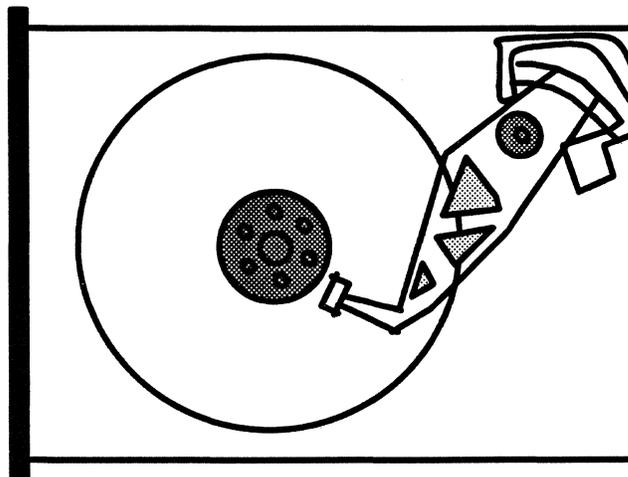




| REVISION HISTORY |          |          |         |
|------------------|----------|----------|---------|
| REV              | DOCUMENT | APPVD BY | DATE    |
| E0               |          | JPM      | 7/7/94  |
| E1               |          | JPM      | 7/13/94 |
| E2               |          | JPM      | 7/28/94 |
|                  |          |          |         |
|                  |          |          |         |



*2.0 Gigabyte Wide Differential  
3.5 inch Low Profile Disk Drive  
Specification*

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 1 of 23  |
| Changes since previous issue noted by: JPM |  | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



1.0 TABLE OF CONTENTS ..... 2

2.0 INTRODUCTION ..... 4

    2.1 Scope ..... 4

    2.2 Applicable Documents ..... 4

3.0 REQUIRED DESIGN FEATURES ..... 5

    3.1 Mechanical/Hardware ..... 5

    3.2 Firmware ..... 5

4.0 FUNCTIONAL SPECIFICATIONS ..... 6

    4.1 General Specifications ..... 6

    4.2 Performance Specification ..... 6

    4.3 Reliability and Life ..... 7

    4.4 Interface Specification ..... 8

    4.5 Power Specifications ..... 8

    4.6 Diagnostics ..... 9

    4.7 Power Management ..... 10

5.0 MECHANICAL SPECIFICATIONS ..... 11

    5.1 Physical Specifications ..... 11

    5.2 Mounting Orientation ..... 11

    5.3 Acoustic Noise Level ..... 11

    5.4 Power Interface ..... 12

    5.5 Signal Interface ..... 12

    5.6 Options ..... 13

    5.7 Cooling Requirements ..... 13

6.0 ENVIRONMENTAL SPECIFICATIONS ..... 14

    6.1 Operating Environment ..... 14

    6.2 Non-Operating Environment ..... 14

    6.3 Transportation Environment ..... 15

    6.4 Product Safety & Emissions ..... 16

    6.5 Labels and Markings ..... 17

7.0 DEFAULT VALUES ..... 18

    7.1 TID Jumpers ..... 18

    7.2 Termination Power ..... 18

    7.3 Mode Select Pages ..... 18

    7.4 Bezel ..... 18

|  |   |                    |
|--|---|--------------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive<br>Specification<br><b>PRELIMINARY</b> | Page 2 of 23       |
| Changes since previous issue noted by: JPM |   | Dwg. No.      Rev. |
| Approval:                                  | HP Part Number: 0950-2605   |                    |



8.0 FIGURES AND TABLES ..... 18

Figure 1 Dimensions and Mounting ..... 19

Figure 2 Combination Connector Pin Assignment ..... 20

Table 1 Current Requirements ..... 20

Table 2 Signal Assignments for Auxiliary Connector ..... 20

Table 3 SCSI Interface Signals ..... 21

Table 4 SCSI ID Settings ..... 22

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 3 of 23  |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**2.0 INTRODUCTION**

**2.1 SCOPE**

This specification outlines the requirements for a 2.0 gigabyte, 3.5 inch by 1.0 inch high form factor, SCSI rigid disk drive with 16 bit differential interface. This document specifies the electrical, mechanical, environmental, reliability, and certification requirements of the drive.

In the event of a difference between the manufacturer's specifications and those outlined in this document the latter shall take precedence.

**2.2 APPLICABLE DOCUMENTS**

The following is a list of the documents by which this specification is based. For more detail, please reference these documents as required.

