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Seagate

Hawk 2XL Disc Drive

ST32151N/W/WC, ST31051N/W/WC

ST32155N/W/WC, ST31055N/W/WC

Product Manual, Volume 1

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Hawk 2XL Disc Drive

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If the SCSI Interface information is needed the Volume 2 Interface Manual should be ordered, P/N 77738479.

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1.0 Scope

This manual describes the Seagate Technology, Inc. Hawk 2XL family of disc drives. This high capacity, high performance member of the Seagate 1-inch high 3.5-inch rigid disk family is a next generation product from the Hawk 2LP (ST34230) disc drive. The Hawk 2XL features a new cost-optimized HDA, reduced cost SCSI code, reduced header fields and the use of innovative technology in the embedded servo, R/W heads, read circuits and SCSI controller. Section 5 lists performance information for this drive. The Hawk 2XL drive operates an interface to the host defined by a subset of ANSI SCSI 2/SCSI 3 as described in Section 9 of this manual (Vol.1) and the Seagate SCSI Interface manual 77738479 (Vol. 2).

The Hawk 2XL family consists of ST32151, ST31051, ST32155 and ST31055 products. Models offered are N, W, and WC.

Table 1 lists the salient features that differentiate the different Hawk 2XL model numbers.

Table 1: Drive model number vs. differentiating features

Fast SCSI-3

Model number	# Heads	I/O Ckts	#I/O connector	I/O data bus bits	Interface Data transfer rate (Mbytes/sec)
ST32151N	8	single-ended	50	8	10
ST32151W	8	single-ended	68	16	20
ST32151WC	8	single-ended	80	16	20
ST31051N	4	single-ended	50	8	10
ST31051W	4	single-ended	68	16	20
ST31051WC	4	single-ended	80	16	20

ULTRA SCSI-3 [1]

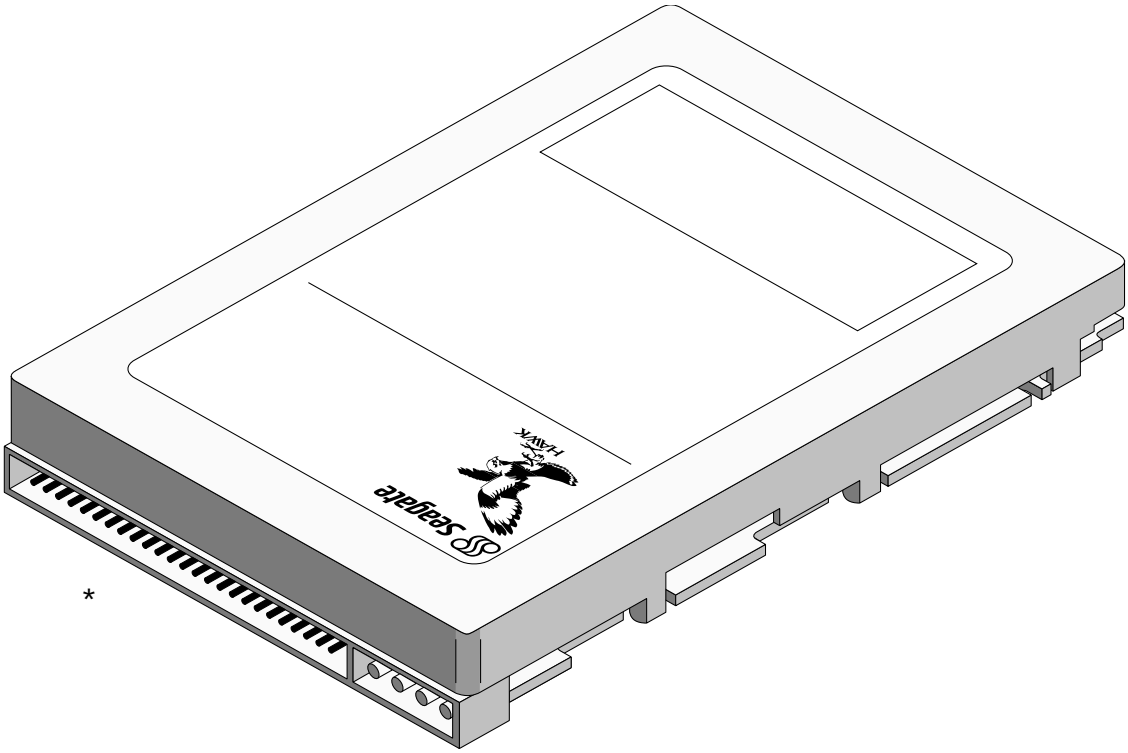
Model number	# Heads	I/O Ckts	#I/O connector	I/O data bus bits	Interface Data transfer rate (Mbytes/sec)
ST32155N	8	single-ended	50	8	20
ST32155W	8	single-ended	68	16	40
ST32155WC	8	single-ended	80	16	40
ST31055N	4	single-ended	50	8	20
ST31055W	4	single-ended	68	16	40
ST31055WC	4	single-ended	80	16	40

