = Derror
1 = Terror

AAAA
0000 = no seeks
0001 = 1 seek
0010 = 2 seeks
0011 = 3 seeks
0100 = 4 seeks
0101 = 5 to 7 seeks
0110 = 8 to 200 seeks
0111 = 201 to 2,000 seeks
1000 = 2,001 to 12,000 seeks
1001 = 12,001 to 25,000 seeks
1010 = 25,001 to 150,000 seeks
1011 = 150,001 to 600,000 seeks
1100 = 600,001 to 4,000,000 seeks
1101 = 4,000,001 to 16,000,000 seeks
1110 = 16,000,001 to 1,000,000,000 seeks
1111 = > 1,000,000,000 seeks

C225X:
This command is valid for all units (0- 14) and the controller (unit 15). This command is allowed for all mechanisms, too.

When a unit 0- 14 is specified, all logs from the mechanisms of the unit are returned along with any RAM log entries for the unit and any RAM log entries that are device wide.

When a mechanism is specified, all logs from the specific mechanism are returned along with any RAM log entries for the mechanism and any RAM log entries that are device wide.

When the controller (unit 15) is specified, only RAM log entries that are device wide are returned. Below is the log format:

The log header is:

Number or records	1 byte
Number of seconds since power on	4 bytes

The record format is:

Logical Address of the error	4 bytes
Mechanism and Unit number	1 byte
Information Bytes	4 bytes
Derror Number	1 byte
Time when Error Occurred	4 bytes
Activity Indicator	1 byte

The record fields are used as follows:

Logical Address of the error :	The address relevant to the error. If there is no associated address with the error, this field has all bits set (FFFFFFFFH).
Mechanism and Unit number	A two-nibble value indicating the mechanism and unit where the error occurred. The upper nibble indicates a mechanism. The lower nibble indicates a unit. A nibble of all ones (FH) indicates unknown mechanism or unit. If both nibbles are all ones (FFH), this error occurred on the controller.
Information Bytes	Additional information bytes associated with the Derror.
Derror Number	Number indicating specific error.
Time when Error Occurred	Time that this error occurred expressed in seconds since the controller was first powered on.
Activity Indicator	A value indicating the number of seeks that occurred between faults. RAM log entries have a value 0.

The range of the activity indicator fields is as follows.

0 = No Accesses
1 = 1 to 2 seeks
2 = 2 to 10 seeks
3 = 11 to 100 seeks
4 = 101 to 1000 seeks
5 = 1001 to 10,000 seeks
6 = 10,001 to 100,000 seeks
7 = 100,001 to 500,000 seeks
8 = 500,001 to 1,000,000 seeks
9 = 1,000,001 to 5,000,000 seeks
A = 5,000,001 to 10,000,000 seeks
B = 10,000,001 to 50,000,000 seeks
C = 50,000,001 to 100,000,000 seeks
D = 100,000,001 to 500,000,000 seeks
E = 500,000,001 to 1,000,000,000 seeks
F = greater than 1,000,000,000 seeks

9.5 CLEAR LOGS UTILITY

DESCRIPTION

The Clear Logs Utility clears the specified logs. The option allows clearing all the logs or clearing only the ERT logs. A sector of zeros will be written out to the permanent log to clear the log header. The device places a zero in the RAM count to clear the entries in the RAM space. In addition, the device clears the recoverable count for the run-time header. The ERT RAM log and the Run-Time RAM log share the same space. It is recommended to update the Run-Time log by the Preset command before running an Error Rate Test.

COMMAND FORMAT

The Initiate Utility opcode for the Clear Logs is 30H, since no execution message exists. The Clear Log micro-opcode is 0CDH. One parameter, the log code, follows the micro-opcode.

00110000	11001101	0000000X
Initiate Utility Opcode	Micro Opcode (CDH)	Log Code 0 = All logs 1 = ERT logs only

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This utility is implemented as described in the general description.

C2201A, C2204A:

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

C225X:

This command is allowed for all units (0- 14) and the controller (unit 15). This command is allowed for all mechanisms, too.

When a unit 0-14 is specified, all logs from the mechanisms of the unit are cleared, as are any RAM log entries for the unit and any RAM log entries that are device wide.

When a mechanism is specified, all logs from the specific mechanism are cleared, as are any RAM log entries for the mechanism and any RAM log entries that are device wide.

When the controller (unit 15) is specified, only RAM log entries that are device wide are cleared.

9.6 ERROR RATE TESTS

Error Rate Tests provide a method of determining device error rates under various operating conditions. They also provide information for sparing, and assistance in testing the device in the field. It is recommended that a Set Address command accompany this utility.

Command Modifiers:

Each Error Rate Test has a unique opcode. A string of modifying parameters follows the opcode.

- Loop parameter
- Parity Error Bit parameter
- Report mode parameter
- Test Area parameter
- Data source parameter

Not all parameters are used with every opcode.

1. ERT Loop Parameter

   Values: 0 through FFH

   A value of FFH causes initiation of continuous testing. A Cancel will abort the test

2. Parity Error Bit

   Values:
   O-Parity Error bit not set
   1-Parity Error bit set

3. Error Report Mode

   It is possible, when the Parity Error bit is enabled, to have a data error with no data bits incorrect. This would result in a cleared error status mask. Note that when the report mode is one, the data read is actually compared with what should have been written. There are not any other cases where this is done.

   Values.
   O-(short) same as Run log entry
   1 -(long) data, Run log entry, and bit map of data error

4. ERT Test Area

   Values:
   0-sector
   1-track
   2-cylinder
   3-surface
   4-volume

5. Data Source

Values:

0-internal pattern table
2-random data

Specific Tests:

Error rate tests (ERT) have two forms. Execute Utility Send and Execute Utility No Message. In the "No Message" mode, the device logs errors and continues the test. In the Utility Send mode, the device stops on an error and reports the error to the host. The report mode parameter determines the type of report. Within these two categories are four possible commands, or eight total:

- Initiate Pattern ERT (also known as Write Then Read)
- Initiate Read Only ERT
- Initiate Random ERT (another Write Then Read)
- Initiate Random Read Only ERT

1. Initiate Pattern ERT

00110010	11001000	XXXXXXXX	0000000X
Initiate Utility Opcode	Micro Opcode (C8H)	Loop (0 to FFH)	Parity Error Bit (0 or 1)

0000000X	00000XXX	000000XX
Report (0 or 1)	Test Area (0 to 4)	Data Source (0 or 2)

2. Initiate Read Only ERT

00110010	11001001	XXXXXXXX	0000000X
Initiate Utility Opcode	Micro Opcode (C9H)	Loop (0 to FFH)	Parity Error Bit (0 or 1)

0000000X	00000XXX
Report (0 or 1)	Test Area (0 to 4)

3. Initiate Random ERT

00110010	11001011	XXXXXXXX	0000000X
Initiate Utility Opcode	Micro Opcode (CBH)	Loop (0 to FFH)	Parity Error Bit (0 or 1)

0000000X	000000XX
Report (0 or 1)	Test Area (0 or 2)

4. Initiate Random Read Only ERT

00110010	11001000	XXXXXXXX	0000000X
Initiate	Micro	Loop	Parity

Utility Opcode	Opcode (CCH)	(0 to FFH)	Error Bit (0 or 1)

0000000X

Report
(0 or 1)

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

The 7937 Error Rate Tests closely resemble the 7933/35 tests. In the command modifiers, the 7937's parity error bit will replace the offset parameter used in the 7933/35.

The Parity Error Bit allows for testing the sync field and framing words of the sector. When the bit is set, media defects in sync field and framing words can be detected. Defects in these areas might result in uncorrectable data for the user.

The 7937 will return 276 bytes instead of the 269 returned in other products. This is due to the seven extra ECC bytes. This report mode determines whether the error occurred in interleave A or interleave B, or in the ECC.

User Defined Pattern is not implemented in the 7937.

C2201A, C2204A:
When the unit number is set to 00K then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed. The ERT will be performed over the logical address space of the individual mechanism.

Random ERT and Random Read Only ERT tests operate as follows. For every loop requested (in the loop count parameter), the device will perform a write (if needed) then read error rate test on 256 random sectors. Thus, if loop count = 1, then 256 tests are performed. If loop count = 2, then 512 tests are performed, etc.

C225X:
The Parity Error Bit and Error Report Mode parameters are not valid.

When the unit number is set to 00H through 0EH then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

Random ERT and Random Read Only ERT tests operate as follows. For every loop requested (in the loop count parameter), the device will perform a write (if needed) then read error rate test on 256 random sectors. Thus, if loop count = 1, then 256 tests are performed. If loop count = 2, then 512 tests are performed, etc.

9.7 BUTTERFLY SEEK UTILITY

DESCRIPTION

The Butterfly Seek Utility provides a general indication that the device's servo system works properly without the read/write functions. The utility performs all possible length seeks in both directions. The host can select an individual head or all heads. If all heads are selected, each head starting with head 0 completes a butterfly seek or varying length alternate (VLA) seek test before the next head starts. If a fault occurs during the test, the device logs the fault; the test continues with the next length seek. The fault logging is done the same way as during run-time operations. No execution message report will be returned to the host. If the test failed by generating one or more faults, the QSTAT will indicate the test failed. It is the responsibility of the host to read the fault log for specific information about the failure. It is recommended that the fault log be cleared before starting the test. A cancel will abort the test if necessary.

COMMAND FORMAT

The Initiate Utility opcode for the Butterfly Seek Utility is 30H since no execution message exists. The Butterfly Seek micro opcode is B1H. There is one parameter following the micro opcode, head number.

00110000	10110001	XXXXXXXX
Initiate Utility Opcode	Micro Opcode (B1H)	Head Number (O to N+1) N = max head # N+1 = all heads

PRODUCT SPECIFICS

HP793TFL, HP7936FL:

This command is supported as described in the general description.

C2201A, C2204A:

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. Each mechanism within the unit will be exercised independently.

The command operates on a specific mechanism when the Set Mechanism command is employed.

C225X:

When the unit number is set to 00H through 0EH then this command operates on the selected unit. This command is not valid for logical unit 0FH the controller. Each mechanism within the unit will be exercised independently.

The command operates on a specific mechanism when the Set Mechanism command is employed.

9.8 PRESET DRIVE UTILITY

DESCRIPTION

The Preset Drive Utility updates the Run-Time and Fault logs. This includes updating the sector count and posting any log entries in the processor RAM to the maintenance tracks. It is advisable before turning the device off to issue this command, in case any log entries are in the RAM.

COMMAND FORMAT

The Initiate Utility opcode for the Preset Drive Utility is 30H, since no execution message exists. The Preset Drive micro-opcode is 0CEH. There is no parameter associated with this command.

00110000	11001110
Initiate Utility Opcode	micro Opcode (CEH)

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is supported as described in the general description.

C2201A, C2204A:

This command is supported as described in the general description.

C225X:

This command is interpreted as a no-op.

9.9 READ REVISION NUMBERS

DESCRIPTION

COMMAND FORMAT

The Initiate Utility opcode for Read Revision Numbers is 32H, since the device returns an execution message. The Read Revision Number micro-opcode is C3H. There are no parameters following the micro-opcode.

00110010	11000011
Initiate Utility Opcode	Micro Opcode (C3H)

The revision number format is RRRRNNNN where RRRR represent the ROM revision number and NNNN represents the rework number.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

The execution message is formatted as follows.

Header - 1 Byte
Number of revision number bytes following

Body - 1 Byte (repeated for each Revision Number needed)
Revision Number

HP7937's rework number is 0. The number of bytes returned in the execution message for the HP7937 is 5. The Header value is 5.

The format of the Body is as follows:

Byte	ROM
1	Firmware
2	Firmware
3	Firmware
4	Firmware
5	Servo System Firmware

C2201A, C2204A:
The execution message is formatted as follows.

Header - 1 Byte
Number of revision number bytes following

Body - 1 Byte (repeated for each Revision Number needed)
Revision Number

The format of the Body is:

Byte	C2201A ROM	C2204A ROM
1	Firmware	Firmware
2	Firmware	Firmware
3	Firmware	Firmware
4	Firmware	Firmware
5	ESDI I unit	ESDI I unit
6	Reserved	ESDI II unit

C225X:

The execution message is formatted as follows.

Header - 2 Byte
Byte 1 - Number of Body Tables following
Mechanism Body Table - 44 Bytes

Bytes 0 - 3	Product Revision Number (ASCII)
Bytes 4 - 13	Product Serial Number (ASCII)
Bytes 14 - 23	HDA Serial Number
Bytes 24 - 33	SCSI Firmware Revision Number
Bytes 34 - 44	ESDI Firmware Revision Number

The Header and Mechanism Body Tables are given when a Set Unit 0-14 accompanies the Read Revision Number command. The Mechanism Body Tables are given in ascending mechanism number order for the unit.