“Enhanced Small Computer System Interface (SCSI-II)”,  
X3T9.2/86-109 Rev. 10h, available through CBEMA

ISO 7779 "Acoustics – Measurement of airborne noise emitted by computer and business equipment

Plug and Play SCSI Specification Version 1.0 (March 30, 1994)

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 4 of 23  |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**3.0 REQUIRED DESIGN FEATURES**

The device must contain and maintain certain design features that are required in the workstation environment. The following is a list of the appropriate design requirements:

**3.1 MECHANICAL/HARDWARE**

- 1) The device must automatically move the recording heads to a landing zone (completely free of user data) and latch them there, upon the loss of DC power, without operator or software intervention.
- 2) Not require any periodic or preventive maintenance.
- 3) Mechanism is to have a breather and filtration system in the HDA.
- 4) Provide dynamic braking of the disks on a power-down cycle.
- 5) Require no sequencing of power.
- 6) Device must have a minimum of a 32K dual port buffer system.
- 7) Be capable of supporting a minimum 48 bit ECC.
- 8) Glitchless drivers/receivers are to be used on the SCSI bus.
- 9) A set of adjacent pins, on the front of the drive, so that a cable for a remote LED indicator can be used.

**3.2 FIRMWARE**

Refer to the Hewlett-Packard document "Standard Firmware for Disk Devices"

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 5 of 23  |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**4.0 FUNCTIONAL SPECIFICATIONS**

The appropriate manufacturer's specifications contain information which must be used in conjunction with this document. In the case of conflicting information, the HP specification shall take precedence.

**4.1 GENERAL SPECIFICATIONS**

**4.1.1 Capacity**

|                  |                                |
|------------------|--------------------------------|
| Unformatted:     | 2.5 GB (ref only)              |
| Formatted (512): | 4194685 blocks (must be exact) |
| Max LBA          | 4194684 (must be exact)        |

**4.2 PERFORMANCE SPECIFICATIONS**

Note: The requirements of this section are to be met under all combinations of operating environment and DC supply voltages of sections 5 and 6. Therefore it represents worst-case requirements.

**4.2.1 Seek Times (all numbers include settling time)**

|                 |           |
|-----------------|-----------|
| Track to track: | 3.5 ms    |
| Average:        | < 15.1 ms |
| Maximum:        | 24 ms     |

**4.2.2 Disk Speed / Rotational Latency**

|                  |                                     |
|------------------|-------------------------------------|
| Average Latency: | 5.56 msec or less (ref only)        |
| Disk Speed:      | 5400 RPM minimum +/-0.5% (ref only) |

**4.2.3 Data Transfer Rates**

**4.2.3.1 Internal (disk)**

Burst: 25 to 46 mbits/sec

**4.2.3.2 External (bus)**

|        |         |
|--------|---------|
| Async: | 10 MB/s |
| Sync:  | 20 MB/s |

**4.2.4 Head Switching**

Must be less than 500 usec

**4.2.5 Command Overhead**

Controller overhead: < 300 usec (ref only)

**4.2.6 Spin-up / Spin-down time**

|                        |        |
|------------------------|--------|
| Power-on to selection: | 1 sec  |
| Power-on to ready:     | 20 sec |
| Start command:         | 20 sec |
| Stop command:          | 20 sec |

**4.2.7 Interleaving**

Interleave: 1:1

|  |  |                    |
|--|--|--------------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 6 of 23       |
| Changes since previous issue noted by: JPM |  | Dwg. No.      Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |                    |



**4.3 RELIABILITY AND LIFE**

The following information specifies the reliability, read and seek error rates, and the expected life of the device. The requirements shall be met with no stabilization time and with no regard to any particular environmental conditions under which the data was written so long as it was within the operating range of section 5 and 6.

MTBF of the device: 800,000 hrs

MTTR of the device: 30 minutes

Design Component Life: 5 years

Preventive Maintenance: not required

Errors Rates (using retries and ECC)

|                                |                                 |
|--------------------------------|---------------------------------|
| Correctable Read Error Rate    | 1 in 10 <sup>10</sup> bits read |
| Uncorrectable Read Error Rate: | 1 in 10 <sup>14</sup> bits read |
| Seek Error Rate:               | 1 in 10 <sup>6</sup> seeks      |

Media Defects:

The manufacturer shall identify all media defects and provide a list of their locations that is retrievable by accessing the drive's primary defect list. The defect list need not be attached physically to the outside of the drive, although it can be. The drive will be shipped with all defects found during manufacturing, mapped to spare blocks.