From this point on in this Product Manual the reference to Hawk 2XL family models is referred to as “the drive” (unless reference to individual models are necessary).

The drive printed circuit board is referred to as a PCB.

[1] ULTRA SCSI is Seagate’s name for the ANSI proposed “FAST-20” interface.

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*Model “N” version with 50 pin SCSI I/O connector

Figure 1. Hawk 2XL family drive

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2.0 Applicable standards and reference documentation

The drive has been developed as a system peripheral to the highest standards of design and construction. The drive depends upon its host equipment to provide adequate power and environment in order to achieve optimum performance and compliance with applicable industry and governmental regulations. Special attention must be given in the areas of safety, power distribution, shielding, audible noise control, and temperature regulation. In particular, the drive must be securely mounted in order to guarantee the specified performance characteristics. Mounting by bottom holes must meet the requirements of Section 8.4.

2.1 Standards

The Hawk 2XL Family complies with Seagate standards as noted in the appropriate sections of this Manual and the Seagate SCSI Interface Manual, P/N 77738479 (Vol. 2).

The Hawk 2XL Family is a UL Recognized component per UL 1950 and a CSA Certified component per CAN/CSA-C22.2 No. 950-M89. It also meets the requirements of DIN VDE 0805/05.90 and EN60950: 1988 (IEC 950).

2.1.1 Electromagnetic compatibility

The drive, as delivered, is designed for system integration and installation into a suitable enclosure prior to use. As such the drive is supplied as a subassembly and is not subject to Subpart J of Part 15 of the FCC Rules and Regulations nor the Radio Interference Regulations of the Canadian Department of Communications. However, the unit has been tested using proper shielding and grounding and found to be compliant with Class A limits of the FCC Rules and the Regulations of the Canadian Department of Communications.

The physical design characteristics of the drive serve to minimize radiation when installed in an enclosure that provides reasonable shielding. As such, the drive is capable of meeting the Class B limits of the FCC Rules and Regulations of the Canadian Department of Communication. However, it is the user's responsibility to assure that the drive meets the appropriate EMI requirements in their system. Shielded I/O cables may be required if the enclosure does not provide adequate shielding. If the I/O cables are external to the enclosure, shielded cables should be used, with the shields grounded to the enclosure or to the host controller, but not both.

2.1.2 Electromagnetic susceptibility

As a component assembly, the drive is not required to meet any susceptibility performance requirements. It is the responsibility of those integrating the drive within their systems to perform those tests required and design their system to ensure that equipment operating in the same system as the drive or external to the system does not adversely affect the performance of the drive. See Section 5.1.1 and Table 2, DC power requirements.

2.2 Electromagnetic Compliance for the European Union

If this model has the CE Marking it complies with the European Union requirements of the Electromagnetic Compatibility Directive 89/336/EEC of 03 May 1989 as amended by Directive 92/31/EEC of 28 April 1992 and Directive 93/68/EEC of 22 July 1993.

Seagate uses an independent laboratory to confirm compliance to the above directives. The drive was tested in a representative system for typical applications. The selected system represents the most popular characteristics for test platforms The system configurations include:

- 486, Pentium, and PowerPC Microprocessors
- 3.5-inch Floppy Disc Drive
- Keyboard
- Monitor/Display

Although the test system with this Seagate model complies to the directives, we cannot guarantee that all systems will comply. The computer manufacturer or system integrator shall conform EMC compliance and provide CE Marking for their product.