The Header and Mechanism Body Table are given when a Set Mechanism accompanies the Read Revision Number command.

9.10 DIAGNOSTIC READ UTILITY

DESCRIPTION

The Diagnostic Read utility allows the user to read up to the maximum bytes of reserved area on the specified head. This area is also used by power on self test and initiate diagnostic.

COMMAND FORMAT

The Initiate Utility opcode for the Diagnostic Read Utility is 32H, since an execution message will be sent to the host. The Diagnostic Read micro-opcode is D3H. There are two parameters following the micro-opcode, head number and length.

00110010	11010011	XXXXXXXX	XXXXXXXX	XXXXXXXX
Initiate Utility Opcode	Micro Opcode (D3H)	Length		Head Number (0 to N) N = max head #

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

C2201A, C2204A:

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.
When the Set Unit command is used, this utility exercises one mechanism within the selected unit. When the Set Mechanism command is used, this utility exercises the specific mechanism.

C225X:

This command is not supported.

9.11 DIAGNOSTIC WRITE UTILITY

DESCRIPTION

The Diagnostic Write utility allows the user to write up to the maximum number of bytes of reserved area on the specified head. This area is also used by power on, self test and initiate diagnostic.

COMMAND FORMAT

The Initiate Utility opcode for the Diagnostic Write Utility is 31H, since the host will send an execution message. The Diagnostic Write micro-opcode is D4H. There are two parameters following the micro-opcode, head number and length.

00110001	11010100	XXXXXXXX	XXXXXXXX	XXXXXXXX
Initiate Utility Opcode	Micro Opcode (D4H)	Length		Head Number (0 to N) N = max head #

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

C2201A, C2204A:

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

When the Set Unit command is used, this utility exercises one mechanism within the selected unit. When the Set Mechanism command is used, this utility exercises the specific mechanism.

C225X:

This command is not supported.

9.12 REBUILD STATUS UTILITY

DESCRIPTION

The Rebuild Status Utility provides a means of determining the progress of a rebuild command. The utility returns the percentage of completion of the rebuild command.

This utility is also the means of canceling a rebuild command.

COMMAND FORMAT

The Initiate Utility opcode for Rebuild Status, Cancel the Rebuild is 30H, since no execution message exists. The Initiate Utility opcode for Rebuild Status, Report Rebuild Percentage is 32H since an execution message will be sent to the host. The Rebuild Status micro-opcode is D5H. There is one parameter byte following the micro-opcode, indicating whether to report the rebuild percentage (0) or to cancel the rebuild (0).

0011000X	10110001	PARAM 1
Initiate Utility Opcode	Micro Opcode (D5H)	Utility Parameter 0 = Report Rebuild Percentage 1 = Cancel Rebuild

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

This command is implemented as described in the general description.

9.13 FIRMWARE UPGRADE

FUNCTION

Instructs the device to accept a firmware upgrade from the host. The firmware upgrade becomes effective at the completion of the report phase for this utility.

COMMAND FORMAT

The Initiate Utility opcode for Firmware Upgrade is 31H. The firmware upgrade is sent to the device in an execution message. The Firmware Upgrade micro-opcode is E0H.

00110001	11100000
Initiate Utility Opcode	Micro Opcode (E0H)

DESCRIPTION

The Firmware Upgrade command allows the host to upgrade firmware on the device's controller or a mechanism's controller. If this command is preceded by a Set Mech command, firmware on the corresponding mechanism's controller will be upgraded. If it is preceded by a Set Unit *fifteen* command, firmware on the device's controller will be upgraded.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

This command is not supported.

C2201A, C2204A:

This command is not supported.

C225X:

This command is implemented as described in the general description.

9.14 READ FULL SECTOR

DESCRIPTION

Read Full Sector returns the entire sector format of the sector specified in the utility's parameter field.

COMMAND FORMAT

The Initiate Utility opcode for Read Full Sector is 32H, since an execution message will be sent to the host. The Read Full Sector micro-opcode is A3H. The six parameters represent the address.

00110010	10100011	PARAM1	PARAM2
Initiate Utility Opcode	Micro Opcode (A3H)		

PARAM3	PARAM4	PARAM5	PARAM6

The Parameters are as follows.

PARAM1 -PARAM3 - Cylinder number of target. (Setting the most significant bit in this field indicates physical addressing.)

PARAM4 - Head number of target
PARAM5-PARAM6 - Sector number of target

FORMAT OF EXECUTION MESSAGE

This utility allows the host to retrieve an entire sector, and its associated overhead. This sector or track, may be damaged in some way, preventing the verify necessary to retrieve the data with a conventional Locate and Read. Read Full Sector allows the disk to seek to the target sector, and send the header, data, CRC, and ECC parity bytes back to the host.

PRODUCT SPECIFICS

HP7937FL, HP7936FL:

The HP7937's implementation of this utility is different from the implementation of past CS80 devices. Here is a list of the special features of HP7937's implementation.

1. A "special" logical address is specified as the target address of this command. This special logical address consists of a logical cylinder and head number, as well as a physical sector number. The physical sector number allows any sector on a logical track to be read, including the spare sector. The host sends the address as part of the command.

2. A 'verify' of the target track is not attempted. If a Read Full Sector command fails or returns the wrong sector's data, then a Locate and Read command (of length > 0 sectors) should be executed to resynchronize the disc hardware. Otherwise, the sector read will not be the target for subsequent Read Full Sector commands.

3. The command opcode for Read Full Sector has been changed for the HP7937 to 0A3H.

The Full Sector format is as follows:

Header -	6 Bytes (stored on disk)	
Data -	256 Bytes	(stored on disk)
CRC -	2 Bytes	(from DMA overhead ram)
ECC -	12 Bytes	(from ECC)
Total	276 Bytes	

The Parameter values are as follows:

Cylinder number of target has Logical values 0 - 1395.

Head number of target has Logical values 0 - 12.

Sector number of target has Physical values 0 - 123.

C2201A, C2204A:

The Parameter values are as follows:

Cylinder number of target has Logical values 0 - 2897.

Head number of target has Logical values 0 - I5.
Sector number of target has Physical values 0 - 113.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. The logical addressing of the unit and the physical addressing of the unit will be supported for this unit.

The command operates on a specific mechanism when the Set Mechanism command is employed, and addressing is mechanism specific.

C225X:

This command must be issued with a Set Mechanism command proceeding it.

APPENDIX A

FLEX OPCODES

Device Commands

00	Locate and Read
02	Locate and Write
04	Locate and Verify
05	Locate and Fill
06	Spare Block
OC	Extended Describe
OD	Request Status
10	Set address, single-vector mode
11	Set address, three-vector mode
18	Set Length
2X	Set Unit
30	Initiate Utility, no execution message
31	Initiate Utility, drive receives execution message
32	Initiate Utility, drive sends execution message
33	Initiate Diagnostic
34	No Op
37	Initialize Media
50	Rebuild
5207	Directed Post
5208	Directed Fetch
5210	Directed Address, single-vector mode
5211	Directed Address, three-vector mode
5215	Directed Bus ID
522X	Directed Unit
63	Set Device Lock
67	Set Nonresponding Host Timeout
69	Set Host to Host Timeout
6B	Delete Device Lock
70	Set Mechanism
71	Set Skip Drive
73	Set Unit Lock
7B	Delete Unit Lock

Transparent Commands

10	Remote Host Reset
40	Transparent Status

Utilities

A3	Read Full Sector
B1	Butterfly Seek
C3	Read Revision Number
C4	Read Drive Tables
C5	Read Run-Time Log
C6	Read Error Rate Log
C7	Read Fault Log
C8	Pattern Error Rate Test
C9	Read Only Error Rate Test
CB	Random Error Rate Test
CC	Random Read Only Error Rate Test
CD	Clear Logs
CE	Preset Drive
D3	Diagnostic Read
D4	Diagnostic Write
D5	Rebuild Status
EO	Firmware Upgrade
E1	Reserved

Appendix B

HP7937FL FLEX SPECIFICS

This appendix shows the FLEX information pertaining only to the HP7937FL.

DEVICE COMMANDS

LOCATE AND READ

This command is implemented as described in section 4.1.

LOCATE AND WRITE

This command is implemented as described in section 4.2.

SET UNIT

This general description of this command is section 4.3.

The device allows only unit 0H and unit FH. Unit FH implies the controller.

SET VOLUME

This command is not supported.

SET ADDRESS

This command is implemented as described in section 4.5.

SET LENGTH

This command is implemented as described in section 4.6.

NO OP

This command is implemented as described in section 4.7.

SET MECHANISM

This command is not supported.

EXTENDED DESCRIBE

This command is implemented as described in section 4.9.

The Extended Describe tables for the HF7937FL are:

CONTROLLER TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
000E	03	08	00	00

HEADER (seven single byte fields plus one byte pad)

C1	C2	C3	C4	C5	C6	C7	C8

byte fields C1-C2
Description
Installed Unit byte: 1 bit for each unit (Unit 0 = LSB)

Product	Decimal Values
HP7937FL	1

byte fields C3-C4
Description
Maximum instantaneous transfer rate in thousands of bytes per second.

Product	Decimal Values
HP7937FL	5000

byte fields C5
Description
Controller Type
0 = Integrated single-unit controller
1 = Integrated multi-unit controller
2 = Integrated multi-port controller
3 = Integrated multi-port, P-Bus only controller
4 = Integrated multi-unit, multi-port controller

Product	Decimal Values
HP7937FL	2

byte fields C6
Description
Host Port Id (0-7)

byte fields C7
Description
Number of host ports provided by the controller

Product	Decimal Values
HP7937FL	8

byte fields C8
Description
Reserved

UNIT & VOLUME TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
0026	04	18	01	0E

HEADER (eighteen single byte fields)

U1	U2	. . .	U18
		. . .	

byte fields U1
Description
Unit Number

Product	Decimal Values
HP7937FL	0

byte fields U2
Description
General Device Type
0 = Fixed Disk
1 = Removable disk or combination
2 = Tape, fixed block size, or random access

Product	Decimal Values
HP7937FL	0

byte fields U3-U5
Description
Device Number. Represents actual HP product number;
XX XX XY (2 digits per byte)
XXXXX = product number, Y = option

Product	Decimal Values
HP7937FL	079371

byte fields U6-U7
Description
Number of bytes per block

Product	Decimal Values
HP7937FL	256

byte fields U8
Description
Number of blocks which can be buffered

Product	Decimal Values
HP7937FL	128

byte fields	Description
U9	Recommended burst size (0 = burst mode not recommended)

Product	Decimal Values
HP7937FL	0

byte fields	Description
U10-U11	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
HP7937FL	179

byte fields	Description
U12-U13	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
HP7937FL	1800

byte fields	Description
U14-U15	Optimal retry time in tens of milliseconds

Product	Decimal Values
HP7937FL	80

byte fields	Description
U16-U17	Access time parameter in tens of milliseconds. (Maximum time from the end of command message test to RTS data or RTR data. Applies to read and write commands only in single host single command environment.

Product	Decimal Values
HP7937FL	84

byte fields	Description
U18	Maximum interleave factor

Product	Decimal Values
HP7937FL	1

RECORD (fourteen single byte fields)

V1	V2	. . .	V14
		. . .	

byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
HP7937FL	1395

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
HP7937FL	12

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
HP7937FL	122

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
HP7937FL	2232203

byte fields	Description
V13	Current interleave factor

Product	Decimal Values
HP7937FL	1

byte fields	Description
V14	Volume Number

Product	Decimal Values
HP7937FL	0

INITIALIZE MEDIA

This command is implemented as described in section 4.10.

SPARE BLOCK

This command is implemented as described in section 4.11.

LOCATE AND VERIFY

This command is implemented as described in section 4.12.

INITIATE UTILITY

This command is implemented as described in section 4.13.

INITIATE DIAGNOSTIC

This command is implemented as described in section 4.14.

The only supported diagnostic is self-test, Diagnostic section number zero (0). This command must be directed to the device's controller (unit 15).

REQUEST STATUS

This command is implemented as described in section 4.15.

SET DEVICE LOCK

This command is implemented as described in section 4.16.

DELETE DEVICE LOCK

This command is implemented as described in section 4.17.

SET UNIT LOCK

This command is not supported.

DELETE UNIT LOCK

This command is not supported.

SET NONRESPONDING HOST TIMEOUT

This command is implemented as described in section 4.20.

The default value is 65534.

SET HOST TO HOST TIMEOUT

This command is not supported.

LOCATE AND FILL

This command is not supported.

DIRECTED POST

This command is not supported.

DIRECTED FETCH

This command is not supported.

DIRECTED BUS ID

This command is not supported.

DIRECTED UNIT

This command is not supported.

DIRECTED VOLUME

This command is not supported.

DIRECTED ADDRESS

This command is not supported.