No more than a maximum of 2 additional defects shall be allowed during the first 24 hours of operation. After the initial 24 hours of operation, a maximum of 50 defects will be allowed during the life of the drive.

Power Cycling: 10,000

The head / media interface shall be able to withstand 10,000 power-on / power-off cycles without suffering any permanent damage or loss of data.

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|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 7 of 23  |
| Changes since previous issue noted by: JPM |  | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**4.4 INTERFACE SPECIFICATION**

Unless otherwise noted the drive shall meet all of the requirements of the following specification:

SCSI-2 ANSI X3T9.2/86-109 Rev. 10h

**4.5 POWER SPECIFICATIONS**

The following requirements are applicable to the main PCB board power interface connector (J2).

Voltage Requirements: +5 Volts (1.2A max.)  
+12 Volts (2.2 A max.)

( Refer to Table 1 for specific requirements under typical use.)

Voltage Tolerance: 5 Volts +/- 5%  
12 Volts +/- 5%  
+/-10% during start-up

Allowable Ripple: 5 Volts: 100 mV p-p from 0 to 100 KHz  
12 Volts: 120 mV p-p from 0 to 100 KHz

Power Consumption: 16 watts maximum

Voltage sequencing requirements: None

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 8 of 23  |
| Changes since previous issue noted by: JPM |  | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**4.6 DIAGNOSTICS**

The following are the minimum diagnostics requirements for the 3.5 inch SCSI disk drive. The interface requirements basically emphasize items in the ANSI SCSI standard that are necessary to meet HP workstation diagnostic goals.

**4.6.1**

Drive self-test diagnostics must execute upon receiving the SCSI send diagnostic command, with the self-test bit set. No other bits shall be required.

**4.6.2**

When the drive reports self-test status for the send diagnostic command, a check condition status indicates self-test failure and a good status indicates self-test passed. Upon receiving the check condition status, the host can send the drive a SCSI request sense command. The drive will use and support the extended sense format for the request sense data. A good status will be reported only upon the diagnostic passing. Upon failure the device should use the sense key 04(hex) to indicate a hardware failure. The additional sense code should supply more information on the error.

**4.6.3**

If the implementation of the send diagnostic command resides originally on the disk, then power-up diagnostics must ensure that this command can be supported, by getting the firmware off the disk, into RAM, and check-summing it. If the power-up self-test passes, it means the drive can support SCSI commands, especially the send diagnostic command. If it fails, the condition of the drive should indicate a check condition status. The sense keys should include the error information. The drive should not report drive ready, but indicate a hardware error if it has found one. The drive should only indicate drive not ready (sense key 02 hex) if it has not found a problem, and is not ready for use. The drive should indicate a drive not ready status until the power up diagnostics are complete and the status is available.

If power-up diagnostics pass, the sense key should be set to unit attention (06 hex) and the additional sense key set to 29 hex, indicating a power-on or reset condition. If the drive fails power-up self-test, then the sense key should be set to hardware failure (04 hex) and the additional sense key should give additional error code as defined in SCSI-2 specification.

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 9 of 23  |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



4.6.4 Diagnostic coverage upon the send diagnostic command should include:

4.6.4.1

Testing of the PCB, servo, seek mechanics, and read/write of all heads, in the most dense recording area of the disk.

4.6.4.2

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

1. PCB board stuck-at-fault coverage for nets should achieve 90%. This can be verified by performing fault insertion to each net on the PCB. A net is a connection between chip pins. Each net should be driven logically high and low. (The nets can be driven high through an external resistor or by another method of protection). The faults should be inserted one at a time, during execution of the send diagnostic command. If the test fails and the drive indicates status accordingly, then the fault is considered to have been detected.

2. Media fault coverage should include testing for write fault conditions.

4.6.5

The power-up diagnostics, and the diagnostic executed by the send diagnostic command, should be non-destructive to the user data. Any writing done on the drive should be done to a reserved cylinder where user data will never exist.

4.6.6

The Request Sense and Inquiry commands should be fully supported in ROM. In this manner the disk need not be spinning to execute these commands. The Inquiry data including manufacturer name, drive model number, firmware revision, and serial number should be included in the ROM as well.

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 10 of 23 |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



4.7 POWER MANAGEMENT

4.7.1

Some level of Power Management will be required. At this time that requirement has not been defined.

|   |   |               |
|---|---|---------------|
| Date this issue: 07/28/94                     | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive<br>Specification<br><b>PRELIMINARY</b> | Page 11 of 23 |
| Changes since previous<br>issue noted by: JPM |   | Dwg. No. Rev. |
| Approval:                                     | HP Part Number: 0950-2605   |               |



**5.0 MECHANICAL SPECIFICATIONS**

**5.1 PHYSICAL SPECIFICATIONS**

The disk drive must conform to the industry standard low profile form factor and mounting scheme. Dimensions do not include the face plate.

