DOCUMENT INFORMATION

This page provides a sequential record of changes for a multi-page drawing. Each "Revision Description" shall also include the appropriate step number(s). (The term "Extensive Changes" may be entered if the loss of history is acceptable). All pages of this drawing shall carry the same revision letter as shown on this page.

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SPECIFICATION CONTROL DRAWING
FIRST ISSUE
INTERNAL USE ONLY

HEWLETT PACKARD

CS80 INSTRUCTION SET

Programming Manual

HP C2200A/C2202A/C2203A

CS80 INSTRUCTION SET

Programming Manual

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PREFACE

The following sections have been changed since the HP7937 manual.

Section 4.18 - INITIALIZE MEDIA

Section 6.11 - 6.16 NEW UTILITIES

CONTENTS

CONTENTS (continued)

RELATED DOCUMENTS

SECTION 1

CS/80 INSTRUCTION SET Programming Manual, Hewlett-Packard, JUL 1982

INTRODUCTION

SECTION 2

This document is essentially a re-write of the CS/80 instruction set programming manual, as it applies specifically to the HP C2200A/C2202A/C2203A disk drive.

CS/80 extensions, not covered in the programming manual, are addressed here.

COMMUNICATION SYSTEM MODEL

SECTION 3

A general description of the communications system model for the HP C2200A/C2202A/C2203A can be found in the CS/80 INSTRUCTION SET Programming Manual (see Related Documents).

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 MESSAGES

There are three message types which occur in a normal transaction:

1) Command messages which contain the HP C2200A/C2202A/C2203A operating commands

2) Execution messages which transfer data

3) Reporting messages which contain the one-byte pass/fail status (QSTAT) of the transaction.

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

3.1.1 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 up to 1024 bytes.

3.1.2 Execution Messages

Execution messages are initiated by the drive unless an execution message has already been established by the host.
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) Detailed Status Report

4) Diagnostic Information

Execution messages are valid only during the execution phase of a transaction which started with a command which calls for an execution message.

The host may cause execution messages to be broken into bursts of smaller messages of uniform length by setting a non-zero burst size.

3.1.3 Reporting Messages

The device initiates reporting messages during:

1) The reporting phase of each transaction

2) Special reporting phases entered for power recovery

3) The service of internal requests

All reporting messages consist of one byte of status information transmitted from the drive to the host. This byte contains the QSTAT pass/fail indication tagged with a message terminator (EOI on HP-IB). The QSTAT byte always reflects the information currently contained in the status report. The only means of clearing the QSTAT byte is by (the host) issuing the Request Status command or the Clear command.

The QSTAT byte indicates one of three conditions relating to the current transaction:

1) Normal Completion. The requested operation was completed without error.

2) Hard Error. Error information is available. The host must issue a Request Status command to determine complete transaction status.

3) Power On. The device has just returned from a power failure or some form of operator intervention. Any incomplete transactions were aborted and should be repeated. The host must reconfigure any programmable operating parameters because they have returned to their power-on values.

3.1.4 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.

Interface testing includes Read and Write loopback.

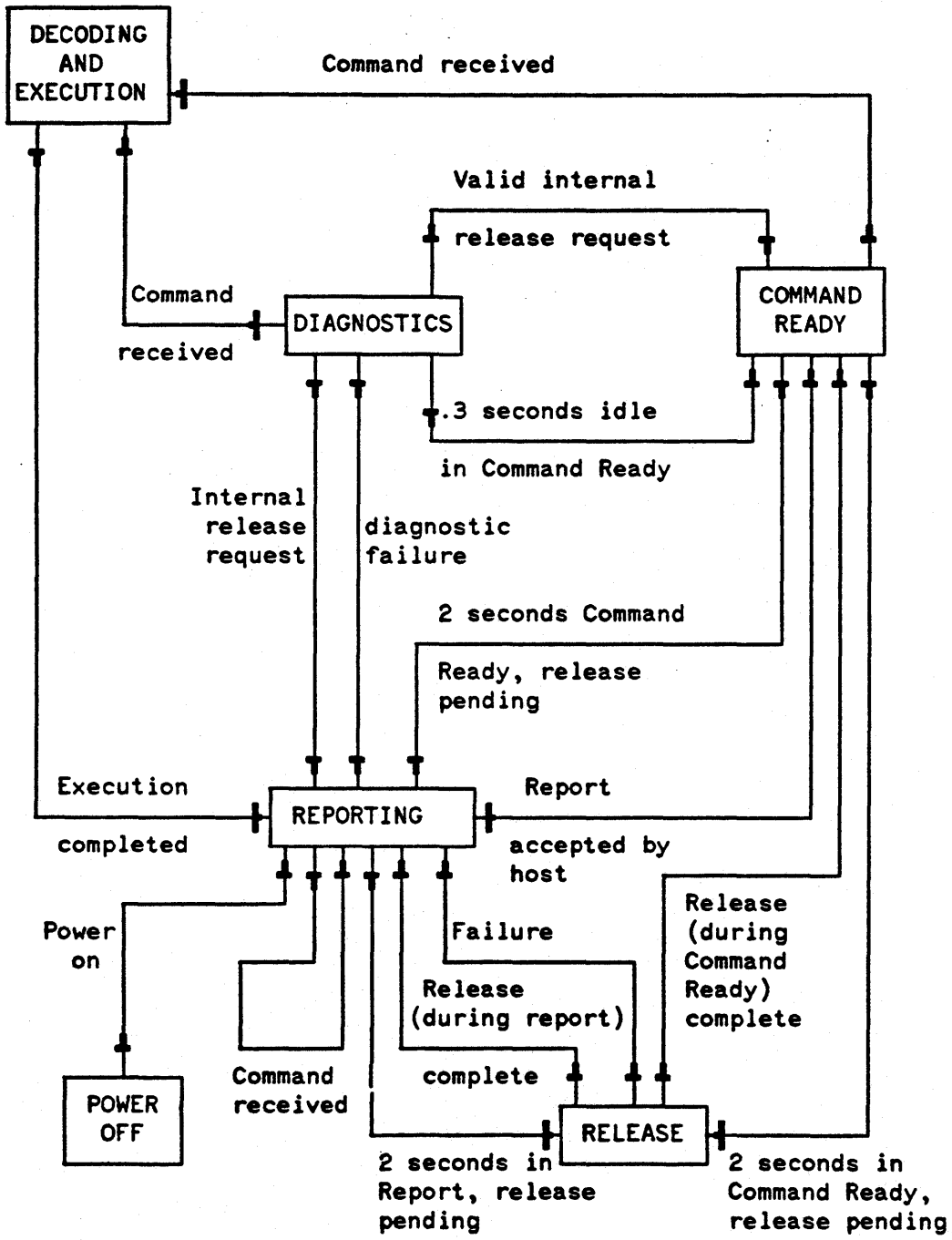
Transparent messages may be initiated by either host or device, and they can be transmitted in either direction. The first byte of the text may be an operating code (opcode) which indicates the purpose of the message. The format of the remainder of the message is a function of the first byte.

3.2 DEVICE OPERATION AND TRANSACTION SEQUENCE RELATIONSHIP

When it is idle, the drive 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 drive enters the execution state and begins to carry out the command. If not, the drive enters the reporting state and prepares an error status report.

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 (via the parallel poll on HP-IB) from the host. The execution message is not required for transactions which do not involve a transfer of information. When the requested operation is complete, the drive computes the status of the operation, enters the reporting state, prepares the status reports, and requests a reporting message from the host. The device supplies a one-byte status report (QSTAT) to the host as the text of a reporting message.

