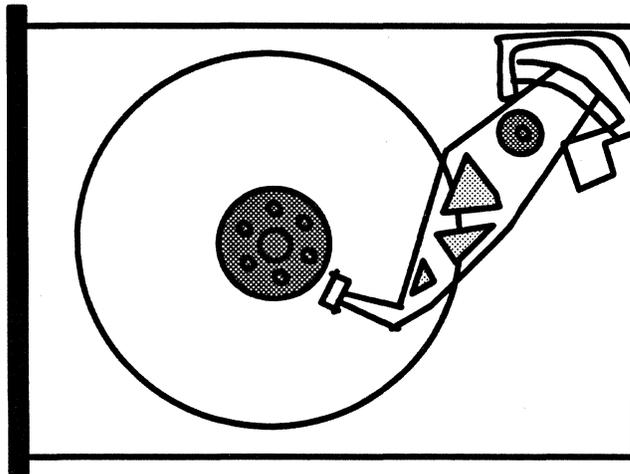




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*1.0 Gigabyte 3.5 inch Low Profile  
Disk Drive Specification*

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**2.0 INTRODUCTION**

**2.1 SCOPE**

This specification outlines the requirements for a 3.5 inch, 1.0 inch high form factor, SCSI rigid disk drive. 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

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**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 the 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.

**3.2 FIRMWARE**

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

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**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:	1.209 GB (ref only)
Formatted (512):	2051460 blocks (must be exact)
Max LBA	2051459 (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:	27 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:	5 MB/s
Sync:	10 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

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**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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**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: 13.5 watts maximum

Voltage sequencing requirements: None

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**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.

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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.

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4.7 POWER MANAGEMENT

4.7.1

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

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**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)

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**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 single ended (Ref. to ANSI SCSI spec X3.131)

SCSI signal pin assignments:

See Table 2

SCSI connector:

A fifty pin, low density, unshielded, keyed, shrouded connector consisting of two rows of 25 male pins with adjacent pins 2.54 mm (0.1 in.) apart.

SCSI connector location:

See Figure 1

Mating Connector/Cable:

A fifty pin, low density, keyed, strain-relief connector consisting of two rows of 25 female contacts with adjacent contacts 2.54mm (0.1 in.) apart.

Termination:

Removable packs or disableable termination is to be used and must conform to the ANSI standard.

Terminator location:

Location of terminators should be on the back end of the PCB.

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**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.

**5.7 COOLING REQUIREMENTS**

Per manufacturers Product Specification or via natural convection if not specified.

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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

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**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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**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

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**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**

<p><b>HP MANUFACTURING USE</b>  Part Number: aaaa-aaaa  Serial Number: bbbbbbbbbbb       </p> <p><b>HP CUSTOMER SERVICE USE</b>  Part Number: xxxxx-xxxxx  Exchange Part Number: yyyyy-yyyyy</p>
--

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.

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**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