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2.3 Reference documents

Installation Guide Seagate P/N 77767490

SCSI Interface Manual Seagate P/N 77738479

ANSI Small Computer System Interface (SCSI): Document Number ANSI3.131-1986 (X3T9/84.40 Rev. 1B) (X3T9.2/82-2 Rev. 17B), X3T9.2/86-109 Revision 10H (SCSI-2) and X3T9.2-184 Rev. 4 (SCSI-3).

ANSI - draft proposed: Document Number X3T10/1071D, SCSI-3 FAST-20 revision 6.

Package Test Specification Seagate P/N 30190-001 (under 100 lb.)

Package Test Specification Seagate P/N 30191-001 (over 100 lb.)

In case of conflict between this document and any referenced document, this document takes precedence.

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3.0 General description

The drives are a member of a family of low cost, high performance, highly reliable, random access storage devices designed to meet the needs of the OEM marketplace.

The drive records and recovers data on 3.5 inch (89 mm) fixed discs.

The drive supports the Small Computer System Interface as described in the ANSI SCSI-2 and SCSI-3 Interface Manuals to the extent described in this product Manual (Vol. 1), which defines the product performance characteristics of the Hawk 2XL Family of drives, and the SCSI Interface Product Manual P/N 77738479 (Vol. 2, Version 2) which describes the general interface characteristics of this and other families of Seagate 3.5-inch drives.

The drive interface supports multiple initiators, disconnect/reconnect, self-configuring host software and automatic features that relieve the host from the necessity of knowing the physical characteristics of the targets (logical block addressing is used).

TheHead/Disc Assembly (HDA) is environmentally sealed at the factory. Air recirculates within the Head/Disc (HDA) through a nonreplaceable filter to maintain a contamination free head/disc environment.

Refer to Figure 2, an exploded view of the drive. NEVER disassemble the Head/Disc Assembly (HDA). This exploded view is for information only. Do not attempt to service items in the sealed environmental enclosure (heads, media, actuator, etc.) as this requires special facilities. The drive contains no parts replaceable by the user. The drive warranty is voided if the HDA is opened.

The Hawk 2XL Family drives use a dedicated landing zone at the innermost radius of the media to eliminate the possibility of destroying or degrading data by landing in the data zone. The drive automatically goes to the landing zone when the power is removed.

The Hawk 2XL Family drives incorporate an automatic shipping lock which prevents potential damage to the heads and discs that result from movement during shipping and handling. The shipping lock is automatically disengaged when power is applied to the drive and the head load process begins.

The Hawk 2XL Family drives decode track location from the servo data embedded on each surface to eliminate mechanical transducer adjustments and related reliability concerns.

The Hawk 2XL Family drives use a high performance actuator assembly that consists of a low inertia, balanced, patented, straight arm design that provides excellent performance with minimum power dissipation.

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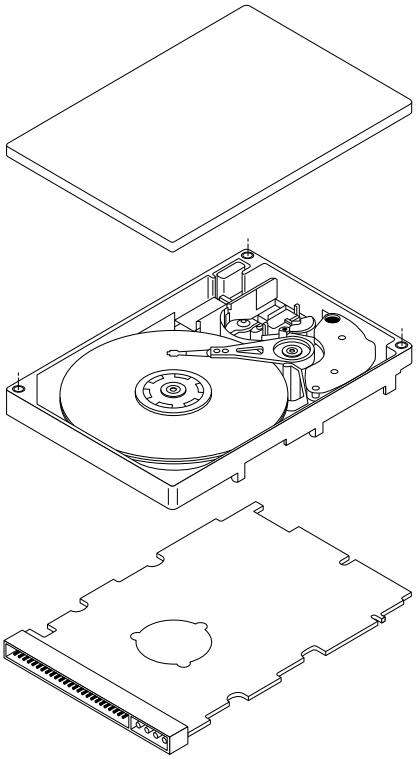