DEVICE OPERATING STATE DIAGRAM



3.3 POWER ON SEQUENCE

The following power-on sequence will be executed:

1) The drive executes its power-on diagnostic

2) A status report is created

3) The drive enters an interlock reporting state

The drive will remain in this interlock reporting state until the host accepts the reporting message or issues the Clear command. A Set Unit command will be executed, but if the host sends any other command, the drive will only accept (not execute) the command. The resultant reporting message will indicate that the drive is still in the power-on state.

If a power-on diagnostic failure has occurred, the status report will not be cleared by the Clear command. The host will see the diagnostic failure in the first reporting message returned by the failing drive.

3.4 BACKGROUND DIAGNOSTICS

Background diagnostics are initiated 0.3 seconds after entering the command-ready state, unless a diagnostic failure has occurred or release is pending. A release must be dealt with before the background diagnostics can begin. Once begun, the drive will continue to run the diagnostics until a failure occurs, an internal request for release is detected, or the host issues a command to the drive. A command will cause the drive to abort the background diagnostic and begin execution of the command. This prevents the background diagnostic from interfering with normal channel communications. An internal release request will cause the diagnostics to abort and will start the proper release sequence.

If a failure occurs during the background diagnostic, the drive will:

1) Set the Diagnostic Result bit in the status report

2) Set a hard error into the QSTAT byte (QSTAT=1)

3) Enter an interlock reporting state

Once in the interlock reporting state, the drive will not execute any commands issued by the host until the diagnostic failure has been reported. The host must accept the reporting message and then issue the Request Status command. This is the only way that the host can clear the status report. The Clear Command will not clear a diagnostic failure.

Diagnostic results are held in non-volatile memory and a drive which suffers power loss after failing its diagnostic will still be failed when power is restored.

3.5 RELEASE SEQUENCE

The drive will need to go offline in order to respond to the following needs:

1) Error logging routine

2) Auto sparing routine

The release sequence can be initiated by the host via the Release command or, if so configured, the drive can release itself in the following ways:

1) Drive is two seconds in Command Ready state AND a release is pending AND auto release is enabled.

2) Drive is two seconds in Reporting state (normal or unsolicited) AND (a release is pending OR an internal release request is detected) AND release timeout is enabled.

When a request for release is pending, the appropriate Release Request bit will be sent in the drive's status message. In addition, the drive unit number will be placed in the parameter field of the status message, providing this field is not needed by a higher priority error. This ensures that the host will see all release requests during the reporting phase (QSTAT=1).

Power may be lost before the drive can be released. When the drive powers up, it will not request release until after the power-on diagnostics have run. However, the drive will request release during the interlock reporting phase.

The exception to this sequence occurs during automatic release; when automatic release is enabled the drive will never request release from the host.

With automatic release enabled and release pending when the Command Ready state is entered, the drive will wait two seconds before releasing itself. If the host issues a command during this interval the command will be executed and the automatic release will not occur. Although the release did not occur, the drive will remember the request and the first time the two-second interval elapses without a command from the host the drive will release itself.

Power may be lost before the drive can release itself. When the drive powers up, it will not attempt to release itself until after it has entered the Command Ready state.

If release timeout is enabled and an internal requirement occurs during background diagnostics, the drive:

1) Aborts background diagnostics

2) Sets the Release Request bit in the status message

3) Goes to the Reporting state

4) Starts the internal timeout clock

5) Requests a reporting message

This sequence puts the drive in an unsolicited reporting state, that is, a reporting state that is not part of a transaction. If the host accepts the reporting message, the hard error QSTAT should cause the host to respond with a Request Status command. The status message will alert the host to the request so the host should release the drive if possible; if not, the host should issue the Release Denied command. If the host does not respond to the unsolicited report before the timeout clock expires, the drive will release itself.

If release timeout is enabled and release is pending when the Command Ready state is entered, the procedure is similar to that described in the preceding paragraph; the only exception being a two-second wait in Command Ready before going to unsolicited Report. During this interval the drive will accept commands from the host and, if possible, execute them. If the host issues a command which cannot be executed because it involves of the needed release, the command will be aborted and the drive will return a status of release required. This informs the host that the release is no longer simply a request and that the command cannot be executed until the drive is released and serviced.

Once the drive has entered the unsolicited Reporting state, commands will no longer be accepted from the host. If the host attempts to send a command, it will fail and a Retransmit error will result. The drive will remain in the unsolicited Reporting state until the host accepts the reporting message or the timeout clock expires. If the host accepts the reporting message, the drive will go to the Command Ready state with release pending. If the timeout clock is disabled, the drive will remain in unsolicited Report until the host accepts the reporting message. The host can clear the release request by issuing the Release Denied command or the Clear command.

When release timeout is enabled, release can also occur during a normal reporting state, that is, a report that occurred as a part of a transaction. If the drive enters Report with release pending and timeout enabled, the host must accept the report within two seconds or release will occur. If the drive is in normal report and an internal release request occurs, the drive will begin its two-second wait. The host must accept the report during this interval or the drive will release itself.

Once the drive has been released and the requirement has been serviced, the drive will return in either the Reporting or Command Ready state; reporting if the release occurred during a normal report or a failure occurred while the drive was released; Command Ready if the release occurred during an unsolicited report or the Command Ready state. Any attempt by the host to communicate with the drive while it is released will result in a Retransmit error when the drive returns. This informs the host that the attempted transaction failed and should be retried.

4.1 LOCATE AND READ

FUNCTION:

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

COMMAND FORMAT:

OPCODE (00H)

DESCRIPTION:

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

First the drive locates the data indicated by the target address and performs its error correction function. A failure of any operation up to this point terminates the transaction leaving it in the reporting phase. Once the data is accessible to the host, the drive requests an execution message. If RPS (Rotational Position Sensing) is enabled, the window size and position relative to the target sector are used to determine when to assert and de-assert requests for messages. 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 Burst mode is enabled, another link is requested when the next burst is available. (RPS is not effective in the burst mode.)

If a data error is encountered in the course of the transfer, the drive is allowed to attempt correction for an interval specified in the Set Retry Time (Complementary) command. If the data is unrecoverable, the drive 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 status report returned by a Request Status command.

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 drive will return a single byte (QSTAT=1) tagged with the message terminator (EOI on HP-IB). The Drive will continue to return this single byte until the host enters the reporting phase of the transaction.

4.2 COLD LOAD READ

FUNCTION:

Used by a host system to bootstrap itself into a higher operating environment from a more primitive state.

COMMAND FORMAT:

OPCODE (0AH)

DESCRIPTION:

Cold Load Read is part of the following unique channel sequence:

Clear: Wait for message request: Clear: Send Cold Load Read

The Clear command ensures that the device Complementary command parameters are all in the initial (power-on) states, and the device is in the command-ready state.

The operation of the Cold Load Read is identical to the operation of the Locate and Read command.

4.3 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 (02H)

DESCRIPTION:

This command is the only means available to write data from the host onto the disk media. The opcode is validated during the command phase. 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. The address is specified by the Target Address. Using any RPS or burst mode settings, the drive determines when it is ready for data, then requests an execution message. The number of data bytes defined by the power-on or last set length value are accepted and written to the host. The message ends with a message terminator (EOI on HP-IB).

The write verifies a sector prior to writing on any track, whether the track was reached by an internally or externally generated seek. The write may be aborted by hardware problems, failure to verify at least one block on the correct track, or by some host intervention. If the drive's internal write process is abnormally terminated, the disk will sink data until the execution phase is complete. The reporting phase is used to resynchronize the transaction.

4.4 SET UNIT

COMMAND FORMAT:

OPCODE (2XH)

X = Unit Number (X= FH implies Device Controller)

DESCRIPTION:

The drive allows unit 0 and F. Unit F is only used for certain utilities and diagnostics which are compatible with earlier CS80 discs.