Width of the device: 101.6 mm (4.0")

Height of the device: 25.4 mm (1.00")

Depth of the device: 146.2 mm (5.75")

Weight of the device: .67kg (1.5 lbs)

**5.2 MOUNTING ORIENTATION**

The disk drive may be mounted in any orientation.

Mounting Specification: Refer to Figure 1

There should not be any additional clearance around the physical limits of the device required to allow for movement.

**5.3 ACOUSTIC NOISE LEVEL**

The drive shall meet the acoustic requirements below. Output measured according to the test procedures outlined in ISO 7779. The values listed are maximum allowable levels.

Idle: 32dbA (A weighted sound pressure)  
4.3 bels (sound power)

Seeking: 34dbA (A weighted sound pressure)  
4.5 bels (sound power)

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 12 of 23 |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**5.4 POWER INTERFACE**

The power interface shall adhere to the following specifications:

- 1. Power connector: AMP mate-n-lock (P/N 350543-1) or equivalent
- 2. Power connector pin assignment: see Figure 2
- 3. Power connector location: see Figure 1
- 4. Mating connector: AMP 1-480424-0 or equivalent
- 5. Ground: The HDA base and cover shall be connected to PCB (DC) ground in order to provide noise shielding.

**5.5 SIGNAL INTERFACE**

Interface:  
SCSI 16 bit differential (Ref. to ANSI SCSI spec X3.131)

SCSI signal pin assignments:  
See Table 3

SCSI connector:  
A 68 pin, high density, unshielded, connector.

SCSI connector location:  
See Figure 1

SCSI auxiliary connector pin assignment  
See Table 3

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 13 of 23 |
| Changes since previous issue noted by: JPM |  | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**5.6 OPTIONS**

Reference section 7 for default values.

**5.6.1 TID JUMPERS**

The device must have a set of ID jumpers, consisting of two rows of male pins with adjacent pins 2 mm apart.

**5.6.2 TERMINATION POWER**

The drive shall supply power to the onboard terminators and the TERM POWER interface pin through a zener diode and a fuse.

**5.6.3 SPINDLE CONTROL**

The drive shall power-up automatically upon application of power.

**5.6.4 BUS PARITY**

The drive shall check parity on commands and data.

**5.6.5 BARCODE**

There shall be a barcode label affixed to the drive following the EIA-556 code 39 standard with the serial number printed and barcoded.

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 14 of 23 |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**6.0 ENVIRONMENTAL SPECIFICATIONS**

**6.1 OPERATING ENVIRONMENT**

Temperature: +0<sup>0</sup> to +55<sup>0</sup> C

Temperature Gradient: 24<sup>0</sup> C per hour

Relative Humidity: 8% to 85% non-condensing  
26.7<sup>0</sup> C maximum wet bulb non-condensing

Vibration:

    Swept Sine: 0.5 G (0-peak), 5 - 400 Hz

    Random: 0.0001 G<sup>2</sup>/Hz, 5 - 500 Hz

There will also be a 5 minute dwell at every predominant resonance per axis.

Shock: 2 G (peak), 11 ms, 1/2 sine wave (no soft errors)  
10 G (peak), 11 ms, 1/2 sine wave (no hard errors)

Altitude: -200 to 10,000 ft.

**6.2 NON-OPERATING ENVIRONMENT**

Temperature: -40<sup>0</sup> to +70<sup>0</sup> C

Temperature Gradient: 24.0<sup>0</sup> C per hour

Relative Humidity: 10% to 90% non-condensing  
26.7<sup>0</sup> C maximum wet bulb non-condensing

Vibration:

    Swept Sine: 0.2 inches (peak to peak), 5-30 Hz  
1.0 G (0-peak), 30 - 500 Hz

    Random: 0.015 G<sup>2</sup>/Hz, 5 - 500 Hz

Shock: 20G (peak), 11ms, 1/2 sinewave  
25 G (peak), 26 ms, trapezoidal

Altitude: -1000 to 40,000 feet

|  |  |                    |
|--|--|--------------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 15 of 23      |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No.      Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |                    |



**6.3 TRANSPORTATION ENVIRONMENT**

Every unit shall be shipped in a ESD bag with desiccant.