REBUILD

This command is not supported.

SKIP DRIVE

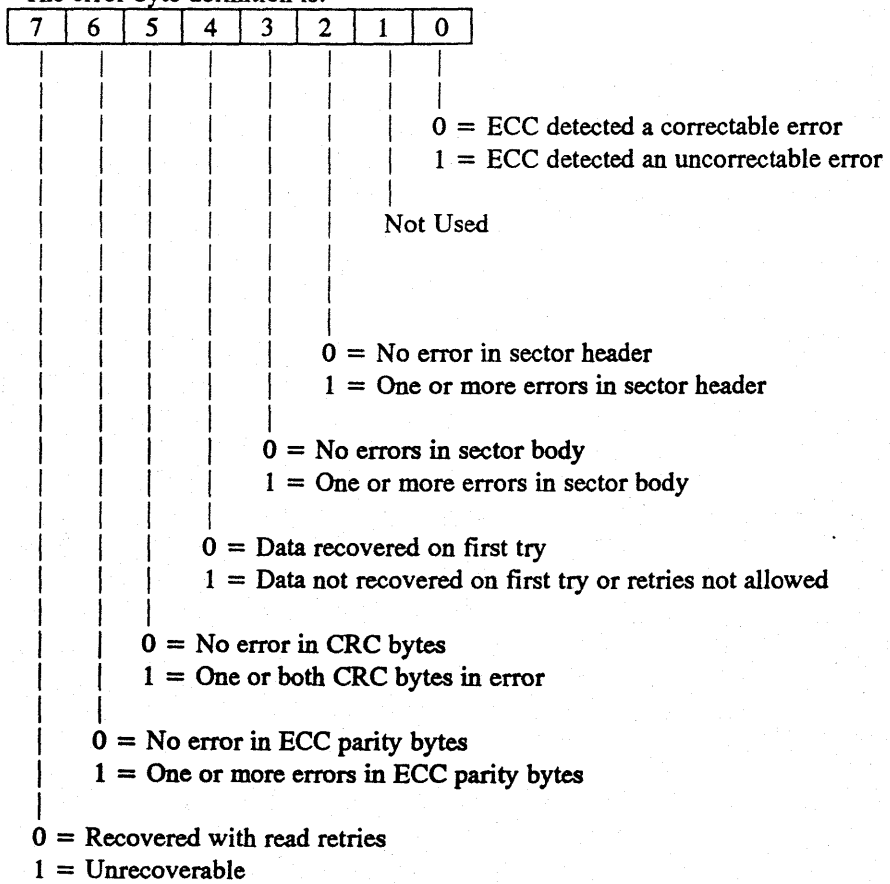
This command is not supported.

READ RUN-TIME LOG UTILITY

The general description for this utility is section 9.2.

A maximum of 5 entries are allowed in the RAM area. The HP7937FL writes the information out to the device as soon as possible. Any more than five entries without device update causes the fifth entry to be replaced. The permanent log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The HP7937 uses the same log format as previous CS80 devices. The definition of the error byte is different. Below is the log format.

The error byte definition is:

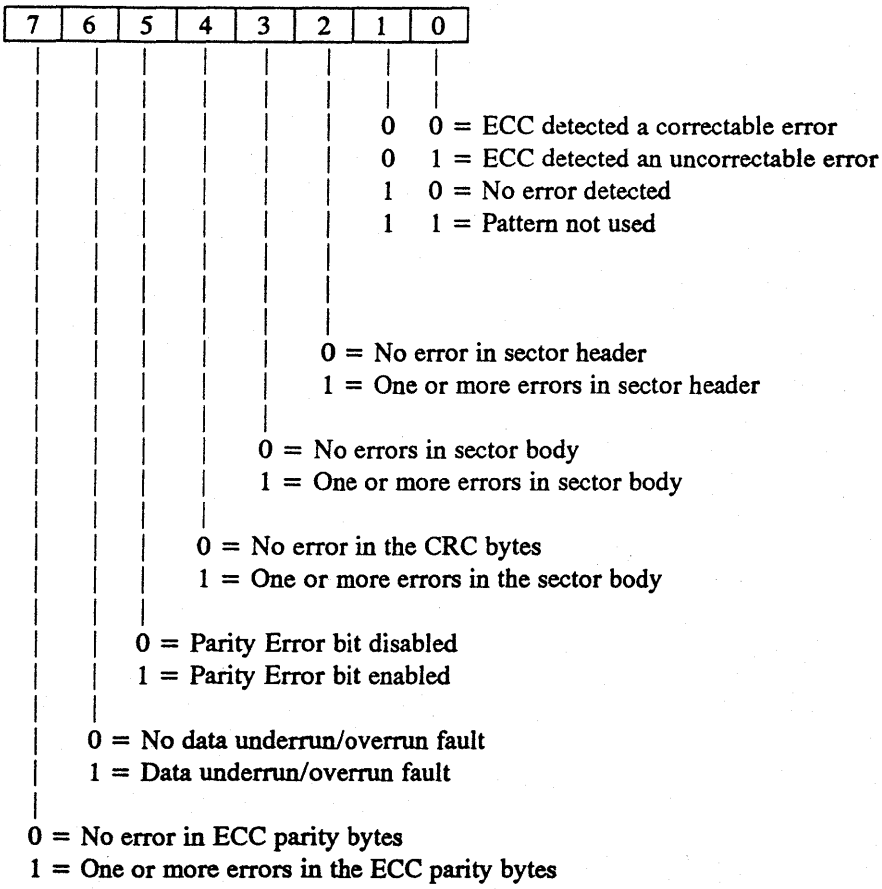


READ ERT LOG UTILITY

The general description for this utility is section 9.3.

After 5 entries are in the RAM area the device moves the entries to the disk. The permanent disk log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The HP7937FL uses the same log format as the run-time log. The error byte definition is different from the run-time log and is shown below. The number of correctable data errors in the log header for ERTs is a count of all correctables (not recoverable on first retry like the Run-Time log).

The error byte definition is:



READ FAULT LOG UTILITY

Below is the log format.

The log header is (number of records):	1 byte

The record format is:

Current logical cylinder address	2 bytes
Current logical head address	1 byte
Current logical sector address	1 byte
Target logical cylinder address	2 bytes
Target logical head address	1 byte

Target logical sector address	1 byte
Status of internal registers	1 byte
Error byte	1 byte
Error type and activity indicator	1 byte

The general description for this utility is section 9.4.

The device initially logs faults and related events in a RAM area. The RAM holds a maximum of 30 entries. The HP7937FL posts the entries to the device after the command completes. The permanent fault log on the device holds a maximum of 44 entries. Thus, a maximum of 74 entries can be returned to the host. The HP7937 uses the same log format as previous CS80 devices. The status definitions of the internal registers error and error type are different. The status of internal registers byte is a collection of bits from the servo register and the endecon register. The purpose of this register is to provide additional information about the Servo and R/W systems when a fault in the data path occurs. If a channel fault occurs, this byte is zero. The bit definitions are shown below.

bit 0	=	Spindle Speed Error bit	(Servo)
bit 1	=	Servo Timing Error bit	(Servo)
bit 2	=	Off Track bit	(Servo)
bit 3	=	AGC Error bit	(Servo)
bit 4	=	Data Overrun bit	(Endecon)
bit 5	=	Undefined	
bit 6	=	Undefined	
bit 7	=	Undefined	

The last byte, error type, indicates whether an error is a Derror, Terror, event or fault by setting/clearing the last two bits of the 2nd nibble. The first nibble is the activity indicator. The activity indicator gives a number which represents the number of seeks within a range that occurred between faults. The ranges are shown below.

A	A	A	A	0	0	T	L

T (Type)
0 = Event
1 = Fault

L (Location)
0 = Derror
1 = Terror

AAAA

0000 = no seeks
0001 = 1 seek
0010 = 2 seeks
0011 = 3 seeks
0100 = 4 seeks
0101 = 5 to 7 seeks
0110 = 8 to 200 seeks
0111 = 201 to 2,000 seeks
1000 = 2,001 to 12,000 seeks
1001 = 12,001 to 25,000 seeks
1010 = 25,001 to 150,000 seeks
1011 = 150,001 to 600,000 seeks
1100 = 600,001 to 4,000,000 seeks
1101 = 4,000,001 to 16,000,000 seeks
1110 = 16,000,001 to 1,000,000,000 seeks
1111 = > 1,000,000,000 seeks

CLEAR LOGS UTILITY

This utility is implemented as described in section 9.5.

ERROR RATE TESTS

The general description for this utility is section 9.6.

The Parity Error Bit allows for testing the sync field and framing words of the sector. When the bit is set, media defects in sync field and framing words can be detected. Defects in these areas might result in uncorrectable data for the user.

7937 will return 276 bytes instead of the 269 returned in other products. This is due to the seven extra ECC bytes. This report mode determines whether the error occurred in interleave A or interleave B, or in the ECC.

User Defined Pattern is not implemented in the 7937.

BUTTERFLY SEEK UTILITY

This utility is implemented as described in section 9.7.

PRESET DRIVE UTILITY

This utility is implemented as described in section 9.8.

READ REVISION NUMBERS

The general description of this utility is section 9.9.

The execution message is formatted as follows.

Header - 1 Byte

Number of revision number bytes following Body - 1 Byte (repeated for each Revision Number needed)

HP7937's rework number is 0. The number of bytes returned in the execution message for the HP7937 is 5. The Header value is 5.

The format of the Body is as follows:

Byte	ROM
1	Firmware
2	Firmware
3	Firmware
4	Firmware
5	Servo System Firmware

DIAGNOSTIC READ UTILITY

The general description of this utility is section 9.10.

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

DIAGNOSTIC WRITE UTILITY

The general description of this utility is section 9.11.

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

REBUILD STATUS

This command is not supported.

FIRMWARE UPGRADE

This command is not supported.

The general description of this utility is section 9.17.

The HP7937's implementation of this utility is different from the implementation of past CS80 devices. Here is a list of the special features of HP7937's implementation.

1. A "special" logical address is specified as the target address of this command. This special logical address consists of a logical cylinder and head number, as well as a physical sector number. The physical sector number allows any sector on a logical track to be read, including the spare sector. The host sends the address as part of the command.

2. A "verify" of the target track is not attempted. If a Read Full Sector command fails or returns the wrong sector's data, then a Locate and Read command (of length > 0 sectors) should be executed to resynchronize the disk hardware. Otherwise, the sector read will not be the target for subsequent Read Full Sector commands.

3 The command opcode for Read Full Sector has been changed for the HP7937 to 0A3H.

The Full Sector format is as follows:

Header -	6 Bytes	(stored on disk)
Data -	256 Bytes	(stored on disk)
CRC -	2 Bytes	(from DMA overhead RAM)
ECC -	12 Bytes	(from ECC)
Total	276 Bytes	

The Parameter values are as follows:

Cylinder number of target has Logical values 0 - 1395.

Head number of target has Logical values 0 - 12.

Sector number of target has Physical values 0 - 123.

Appendix C

HP7936FL FLEX SPECIFICS

This appendix shows the FLEX information pertaining only to the HP7936FL.

DEVICE COMMANDS

LOCATE AND READ

This command is implemented as described in section 4.1.

LOCATE AND WRITE

This command is implemented as described in section 4.2.

SET UNIT

This general description of this command is section 4.3.

The device allows only unit 0H and unit FH. Unit FH implies the controller.

SET VOLUME

This command is not supported.

SET ADDRESS

This command is implemented as described in section 4.5.

SET LENGTH

This command is implemented as described in section 4.6.

NO OP

This command is implemented as described in section 4.7.

SET MECHANISM

This command is not supported.