4.5 SET VOLUME

COMMAND FORMAT:

OPCODE (4XH)

The value X may range from 0 through 7 and specifies the volume number.

DESCRIPTION:

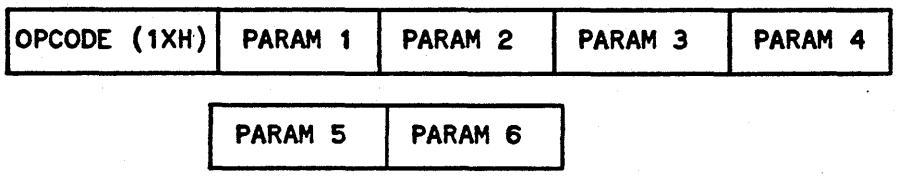
This command does not apply to the HP C2200A/C2202A/C2203A since it has no removeable media.

4.6 SET ADDRESS

FUNCTION:

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

COMMAND FORMAT:




```
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 Set Address command is used to set the value of the drive's target address. The target address is then used by all other commands accessing data on the drive. The Set Address power-on value address is address 0.

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.

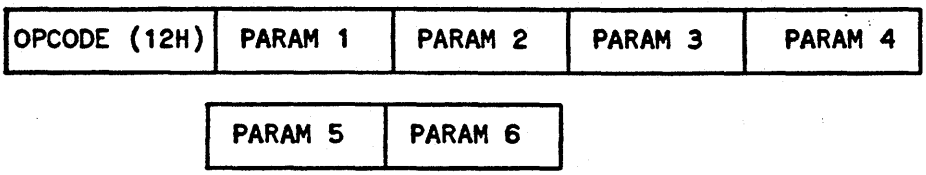
If an Address Bounds error occurs during a Set Address command, the target address will be set to zero. The target address is also set to zero any time and End of Volume occurs.

4.7 SET BLOCK DISPLACEMENT

FUNCTION:

Adjusts the target address by the number of blocks indicated in the parameter field.

COMMAND FORMAT:



Parameter format: 6-byte, signed, two's complement, binary number

DESCRIPTION:

The block displacement parameter is a double precision signed two's complement number which is added to the current target address. The new target address is tested for bounds violation.

The next accessing command will cause a seek to the new target address.

4.8 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 the drive to respond to a Real Time command with a Locate only (seek). No data is transferred. A Real Time command executed in this manner does not require an execution message. After this type of seek, no verification of the target block dress is performed.

4.9 SET BURST

FUNCTION:

Activates (and de-activates) burst mode.

COMMAND FORMAT:

OPCODE (3XH)	PARAM 1

X=C indicates that the last burst only is tagged with a terminator

X=D indicates that all bursts are tagged with a terminator

Parameters: PARAM 1 = Number of 256 byte segments in each burst

DESCRIPTION:

Set Burst applies only to real-time commands. Multiple execution messages may be used to accomodate certain timing requirements. The host uses this burst value to define the maximum amount of data to be transferred in any one execution message. The value specified by the Set Length command is then divided by the size of each burst to calculate the number of execution messages expected. The last burst may be shorter than the others.

Set Burst is disabled at power on.

4.10 SET RPS

FUNCTION:

Set time-to-target and window-size time intervals for RPS data transfers.

COMMAND FORMAT:

OPCODE (39H)	PARAM 1	PARAM 2

Parameters: PARAM 1 = time-to-target in hundreds of microseconds
PARAM 2 = window size in hundreds of microseconds

DESCRIPTION:

Rotational Position Sensing (RPS) is provided to minimize non-productive channel usage while waiting for the drive to locate the area at which a transfer will begin. Using this feature, the drive will request an execution message containing read or write data only during a period called the RPS window. The window opens at a point in time which precedes the target address by an interval specified as time-to-target, and remains open for a duration specified by window-size. If the host does not respond with an execution message during this window, the execution message request will be removed until the next time the target address becomes accessible

If PARAM 1 = 0, RPS is disabled and the execution message request will occur upon completion of the seek operation.

If PARAM 2 >0 (RPS enabled) and PARAM 2 = 0, the window will remain open and the execution message request will continue until the host responds with an execution message.

If either of these parameters exceeds the latency time period, it will be treated in the same manner as a zero value.

At power-on, or after a Clear command is executed, RPS is disabled.

4.11 SET RETRY TIME

FUNCTION:

Used to set the amount of time available for read and seek retries.

COMMAND FORMAT:

OPCODE (3AH)	PARAM 1	PARAM 2

Parameters: PARAM1 - PARAM2 = Retry time in tens of milliseconds
(16 bit, unsigned, binary number)

DESCRIPTION:

Retries are attempted after an uncorrectable data error is encountered or when an attempted seek fails. The power-on value is equal to the optimal retry time specified by the Describe command.

A retry time of 0 causes no read retries to take place. This does not eliminate latencies induced by unrecoverable errors. In general, one latency per read attempt will be observed, once for any unrecoverable error.

A controller may impose a minimum allowable retry time. If the current retry time is set below the imposed minimum, it will be forced to the minimum value. No error is generated in the process.

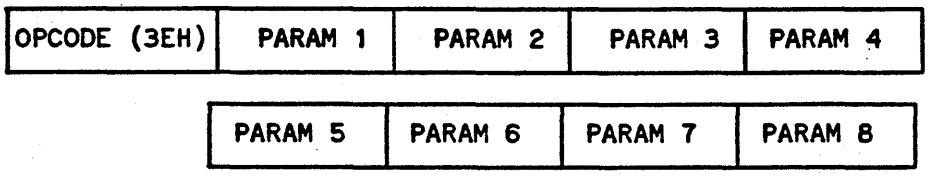
When specifying retry time the host is specifying the maximum delay between any two bytes of a data transfer over the channel. As this is directly related to channel timeout, the maximum retry time should be set to some value less than the defined channel timeout. Using this rule, it is possible that the maximum retry time could be invoked for each block of a data transfer. This situation would imply such a high error rate as to indicate a hardware problem.

4.12 SET STATUS MASK

FUNCTION:

Allows masking of error conditions reported by the Request Status (Diagnostic) command.

COMMAND FORMAT:



Parameter format: Bit positions in parameter bytes correspond to error bit positions in the error reporting fields of the status report (see Table 2-25, CS/80 instruction set programming manual).

If a bit is set to one, it indicates that error is to be masked.

DESCRIPTION:

This opcode is followed by 8 bytes containing the status bits to be masked. All error conditions except fault errors may be masked.

If any non-maskable status bits are set, a Parameter Bounds error will result. The power-on value has no error conditions masked.

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

4.13 NO OP

FUNCTION:

Causes the drive 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. Then again, it may not.

4.14 SET RELEASE

FUNCTION:

Used by the host to set specific options.

COMMAND FORMAT:

OPCODE (3BH)	PARAM 1