The original shipping container must be capable of withstanding (without functional or cosmetic damage) three 30 inch free fall drops onto any face, edge and corner of the shipping container.

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|--|---|--------------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive<br>Specification | Page 16 of 23      |
| Changes since previous issue noted by: JPM |   | <b>PRELIMINARY</b> |
| Approval:                                  | HP Part Number: 0950-2605   |                    |



**6.4 PRODUCT SAFETY AND EMISSIONS**

The device shall comply with the following agency regulations. The device when installed in any system or subsystem for which its use is intended shall not prevent HP from obtaining approval from any agency.

1. UL 1950 (1<sup>st</sup> edition), Safety of Information Technology Equipment Including Electrical Business Equipment, UL RECOGNIZED.
2. CSA C22.2 No. 950–M89 Safety of Information Technology Equipment, Including Electrical Business Equipment.
3. IEC 950 (1<sup>st</sup> edition), Safety of Information Technology Equipment Including Electrical Business Equipment, TUV or VDE' Bauart Geprüft' COMPONENT LICENSED.
4. ZH 1/618, Edition 10/80, safety Regulations for Display Work places in the of Office Sector. Certified by Technischer Uberwachungs–Verein or Verband Deutscher Elektrotechniker.
5. This product shall demonstrate statistical compliance with the radiated emission requirements of EN55022 class B. Statistical compliance shall be determined by the methods of par. 7.2.3 of EN55022 using a sample size of no less than 5 units.

- A. IEC 801–3 : 1984
- B. FCC Part 15, Class B with 6 db margin
- C. EN 55022 (CISPER Class B) with 6dB margin
- D. VCCI Class 1 ITE
- E. IEC 801–2: 1991

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 17 of 23 |
| Changes since previous issue noted by: JPM |  | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950–2605  |               |



**6.5 LABELS AND MARKINGS**

The drive shall have the following markings and labels:

1. Manufacturer's Model, Serial, and Part numbers (with revision)
2. UL Recognition Mark
3. CSA Component Certification Mark
4. TUV or VDE "Bauart Geprüft" mark
5. The following label should be applied to both newly manufactured and customer service drives:

**Mfg. p/n**

**Cust. Serv. p/n**

**Cust Serv. Exchange p/n**

**HP MANUFACTURING USE**

Part Number: aaaa-aaaa

Serial Number: bbbbbbbbbbb

|||||

**HP CUSTOMER SERVICE USE**

Part Number: xxxxx-xxxxx

Exchange Part Number: yyyyy-yyyyy

aaaa-aaaa is HP Manufacturing p/n

bbbbbbbbbb is Supplier serial number

||||| is barcoded Supplier serial number (code 39 preferred)

xxxxx-xxxxx is HP Spare p/n

yyyyy-yyyyy is HP Exchange p/n

HP Spare p/n and HP Exchange p/n will change if there is a major quality problem which requires rework.

Supplier may put information on parts in any one of the following ways:

- A single additional label with all above information.
- Two additional labels, one for HP Manufacturing, one for HP Customer Service.
- Print this information on an existing label.

Supplier may customize the size and layout of the label to fit on part.

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 18 of 23 |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**7.0 DEFAULT VALUES**

**7.1 TID JUMPERS**

The drive is to be shipped at target ID 6.

**7.2 TERMINATION AND TERMINATION POWER**

The device is to be shipped with terminators removed or termination disabled.

**7.3 MODE SELECT PAGES**

HP requires the following Mode Page settings. Those values not specified should be set to the manufacturers default values.

Error Recovery: Page 01

byte 2 = C0

Disconnect/Reconnect: Page 02

byte 2 & 3 tuned on an HP system by the manufacturer to obtain best performance

byte 12 = 00

Caching: Page 08

byte 02 = 04

Control Mode: Page 0A

byte 3 = 00

**7.4 BEZEL AND LED**

The drive is to be shipped without a bezel.

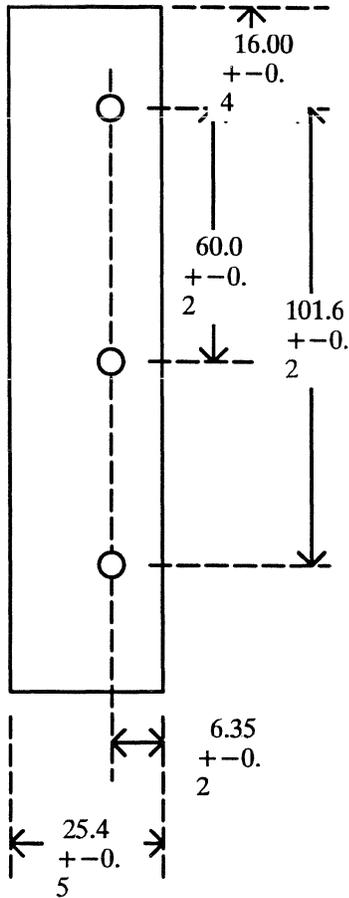
The drive shall have a green LED mounted on the front of the PCB.