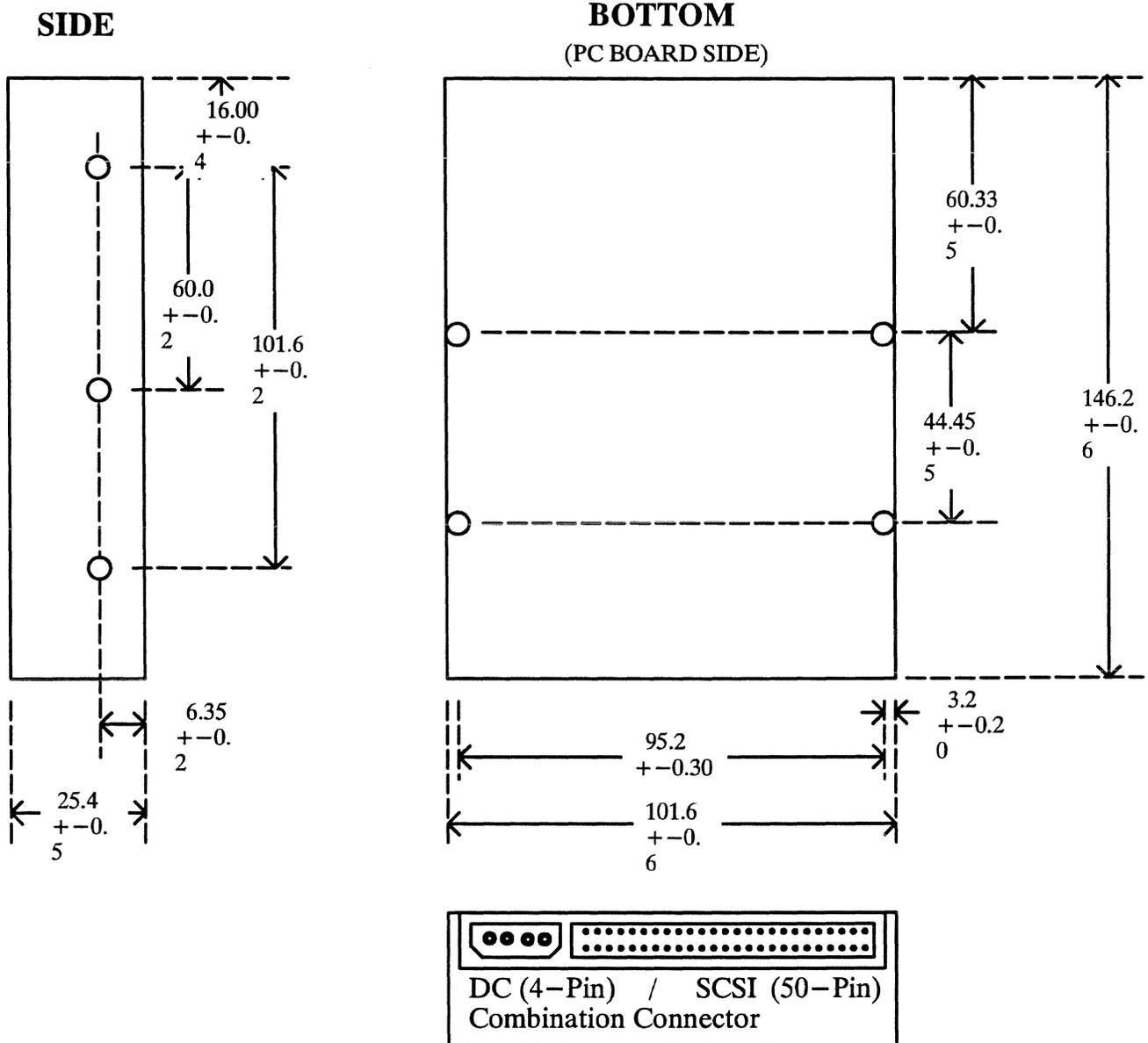
Control Mode: Page 0A  
byte 3 = 00

**7.4 BEZEL AND LED**

The drive is to be shipped without a bezel.  
The drive will have a green led mounted on the front of the PCB

**8.0 FIGURES AND TABLES**

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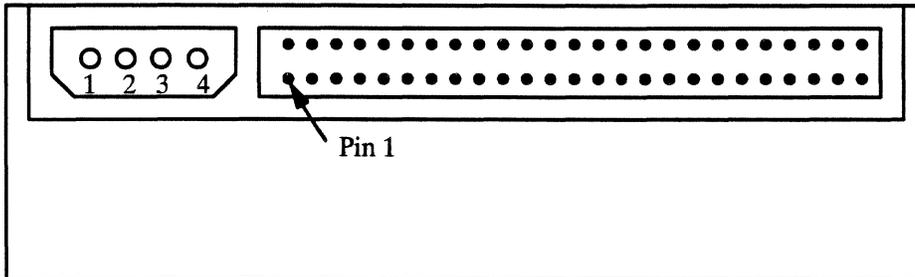
Note:  
All dimensions are in mm.  
Mounting Holes are 6-32

**FIG. 1 DIMENSIONS AND MOUNTING**

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**J41 DC (4-Pin) / SCSI (50-Pin) Combination Connector**



**DC Power Connector Pin Assignment**

- Pin 1            +12 Volts DC
- Pin 2            +12 Volts Return
- Pin 3            +5 Volts Return
- Pin 4            +5 Volts DC

**Figure 2 Combination Connector Pin Assignment**

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**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

**Table 2 SCSI Interface Signals**

PIN NO.	NAME	TO	DESCRIPTION
02	DB(0)	B	Data Bus (LSB)
04	DB(1)	B	Data Bus
06	DB(2)	B	Data Bus
08	DB(3)	B	Data Bus
10	DB(4)	B	Data Bus
12	DB(5)	B	Data Bus
14	DB(6)	B	Data Bus
16	DB(7)	B	Data Bus (MSB)
18	DB(P)	B	Data Bus Parity
20			Not Used (GND)
22			Not Used (GND)
24			Reserved
26	Termpwr	B	Terminator Power
28			Reserved
30			Not Used (GND)
32	ATN	D	Indicates Message available for drive
34			Not Used (GND)
36	BSY	B	Signal indicating bus is in use
38	ACK	D	Data/Command transfer handshake
40	RST	B	Or-tied signal indicating reset condition
42	MSG	H	Indicates message phase
44	SEL	B	Signal indicating selection/reselection phase
46	C/D	H	Indicates whether control or data information is on data bus. Assertion indicates control.
48	REQ	H	Data/Command transfer handshake
50	I/O	H	Indicates direction of information transfer. Assertion indicates transfer to host.

H = Host D = Drive B = Bidirectional

NOTE: All odd pins shall be signal returns and shall be connected to signal GND at the drive, except pin 25 which is left free to protect against mis-insertion.

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**Table 3 SCSI ID SETTINGS**

SCSI ID Address	A2	A1	A0
0	OFF	OFF	OFF
1	OFF	OFF	ON
2	OFF	ON	OFF
3	OFF	ON	ON
4	ON	OFF	OFF
5	ON	OFF	ON
6	ON	ON	OFF
7	ON	ON	ON

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