EXTENDED DESCRIBE

This command is implemented as described in section 4.9. The Extended Describe tables for the HP7937FL are:

CONTROLLER TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
000E	03	08	00	00

HEADER (seven single byte fields plus one byte pad)

C1	C2	C3	C4	C5	C6	C7	C8

byte fields C1-C2
Description
Installed Unit byte: 1 bit for each unit (Unit 0 = LSB)

Product	Decimal Values
HP7936FL	1

byte fields C3-C4
Description
Maximum instantaneous transfer rate in thousands of bytes per second

Product	Decimal Values
HP7936FL	5000

byte fields C5
Description
Controller Type
0 = Integrated single-unit controller
1 = Integrated multi-unit controller
2 = Integrated multi-port controller
3 = Integrated multi-unit, P-Bus only controller
4 = Integrated multi-unit, multi-port controller

Product	Decimal Values
HP7936FL	2

byte fields C6
Description
Host Port Id (0-7)

byte fields C7
Description
Number of host ports provided by controller

Product	Decimal Values
HP7936FL	8

byte fields C8
Description
Reserved

UNIT & VOLUME TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
0026	04	18	01	0E

HEADER (eighteen single byte fields)

U1	U2	. . .	U18
		. . .	

byte fields: U1
Description: Unit Number

Product	Decimal Values
HP7936FL	0

byte fields: U2
Description:
General Device Type
0 = Fixed Disk
1 = Removable disk or combination
2 = Tape, fixed block size, or random access

Product	Decimal Values
HP7936FL	0

byte fields: U3-U5
Description:
Device Number. Represents actual HP product number;
XX XX XY (2 digits per byte)
XXXXX = product number, Y = option

Product	Decimal Values
HP7936FL	079361

byte fields: U6-U7
Description: Number of bytes per block

Product	Decimal Values
HP7936FL	256

byte fields: U8
Description: Number of blocks which can be buffered

Product	Decimal Values
HP7936FL	128

byte fields	Description
U9	Recommended burst size (0 = burst mode not recommended)

Product	Decimal Values
HP7936FL	0

byte fields	Description
U10-U11	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
HP7936FL	179

byte fields	Description
U12-U13	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
HP7936FL	1800

byte fields	Description
U14-U15	Optimal retry time in tens of milliseconds

Product	Decimal Values
HP7936FL	80

byte fields	Description
U16-U17	Access time parameter in tens of milliseconds. (Maximum time from the end of command message test to RTS data or RTR data. Applies to read and write commands only in single host single command environment.

Product	Decimal Values
HP7936FL	84

byte fields	Description
U18	Maximum interleave factor

Product	Decimal Values
HP7936FL	1

RECORD (fourteen single byte fields)

V1	V2	. . .	V14
		. . .	

byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
HP7936FL	1395

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
HP7936FL	6

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
HP7936FL	122

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
HP7936FL	1116101

byte fields	Description
V13	Current interleave factor

Product	Decimal Values
HP7936FL	1

byte fields	Description
V14	Volume Number

Product	Decimal Values
HP7936FL	0

INITIALIZE MEDIA

This command is implemented as described in section 4.10.

SPARE BLOCK

This command is implemented as described in section 4.1.1.

LOCATE AND VERIFY

This command is implemented as described in section 4.12.

INITIATE UTILITY

This command is implemented as described in section 4.13.

INITIATE DIAGNOSTIC

This command is implemented as described in section 4.14.

The only supported diagnostic is self-test, Diagnostic section number zero (0). This command must be directed to the device's controller (unit 15).

REQUEST STATUS

This command is implemented as described in section 4.15.

SET DEVICE LOCK

This command is implemented as described in section 4.16.

DELETE DEVICE LOCK

This command is implemented as described in section 4.17.

SET UNIT LOCK

This command is not supported.

DELETE UNIT LOCK

This command is not supported.

SET NONRESPONDING HOST TIMEOUT

This command is implemented as described in section 4.20.

The default value is 65534.

SET HOST TO HOST TIMEOUT

This command is not supported.

LOCATE AND FILL

This command is not supported.

REBUILD

This command is not supported.

SKIP DRIVE

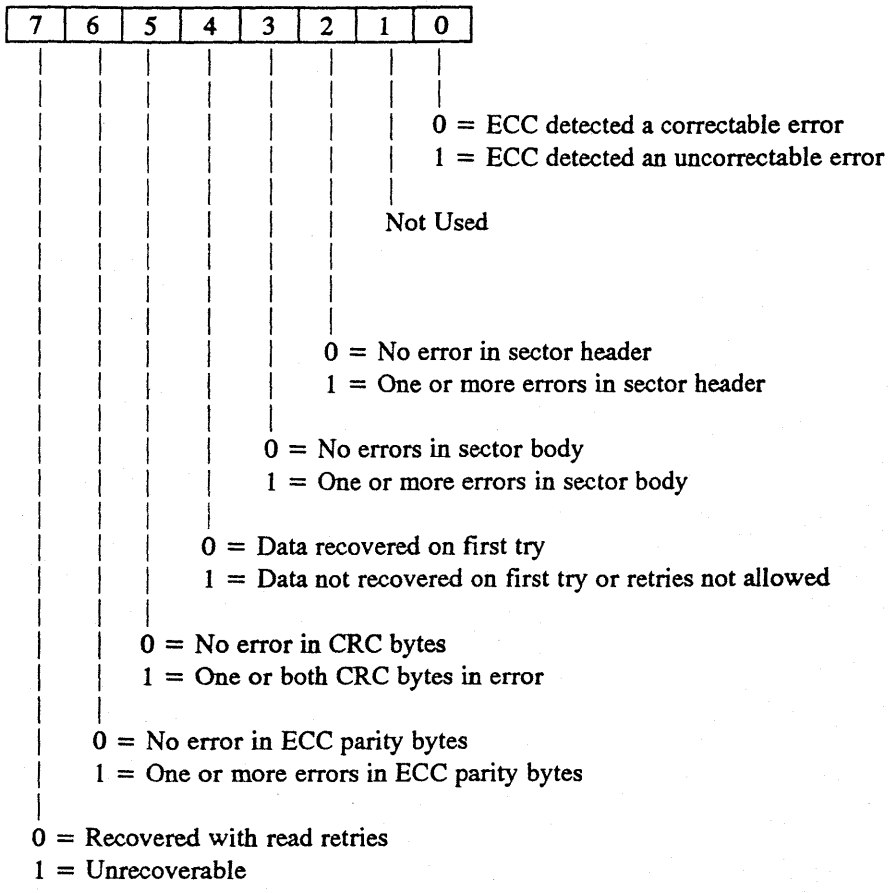
This command is not supported.

READ RUN-TIME LOG UTILITY

The general description for this utility is section 9.2.

A maximum of 5 entries are allowed in the RAM area. The HP7936FL writes the information out to the device as soon as possible. Any more than five entries without device update causes the fifth entry to be replaced. The permanent log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The HP7936 uses the same log format as previous CS80 devices. The definition of the error byte is different. Below is the log format.

The error byte definition is:



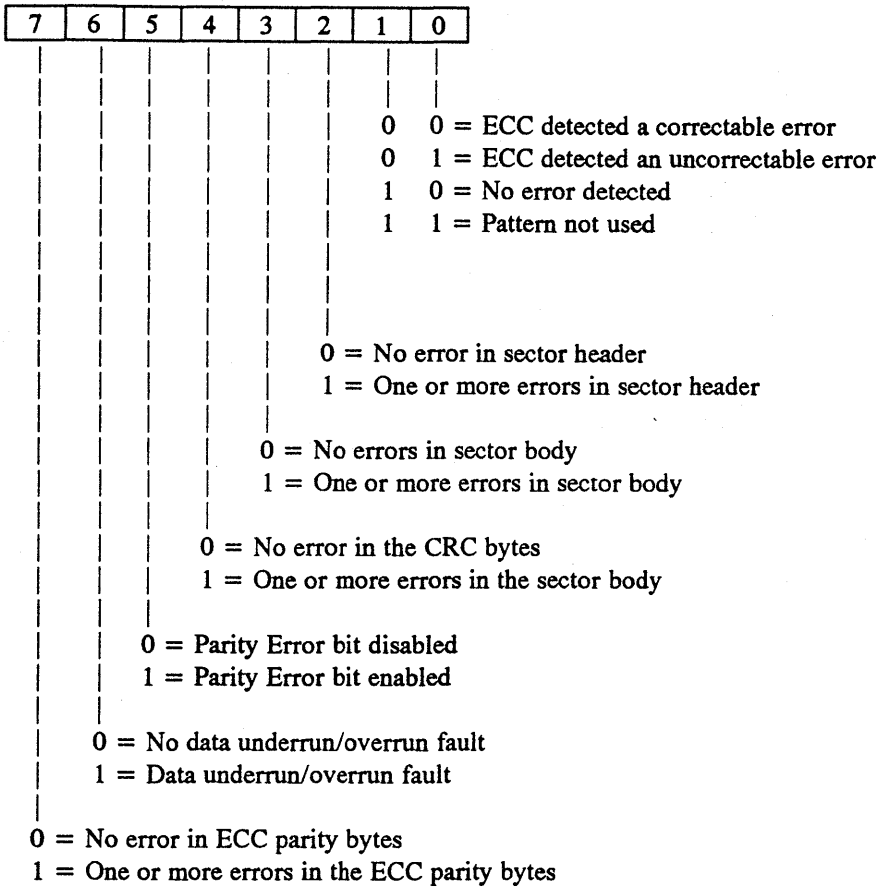
READ ERT LOG UTILITY

The general description for this utility is section 9.3.

After 5 entries are in the RAM area the device moves the entries to the disk. The permanent disk log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head.

The HP7936FL uses the same log format as the run-time log. The error byte definition is different from the run-time log and is shown below. The number of correctable data errors in the log header for ERTs is a count of all correctables (not recoverable on first retry like the Run-Time log).

The error byte definition is:



READ FAULT LOG UTILITY

Below is the log format.

The log header is (number of records):	1 byte

The record format is:

Current logical cylinder address	2 bytes
Current logical head address	1 byte
Current logical sector address	1 byte
Target logical cylinder address	2 bytes
Target logical head address	1 byte
Target logical sector address	1 byte
Status of internal registers	1 byte
Error byte	1 byte
Error type and activity indicator	1 byte

The general description for this utility is section 9.4.

The device initially logs faults and related events in a RAM area. The RAM holds a maximum of 30 entries. The HP7936FL posts the entries to the device after the command completes. The permanent fault log on the device holds a maximum of 44 entries. Thus, a maximum of 74 entries can be returned to the host. The HP7936 uses the same log format as previous CS80 devices. The

status definitions of the internal registers error and error type are different. The status of internal registers byte is a collection of bits from the servo register and the endecon register. The purpose of this register is to provide additional information about the Servo and R/W systems when a fault in the data path occurs. If a channel fault occurs, this byte is zero. The bit definitions are shown below.

bit 0	=	Spindle Speed Error bit	(Servo)
bit 1	=	Servo Timing Error bit	(Servo)
bit 2	=	Off Track bit	(Servo)
bit 3	=	AGC Error bit	(Servo)
bit 4	=	Data Overrun bit	(Endecon)
bit 5	=	Undefined	
bit 6	=	Undefined	
bit 7	=	Undefined	

The last byte, error type, indicates whether an error is a Derror, Terror, event or fault by setting/clearing the last two bits of the 2nd nibble. The first nibble is the activity indicator. The activity indicator gives a number which represents the number of seeks within a range that occurred between faults. The ranges are shown below.

A	A	A	A	0	0	T	L

T (Type)
0 = Event
1 = Fault

L (Location)
0 = Derror
1 = Terror

AAAA
0000 = no seeks
0001 = 1 seek
0010 = 2 seeks
0011 = 3 seeks
0100 = 4 seeks
0101 = 5 to 7 seeks
0110 = 8 to 200 seeks
0111 = 201 to 2,000 seeks
1000 = 2,001 to 12,000 seeks
1001 = 12,001 to 25,000 seeks
1010 = 25,001 to 150,000 seeks
1011 = 150,001 to 600,000 seeks
1100 = 600,001 to 4,000,000 seeks
1101 = 4,000,001 to 16,000,000 seeks
1110 = 16,000,001 to 1,000,000,000 seeks
1111 = > 1,000,000,000 seeks

CLEAR LOGS UTILITY

This utility is implemented as described in section 9.5.

ERROR RATE TESTS

The general description for this utility is section 9.6.

The Parity Error Bit allows for testing the sync field and framing words of the sector. When the bit is set, media defects in sync field and framing words can be detected. Defects in these areas might result in uncorrectable data for the user.

7936 will return 276 bytes instead of the 269 returned in other products. This is due to the seven extra ECC bytes. This report mode determines whether the error occurred in interleave A or interleave B, or in the ECC.

User Defined Pattern is not implemented in the 7936.

BUTTERFLY SEEK UTILITY

This utility is implemented as described in section 9.7.

PRESET DRIVE UTILITY

This utility is implemented as described in section 9.8.

READ REVISION NUMBERS

The general description of this utility is section 9.9.

The execution message is formatted as follows.

Header - 1 Byte
Number of revision number bytes following

Body - 1 Byte (repeated for each Revision Number needed)
Revision Number

HP7936's rework number is 0. The number of bytes returned in the execution message for the HP7936 is 5. The Header value is 5.

The format of the Body is as follows:

Byte	ROM
1	Firmware
2	Firmware
3	Firmware
4	Firmware
5	Servo System Firmware

DIAGNOSTIC READ UTILITY

This utility is implemented as described in section 9.10.

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

DIAGNOSTIC WRITE UTILITY

This utility is implemented as described in section 9.11.

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

REBUILD STATUS

This command is not supported.

FIRMWARE UPGRADE

This command is not supported.

The general description of this utility is section 9.17.

The HP7936's implementation of this utility is different from the implementation of past CS80 devices. Here is a list of the special features of HP7936's implementational.