```
Parameter format:  PARAM 1 = TZ000000B
                             T = 1 Suppress release timeout
                             Z = 1 Release automatically during idle time
```

DESCRIPTION:

The Set Release command allows the host to define how the device will respond to an internal release request. There are four ways the device can be configured. The first is with the release timeout enabled and automatic release disabled (T=0,Z=0). This configuration will impose a two-second limit on the time the device will remain in the reporting phase requesting release. If the two-second interval elapses without any response from the the host, the device will release itself. The host can prevent the device from ever releasing itself by disabling both the timeout clock and automatic release (T=1,Z=0). In this, the second case, the device will still enter the unsolicited reporting phase to request release but will be unable to release itself. A Release command issued by the host is the only way the device can be released when this configuration is used.

The third configuration enables automatic release (T=1,Z=1) and allows the device to release itself without requesting release from the host. If release is pending, the device will wait in the command-ready state for two seconds. If no channel activity occurs during this period, the device will release itself. The final configuration also enables automatic release (Y=0,Z=1) but, with timeout enabled as well, automatic release may occur after two seconds in either the command-ready or reporting state.

The power-on values of T and Z are 0.

4.15 SET OPTIONS

FUNCTION:

Activates (and de-activates) burst mode.

COMMAND FORMAT:

OPCODE (38H)	PARAM 1

DESCRIPTION:

This command is not implemented.

4.16 SET RETURN ADDRESSING MODE

FUNCTION:

Allows the host to specify the type of address (single or three-vector) returned in the Request Status message.

COMMAND FORMAT:

OPCODE (48H)	PARAM 1

```
Parameter format:  PARAM 1 = 0
                             Single-vector mode