Figure 2. Hawk 2XL family drive

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3.1 Standard features

The Hawk 2XL Family has the following standard features:

- Integrated SCSI Controller with reduced complexity SCSI code
- Single-ended SCSI drivers and receivers
- Asynchronous and Synchronous data transfer protocol
- Firmware downloadable via SCSI interface
- Flawed sector reallocation at format time
- Programmable auto write and read reallocation
- Reallocation of defects on command (Post Format)
- 96 bit Reed-Solomon error correcting code
- Sealed Head/Disc Assembly
- No preventative maintenance or adjustment required
- Dedicated head landing zone
- Embedded servo data rather than a separate servo data surface
- Self diagnostics performed at power on
- 1:1 Interleave
- Zoned Bit Recording (ZBR)
- Vertical, horizontal, or top down mounting
- Dynamic spindle brake
- Permanently mounted terminators on “N” and “W” models, enabled by installation of a jumper plug.
- 256 K byte data buffer (512K byte data buffer for “W” and “WC” models and all Ultra SCSI models)
- Hot Plug compatibility (Section 9.6.4.3 lists proper host connector needed)
- SCAM plug-n-play compliant [1]
- ULTRA SCSI (Models ST32155 and ST31055)

3.2 Media characteristics

The media used on the drive has a diameter of approximately 3.5 inches (89 mm). The aluminum substrate is coated with a thin film magnetic material, overcoated with a proprietary protective layer for improved durability and environmental protection.

3.3 Performance

- Programmable multi-segmentable cache buffer
- 5411 RPM Spindle. Average latency = 5.54 msec
- Command Queuing of up to 64 commands
- Background processing of queue
- Supports start and stop commands (spindle stops spinning)
- Low audible noise for office environment
- Low power consumption

3.4 Reliability

- 800,000 hour MTBF
- Adaptive servo calibration for improved seek performance
- LSI circuitry
- Balanced low mass rotary voice coil actuator
- 5 year warranty for ST32151 and ST32155; 3 year warranty for ST31051 and ST31055

[1] Supports SCAM Level 1 at the moment. Will support Level 2 when all presently unresolved requirements are fully defined. As a factory installed option SCAM can be turned off.

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3.5 Unformatted and formatted capacities

Formatted capacity depends on the number of spare reallocation sectors reserved and the number of bytes per sector. The following table shows some typical 512 byte sector size [1] formatted capacities (rounded off).

	ST32151 GB ST32155 GB	ST31051 GB ST31055 GB
Spare Sector or Cylinders		
Reserved for reallocation		
No Spares	2.18	1.07
Five Spare Sectors per Cylinder [2]	-	1.06
Ten Spare Sectors per Cylinder [2]	2.15	-

The standard OEM model is as follows:

	Formatted Data Block Size 512 Byte/Sector	Unformatted
ST32151/ST32155	2.148 GB[4]	2.54 GB
ST31051/ST31055	1.060 GB[5]	1.26 GB

Notes.

[1] Sector size selectable when formatted at factory.
[2] All spare sectors are on one track.
[3] Spare cylinders are on the two inner tracks.
[4] Sparing equivalent to eight spare sector per cylinder (all spare sectors are on one track), two spare cylinders/unit.[3]
[5] Sparing equivalent to five spare sectors per cylinder (all spare sectors are on one track), two spare cylinders/unit.[3]

3.6 Factory installed accessories

OEM Standard drives are shipped with Installation Guide P/N 77767490 (unless otherwise specified). The factory also ships with the drive a small bag of the two jumper plug types used for the option select jumper headers.

3.7 Options (factory installed)

All customer requested options are incorporated during production or packaged at the manufacturing facility before shipping. Some of the options available are (not an exhaustive list of possible options):

- The capacities shown in Section 3.5. Other capacities can be ordered depending on sparing scheme and sector size requested.
- Black plastic front panel. Other panel colors may be specially ordered. Panel has a green, rectangular LED drive activity indicator lens. The indicator glows when the drive is selected.
- Single unit shipping pack. The drive is normally shipped in bulk packaging to provide maximum protection against transit damage. Units shipped individually require additional protection as provided by the single unit shipping pack. Users planning single unit distribution should specify this option.
- The Installation Guide (P/N 77767490) is usually included with each standard OEM drive shipped, but extra copies may be ordered.