**8.0 FIGURES AND TABLES**

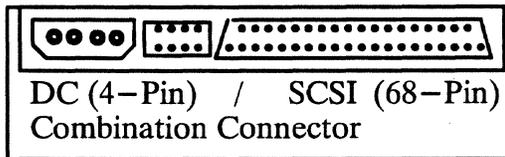
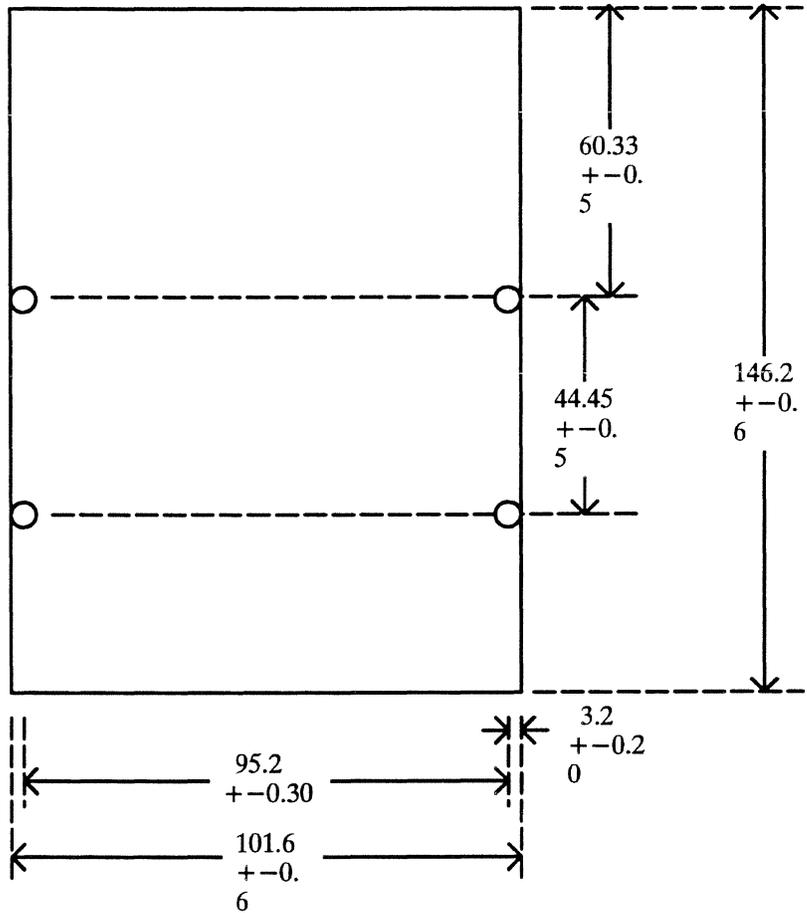
|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 19 of 23 |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**SIDE**



**BOTTOM**  
(PC BOARD SIDE)



**BACK**

Note:  
All dimensions are in mm.  
Mounting Holes are 6-32

**FIG. 1 DIMENSIONS AND MOUNTING**

|  |  |               |
|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 20 of 23 |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