                   PARAM 1 = 1
                             Three-vector mode
```

DESCRIPTION:

This command allows the host to specify the type of address (single or three-vector) to be returned in the Request Status message. This allows the host to select either the same address mode defined in the Set Address command or use a different mode. The selection of the type of address returned in the Request Status message is determined by the host and the specific type of device involved, providing the drive supports the address mode selected.

The power-on value is 0 (single-vector).

4.17 DESCRIBE FOR HP C2200A/C2202A/C2203A

FUNCTION

Returns (in an execution message) up to 256 bytes of information concerning device type and characteristics.

COMMMAND FORMAT:

OPCODE (35H)

DESCRIPTION:

This command provides enough information about the drive to allow it to be configured into a system without the host having prior knowledge about this device type. The drive will return a maximum of 256 bytes of information in the execution message.

See table 2-4 of the CS/80 instruction set programming manual for details of the execution message format.

The last byte of this message will be tagged with a message terminator (EOI on HP-IB) so that fewer than 256 bytes may be transmitted. There are three types of description fields returned: the controller field (5 bytes), the unit field (19 bytes), and the volume field (13 bytes). The format (quantity and sequence) of the description fields returned to the host in an execution message is determined by the unit addressed.

If a selected unit (not the controller) is addressed, the returned sequence format is:

Controller field	Unit 0 field	Volume 0 field

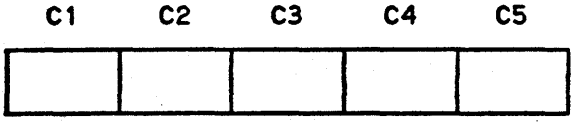
The unit field describes the addressed unit and the volume field describes the currently specified volume. Each field is returned once per transaction.

If the controller unit is addressed, the returned sequence format is:

Controller field	Unit 0 field	Volume 0 field

The controller field, unit 0 field and volume 0 field are returned since the drive has only one unit and one volume.

CONTROLLER FIELD

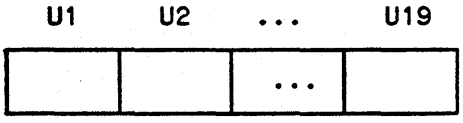


C1-C2 = Installed unit byte: 1 bit for each unit. (Unit 0 = LSB)
<1>

C3-C4 = Maximum instantaneous transfer rate in thousands of bytes
<1250> per second.

C5 = Controller Type
<0> 0=Integrated single-unit controller
1=Integrated multi-unit controller
2=Integrated multi-port controller

UNIT FIELD



U1 = Generic Device Type
<0> 0=Fixed disk
1=Removable disk or combination
2=Tape , fixed block size, random access

U2-U4 = Device number. Represents actual HP product number: XX XX XY
<022000> (BCD Coded, 2 digits per byte) - HP C2200A
<022020> (BCD Coded, 2 digits per byte) - HP C2202A
<022030> (BCD Coded, 2 digits per byte) - HP C2203A
XXXXX = product number Y = option

U5-U6 = Number of bytes per block
<256>

U7 = Number of blocks which can be buffered
<128>

U8 = Recommended burst size (0=burst mode not recommended).
<0>

U9-U10 = Block Time in microseconds (Time is from beginning of one
<132> block to beginning of next).

U11-U12 = Continuous average transfer rate for long (full volume)
<1000> transfers in thousands of bytes per second.

U13-U14 = Optimal retry time in 10's of milliseconds.
<80>

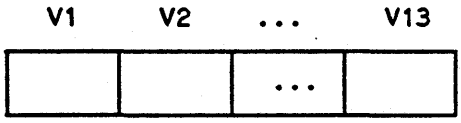
U15-U16 = Access time parameter in 10's of milliseconds. (Maximum time
<84> from the end of command message text to assertion of parallel poll.)

U17 = Maximum interleave factor
<1>

U18 = Fixed Volume Byte (Volume 0 = LSB)
<1>

U19 = Removable Volume Byte (Volume 0 = LSB)
<0>

VOLUME FIELD



V1-V3 = Maximum value of cylinder address vector
<1448>

V4 = Maximum value of head address vector
<7> - HP C2200A
<15> - HP C2202A/C2203A

V5-V6 = Maximum value of sector address vector
<112>

V7-V12 = Maximum value of single-vector address
<1309895> - HP C2200A
<2619791> - HP C2202A/C2203A

V13 = Current interleave factor
<1>

4.18 INITIALIZE MEDIA

FUNCTION:

CAUTION

Execution of the Initialize Media command will destroy data on the selected unit (unit 0).

COMMAND FORMAT:

OPCODE (37H)	PARAM 1	PARAM 2

Parameter format: PARAM 1 = 00H
Initialize retaining all factory and field spares

PARAM 1 = 01H
Initialize retaining only factory spares

PARAM 1 = 02H
Initialize maintenance tracks only

PARAM 1 = 03H
Initialize retaining no spares

PARAM 1 = ANY OTHER VALUE
Invalid 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 = 2) 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.

4.19 SPARE BLOCK

FUNCTION: Instructs the drive to replace a section of media with a spare section of media.

COMMAND FORMAT:

OPCODE (06H)	PARAM 1

Parameter format: PARAM 1 = 0000000XB
Skip spare mode

PARAM 1 = 00000000B
Retain data on reformatted track

PARAM 1 = 00000001B
Retain no data on reformatted track

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 drive, it is necessary to reformat the entire data track on which the defective block resides. If the option to retain data is specified (PARAM 1 = 0), the sparing operation will be performed but none of the data will be retained. If the host attempts to spare a defective block with the option to retain data and an additional defective block is found on the data track, an Unrecoverable Data Error will result. In this case, the host must spare without retaining data.

Following a Spare Block command, the parameter field of the status message will contain information concerning the address and length of the area reformatted by the command. The parameter bytes (PARAM 1 - PARAM 6) contain the beginning address of the reformatted area and the fault log bytes (PARAM 7 - PARAM 10) contain the length in sectors of the reformatted area.

Because of the information contained in the parameter field of the status message, status should always be requested (by the host) after a Spare Block command. This will return information about the area affected by the sparing operation and will also clear the status message.

4.20 LOCATE AND VERIFY

FUNCTION:

Instructs the drive 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 set 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.

4.21 COPY DATA

FUNCTION:

Copies the amount of data specified by the power-on or last set length value from the specified unit and volume to a selected unit and volume.

the HP C2200A/C2202A/C2203A has only one unit and volume; this command is ignored.

COMMAND FORMAT:

OPCODE (08H)	PARAM 1	PARAM 2	PARAM 3	PARAM 4
PARAM 5	PARAM 6	PARAM 7	PARAM 8	
PARAM 9	PARAM 10	PARAM 11	PARAM 12	
PARAM 13	PARAM 14	PARAM 15	PARAM 16	

DESCRIPTION:

This command is ignored.

4.22 RELEASE

FUNCTION:

Used to release the drive for a period of time.

COMMAND FORMAT:

OPCODE (0EH)

DESCRIPTION:

Using the Release command, the host can allow the drive to go offline to service an internal requirement. The host is informed of this requirement via the Release Request bits in the status message returned by the drive. Once released, the drive will service the internal requirement and then return in the reporting state. If the host attempts to communicate with the drive while it is released, a Retransmit error will be reported when the drive returns.

When the host issues the Release command the drive will go offline and service one internal requirement. If more than one release request is present at one time, a separate release sequence will be required to service each request.