3.8 Accessories (user installed)

The following accessories are available. All accessories may be installed in the field.

- Front Panel Kit (with green rectangular LED lens).
- Single unit shipping pack.
- Adapter Accessory Frame Kit P/N 75790701. This kit adapts a 3.5 inch Model “N” and “W” drives to fit in a 5.25 inch drive mounting space. The frame does not work for “WC” model drives which plug directly into a bulkhead or backplane connector.

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4.0 Performance characteristics

4.1 Internal drive characteristics (transparent to user)

	ST32151/ST32155	ST31051/ST31055	
Drive Capacity	2.54	1.26	GByte (UNF) (Rounded off values)
Read/Write Heads	8		
Bytes/Track	75,900	75,900	Bytes (Avg) (Rounded off values)
Bytes/Surface	318	315	Mbytes (UNF) (Rounded off values)
Tracks/Surface, Total	4176	4176	Tracks (user accessible)
Tracks/Inch	4800	4800	TPI
Servo Heads	0	0	(embedded servo)
Internal Data Rate	44 - 66	44 - 66	Mbits/sec (variable with zone)
Disc Rotational Speed	5411 ± 0.5%	5411 ± 0.5%	r/min
Average Rotational Latency	5.54	5.54	ms

4.2 SCSI Seek performance characteristics (visible to user) [6]*

The values given in Section 4.2.1 apply to all models of the Hawk 2XL family unless otherwise specified. Refer to Section 9.9 and to the SCSI-2 Interface Product Manual 77738479 for additional timing details.

4.2.1 Access time

				Including Controller Overhead (without disconnect) [1] [4] Drive Level Read	Write
				ms	
Average	-	Typical	[3]	10.4	11.4
		Max.	[2]	11.9	13.4
Single Track	-	Typical	[3]	2.7	2.9
		Max.	[2]	3.8	4.3
Full Stroke	-	Typical	[3]	20.4	21.4
		Max.	[2]	23.9	24.9

*[ ] All notes for Sections 4.2 are listed at end of Section 4.2.3.

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4.2.2 Format command execution time (minutes) [1]

	ST32151/ST32155	ST31051/ST31055
Maximum (with verify)	30	20
Maximum (no verify)	20	10

4.2.3 Generalized performance characteristics

Minimum Sector Interleave (all Hawk 2XL models) 1 to 1

Data Transfer Rate (1 sector) - 512 Byte Sector, Data Buffer To/From Disc Media:

		ST32151/ST32155		ST31051/ST31055	
Min.	[4]*	5.1	MByte/sec	5.1	MByte/sec
Avg.	[4]	7.1	MByte/sec	7.1	MByte/sec
Max.	[4]	8.2	MByte/sec	8.2	MByte/sec

Data Transfer Rate (< 1 Track) - 512 Byte Sector, Data Buffer To/From Disc Media:

		ST32151/ST32155		ST31051/ST31055		
Min.	[4]	3.8	MByte/secs	3.8	MByte/sec	divided by (Interleave Factor)
Avg.	[4]	5.6	MByte/secs	5.6	MByte/sec	divided by (Interleave Factor)
Max.	[4]	6.4	MByte/secs	6.4	MByte/sec	divided by (Interleave Factor)

SCSI Interface Data Transfer Rate (Asynchronous) [5] (all Hawk 2XL models):

Maximum Instantaneous	6.0 [6]	MBytes/sec
Maximum Average	6.0	MBytes/sec

The remainder of the specifications of Section 4.2.3 apply to all Hawk 2XL models:

Sector Sizes	Variable (180 to 4096 bytes per sector, but factory configurable only) in even number of bytes per sector.