Figure 2 Combination Connector Pin Assignment

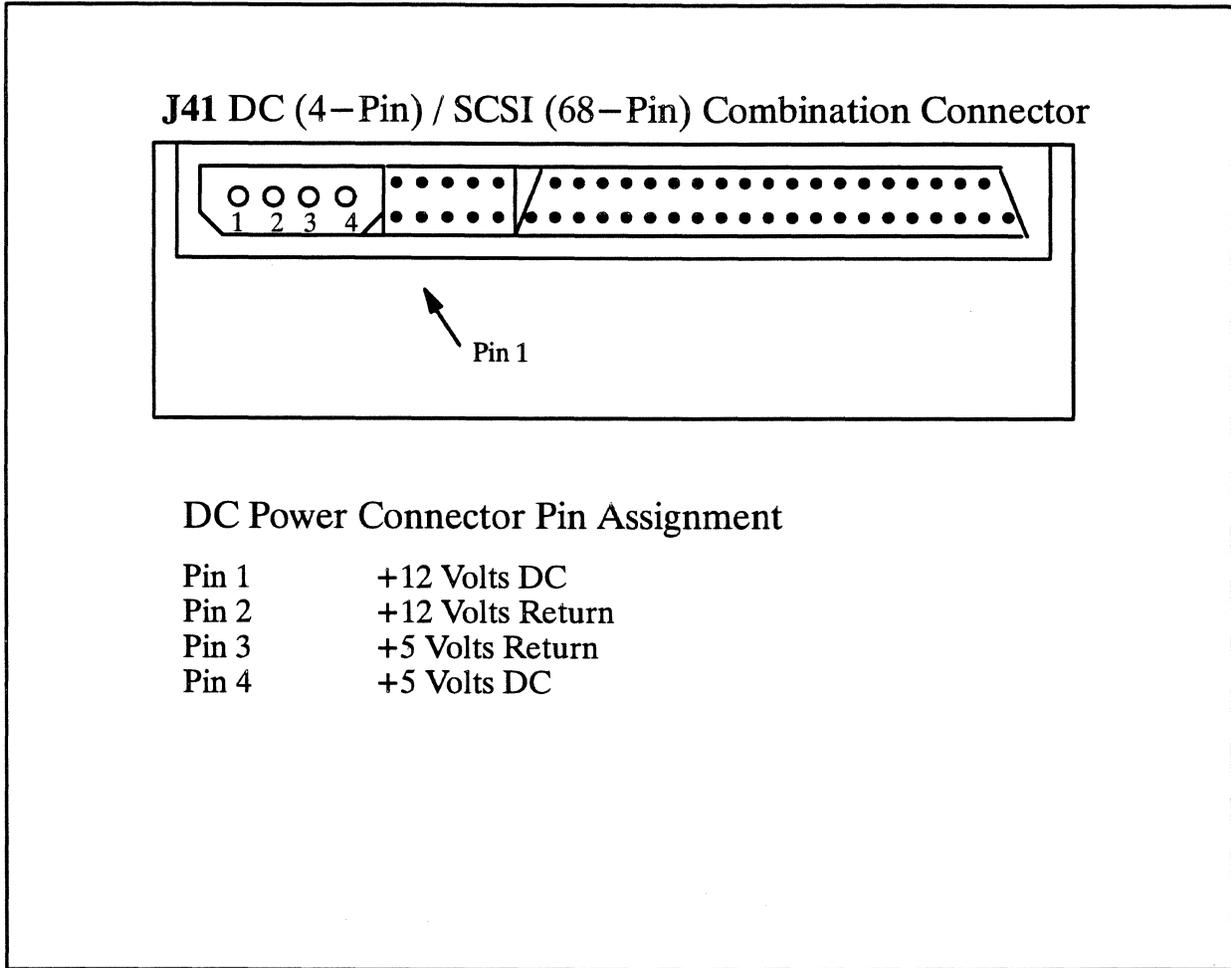


Table 1 Maximum Current Requirements

| Voltage   | Start-Up |       | Idle  |       | Random Read/Write |        |
|-----------|----------|-------|-------|-------|-------------------|--------|
|           | Avg      | Peak  | Avg   | Peak  | Avg               | Peak   |
| +5 Volts  | 1.0 A    | 1.0 A | 1.0 A | 1.0 A | 1.0 A             | 1.0 A  |
| +12 Volts | 2.0 A    | 2.2 A | .56 A | 1.8 A | 1.0 A             | 1.85 A |

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| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 21 of 23      |
| Changes since previous issue noted by: JPM |  | Dwg. No.      Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |                    |



**Table 2 Signal Assignments for Auxiliary Connector**

| Pin | Signal | Description        | Host   Direction   Device |
|-----|--------|--------------------|---------------------------|
| 01  | Sel 0  | SCSI ID Sel 0      | x -----> x                |
| 02  | XTFALT | External Fault     | x <----- x                |
| 03  | Sel 1  | SCSI ID Sel 1      | x -----> x                |
| 04  | VUNIQ  | Vendor Unique      | x <----- x                |
| 05  | Sel 2  | SCSI ID Sel 2      | x -----> x                |
| 06  | SPSYNC | Spindle Synch      | x <----- x                |
| 07  | Sel 3  | SCSI ID Sel 3      | o -----> x                |
| 08  | XTACTV | External Activity  | x <----- x                |
| 09  | ENTERM | Enable Termination | o -----> x                |
| 10  | Ground | Ground             | <----- x                  |
| 11  | +5v    | +5v                | <----- x                  |
| 12  | Fault  | Drive Fault        | x -----> x                |

**Notes:**

Direction column indicates the direction of the signal between host and device.