4.23 RELEASE DENIED

FUNCTION:

Prohibits the drive from releasing itself.

COMMAND FORMAT:

OPCODE (0FH)

DESCRIPTION:

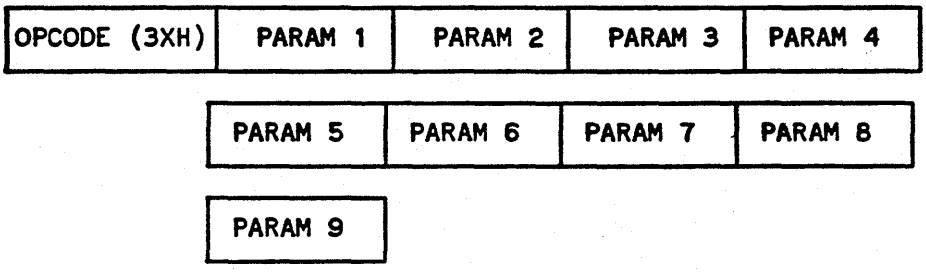
This command will be issued by the host if the drive returns a release request status report and the host does not want the drive to be released. By specifically denying the release, the host can keep the drive from timing out and releasing itself. The Release Denied command will clear all release requests which are pending when the command is issued. Once release has been denied, the event which initiated the release request must reoccur before the drive will issue another request.

4.24 INITIATE UTILITY

FUNCTION:

Directs the drive to perform one utility routine.

COMMAND FORMAT:



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.

4.25 INITIATE DIAGNOSTICS

FUNCTION:

Directs the drive 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 drive to perform one internally defined diagnostic routine. The Diagnostic Result parameters of the status message will contain information concerning the results of the diagnostic. The Initiate Diagnostic command must be directed to the drive controller (unit 15).

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.

4.26 REQUEST STATUS

FUNCTION:

Instructs the HP C2200A/C2202A/C2203A drive to return (in an execution message) the status report.

COMMAND FORMAT:

OPCODE (0DH)

DESCRIPTION:

The Request Status command returns a 20-byte status report (in an execution message) indicating the cumulative status of all transactions which have occurred since the status report was last cleared. The status report can only be cleared by executing Request Status command or a Clear command. The status report consists of a 2-byte identification field, an 8-byte error reporting field, and ten bytes of additional information in the parameter field. Table 2-5 of the CS/80 instruction set programming manual shows the complete format of the status report, and table 2-6 of that manual shows the errors that apply to a given command.

The 2-byte identification field contains the volume number, the unit number, and an identification of other units within the drive that have status pending.

The 8-byte error reporting field contains four categories: Reject Errors, Fault Errors, Access Errors, and Information Errors. Each category has a 2-byte error field. All error conditions are assigned specific bit positions in one of these fields. The error bit positions correspond to bit positions in the Set Status Mask (Complementary) command parameter field.

The content of the parameter field is dependent on the errors being reported. The parameter field contents are awarded to the error with the highest priority (lowest bit position in the error reporting field). An error that has been masked in a Set Status Mask command will not be reported and will not generate parameters. All address parameters are reported in the format (single or three-vector) last specified in a Set Return Addressing Mode command. Whenever the 6-byte address field is not being used, either by a status bit which has a parameter or by a Spare Block command, it will contain the current target address. The last four bytes (PARAM 7 - PARAM 10) of the parameter field will contain device specific fault log information except after a Spare Block command. After a Spare Block command, bytes PARAM 1 - PARAM 6 contain the address of the area affected by the command and bytes PARAM 7 - PARAM 10 contain the length of the affected area.

The Clear command will cause the drive to abort the transaction in process as soon as possible without losing any data. There are three mechanisms available to clear the drive:

1) HP-IB Universal Clear command

2) HP-IB Selected Device Clear command

3) Channel Independent Clear command

All three commands will cause identical clearing action in the drive, unless the Channel Independent Clear command is directed to Unit 0 rather than the controller (Unit 15).

The Clear command will reset:

1) Clearable hardware functions

2) Internal buffers

3) Channel interface buffers

4) Complementary values

5) Status report, unless the Diagnostic Result bit is set.

6) Drive dependent, programmable functions

5.1 UNIVERSAL DEVICE CLEAR

FUNCTION:

A universal command that forces all devices on the HP-IB to return to a known reset state.

COMMAND FORMAT (HP-IB):

ATTENTION	OPCODE(X4H)

Opcode format: X = 1: Even parity
X = 9: Odd parity

DESCRIPTION:

After the Clear operation, the drive goes to the reporting state. No reporting message will be sent.

In response to the Clear command, the drive will:

1) Abort the current operation at the earliest opportunity such that no data is corrupted.

2) Clear all clearable drive or interface conditions currently used.

3) Reset all Complementary parameters to their power-on values.

4) Reset status report, unless the Diagnostic Result status bit is set. This includes resetting power-on status.

5) Set QSTAT value to indicate whether or not status should be requested. QSTAT will indicate any diagnostic results in addition to the occurrence of an internal release request.

6) Enter the Reporting state.

5.2 SELECTED DEVICE CLEAR

FUNCTION:

An HP-IB channel command that forces only currently addressed devices to return to a known reset state.

COMMAND FORMAT:

ATTENTION	P01ADDRS

ATTENTION	P0000100

Parameter format: P Represents the parity bit.

ADDRS is a 5-bit HP-IB address.

DESCRIPTION:

This command description is identical to the description for the Universal Device Clear command.

5.3 CHANNEL INDEPENDENT CLEAR

FUNCTION:

The recommended clearing mechanism for channels other than HP-IB.

DESCRIPTION:

the HP C2200A/C2202A/C2203A is intended to operate solely on HP-IB; therefore this command will be ignored.

5.4 CANCEL

FUNCTION:

This command causes graceful termination of the current transaction, leaving it in the Reporting phase.

COMMAND FORMAT:

OPCODE (2XH)	09H

DESCRIPTION:

The Cancel command suppresses message length errors. The recommended way to terminate a transaction is to terminate the message link, then send the Cancel command.

5.5 LOOPBACK

FUNCTION:

Initiates a sequence to test channel integrity.

COMMAND FORMAT:

OPCODE (0XH)	PARAM 1	PARAM 2	PARAM 3	PARAM 4

Opcode format: X = 2: Read loopback test

X = 3: Write loopback test

Parameter format: PARAM 1 - PARAM 4 = Byte length parameter
unsigned, binary number

DESCRIPTION:

Loopback is an interface test performed by the channel module consisting of two transparent messages followed by a reporting message. The first transparent message specifies that a read or write loopback operation of n bytes will follow, and the second transparent message contains the test data specified by the first. The host can then progress to the reporting phase without waiting for a poll from the drive.

Normally the drive remains in the Command Ready state during a loopback test and does not request a reporting message. Therefore, unless an error has occurred, a reporting message to retrieve QSTAT is optional and the drive will accept and execute a command message following the second transparent message.

If an error occurs during the loopback sequence, the drive will enter an interlock reporting state. In this state the drive will not execute any commands from the host until the failure has been reported. If the transferred data bytes are not correct, or if the number of bytes transferred is not equal to the number specified in the Loopback command, a Channel Parity error will result.