1. A "special" logical address is specified as the target address of this command. This special logical address consists of a logical cylinder and head number, as well as a physical sector number. The physical sector number allows any sector on a logical track to be read, including the spare sector. The host sends the address as part of the command.

2. A "verify" of the target track is not attempted. If a Read Full Sector command fails or returns the wrong sector's data, then a Locate and Read command (of length > 0 sectors) should be executed to resynchronize the disk hardware. Otherwise, the sector read will not be the target for subsequent Read Full Sector commands.

3. The command opcode for Read Full Sector has been changed for the HP7936 to 0A3H.

The Full Sector format is as follows:

Header -	6 Bytes	(stored on disk)
Data -	256 Bytes	(stored on disk)
CRC -	2 Bytes	(from DMA overhead RAM)
ECC -	12 Bytes	(from ECC)
Total	276 Bytes	

The Parameter values are as follows:

Cylinder number of target has Logical values 0 - 1395.

Head number of target has Logical values 0 - 6.

Sector number of target has Physical values 0 - 123.

Appendix D

C2201A FLEX SPECIFICS

This appendix shows the FLEX information pertaining only to the C2201A.

DEVICE COMMANDS

LOCATE AND READ

This command is implemented as described in section 4.1.

LOCATE AND WRITE

This command is implemented as described in section 4.2.

SET UNIT

The general description of this command is section 4.3.

The device allows only unit -0H and unit FH. Unit FH implies the controller.

The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.

If the Set Unit command is issued, it must be the first command in the command sequence.

If both the Set Unit command and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.

SET VOLUME

This command is not supported.

SET ADDRESS

This command is implemented as described in section 4.5.

SET LENGTH

This command is implemented as described in section 4.6.

NO OP

This command is implemented as described in section 4.7.

SET MECHANISM

This command is implemented as described in section 4.8.

The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.

If the Set Mechanism command is issued, it must be the first command in the command sequence.

If both the Set Unit command and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.

EXTENDED DESCRIBE

This command is implemented as described in section 4.9.

The Extended Describe tables for C2201A are:

CONTROLLER TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
000E	03	08	00	00

HEADER (seven single byte fields plus one byte pad)

C1	C2	C3	C4	C5	C6	C7	C8

byte fields	Description
C1-C2	Installed Unit byte: 1 bit for each unit (Unit 0 = LSB)

Product	Decimal Values
C2201A	1

byte fields	Description
C3-C4	Maximum instantaneous transfer rate in thousands of bytes per second

Product	Decimal Values
C2201A	5000

byte fields	Description
C5	Controller Type 0 = Integrated single-unit controller 1 = Integrated multi-unit controller 2 = Integrated multi-port controller 3 = Integrated multi-unit, P-Bus only controller 4 = Integrated multi-unit, multi-port controller

Product	Decimal Values
C2201A	2,3

byte fields	Description
C6	Host Port Id (0-7)

byte fields	Description
C7	Number of host ports provided by controller

Product	Decimal Values
HP7936FL	8

byte fields	Description
C8	Reserved

UNIT & VOLUME TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
0026	04	12	01	0E

HEADER (eighteen single byte fields)

U1	U2	. . .	U18
		. . .	

byte fields	Description
U1	Unit Number

Product	Decimal Values
C2201A	0

byte fields	Description
U2	General Device Type 0 = Fixed Disk 1 = Removable disk or combination 2 = Tape, fixed block size, or random access

Product	Decimal Values
C2201A	0

byte fields	Description
U3-U5	Device Number. Represents actual HP product number; XX XX XY (2 digits per byte) XXXXX = product number, Y = option

Product	Decimal Values
C2201A	022010

byte fields	Description
U6-U7	Number of bytes per block

Product	Decimal Values
C2201A	256

byte fields	Description
U8	Number of blocks which can be buffered

Product	Decimal Values
C2201A	128

byte fields	Description
U9	Recommended burst size (0 = burst mode not recommended)

Product	Decimal Values
C2201A	0

byte fields	Description
U10-U11	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
C2201A	130

byte fields	Description
U12-U13	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C2201A	1434

byte fields	Description
U14-U15	Optimal retry time in tens of milliseconds

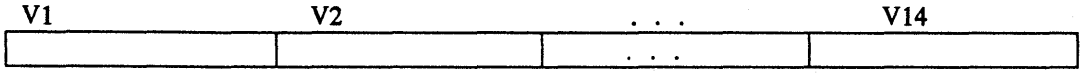
Product	Decimal Values
C2201A	80

byte fields	Description
U16-U17	Access time parameter in tens of milliseconds. (Maximum time from the end of command message test to RTS data or RTR data. Applies to read and write commands only in single host single command environment.

	Product	Decimal Values
	C2201A	84
byte fields	Description	
U18	Maximum interleave factor	

Product	Decimal Values
C2201A	1

RECORD (fourteen single byte fields)



byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C2201A	1448

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C2201A	15

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C2201A	112

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
C2201A	2619791

byte fields	Description
V13	Current interleave factor

Product	Decimal Values
C2201A	1

byte fields	Description
V14	Volume Number

Product	Decimal Values
C2201A	0

MECHANISM TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
001F	05	0D	01	0C

HEADER (thirteen single byte fields)

U1	U2	. . .	U13
		. . .	

byte fields: U1
Description: Mechanism Number/Address

Product	Decimal Values
C2201A	1

byte fields: U2
Description:
General Device Type
0 = Fixed Disk
1 = Removable disk or combination
2 = Tape, fixed block size, or random access

Product	Decimal Values
C2201A	0

byte fields: U3-U5
Description:
Device Number. Represents actual HP product number;
XX XX XY (BCD coded, 2 digits per byte)
XXXXX = product number, Y = option
Y = 0 for ESDI; Y = 1 for SCSI

Product	Decimal Values
C2201A	975480

byte fields: U6-U7
Description: Number of bytes per block

Product	Decimal Values
C2201A	256

byte fields: U8
Description: Number of blocks which can be buffered

Product	Decimal Values
C2201A	128

byte fields	Description
U9	Interface Type 0 = ESDI 1 = SCSI

Product	Decimal Values
C2201A	0

byte fields	Description
U10	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
C2201A	130

byte fields	Description
U11-U12	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C2201A	1434

byte fields	Description
U13	Maximum interleave factor

Product	Decimal Values
C2201A	1

RECORD (twelve single byte -fields)

V1	V2	. . .	V12
		. . .	

byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C2201A	1448

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C2201A	15

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C2201A	112

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
C2201A	2619791

INITIALIZE MEDIA

The general description of this command is section 4.10.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

SPARE BLOCK COMMAND

The general description of this command is section 4.11.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

LOCATE AND VERIFY

This command is implemented as described in section 4.12.

INITIATE UTILITY

This command is implemented as described in section 4.13.

INITIATE DIAGNOSTIC

This command is implemented as described in section 4.14.

The only supported diagnostic is self-test, Diagnostic section number zero (0). This command must be directed to the device's controller (unit 15).

REQUEST STATUS

This command is implemented as described in section 4.15.

SET DEVICE LOCK

This command is implemented as described in section 4.16.

DELETE DEVICE LOCK

This command is implemented as described in section 4.17.

SET UNIT LOCK

This command is not supported.

DELETE UNIT LOCK

This command is not supported.

SET NONRESPONDING HOST (NRH) TIMEOUT

This command is implemented as described in section 4.20.

The default value is 65534.

SET HOST TO HOST TIMEOUT

This command is implemented as described in section 4.19.

LOCATE AND FILL

This command is implemented as described in section 4.20.

REBUILD

This command is not supported.

SKIP DRIVE

This command is not supported.

READ RUN-TIME LOG UTILITY

The general description of this utility is section 9.2

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current physical addresses and the Current logical addresses reflect the address space of the logical unit. Thus, the Current physical addresses reflect the physical addresses of the logical unit; the Current logical addresses reflect the logical addresses of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism the Current physical addresses and the Current logical addresses reflect the address space of the individual mechanism. Thus, the Current physical address reflect the physical addresses of the individual mechanism; the Current logical address reflect the logical addresses of the individual mechanism.

READ ERT LOG UTILITY

The general description of this utility is section 9.3.
When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the

logical unit, the Current physical addresses and the Current logical addresses reflect the address space of the logical unit.

Thus, the Current physical addresses reflect the physical addresses of the logical unit; the Current logical addresses reflect the logical addresses of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current physical addresses and the Current logical addresses reflect the address space of the individual mechanism. Thus, the Current physical address reflects the physical addresses of the individual mechanism; the Current logical address reflect the logical addresses of the individual mechanism.

After 5 entries are in the RAM area the device moves the entries to the disk. The permanent disk log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The C2201A uses the same log format as the run-time log. The error byte definition is different from the run-time log and is shown below. The number of correctable data errors in the log header for ERTs is a count of all correctables (not recoverable on first retry like the Run-Time log).

The error byte definition is:

7	6	5	4	3	2	1	0

- 1 0 = ECC detected a correctable error
- 0 1 = ECC detected an uncorrectable error
- 1 0 = No error detected
- 1 1 = Pattern not used
- 0 = No error in sector header
- 1 = One or more errors in sector header
- 0 = No errors in sector body
- 1 = One or more errors in sector body
- 0 = No error in the CRC bytes
- 1 = One or more errors in the sector body
- 0 = Parity Error bit disabled
- 1 = Parity Error bit enabled
- 0 = No data underrun/overrun fault
- 1 = Data underrun/overrun fault
- 0 = No error in ECC parity bytes
- 1 = One or more errors in the ECC parity bytes

READ FAULT LOG UTILITY

The general description of this utility is section 9.4.

Below is the log format:

The log header is (number of records):	1 byte
The record format is:	
Current logical cylinder address	2 bytes
Current logical head address	1 byte
Current logical sector address	1 byte
Target logical cylinder address	2 bytes
Target logical head address	1 byte
Target logical sector address	1 byte
Status of internal registers	1 byte
Error byte	1 byte
Error type and activity indicator	1 byte

Two fields in the record format hold special meanings. For the Current Logical Cylinder Address and the Target Logical Cylinder Address, if the upper bit is set to 1, then the value is a physical address rather than a logical address.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current logical addresses and the Target logical addresses reflect the address space of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current logical addresses and the Target logical addresses reflect the logical address space of the individual mechanism. The device initially logs faults and related events in a RAM area. The RAM holds a maximum of 30 entries. The C2201A posts the entries to the device after the command completes. The permanent fault log on the device holds a maximum of 44 entries. Thus, the C2201A can return a maximum of 74 entries to the host. The C2201A uses the same log format as previous CS80 devices. The status definitions of the internal registers error and error type are different. The status of internal registers byte is a collection of bits from the servo register and the endecon register. The purpose of this register is to provide additional information about the Servo and R/W systems when a fault in the data path occurs. If a channel fault occurs, this byte is zero. The bit definitions are shown below.

bit 0	=	Spindle Stopped	(ESDI)
bit 1	=	Data Path Fault	(CTRL)
bit 2	=	Seek Fault	(ESDI)
bit 3	=	Write Protect	(ESDI)
bit 4	=	Write Fault	(ESDI)
bit 5	=	Com/Stat ESDI Fault	(ESDI)
bit 6	=	Com/Stat Ctrl Fault	(CTRL)
bit 7	=	Data Clock Fault	(CTRL)

The conditions under which each bit is set is described below:

Spindle Stopped	: The spindle motor is not up to speed
Data Path Fault	: Power Fail or Write Hold Off
Seek Fault	: Seek failure or drive lost spindle lock
Write Protect	: Write Protected, Fixed Media
Write Fault	: See ESDI standard status documentation

Appendix E

C2204A FLEX SPECIFICS

This appendix shows the FLEX information pertaining only to the C2204A.

DEVICE COMMANDS

LOCATE AND READ

This command is implemented as described in section 4.1.

LOCATE AND WRITE

This command is implemented as described in section 4.2.

SET UNIT

The general description of this command is section 4.3.

The device allows only unit 0H and unit FH. Unit FH implies the controller.

The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.

If the Set Unit command is issued, it must be the first command in the command sequence.

If both the Set Unit command and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.

SET VOLUME

This command is not supported.

SET ADDRESS

This command is implemented as described in section 4.5.

SET LENGTH

This command is implemented as described in section 4.6.

NO OP

This command is implemented as described in section 4.7.

SET MECHANISM

This command is implemented as described in section 4.8.

The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.

If the Set Mechanism command is issued, it must be the first command in the command sequence.

If both the Set Unit command and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.

EXTENDED DESCRIBE

This command is implemented as described in section 4.9.

