



**HEWLETT  
PACKARD**

**SPECIFICATION CONTROL DOCUMENT**

**REVISION HISTORY**

<b>REV</b>	<b>DOCUMENT</b>	<b>APPRVD BY</b>	<b>DATE</b>
<b>1.0</b>		<b>WGH</b>	<b>04/07/94</b>
<b>1.1</b>	<b>Preliminary</b>		



Date: May 24, 1994

**Title: Standard Firmware for Disk Devices**

Title Page

**PRELIMINARY**

Systems Interconnect Lab, Peripheral Evaluation Team

Approval



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## 1.0 INTRODUCTION

### 1.1 Scope

This specification outlines the firmware requirements for SCSI disk drives that are to be connected to HP-UX, version 10.0 and greater, workstation and multi-user computer systems. This document specifies the functional requirements of the drive firmware. In the event of a difference between the manufacturer's specifications and those outlined in this document the latter shall take precedence. Those features or requirements that are indicated as mandatory shall be considered mandatory regardless of whether or not the ANSI SCSI specifications indicates that feature or requirement is optional.

### 1.2 Applicable Documents

"Small Computer System Interface (SCSI)", X3.131-1989, American National Standard for Information Systems (ANSI)

SCSI-2 ANSI X3T9.2 Rev. 10h (any revision greater than 'h' supersedes the 'h' revision)

## 2.0 REQUIRED FIRMWARE DESIGN FEATURES

The device shall contain and maintain certain firmware features that are required in the HP-UX workstation and multi-user computer systems environment. The following is a list of the appropriate design requirements:

The device shall ...

- be capable of performing self-test diagnostics executed upon power-up, reset, and the send diagnostic command.
- perform an interruptible read ahead.
- perform an intelligent in-line sector sparing algorithm on reallocation. (write & read).
- perform reallocation with only fully recovered data.
- support the completion of a write operation to the current sector boundary on a SCSI bus reset or Bus Device Reset message.
- perform write operations in such a manner as to guarantee that the sectors are always written in sequential order starting with the first sector in the operation.
- perform write caching.
- provide Tagged Queuing of at least 64 commands deep.
- provide support for multi-initiators and contingent alligence.
- provide down loadable code via the SCSI Write Buffer command.
- provide download protection such that HP firmware is prevented from being downloaded to OEM devices.

## 3.0 FUNCTIONAL SPECIFICATIONS

### 3.1 SCSI Bus Overhead

Command overhead is defined as the amount of time required to perform the following SCSI sequence. This time shall be less than 500 us.

Arbitrate ♦ Select ♦ Message transfers ♦ Command transfer ♦ Disconnect or Command Complete message

Arbitrate ♦ Select ♦ Message transfers ♦ Command transfer ♦ Data transfer (*This time is not included*) ♦ Disconnect or Command Complete message

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Data transfer overhead is defined as the amount of time required to perform the following SCSI sequence. This time shall be less than 1 ms.

Arbitrate ♦ Reselect ♦ Message transfers ♦ Data transfer (*This time is not included*) ♦ Disconnect or Command Complete message

Completion overhead is defined as the amount of time required to perform the following SCSI sequence. This time shall be less than 10 us.

Arbitrate ♦ Reselect ♦ Message transfers ♦ Command Complete message

### 3.2 Diagnostics

The following sections describe the minimum diagnostic requirements for SCSI disk drives. The interface requirements basically emphasize items in the ANSI SCSI specification that are necessary to meet HP diagnostic goals.

#### 3.2.1 Power-up

Diagnostic coverage during power-up shall include the testing of the PCB, servo, seek mechanics, and read/write of all heads in the most densely recording area of the disk. The power-up diagnostics shall be non-destructive to all user data stored on the media. Any read/write operations done during the power-up or self-test diagnostics shall be done to a reserved location of the device where user data will never exist.

At power-up the drive shall indicate DRIVE NOT READY (02 hex) during the execution of the diagnostics and while the device is not ready for use. The drive shall continue to indicate a DRIVE NOT READY status until the power-up diagnostics are complete and the drive is available. The drive shall respond with the appropriate status and sense data within 25 seconds of power-up.

If the power-up diagnostics are successful, the sense key shall be set to UNIT ATTENTION (06 hex) with the additional sense key set to 29 hex, indicating a power-on condition. If the power-up diagnostics fail, the sense key shall be set to HARDWARE ERROR (04 hex) with the additional sense code and additional sense code qualifier providing more information.