Internal requests are suppressed once the loopback command is given and re-enabled after completion of the loopback sequence.

The loopback test sequence begins with a FFH and each byte that follows is equal to its predecessor plus one. Carry is ignored.

5.6 HPIB PARITY CHECKING

FUNCTION:

This command determines if the drive will detect channel command parity errors.

COMMAND FORMAT:

OPCODE (01H)	000000XY	EOI

Parameter format: X = 0: Disable SRQ during poll

X = 1: Enable SRQ during poll

Y = 0: Parity checking disabled

Y = 1: Parity checking enabled

DESCRIPTION:

If parity checking is enabled, and a channel command present on the bus does not contain odd parity, the drive will not accept the command; i.e., NOT DATA ACCEPTED (NDAC) will remain in the low state (asserted). This condition will remain until the host removes Data Valid (DAV) and corrects the channel command parity.

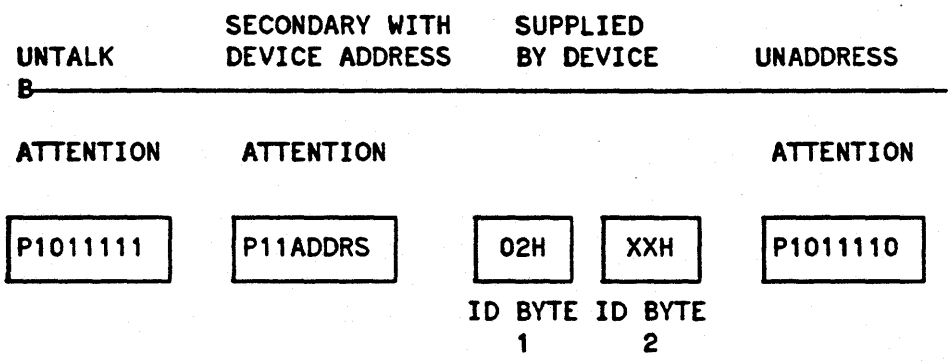
If the Y bit is set, the Service Request (SRQ) line will be asserted whenever the drive polls.

5.7 IDENTIFY

FUNCTION:

Identify is a special-case HP-IB command used by the host at power-on to identify the devices connected to the bus.

COMMAND FORMAT:



Parameter format: P = parity bit

ADDRS = HP-IB address

XX = Device type code

DESCRIPTION:

The drive returns a two-byte identity code which the host can use to configure itself. All CS/80 devices return the value of 2 in ID BYTE 1, and the product type code in ID BYTE 2.

HP C2200A/C2202A/C2203A controllers will return the following ID Bytes:

Product	ID Bytes
HP C2200A	022F
HP C2202A	0231
HP C2203A	0230

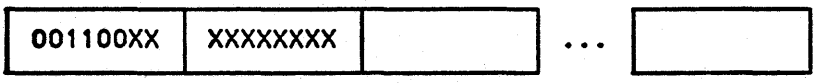
The transparent secondary command is not used in this sequence.

In the HP C2200A/C2202A/C2203A controller, there are currently 13 utilities. Below are the 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. The HP C2200A/C2202A/C2203A implements one table: Spare Track.
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.

OCEH	Preset Drive	In the HP C2200A/C2202A/C2203A, this utility forces logging of any run-time data errors and device faults.
OA3H	Read Full Sector	Seeks to the current host address, reads a full sector with no verify and returns the data.
OC3H	Read Revision Number	The host receives the firmware ROM revision numbers.
OD8H	Diagnostic Read	The host can read 16,384 bytes of data from a reserved area
OD9H	Diagnostic Write	The host can write 16,384 bytes of data to a reserved area
ODOH	Reset Cache Stats	The host can clear the cache statistics
OBEH	Read Cache Error Log	The host receives a copy of the number of correctable and uncorrectable cache errors
OD3H	Cache Control	The host can turn on and off the read and write cache
OD4H	Set Cache Page Size	The host can set the page size for the read cache

General format of Execute Utility Commands:



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

Utilities

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
10	Butterfly Seek
00	Preset Drive
10	Read Full Sector
10	Read Revision Number
10	Diagnostic Read
01	Diagnostic Write
00	Reset Cache Statistics
10	Read Cache Error Log
00	Cache Control
00	Set Cache Page Size

6.1 READ DRIVE TABLES UTILITY

DESCRIPTION

The HP C2200A/C2203A without cache implements the Spare Track table and the HP C2202A with cache implements the Spare Track Table and the Cache Statistics in the Read Drive Table Utility. A parameter bounds error occurs if other table numbers are sent. 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 Cache Statistic table allows the host to calculate the read and write hit ratios and read/write ratio.

COMMAND FORMAT

The Initiate Utility opcode for the Read Spare Track 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. For Read Spare Track Table, the table number is 1. For Cache Statistics the table number is 7.

00110010	11000100	00000001
Initiate Utility Opcode	Micro Opcode (C4H)	1=Spare Track 7=Cache

FORMAT OF EXECUTION MESSAGE

The HP C2200A/C2202A/C2203A uses the same log format as previous CS80 devices, but always returns zero for the number of secondary spare operations. It 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 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 maximum number of spares for drive is 78 tracks. Individual heads do not have a set number of spares. The maximum message length for the drive is 368 bytes = (96*3) + (5*16 heads). The MSB of the scalar spare number will be set if the spare was a factory spare.

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

The format of the cache statistics table is as follows:

Read cache status	1 byte (see below)
Write cache status	1 byte (see below)
Page size (bytes)	2 bytes
Number of pages	2 bytes
Number of reads	4 bytes
Number of read hits	4 bytes
Number of writes	4 bytes
Number of write hits	4 bytes

If any of the statistic counts overflow, they will be reset to zero

The cache status bytes in the Cache Statistics Table have the following values.

0 - Cache enabled
1 - Cache disabled by host request
2 - Cache hardware not installed
3 - Cache disabled due to error

6.2 READ RUN-TIME LOG UTILITY

DESCRIPTION

The Read Run-Time Log Utility provides run-time data errors for a specified head. The device initially logs run-time data errors in a RAM area. A maximum of 5 entries are allowed in the RAM area. The drive 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.

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	Micro Opcode (C5H)	Head Number (0 to 15)

FORMAT OF EXECUTION MESSAGE

the HP C2200A/C2202A/C2203A uses the same log format as previous CS80 devices. The definition of the error byte is different. Below is the log format.

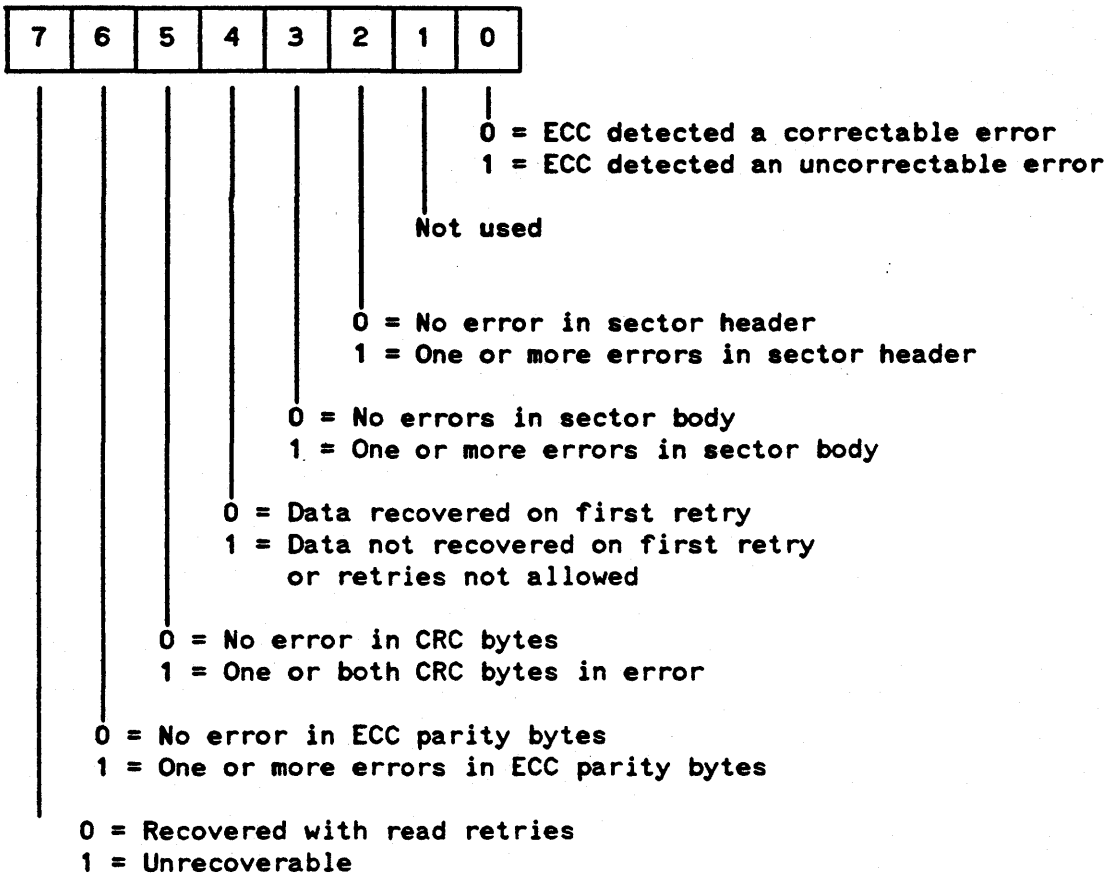
The log header for each head is:

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

The error byte definition is:



6.3 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. 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.

COMMAND FORMAT

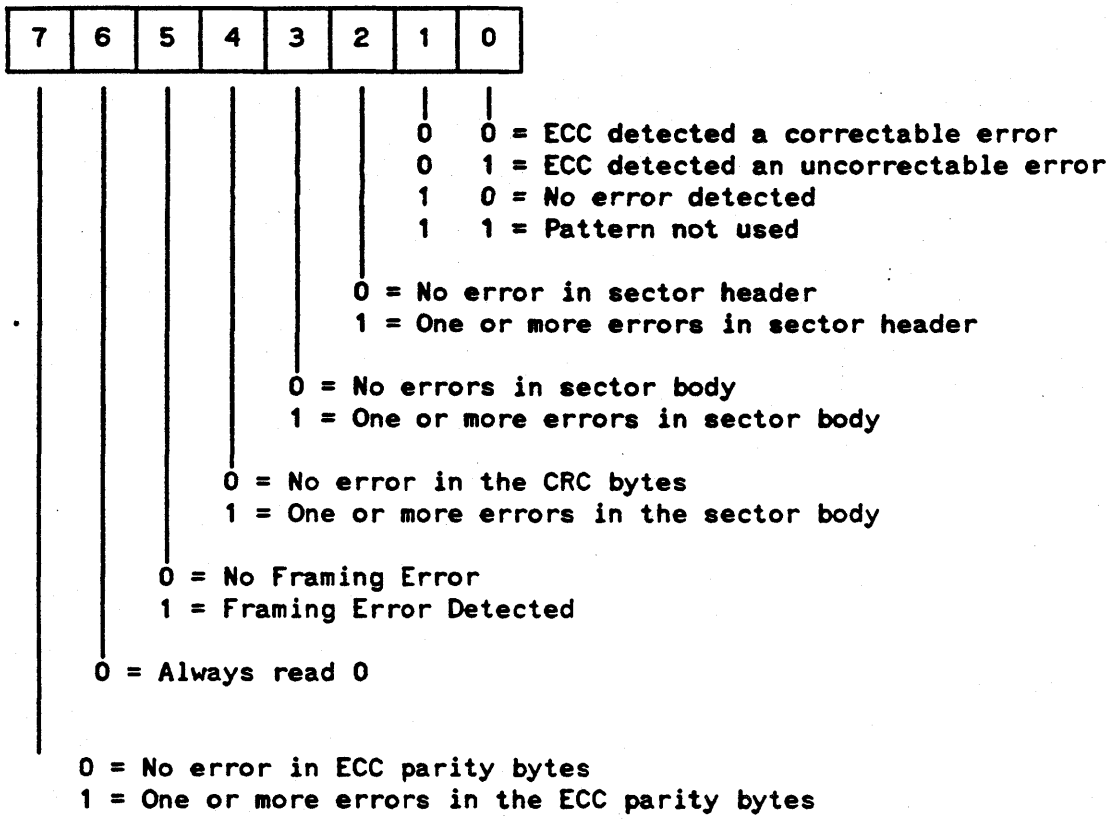
The Initiate Utility opcode for the Read ERT Log is 32H, since the device returns an execution message containing the log. The Read ERT Log micro-opcode is C6H. One parameter, the head number, follows the micro-opcode.

00110010	11000110	0000XXXX
Initiate Utility Opcode	Micro Opcode (C6H)	Head Number (0 to 15)

FORMAT OF EXECUTION MESSAGE

the HP C2200A/C2202A/C2203A 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:



6.4 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. The RAM holds a maximum of 30 entries. The drive 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.

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

The HP C2200A/C2202A/C2203A uses the same log format as previous CS80 devices. The status definitions of the internal registers error and error type are different. 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 status of internal registers byte is a collection of bits from the ECC and TWIST registers, as well as the ESDI status register. The purpose of this register is to provide additional information about the ESDI hardware when a fault in the data path occurs. If a channel fault occurs, this byte is zero. The bit definitions are shown below.

The names in parentheses indicates the FRU which is the source of the fault status:

(ESDI) = ESDI unit
(CTRL) = Controller