The Extended Describe tables for C2204A are:

CONTROLLER TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
000E	03	08	00	00

HEADER (seven single byte fields plus one byte pad)

C1	C2	C3	C4	C5	C6	C7	C8

byte fields	Description
C1-C2	Installed Unit byte: 1 bit for each unit (Unit 0 = LSB)

Product	Decimal Values
C2204A	1

byte fields	Description
C3-C4	Maximum instantaneous transfer rate in thousands of bytes per second

Product	Decimal Values
C2204A	5000

byte fields	Description
C5	Controller Type 0 = Integrated single-unit controller 1 = Integrated multi-unit controller 2 = Integrated multi-port controller 3 = Integrated multi-unit, P-Bus only controller 4 = Integrated multi-unit, multi-port controller

Product	Decimal Values
C2204A	2,3

byte fields	Description
C6	Host Port Id (0-7)

byte fields	Description
C7	Number of host ports provided by controller

Product	Decimal Values
C2204A	8

byte fields	Description
C8	Reserved

UNIT & VOLUME TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
0026	04	12	01	0E

HEADER (eighteen single byte fields)

U1	U2	. . .	U18
		. . .	

byte fields	Description
U1	Unit Number

Product	Decimal Values
C2204A	0

byte fields	Description
U2	General Device Type 0 = Fixed Disk 1 = Removable disk or combination 2 = Tape, fixed block size, or random access

Product	Decimal Values
C2204A	0

byte fields	Description
U3-U5	Device Number. Represents actual HP product number; XX XX XY (BCD coded, 2 digits per byte) XXXXX = product number, Y = option

Product	Decimal Values
C2204A	022040

byte fields	Description
U6-U7	Number of bytes per block

Product	Decimal Values
C2204A	256

byte fields	Description
U8	Number of blocks which can be buffered

Product	Decimal Values
C2204A	128

byte fields	Description
U9	Recommended Burst size 0 = burst mode not recommended

Product	Decimal Values
C2204A	0

byte fields	Description
U10-U11	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
C2204A	130

byte fields	Description
U12-U13	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C2204A	1434

byte fields	Description
U14-U15	Optimal retry time in tens of milliseconds

Product	Decimal Values
C2204A	80

byte fields	Description
U16-U17	Access time parameter in tens of milliseconds. (Maximum time from the end of command message text to RTS data or RTR data. Applies to read and write commands only in single host single command environment.)

Product	Decimal Values
C2204A	84

byte fields	Description
U18	Maximum interleave factor

Product	Decimal Values
C2204A	1

RECORD (fourteen single byte fields)

V1	V2	. . .	V14
		. . .	

byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C2204A	2897

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C2204A	15

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C2204A	112

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
C2204A	5239583

byte fields	Description
V13	Current interleave factor

Product	Decimal Values
C2204A	1

byte fields	Description
V14	Volume Number

Product	Decimal Values
C2204A	0

MECHANISM TABLE (one table for each mechanism)

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
001F	05	0D	01	0C

HEADER (thirteen single byte fields)

U1	U2	. . .	U13
		. . .	

byte fields U1 — Description: Mechanism Number/Address

Product	Decimal Values
C2204A	1-2

byte fields U2 — Description:
General Device Type
0 = Fixed Disk
1 = Removable disk or combination
2 = Tape, fixed block size, or random access

Product	Decimal Values
C2204A	0

byte fields U3-U5 — Description:
Device Number. Represents actual HP product number;
XX XX XY (BCD coded, 2 digits per byte)
XXXXX = product number, Y = option
Y = 0 for ESDI; Y = 1 for SCSI

Product	Decimal Values
C2204A	975480

byte fields U6-U7 — Description: Number of bytes per block

Product	Decimal Values
C2204A	256

byte fields U8 — Description: Number of blocks which can be buffered

Product	Decimal Values
C2204A	128

byte fields	Description
U9	Interface Type 0 = ESDI 1 = SCSI

Product	Decimal Values
C2204A	0

byte fields	Description
U10	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
C2204A	130

byte fields	Description
U11-U12	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C2204A	1434

byte fields	Description
U13	Maximum interleave factor

Product	Decimal Values
C2204A	1

RECORD (twelve single byte -fields)

V1	V2	. . .	V12
		. . .	

byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C2204A	1448

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C2204A	15

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C2204A	112

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
C2204A	2619791

INITIALIZE MEDIA

The general description of this command is section 4.10.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

SPARE BLOCK COMMAND

The general description of this command is section 4.11.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

LOCATE AND VERIFY

This command is implemented as described in section 4.12.

INITIATE UTILITY

This command is implemented as described in section 4.13.

INITIATE DIAGNOSTIC

This command is implemented as described in section 4.14.

The only supported diagnostic is self-test, Diagnostic section number zero (0). This command must be directed to the device's controller (unit 15).

REQUEST STATUS

This command is implemented as described in section 4.15.

SET DEVICE LOCK

This command is implemented as described in section 4.16.

DELETE DEVICE LOCK

This command is implemented as described in section 4.17.

SET UNIT LOCK

This command is not supported.

DELETE UNIT LOCK

This command is not supported.

SET NONRESPONDING HOST (NRH) TIMEOUT

This command is implemented as described in section 4.20.

The default value is 65534.

SET HOST TO HOST TIMEOUT

This command is implemented as described in section 4.19.

LOCATE AND FILL

This command is implemented as described in section 4.20.

REBUILD

This command is not supported.

SKIP DRIVE

This command is not supported.

READ RUN-TIME LOG UTILITY

The general description of this utility is section 9.2

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current physical addresses and the Current logical addresses reflect the address space of the logical unit. Thus, the Current physical addresses reflect the physical addresses of the logical unit; the Current logical addresses reflect the logical addresses of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current physical addresses and the Current logical addresses reflect the address space of the individual mechanism. Thus, the Current physical address reflects the physical addresses of the individual mechanism; the Current logical address reflect the logical address of the individual mechanism.

READ ERT LOG UTILITY

The general description of this utility is section 9.3.

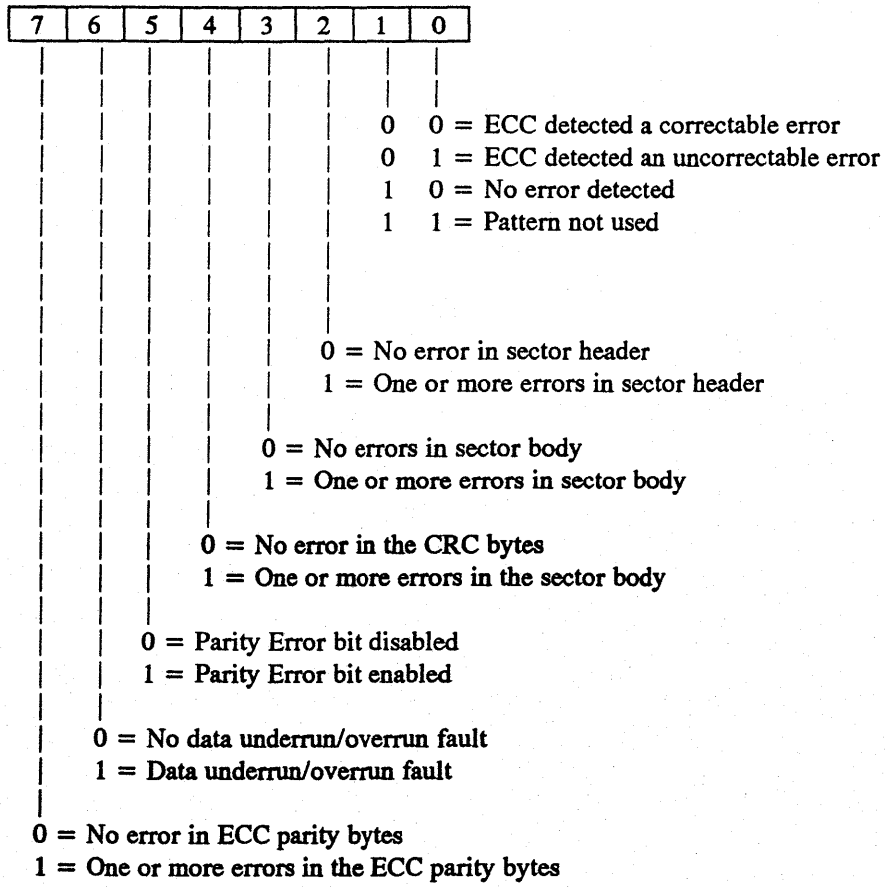
When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current physical addresses and the Current logical addresses reflect the address space of the logical unit.

Thus, the Current physical addresses reflect the physical addresses of the logical unit; the Current logical address reflect the logical addresses of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current physical addresses and the Current logical addresses reflect the address of the individual mechanism. Thus, the Current physical address reflect the physical addresses of the individual mechanism; the Current logical address reflects the logical addresses of the individual mechanism.

After 5 entries are in the RAM area the device moves the entries to the disk. The permanent disk log can hold a maximum of 101 entries. Thus, a maximum of 106 entries can be returned for each head. The C2204A uses the same log format as the run-time log. The error byte definition is different from the run-time log and is shown below. The number of correctable data errors in the log header for ERTs is a count of all correctables (not recoverable on first retry like the Run-Time log).

The error byte definition is:



READ FAULT LOG UTILITY

The general description of this utility is section 9.4.

Below is the log format.

The log header is (number of records):	1 byte

The record format is:

Current logical head address	1 byte
Current logical sector address	1 byte
Target logical cylinder address	2 bytes
Target logical head address	1 byte
Target logical sector address	1 byte
Status of internal registers	1 byte
Error byte	1 byte
Error type and activity indicator	1 byte

Three fields in the record format hold special meanings. For the Two fields in the record format hold special meanings. For the Current Logical Cylinder Address and the Target Logical Cylinder Address, if the upper bit is set to 1, then the value is a physical address rather than a logical address.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current logical addresses and the Target logical addresses reflect the address space of the logical unit

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current logical addresses and the Target logical addresses reflect the logical address space of the individual mechanism. The device initially logs faults and related events in a RAM area. The RAM holds a maximum of 30 entries. The C2204A posts the entries to the device after the command completes. The permanent fault log on the device holds a maximum of 44 entries. Thus, the C2204A can return a maximum of 148 entries to the host. The C2204A uses the same log format as previous CS80 devices. The status definitions of the internal registers error and error type are different. The status of internal registers byte is a collection of bits from the servo register and the endecon register. The purpose of this register is to provide additional information about the Servo and R/W systems when a fault in the data path occurs. If a channel fault occurs, this byte is zero. The bit definitions are shown below.

bit 0	=	Spindle Stopped	(ESDI)
bit 1	=	Data Path Fault	(CTRL)
bit 2	=	Seek Fault	(ESDI)
bit 3	=	Write Protect	(ESDI)
bit 4	=	Write Fault	(ESDI)
bit 5	=	Com/Stat ESDI Fault	(ESDI)
bit 6	=	Com/Stat Ctrl Fault	(CTRL)
bit 7	=	Data Clock Fault	(CTRL)

The conditions under which each bit is set is described below:

Spindle Stopped	: The spindle motor is not up to speed
Data Path Fault	: Power Fail or Write Hold Off
Seek Fault	: Seek failure or drive lost spindle lock
Write Protect	: Write Protected, Fixed Media
Write Fault	: See ESDI standard status documentation
Com/Stat ESDI Fault	: Inter-face Fault or Frame Error or Illegal Command
Com/Stat CTRL Fault	: Port Fault or Frame Error or Command Abort
Data Clock Fault	: TFault or Disk Error (from DMA) No other bits shall be set in this register at the time TFault or Disk Error are set

The last byte, error type, indicates whether an error is a Derror, Terror, event or fault by setting/clearing the last two bits of the 2nd nibble. The first nibble is the activity indicator. The activity indicator gives a number which represents the number of seeks within a range that occurred between faults. The ranges are shown below.

A	A	A	A	0	0	T	L

T (Ty pe)
0 = Event
1 = Fault

L (Location)
0 = Derror
1 = Terror
AAAA

0000 = no seeks
0001 = 1 seek
0010 = 2 seeks
0011 = 3 seeks
0100 = 4 seeks
0101 = 5 to 7 seeks
0110 = 8 to 200 seeks
0111 = 201 to 2,000 seeks
1000 = 2,001 to 12,000 seeks
1001 = 12,001 to 25,000 seeks
1010 = 25,001 to 150,000 seeks
1011 = 150,001 to 600,000 seeks
1100 = 600,001 to 4,000,000 seeks
1101 = 4,000,001 to 16,000,000 seeks
1110 = 16,000,001 to 1,000,000,000 seeks
1111 = > 1,000,000,000 seeks

Current Logical Cylinder Address and the Target Logical Cylinder Address, if the upper bit is set to 1, then the value is a physical address rather than a logical address.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. When this command operates on the logical unit, the Current physical addresses and the Current logical addresses reflect the address

spare of the logical unit. Thus, the Current physical addresses reflect the physical addresses of the logical unit; the Current logical address reflects the logical addresses of the logical unit.