Synchronous Transfer Rate for ULTRA SCSI-2 models from 1.25 MBytes/sec to 20.0 MBytes/sec for 8 bit data bus and 40.0 MBytes/sec for 16 bit data bus. (see Section 9.5)

Synchronous Transfer Rate for Fast SCSI-2 models from 1.25 MBytes/sec to 10.0 MBytes/sec for 8 bit data bus and 20.0 MBytes/sec for 16 bi6t data bus. (see Section 9.5)

Read/Write consecutive sectors on a track	Yes
Flaw reallocation performance impact (For flaws reallocated at format time using the spare sectors per cylinder reallocation scheme.) [7]	Negligible
Flaw reallocation performance impact (For flaws reallocated at format time using the spare tracks per volume reallocation scheme.)[7]	22.16 msec (typical)
Overhead time for head switch (512 byte sectors)	1 msec
Overhead time for one track cylinder switch	<3 msec Typical
Average rotational latency	5.54 msec

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Notes for Sections 4.2.

[1] Execution time measured from receipt of the last Byte of the Command Descriptor Block (CDB) to the request for a Status Byte Transfer to the Initiator (excluding connect/disconnect).
[2] Maximum times are specified over the worst case conditions of temperature, voltage margins and drive orientation. When comparing specified access times, care should be taken to distinguish between typical access times and maximum access times. The best comparison is obtained by system benchmark tests conducted under identical conditions. Maximum times do not include error recovery.
[3] Typical Access times are measured under nominal conditions of temperature, voltage, and horizontal orientation as measured on a representative sample of drives.
[4] Assumes no errors and no sector has been relocated.
[5] Rate measured from the start of the first sector transfer to or from the Host.
[6] Assumes system ability to support the rate given and no cable loss.
[7] Simulated.

4.3 Start/stop time

After DC power has been applied, the drive becomes ready within 20 seconds if the Motor Start Option is disabled (i.e. the motor starts as soon as the power has been applied). During this time the drive responds to some commands over the SCSI interface in less than 3 seconds. Stop time is 20 seconds from removal of DC power.

If the Motor Start Option is enabled, the internal controller accepts the commands listed in the SCSI Interface Product Manual* less than 3 seconds after DC power has been applied. After the Motor Start Command has been received the drive becomes ready for normal operations within 13 seconds typically. The Motor Start Command can also be used to command the drive to stop the spindle*.

There is no power control switch on the drive.

4.4 Prefetch/multi-segmented cache control

The drive provides prefetch (read look-ahead) and multi-segmented cache control algorithms that in many cases can enhance system performance. “Cache” as used herein refers to the drive buffer storage space when it is used in “cache” operations. To select prefetch and cache features the host sends the Mode Select command with the proper values in the applicable bytes in Mode Page 08h. Prefetch and cache operation are independent features from the standpoint that each is enabled and disabled independently via the Mode Select command. However, in actual operation the prefetch feature overlaps cache operation somewhat as is noted in Sections 4.5.1 and 4.5.2.

All default cache and prefetch Mode parameter values (Mode Page 08h) for standard OEM versions of this drive family are given in Tables 8a and 8b.

4.5 Cache operation

In general, on “N” models 202,448 bytes of the 256 Kbyte physical buffer space, and on “W” and “WC” models, 431,136 Kbytes of the 512 Kbytes of physical buffer space in the drive can be used as storage space for cache operations. The buffer can be divided into logical segments (Mode Select Page 08h, byte 13) from which data is read and to which data is written. The drive maintains a table of logical block disk medium addresses of the data stored in each segment of the buffer. If cache operation is enabled (RCD bit = 0 in Mode Page 08h, byte 2, bit 0. See SCSI Interface Product Manual P/N 77738479), data requested by the host with a Read command is retrieved from the buffer (if it is there), before any disc access is initiated. If cache operation is not enabled, the buffer (still segmented with required number of segments) is still used, but only as circular buffer segments during disc medium read operations (disregarding Prefetch operation for the moment). That is, the drive does not check in the buffer segments for the requested read data, but goes directly to the medium to retrieve it. The retrieved data merely passes through some buffer segment on the way to the host. On a cache “miss”, all datatransfers to the host are in accordance with “buffer-full” ratio rules. On a cache “hit” the drive ignores the “buffer-full” ratio rules. See explanations associated with Mode page 02h (disconnect/reconnect control) in the SCSI Interface Product Manual P/N 77738479.