#### 3.2.2 Reset

Diagnostic coverage performed as a result of a reset shall include the testing of the PCB, servo, seek mechanics, and read/write of all heads in the most densely recording area of the disk. The reset diagnostics shall be non-destructive to all user data stored on the media. Any read/write operations done during the reset diagnostics shall be done to a reserved location of the device where user data will never exist.

The drive shall indicate DRIVE NOT READY (02 hex) during the execution of the reset diagnostics and while the device is not ready for use. The drive shall continue to indicate a DRIVE NOT READY status until the reset diagnostics are complete and the drive is available. The drive shall respond with the appropriate status and sense data within 15 seconds of the reset.

If the reset diagnostics are successful, the sense key shall be set to UNIT ATTENTION (06 hex) with the additional sense key set to 29 hex, indicating a reset condition. If the reset diagnostics fail, the sense key shall be set to HARDWARE ERROR (04 hex) with the additional sense code and additional sense code qualifier providing more information.

#### 3.2.3 Send Diagnostic

Drive self-test diagnostics shall be executed upon receiving the SCSI Send Diagnostic command with the self-test bit set. All other bits shall be set or cleared as defined by the ANSI SCSI specification.



Diagnostic coverage shall include testing of the PCB, servo, seek mechanics, and read/write of all heads in the most densely recording area of the disk. The diagnostics executed by the Send Diagnostic command shall be non-destructive to all user data stored on the media. Any read/write operations done during the power-up or self-test diagnostics shall be done to a reserved location of the device where user data will never exist.

The coverage of stuck-at-faults for the drive hardware should be >90%. In order to show this has been achieved:

- PCB board stuck-at-fault coverage for nets should be >90%. This can be verified by performing fault insertion to each node on the PCB. If the test fails and the drive indicates an error status accordingly, then the fault is considered to have been detected.
- HDA coverage should include write fault conditions.

If the self-test diagnostics successfully pass, the command shall be terminated with a GOOD status, otherwise the command shall be terminated with a CHECK CONDITION status and the sense key shall be set to HARDWARE ERROR (04 hex). The additional sense code and additional sense code qualifier may be used to supply more information.

#### **4.0 DEFAULT DEVICE VALUES**

##### **4.1 Device Initiated Synchronous Data Transfer Request (SDTR)**

The drive shall provide a bit field within a vendor unique mode page which when equal to one (enabled) will instruct the drive to initiate a SDTR message the first time the drive is selected with Attention and is in asynchronous mode (usually after a power-on or reset condition). This bit field shall have a default value of one (1).

##### **4.2 Mode Select Pages**

This section defines those mode page fields that contain required values. All other mode page fields will contain values that are optimally set by vendor.

###### **4.2.1 Page 0x01 (Read Write Error Recovery)**

AWRE = ON

ARRE = ON

PER = OFF

###### **4.2.2 Page 0x08 (Caching)**

WCE = ON

###### **4.2.3 Page 0x0a (Control Mode)**

Queue Algorithm Modifier = 1

##### **4.3 Inquiry**

Disk devices shall be identified by a unique firmware revision that will contain the characters **HPXX**, where **XX** is a two digit revision number. The two digit hexadecimal revision number shall start at a value of 00 and shall be incremented when any change is made to the firmware. This unique firmware revision shall be contained in the Product Revision Level field (bytes 32 – 35) of the standard Inquiry data format.

Devices shall provide the following mandatory Vital Product Data pages via the Inquiry command. Those VPD pages marked as optional in the following table may be implemented per the vendor's discretion. All other VPD pages are either reserved or vendor specific as defined by the ANSI SCSI specification.

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**Vital Product Data**

<b>Page Code</b>	<b>Description</b>	
<b>00h</b>	<b>Supported Vital Product Data Pages</b>	<b>Mandatory</b>
<b>01h – 7Fh</b>	<b>ASCII Information Page</b>	<b>Optional</b>
<b>80h</b>	<b>Unit Serial Number Page</b>	<b>Mandatory</b>
<b>81h</b>	<b>Implemented Operating Definitions Page</b>	<b>Optional</b>
<b>82h</b>	<b>ASCII Implemented Operating Definitions Page</b>	<b>Optional</b>

**4.4 Log Pages**

Devices shall provide the following mandatory Log pages. Those Log pages marked as optional may be implemented per the vendor's discretion. All other Log pages are either reserved or vendor specific as defined by the ANSI SCSI specification.