This command operates on an individual mechanism when the Set Mechanism command is employed. When this command operates on a mechanism, the Current physical addresses and the Current logical addresses reflect the address space of the individual mechanism. Thus, the Current physical address reflects the physical addresses of the individual mechanism; the Current logical address reflect the logical addresses of the individual mechanism.

CLEAR LOGS UTILITY

This utility is implemented as described in section 9.5.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

ERROR RATE TESTS

The general description of this utility is section 9.6.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed. The ERT will be performed over the logical address space of the individual mechanism.

Random ERT and Random Read Only ERT tests operate as follows. For every loop requested (in the loop count parameter), the device will perform a write (if requested) then read error rate test on 256 random sectors. Thus, if loop count =1, 256 tests are performed. If loop count =2, then 512 tests are performed, etc.

BUTTERFLY SEEK UTILITY

The general description of this utility is section 9.7.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. Each mechanism within the unit will be exercised independently.

The command operates on a specific mechanism when the Set Mechanism command is employed.

PRESET DRIVE UTILITY

The general description of this utility is section 9.8.

READ REVISION NUMBERS

The general description of this utility is section 9.9.

The execution message is formatted as follows.

Header - 1 Byte
Number of revision number bytes following

Body - 1 Byte (repeated for each Revision Number needed)
Revision Number

The format of the Body is:

Byte	C2204A ROM
1	Firmware
2	Firmware
3	Firmware
4	Firmware
5	ESDI I unit
6	ESDI II unit

DIAGNOSTIC READ UTILITY

The general description of this utility is section 9.10.

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

When the Set Unit command is used, this utility exercises one mechanism within the selected unit. When the Set Mechanism command is used, this utility exercises the specific mechanism.

DIAGNOSTIC WRITE UTILITY

The general description of this utility is section 9.11.

The maximum bytes of reserved area is 16,384 bytes. The Length must be 0 to 16,384.

When the Set Unit command is used, this utility exercises one mechanism within the selected unit. When the Set Mechanism command is used, this utility exercises the specific mechanism.

REBUILD STATUS

This command is not supported.

FIRMWARE UPGRADE

This command is not supported.

The general description of this utility is section 9.17.

The Parameter values are as follows:

Cylinder number of target has Logical values 0-2897.

Head number of target has Logical values 0-15.

Sector number of target has Physical values 0-113.

When the unit number is set to 00H, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. The logical addressing of the unit and the physical addressing of the unit will be supported for this unit.

The command operates on a specific mechanism when the Set Mechanism command is employed, and addressing is mechanism specific.

Appendix F

C225X FLEX SPECIFICS

This appendix shows the FLEX information pertaining only to the C225X.

DEVICE COMMANDS

LOCATE AND READ

This command is implemented as described in section 4.1.

LOCATE AND WRITE

This command is implemented as described in section 4.2.

SET UNIT

This general description of this command is section 4.3.

For Independent C225X, units 0H through EH indicate the logical units, while unit FH indicates the controller.

For Striped C225X, units 0H through 2H indicate the logical units, while unit FH indicates the controller.

For Two-Plus-Two C225X, units 0H through 5H indicate the logical units, while unit FH indicates the controller.

The Set Unit command and the Set Mechanism command are mutually exclusive. Only one of these two commands may exist in the command sequence.

If the Set Unit command is issued, it must be the first command in the command sequence.

If both the Set Unit and the Set Mechanism command are absent in the command sequence, a Set Unit command will be supplied for the transaction. This supplied Set Unit command will assume the value of the most recently issued Set Unit command.

SET VOLUME

This command is not supported.

SET ADDRESS

This command is implemented as described in section 4.5.

SET LENGTH

This command is implemented as described in section 4.6.

NO OP

This command is implemented as described in section 4.7.

SET MECHANISM

This command is supported as described in section 4.8. Only mechanism numbers 00H through 0FH are allowed. Mechanism 0FH indicates the controller.

EXTENDED DESCRIBE

This command is implemented as described in section 4.9.

The Extended Describe tables for C225X are:

CONTROLLER TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
0016	03	10	00	00

HEADER (seven single byte fields plus one byte pad)

C1	C2	C3	C4	C5	C6	C7	C8

C9	C10	C11	C12	C13	C14	C15	C16

byte fields	Description
C1-C2	Installed Unit byte: 1 bit for each unit (Unit 0 = LSB)

Product	Decimal Values
C225X, striped	1-3
C225X, independent	1-32767
C225X, 2+2	1-63

byte fields	Description
C3-C4	Maximum instantaneous transfer rate in thousands of bytes per second

Product	Decimal Values
C225X, striped	5000
C225X, independent	5000
C225X, 2+2	5000

byte fields	Description
C5	Controller Type 0 = Integrated single-unit controller 1 = Integrated multi-unit controller 2 = Integrated multi-port controller 3 = Integrated multi-unit, P-Bus only controller 4 = Integrated multi-unit, multi-port controller

Product	Decimal Values
C225X, striped	2,4
C225X, independent	3
C225X, 2+2	3

byte fields	Description
C6	Host Port Id (0-7)

byte fields	Description
C7	Number of host ports provided by controller

Product	Decimal Values
C225X, striped	8
C225X, independent	8
C225X, 2+2	8

byte fields	Description
C8	Controller Mode 0 = Single integrated controller/unit 1 = Independent 2 = Two-plus-two 3 = One with Parity 4 = Two striped 5 = Two with Parity 6 = Four striped 7 = Four with Parity

Product	Decimal Values
C225X, striped	3, 4, 5, 6, or 7
C225X, independent	1
C225X, 2+2	2

byte fields	Description
C9-C11	Controller Number. Represents an actual HP product number; XX XX XY (2 digits per bytes) XXXXX = product number; Y=option

Product	Decimal Values
C225X, striped	022500
C225X, independent	022500
C225X, 2+2	022500

byte fields	Description
C12-C15	Controller Specific Information

Product	Decimal Values
C225X, striped	Contents of board settings, set at power-on
C225X, independent	Contents of board settings, set at power-on
C225X, 2+2	Contents of board settings, set at power-on

byte fields	Description
C16	Reserved

UNIT & VOLUME TABLE

TABLE DESCRIPTOR (values in hex format)

Table size	type	hdr size	# rec	rec size
0026	04	12	01	0E

HEADER (eighteen single byte fields)

U1	U2	. . .	U18
		. . .	

byte fields	Description
U1	Unit Number

Product	Decimal Values
C225X, striped	0-2
C225X, independent	0-14
C225X, 2+2	0-5

byte fields	Description
U2	General Device Type 0 = Fixed Disk 1 = Removable disk or combination 2 = Tape, fixed block size, or random access

Product	Decimal Values
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

byte fields	Description
U3-U5	Device Number. Represents actual HP product number; XX XX XY (2 digits per byte) XXXXX = product number, Y = option

Product	Decimal Values
C225X, striped	022510
C225X, independent	022510
C225X, 2+2	022510

byte fields	Description
U6-U7	Number of bytes per block

Product	Decimal Values
C225X, striped	512, 1024, or 2048
C225X, independent	512
C225X, 2+2	1024

byte fields	Description
U8	Number of blocks which can be buffered

Product	Decimal Values
C225X, striped	112
C225X, independent	112
C225X, 2+2	112

byte fields	Description
U9	Recommended burst size (0 = burst mode not recommended)

Product	Decimal Values
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

byte fields	Description
U10-U11	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
C225X, striped	210
C225X, independent	210
C225X, 2+2	210

byte fields	Description
U12-U13	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C225X, striped	5000
C225X, independent	1598
C225X, 2+2	3196

byte fields	Description
U14-U15	Optimal retry time in tens of milliseconds

Product	Decimal Values
C225X, striped	80
C225X, independent	80
C225X, 2+2	80

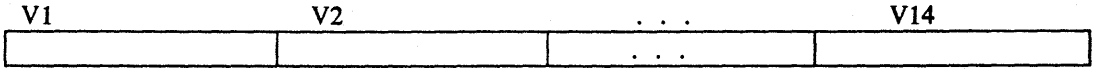
byte fields	Description
U16-U17	Access time parameter in tens of milliseconds. (Maximum time from the end of command message text to RTS data or RTR data. Applies to read and write commands only in single host single command environment.)

Product	Decimal Values
C225X, striped	84
C225X, independent	84
C225X, 2+2	84

byte fields	Description
U18	Maximum interleave factor

Product	Decimal Values
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

RECORD (fourteen single byte fields)



byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C225X, striped	1934
C225X, independent	1934
C225X, 2+2	1934

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C225X, striped	18
C225X, independent	18
C225X, 2+2	18

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C225X, striped	71
C225X, independent	71
C225X, 2+2	71

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
C225X, striped	2647079
C225X, independent	2647079
C225X, 2+2	2647079

byte fields	Description
V13	Current interleave factor

Product	Decimal Values
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

byte fields	Description
V14	Volume number

Product	Decimal Values
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

MECHANISM TABLE

TABLE DESCRIPTOR (values in hex format) FOR C225X

Table size	type	hdr size	# rec	rec size
0021	06	0F	01	0C

HEADER (fifteen single byte fields)

U1	U2	. . .	U15
		. . .	

byte fields	Description
U1	Mechanism Number/Address

Product	Decimal Values
C225X, striped	0-14
C225X, independent	0-14
C225X, 2+2	0-3, 5-8, 10-13

byte fields	Description
U2	General Device Type 0 = Fixed Disk 1 = Removable disk or combination 2 = Tape, fixed block size, or random access

Product	Decimal Values
C225X, striped	0
C225X, independent	0
C225X, 2+2	0

byte fields	Description
U3-U5	Device Number. Represents actual HP product number; XX XX XY (BCD coded, 2 digits per byte) XXXXX = product number, Y = option Y = 0 for ESDI; Y = 1 for SCSI

Product	Decimal Values
C225X, striped	022511
C225X, independent	022511
C225X, 2+2	022511

byte fields	Description
U6-U7	Number of bytes per block

Product	Decimal Values
C225X, striped	512
C225X, independent	512
C225X, 2+2	512

byte fields	Description
U8	Number of blocks which can be buffered

Product	Decimal Values
C225X, striped	112
C225X, independent	112
C225X, 2+2	112

byte fields	Description
U9	Interface Type 0 = ESDI 1 = SCSI

Product	Decimal Values
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

byte fields	Description
U10-U11	Block Time in microseconds (Time is from beginning of one block to beginning of next.)

Product	Decimal Values
C225X, striped	210
C225X, independent	210
C225X, 2+2	210

byte fields	Description
U12-U13	Continuous average transfer rate for long (full volume) transfers in thousands of bytes per second

Product	Decimal Values
C225X, striped	5000
C225X, independent	1598
C225X, 2+2	3196

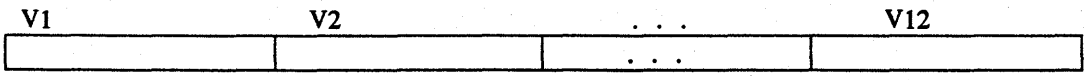
byte fields	Description
U14	Maximum interleave factor

Product	Decimal Values
C225X, striped	1
C225X, independent	1
C225X, 2+2	1

byte fields	Description
U15	Mechanism status 0 = Good 1 = Being Rebuilt 2 = Non-operational 3 = Unassigned (not broke, but not a member of a logical unit)

Product	Decimal Values
C225X, striped	Set at power-on
C225X, independent	Set at power-on
C225X, 2+2	Set at power-on

RECORD (twelve single byte fields)



byte fields	Description
V1-V3	Maximum value of cylinder address vector

Product	Decimal Values
C225X, striped	1934
C225X, independent	1934
C225X, 2+2	1934

byte fields	Description
V4	Maximum value of head address vector

Product	Decimal Values
C225X, striped	18
C225X, independent	18
C225X, 2+2	18

byte fields	Description
V5-V6	Maximum value of sector address vector

Product	Decimal Values
C225X, striped	71
C225X, independent	71
C225X, 2+2	71

byte fields	Description
V7-V12	Maximum value of single-vector address

Product	Decimal Values
C225X, striped	2647079
C225X, independent	2647079
C225X, 2+2	2647079

INITIALIZE MEDIA

The general description of this command is section 4.10.

The 02H PARAM 1 value is not allowed.

When the unit number is set to 00H through 0EH then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed.

SPARE BLOCK

This command is implemented as described in section 4.11.

This command is not valid for the controller.

Independent C225X:

This command is implemented as described in the general description.

Striped C22SX, Two-plus-two C22SX:

When a Set Unit 00H through 0EH is issued, and an unrecoverable read was previously detected, the Spare Block command will spare the individual mechanism that reported the unrecoverable read.

When a Set Unit 00H through 0EH is issued, and no unrecoverable read has been detected, the Spare Block command will spare all the mechanisms in the unit.