```
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 = Rd 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 Parity Error or Illegal Command

Com/Stat CTRL Fault : Port Fault or Parity Error or Command Abort

Read 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 (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                    (1-6 hours)
1011 = 150,001 to 600,000 seeks                   (6-24 hours)
1100 = 600,001 to 4,000,000 seeks                 (1-7 days)
1101 = 4,000,001 to 16,000,000 seeks              (1-4 weeks)
1110 = 16,000,001 to 1,000,000,000 seeks          (1-6 months)
1111 = > 1,000,000,000 seeks                      (6 months)
```

6.5 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 would be wise 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

6.6 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. The HP C2200A/C2202A/C2203A Error Rate Tests closely resemble the 7933/35 tests. In the command modifiers, the drive's Frame error bit will replace the offset parameter used in the 7933/35.

6.6.1 Command Modifiers

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

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

Not all parameters are used with every opcode.

1. ERT Loop Parameter

   HP C2200A/C2002A/C2003A Differences: none

   Values: 0 thru FFH

2. Frame Error Detect Bit

   HP C2200A/C2202A/C2203A Differences: 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.

   Values:
   0-Frame Error bit not set
   1-Frame Error bit set

3. Error Report Mode

   HP C2200A/C2202A/C2203A Differences: the HP C2200A/C2202A/C2203A 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.

   It is possible, when the Frame 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:
   0-(short) same as Run log entry
   1-(long) data, Run log entry, and bit map of data error

4. ERT Test Area

HP C2200A/C2202A/C2203A Differences: none

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

5. Data Source

HP C2200A/C2202A/C2203A Differences: User Defined Pattern is not implemented in the HP C2200/C2202A/C2203A.

Values:
0-internal pattern table
2-random data

6.6.2 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 a 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)	Data Source (0 or 2)

4. Initiate Random Read Only ERT

00110010	11001100	XXXXXXXX	0000000X
Initiate Utility Opcode	Micro Opcode (CCH)	Loop (0 to FFH)	Parity Error Bit (0 or 1)

0000000X
Report (0 or 1)

6.7 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 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 (0 to N+1) N = max head # N+1 = all heads

6.8 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 are no parameters associated with this command.

00110000	11001110
Initiate Utility Opcode	Micro Opcode (CEH)

6.9 READ FULL SECTOR

DESCRIPTION

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

The HP C2200A/C2202A/C2203A's implementation of this utility is different from the implementation of past CS80 devices. Here is a list of the special features of the HP C2200A/C2202A/C2203A'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 HP C2200A/C2202A/C2203A to 0A3H.

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 (A3)		

PARAM3	PARAM4	PARAM5	PARAM6

The Parameters are as follows.

PARAM1-PARAM3 - Cylinder number of target (Logical 0 - 1448)

PARAM4 - Head number of target (Logical 0 - 15)

PARAM5-PARAM6 - Sector number of target (Physical 0 - 112)

FORMAT OF EXECUTION MESSAGE

```
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
```

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.

6.10 READ REVISION NUMBERS

DESCRIPTION

This utility reads the ROM pair revision numbers and returns the values for each ROM in an execution message. A ROM pair has the same revision number, since the pair needs to be replaced rather than an individual ROM. The revision numbers begin with zero.

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)

FORMAT OF EXECUTION MESSAGE

```
Header - 1 Byte
         Number of revision number bytes following
         (2 for the HP C2200A/C2202A/C2203A)

Body   - 1 Byte      (repeated for each ROM)
         Revision Number
```

The revision number format is RRRRNNNN where RRRR represent the Rom revision number and NNNN represents the rework number. The HP C2200A/C2202A/C2203A's rework number is 0. The number of bytes returned in the execution message for the HP C2200A/C2202A/C2203A is 3.

6.11 DIAGNOSTIC READ UTILITY

DESCRIPTION

The Diagnostic Read utility allows the user to read up to 16,384 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 D8H. There are two parameters following the micro-opcode, head number and length.

00110010	11010011	XXXXXXXX	XXXXXXXX	XXXXXXXX
Initiate Utility Opcode	Micro Opcode (D8H)	Length (0 to 16384)		Head Number (0 to N) N = max head#

6.12 DIAGNOSTIC WRITE UTILITY

DESCRIPTION

The Diagnostic Write utility allows the user to write up to 16,384 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 will be sent to the host. The Diagnostic Write micro-opcode is D9H. There are two parameters following the micro-opcode, head number and length.

00110001	11010100	XXXXXXXX	XXXXXXXX	XXXXXXXX
Initiate Utility Opcode	Micro Opcode (D9H)	Length (0 to 16384)		Head Number (0 to N) N = max head #

6.13 RESET CACHE STATISTICS

DESCRIPTION

The Reset Cache Statistic utility allows the user to clear the cache statistics.

COMMAND FORMAT

The Initiate Utility opcode for the Reset Cache Statistic Utility is 30H, since no execution message will be sent to the host. The Reset Cache Statistic micro-opcode is D0H.

The cache statistics will be reset to zero in the following cases.

1. Device Clear command from the host
2. Cache Enable command from the host when actually enabled.
3. Cache enabled automatically by the drive. (Power on)
4. Clear Cache Statistics command from the host.
5. If any statistics count overflows the 4 byte integer.

00110000	11010000
Initiate Utility Opcode	Micro Opcode (D0H)

6.14 READ CACHE ERROR LOG

DESCRIPTION

This utility will allow the host to read the cache error log. The number of correctable and uncorrectable errors in the cache memory are returned in the error log. (This is NOT related to the correctable and uncorrectable counts from the ECC). The definition of a correctable error is a single-bit error in a byte of cache memory. The definition of a uncorrectable error is a double-bit error in a single byte.

COMMAND FORMAT

The Initiate Utility opcode for the Read Cache Error Log Utility is 32H, since an execution message will be sent to the host. The Read Cache Error Log micro-opcode is BEH.

00110010	10111110
Initiate Utility Opcode	Micro Opcode (BEH)

FORMAT OF EXECUTION MESSAGE

```
Number of correctable errors   - 2 bytes
Number of uncorrectable errors - 2 bytes
```

6.15 CACHE CONTROL

DESCRIPTION

This utility will allow the host to enable and disable read cache and the immediate write buffer according to the following rules. If the disk drive receives a request to turn the cache and/or immediate writes off and they are already off, the request will be ignored. If the disk drive receives a request to turn the cache and/or immediate writes on and they are already on, the request will be ignored and no further action will be taken. There is no execution message.

If the cache was disabled by a diagnostic failure, this command will NOT enable it. The only way to enable cache in this case is to successfully pass the DMA diagnostic or the Power-On diagnostic.

When using this command, it must be kept in mind that there is a relationship between the read cache and the write cache. The write cache cannot be enabled at any time unless the read cache is also enabled at the same time. Therefore, if the user asks to disable read cache, the disk drive will disable write cache at the same time. Similarly, if the read cache memory diagnostic fails, both the read cache and the write cache will be disabled.

It is also important to note that if both caches are disabled, enabling read cache does NOT automatically enable write cache.

The following events will cause the disk drive to enable the cache system and immediate write capability:

1. Power On
2. Device Clear command from host
3. Cache Enable command from host (above)

The following events will cause the disk drive to disable the cache system:

1. Power-on diagnostic failure
2. Cache Disable command from host
3. Invalid data in the write cache buffer
4. A pending write update fails on power-on

All of these events will disable both the read cache and the write cache capability of the disk drive. The Cache Disable command may disable only the write cache depending upon the user specification.

There are certain conditions and events which can happen which will require the HP C2202A to flush the cache. The conditions under which the HP C2202A will flush the cache are detailed below:

1. Cache Disable command from host
2. Spare operation
3. Error Rate Test
4. Self-Test (DMA diagnostic)
5. Initialize Media command from host
6. Device Clear command from host
7. Power-on

COMMAND FORMAT

The Initiate Utility opcode for the Cache Control Utility is 30H, since no execution message will be sent to the host. The Cache Control micro-opcode is D3H.

00110000	11010011	000000XY

```
Initiate    Micro     X = 0 turn read cache off
Utility     Opcode    X = 1 turn read cache on
Opcode      (D3H)     Y = 0 turn write cache off
                      Y = 1 turn write cache on
```

6.16 SET CACHE PAGE SIZE

DESCRIPTION

This utility will allow the host to set the page size for the cache. This device uses the page size for only the read cache. Any page size smaller than allowed on the device, will be set to the smallest allowed page size. Any page size larger than allowed on the device will be set to the largest allowed page size. The default page size on power on will be the smallest allowed page size.

COMMAND FORMAT

The Initiate Utility opcode for the Set Cache Page Size is 30H, since no execution message will be sent to the host. The Set Cache Page Size micro-opcode is D4H.

00110010	11010100	XXXXXXXX
Initiate Utility Opcode	Micro Opcode (D4H)	Page Size (power of 2 * 1024) C2202A allows 2 to 5 (4096 to 32768)