The contents and definitions of the Log pages shall be as defined by the ANSI SCSI specification.

**Log Pages**

<b>Page Code</b>	<b>Description</b>	
<b>00h</b>	<b>Supported Log Pages</b>	<b>Mandatory</b>
<b>01h</b>	<b>Buffer Over-Run/Under-Run</b>	<b>Optional</b>
<b>02h</b>	<b>Error Counter (Write)</b>	<b>Mandatory</b>
<b>03h</b>	<b>Error Counter (Read)</b>	<b>Mandatory</b>
<b>05h</b>	<b>Error Counter (Verify)</b>	<b>Mandatory</b>
<b>06h</b>	<b>Non-Medium Errors</b>	<b>Mandatory</b>
<b>07h</b>	<b>Last n Events Errors</b>	<b>Optional</b>

Devices shall support all parameter codes, as defined by the ANSI SCSI specification, for the Error Counter log pages (write, read, verify).

**5.0 Disk Device SCSI Command Set**

Devices shall provide the following mandatory SCSI commands. Those SCSI commands not mentioned shall remain as defined by the ANSI SCSI specification. All fields within each mandatory command shall be as defined by the ANSI SCSI specification.

SCSI Commands	
Opcode	Command
00h	TEST UNIT READY
03h	REQUEST SENSE
04h	FORMAT UNIT
07h	REASSIGN BLOCKS
08h	READ (6)
0Ah	WRITE (6)
0Bh	SEEK
12h	INQUIRY
15h	MODE SELECT (6)
16h	RESERVE
17h	RELEASE
1Ah	MODE SENSE (6)
1Bh	START/STOP UNIT
1Ch	RECEIVE DIAGNOSTIC
1Dh	SEND DIAGNOSTIC
25h	READ CAPACITY
28h	READ (10)
2Ah	WRITE (10)
2Bh	SEEK (10)
2Fh	VERIFY
35h	SYNCHRONIZE CACHE
37h	READ DEFECT DATA
3Bh	WRITE BUFFER
3Ch	READ BUFFER
3Eh	READ LONG
3Fh	WRITE LONG
4Ch	LOG SELECT
4Dh	LOG SENSE
55h	MODE SELECT (10)
5Ah	MODE SENSE (10)

**5.1 FUA**

If a device supports WCE (Mode Pg. 8: Write Cache Enable), the disk shall provide support for the FUA field within the Write(10) and Read(10) command.

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**5.2 Mode Select**

The Mode Select command shall support the SP (Save Page) bit, which causes the saved page values to be the new power-on default. At a minimum, those required mode page fields indicated previously shall be changeable and saveable.

**5.3 Write Buffer**

The device shall support firmware download via the Write Buffer command and with the Write Buffer mode field set to 101b. If the device requires a firmware download of greater than 255K bytes, the device shall provide firmware download capability by allowing the breaking up of the download into blocks less than or equal to 255K bytes. This method shall use the Write Buffer mode field values of 100b and 101b to indicate intermediate blocks and the final firmware block.

After the completion of a successful Write Buffer command with a mode field value equaling 101b any previously-arranged data transfer agreements with the host that issued the command shall be maintained or the device shall re-negotiate synchronous and wide data transfers accordingly with that host.

**6.0 Minimum Required SCSI Message Set**

CODE	DESCRIPTION	
00h	Command Complete	Mandatory
01h 00h	Modify Data Pointer	Not supported by HP
01h 01h	Extended Message, Synchronous Transfer	Mandatory
01h 03h	Extended Message, Wide Bus Transfer	Mandatory
02h	Save Data Pointer	Mandatory
03h	Restore Pointers	Mandatory
04h	Disconnect	Mandatory
05h	Initiator Detected Error	Optional
06h	Abort	Mandatory
07h	Message Reject	Mandatory
08h	No Operation	Mandatory
09h	Message Parity Error	Mandatory
0Ch	Bus Device Reset	Mandatory
0Dh	Abort Tag	Mandatory
0Eh	Clear Queue	Mandatory
0Fh	Initiate Recovery	Mandatory
10h	Release Recovery	Mandatory
11h	Terminate I/O Process	Optional
20h	Simple Queue Tag	Mandatory
21h	Head of Queue Tag	Mandatory
22h	Ordered Queue Tag	Mandatory
23h	Ignore Wide Residue	Mandatory
80h-FFh	Identify	Mandatory