An x in the Host column means this signal shall be supported by the Host.

An x in the Device column means the signal shall be supported by the Device.

An o means this signal is optional.

If there is nothing in the Device column for a pin location, than no connection should be made to that pin.

Pins 2, 4, 6 and 8 are open-collector outputs.

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|--|--|---------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification | Page 22 of 23 |
| Changes since previous issue noted by: JPM | <b>PRELIMINARY</b>   | Dwg. No. Rev. |
| Approval:                                  | HP Part Number: 0950-2605  |               |



**Table 3 SCSI Interface Signals**

| PIN NO. | NAME     | PIN NO. | NAME     |
|---------|----------|---------|----------|
| 01      | DB(12)   | 35      | -DB(12)  |
| 02      | DB(13)   | 36      | -DB(13)  |
| 03      | DB(14)   | 37      | -DB(14)  |
| 04      | DB(15)   | 38      | -DB(15)  |
| 05      | DB(P1)   | 39      | -DB(P1)  |
| 06      | GROUND   | 40      | GROUND   |
| 07      | DB(0)    | 41      | -DB(0)   |
| 08      | DB(1)    | 42      | -DB(1)   |
| 09      | DB(2)    | 43      | -DB(2)   |
| 10      | DB(3)    | 44      | -DB(3)   |
| 11      | DB(4)    | 45      | -DB(4)   |
| 12      | DB(5)    | 46      | -DB(5)   |
| 13      | DB(6)    | 47      | -DB(6)   |
| 14      | DB(7)    | 48      | -DB(7)   |
| 15      | DB(P)    | 49      | -DB(P)   |
| 16      | DIFFSENS | 50      | GROUND   |
| 17      | TERMPWR  | 51      | TERMPWR  |
| 18      | TERMPWR  | 52      | TERMPWR  |
| 19      | RESERVED | 53      | RESERVED |
| 20      | ATN      | 54      | -ATN     |
| 21      | GROUND   | 55      | GROUND   |
| 22      | BSY      | 56      | -BSY     |
| 23      | ACK      | 57      | -ACK     |
| 24      | RST      | 58      | -RST     |
| 25      | MSG      | 59      | -MSG     |
| 26      | SEL      | 60      | -SEL     |
| 27      | C/D      | 61      | -C/D     |
| 28      | REQ      | 62      | -REQ     |
| 29      | I/O      | 63      | -I/O     |
| 30      | GROUND   | 64      | GROUND   |
| 31      | DB(8)    | 65      | -DB(8)   |
| 32      | DB(9)    | 66      | -DB(9)   |
| 33      | DB(10)   | 67      | -DB(10)  |
| 34      | DB(11)   | 68      | -DB(11)  |

NOTE: The minus sign preceding the signal name indicates active low.

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|--|--|--------------------|
| Date this issue: 07/28/94                  | Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification<br><b>PRELIMINARY</b> | Page 23 of 23      |
| Changes since previous issue noted by: JPM |  | Dwg. No.      Rev. |
| Approval:                                  | HP Part Number: <b>0950-2605</b>   |                    |



Table 4 SCSI ID SETTINGS

| SCSI ID Address | A3  | A2  | A1  | A0  |
|-----------------|-----|-----|-----|-----|
| 0               | OFF | OFF | OFF | OFF |
| 1               | OFF | OFF | OFF | ON  |
| 2               | OFF | OFF | ON  | OFF |
| 3               | OFF | OFF | ON  | ON  |
| 4               | OFF | ON  | OFF | OFF |
| 5               | OFF | ON  | OFF | ON  |
| 6               | OFF | ON  | ON  | OFF |
| 7               | OFF | ON  | ON  | ON  |
| 8               | ON  | OFF | OFF | OFF |
| 9               | ON  | OFF | OFF | ON  |
| 10              | ON  | OFF | ON  | OFF |
| 11              | ON  | OFF | ON  | ON  |
| 12              | ON  | ON  | OFF | OFF |
| 13              | ON  | ON  | OFF | ON  |
| 14              | ON  | ON  | ON  | OFF |
| 15              | ON  | ON  | ON  | ON  |

Date this issue: 07/28/94

Changes since previous issue noted by: JPM

Approval:

Title: 2.0GB 3.5" Wide Differential Low Profile Disk Drive Specification

**PRELIMINARY**

HP Part Number: 0950-2605

Page 24 of 23

Dwg. No. Rev.