When a Set Mechanism 00H through 0EH is issued, the individual mechanism is spared.

Parity C225X:

When a Set Unit 00H through 0EH is issued, and an unrecoverable read was previously detected, the Spare Block command will spare the individual mechanism that reported the unrecoverable read. Following the spare, C225X will recover the data for the individual mechanism that was spared. In order to recover the mechanism data, no skip drive can exist.

When a Set Unit 00H through 0EH is issued, and no unrecoverable read has been detected, the Spare Block command will spare all the mechanisms in the unit.

When a Set Mechanism 00H through 0EH is issued, the individual mechanism is spared.

LOCATE AND VERIFY

This command is implemented as described in section 4.12.

INITIATE UTILITY

This command is implemented as described in section 4.13.

INITIATE DIAGNOSTIC

This command is implemented as described in section 4.14.

The only supported diagnostic is self-test, Diagnostic section number zero (0). This command is allowed for all units (0-14) and for the controller (unit 15).

Diagnostics issued to the controller (unit 15) perform as described.

Diagnostics issued to units 0-14 perform mechanism self-tests to each mechanism of the unit.

REQUEST STATUS

This command is implemented as described in section 4.15.

SET DEVICE LOCK

This command is implemented as described in section 4.16. Additionally, this command is considered an invalid request if any Unit Lock exists.

DELETE DEVICE LOCK

This command is implemented as described in section 4.17. Additionally, this command is considered an invalid request if any Unit Lock exists.

SET UNIT LOCK

This command is implemented as described in section 4.18. Additionally, this command is considered an invalid request if any Device Locks exist.

DELETE UNIT LOCK

This command is implemented as described in section 4.19. Additionally, this command is considered an invalid request if any Device Locks exist.

SET NONRESPONDING HOST TIMEOUT

This command is implemented as described in section 4.20.

The device uses the NRH timeout command to set the longest time allotted for any command. If the NRH timeout command is not included in the command message, the value will be determined by the power-on or last set value. The power-on value is 65534(10.92 minutes). The maximum value is 65535, indicating 60 minutes.

When this command is included in the command message of a Real Time command, only the Real Time command will be affected by the NRH timeout value.

SET HOST TO HOST TIMEOUT

This command is implemented as described in section 4.21.

The device uses the HTH timeout command to set the longest time allotted for any HTH command. If the HTH timeout command is not included in the command message, the value will be determined by the power-on or last set value. The power-on value is 65534 (10.92 minutes). The maximum value is 65535, indicating 60 minutes.

When this command is included in the command message of a Real Time command, only the Real Time command will be affected by the HTH timeout value issued.

LOCATE AND FILL

This command is implemented as described in section 4.22.

DIRECTED POST

The general description for this command is section 4.23.

This command is supported as described in the general description. The Set Volume and Directed Volume complementary commands cannot be used to describe the C225X device. Data transfers are not allowed within the same unit. Data transfers are not allowed within the same module.

DIRECTED FETCH

The general description for this command is section 4.24.

This command is supported as described in the general description. The Set Volume and Directed Volume complementary commands cannot be used to describe the C225X device. Data transfers are not allowed within the same unit. Data transfers are not allowed within the same module.

DIRECTED BUS ID

This command is implemented as described in section 4.25.

DIRECTED UNIT

This command is implemented as described in section 4.26.

DIRECTED VOLUME

The general description of this command is section 4.27.

This command is implemented as described in the general description. This command cannot be used to identify a C225X device.

DIRECTED ADDRESS

This command is implemented as described in section 4.28.

REBUILD

This command is implemented as described in section 4.29.

The C225X must recognize a drive missing from a parity set.

The command validates the mechanism can be rebuilt when the Set Mechanism command is employed.

This command validates the unit has a mechanism that can be rebuilt when the Set Unit command is employed.

The default unit is used when neither a Set Mechanism or Set Unit command accompanies this command. This command validates the default unit has a mechanism that can be rebuilt.

There is no execution message with the Rebuild command. An immediate report is issued. To determine when a Rebuild has completed, the Rebuild Status utility in conjunction with Extended Describe must be used.

SKIP DRIVE

This command is implemented as described in section 4.30. Once a skip drive is set, it can only be accessed via Set Mechanism commands.

UTILITIES

READ DRIVE TABLES UTILITY

The general description of this utility is section 9.1.

The C225X implements only the Spare Track table of the Read Drive Tables Utility. A parameter bounds error occurs if other table numbers are sent.

When the unit number is set to 00H through 0EH, then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed. The Scalar Spare number is always zero (0).

READ RUN-TIME LOG UTILITY

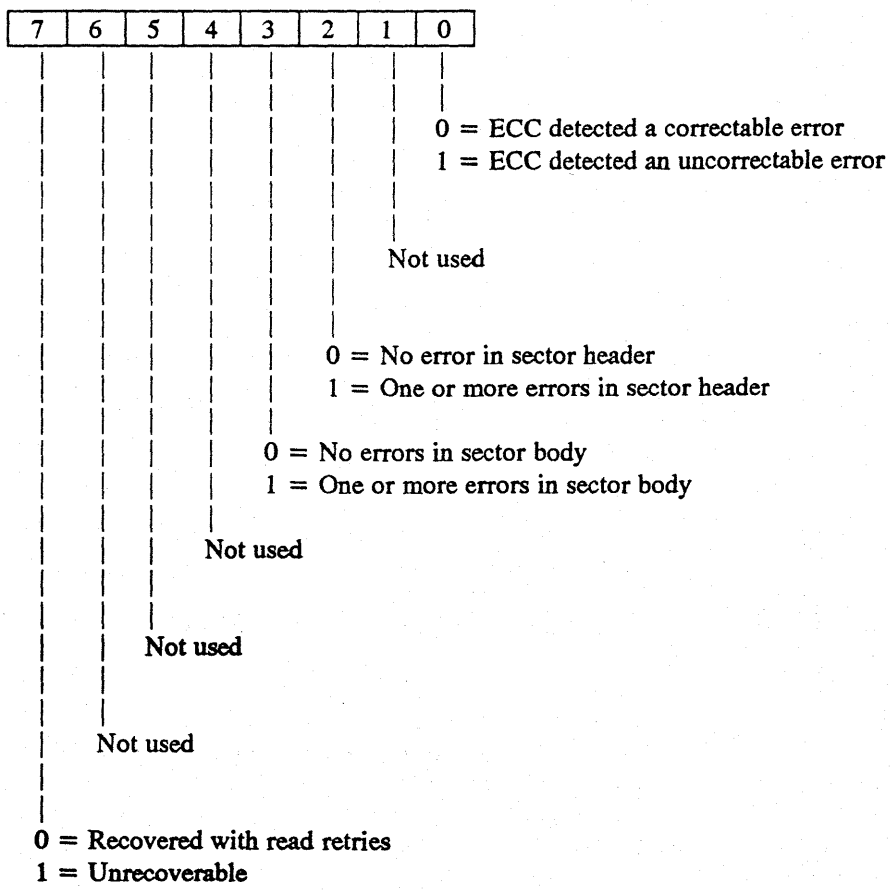
The general description of this utility is section 9.2

This command is allowed for units 0-14 and for mechanisms 0-14. This command is not allowed for the controller (unit 15).

The Number of Sectors Read is not head specific. Instead, the Number of Sectors Read indicates the total number of errors read on a mechanism.

The Number of correctable errors and the Number of uncorrectable errors are head specific, but their value indicates a summation of all mechanisms of the unit.

The Physical Cylinder, Physical Head and Physical Sector values are actually Logical values. The error byte definition is:



READ ERT LOG UTILITY

This command is not supported.

READ FAULT LOG UTILITY

The general description of this utility is section 9.4.

This command is valid for all units (0-14) and the controller (unit 15). This command is allowed for all mechanisms, too.

When a unit 0-14 is specified, all logs from the mechanisms of the unit are returned along with any RAM log entries for the unit and any RAM log entries that are device wide.

When a mechanism is specified, all logs from the specific mechanism are returned along with any RAM log entries for the mechanism and any RAM log entries that are device wide.

When the controller (unit 15) is specified, only RAM log entries that are device wide are returned. Below is the log format.

The	log header is:	
	Number or records	1 byte
	Number of seconds since power on	4 bytes
The	record format is:	
	Logical Address of the error	4 bytes
	Mechanism and Unit number	1 byte
	Information Bytes	4 bytes
	Derror Number	1 byte
	Time when Error Occurred	4 bytes
	Activity Indicator	1 byte

The record fields are used as follows:

Logical Address of the error	The address relevant to the error. If there is no associated address with the error, this field has all bits set (FFFFFFFFH).
Mechanism and Unit number	A two-nibble value indicating the mechanism and unit where the error occurred. The upper nibble indicates a mechanism. The lower nibble indicates a unit. A nibble of all ones (FH) indicates unknown mechanism or unit. If both nibbles are all ones (FFH), this error occurred on the controller.
Information Bytes	Additional information bytes associated with the Derror.
Derror Number	Number indicating specific error.
Time when Error Occurred	Time that this error occurred expressed in seconds since the controller was powered on.
Activity Indicator	A value indicating the number of seeks that occurred between faults.

The range of the activity indicator fields is a follows:

0 = No Accesses
1 = 1 to 2 seeks
2 = 2 to 10 seeks
3 = 11 to 100 seeks
4 = 101 to 1000 seeks
5 = 1001 to 10,000 seeks
6 = 10,001 to 100,000 seeks
7 = 100,001 to 500,000 seeks
8 = 500,001 to 1,000,000 seeks
9 = 1,000,001 to 5,000,000 seeks
A = 5,000,001 to 10,000,000 seeks
B = 10,000,001 to 50,000,000 seeks
C = 50,000,001 to 100,000,000 seeks
D = 100,000,001 to 500,000,000 seeks
E = 500,000,001 to 1,000,000,000 seeks
F = greater than 1,000,000,000 seeks

CLEAR LOGS UTILITY

This general description of this utility is section 9.5.

This command is allowed for all units (0-14) and the controller (unit 15). This command is allowed for all mechanisms, too.

When a unit 0-14 is specified, all logs from the mechanisms of the unit are cleared, as are any RAM log entries for the unit.

When a mechanism is specified, all logs from the specific mechanism are cleared, as are any RAM log entries for the mechanism.

When the controller (unit 15) is specified, only RAM log entries that are device wide are cleared.

ERROR RATE TESTS

The general description of this utility is section 9.6.

When the unit number is set to 00H through 0EH, then this command operates on the selected unit This command is not valid for logical unit 0FH, the controller.

The command operates on a specific mechanism when the Set Mechanism command is employed. The ERT will be performed over the logical address spare of the individual mechanism.

Random ERT and Random Read Only ERT tests operate as follows. For every loop requested (in the loop count parameter), the device will perform a write (if requested) then read error rate test on 256 random sectors. Thus, if loop count = 1, then 256 tests are performed. If loop count - 2, then 512 tests are performed, etc.

BUTTERFLY SEEK UTILITY

The general description of this utility is section 9.7.

When the unit number is set to 00H through 0EH then this command operates on the selected unit. This command is not valid for logical unit 0FH, the controller. Each mechanism within the unit will be exercised independently.

The command operates on a specific mechanism when the Set Mechanism command is employed.

PRESET DRIVE UTILITY

This command is not supported.

READ REVISION NUMBERS

The general description of this utility is section 9.9.

The execution message is formatted as follows.

Header - 2 Bytes
- Byte 1 - Number of Body Tables following
- Byte 2 - Number of revision number bytes in each Body Table

Mechanism Body Table - 44 Bytes
- Bytes 0-3 - Product Revision Number (ASCII)
- Bytes 4-13 - Product Serial Number (ASCII)
- Bytes 14-23 - HDA Serial Number
- Bytes 24-33 - SCSI Firmware Revision Number
- Bytes 34-43 - ESDI Firmware Revision Number

Controller Body Table - 2 Bytes
- Byte 1 - Firmware Revision Number
- Byte 2 - Board Revision Number

The Header and Controller Body Table are given when a Set Unit 15 accompanies the Read Revision Number command.

The Header and Mechanism Body Tables are given when a Set Unit 0-14 accompanies the Read Revision Number command. The Mechanism Body Tables are given in ascending mechanism number order for the unit.

The Header and Mechanism Body Table are given when a Set Mechanism accompanies the Read Revision Number command.

DIAGNOSTIC READ UTILITY

This command is not supported.

DIAGNOSTIC WRITE UTILITY

This command is not supported.

REBUILD STATUS

This command is implemented as described in section 9.12.

FIRMWARE UPGRADE

This command is implemented as described in section 9.13.

READ FULL SECTOR

This utility is supported as described in section 9.17.

This command must be issued with a Set Mechanism command preceding it.