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The following is a simplified description of a read operation with cache operation enabled:

Case A - A Read command is received and the first logical block (LB) is already in cache:

1. Drive transfers to the initiator the first LB requested plus all subsequent contiguous LB's that are already in the cache. This data may be in multiple segments.
2. When the requested LB is reached that is not in any cache segment, the drive fetches it and any remaining requested LB's from the disc and puts them in a segment of the cache. The drive transfers the remaining requested LB's from the cache to the host in accordance with the disconnect/reconnect specification mentioned above.
3. If the prefetch feature is enabled, refer to Section 4.5.2 for operation from this point.

Case B - A Read command requests data, the first LB of which is not in any segment of the cache:

1. The drive fetches the requested LB's from the disc and transfers them into a segment, and from there to the host in accordance with the disconnect/reconnect specification referred to in case A.
2. If the prefetch feature is enabled, refer to Section 4.5.2 for operation from this point.

Each buffer segment is actually a self-contained circular storage (wrap-around occurs), the length of which is an integer number of disc medium sectors. The wrap-around capability of the individual segments greatly enhances the buffer's overall performance as a cache storage, allowing a wide range of user selectable configurations, which includes their use in the prefetch operation (if enabled), even when cache operation is disabled (see Section 4.5.2). The number of segments may be selected using the Mode Select command, but the size can not be directly selected. Size is selected only as a by-product of selecting the segment number specification. The size in Kbytes of each segment is reported by the Mode Sense command page 08h, bytes 14 and 15. If a size specification is sent by the host in a Mode Select command (bytes 14 and 15) no new segment size is set up by the drive, and if the "STRICT" bit in Mode page 00h (byte 2, bit 1) is set to one, the drive responds as it does for any attempt to change unchangeable parameters (see SCSI I/O Product Manual P/N 77738479). The drive supports operation of any integer number of segments from 1 to 16.6

4.5.1 Caching write data

Write caching is a write operation by the drive that makes use of a drive buffer storage area where the data to be written to the medium is stored in one or more segments while the drive performs the write command.

Write caching is enabled along with read caching. For write caching, the same buffer space and segmentation is used as set up for read functions. The buffer segmentation scheme is set up or changed independently, having nothing to do with whether or not read and write caching is enabled or disabled. When a write command is issued, the cache is first checked to see if any logical blocks that are to be written are already stored in the cache from a previous read or write command. If there are, the respective cache segments are cleared. The new data is cached for subsequent Read commands.

If the number of write data logical blocks exceeds the size of the segment being written into when the end of the segment is reached, the data is written into the beginning of the same cache segment, overwriting the data that was written there at the beginning of the operation. However, the drive does not overwrite data that has not yet been written to the medium.

Tables 8a and 8b show Mode default settings for the drives.

4.5.2 Prefetch operation

If the Prefetch feature is enabled, data in contiguous logical blocks on the disc immediately beyond that which was requested by a Read command can be retrieved and stored in the buffer for immediate transfer from the buffer to the host on subsequent Read commands that request those logical blocks (this is true even if "cache" operation is disabled). Though the prefetch operation uses the buffer as a "cache", finding the requested data in the buffer is a prefetch "hit", not a "cache" operation "hit". Prefetch is enabled using Mode Select page 08h, byte 12, bit 5 (Disable Read Ahead - DRA bit). DRA bit = 0 enables prefetch. Since data that is prefetched replaces data already in some buffer segment(s), the host can limit the amount of prefetch data to optimize system performance. The max prefetch field (bytes 8 and 9) limits the amount of prefetch. The drive does not use the prefetch "ceiling" field (bytes 10 and 11).

During a prefetch operation, the drive crosses a cylinder boundary to fetch more data only if the Discontinuity (DISC) bit is set to one in bit 4 of byte 2 of Mode parameters page 08h.

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Whenever prefetch (read look-ahead) is enabled (enabled by DRA = 0), it operates under the control of ARLA (Adaptive Read Look-Ahead). If the host uses software interleave, ARLA enables prefetch of contiguous blocks from the disk when it senses that a prefetch “hit” will likely occur, even if two consecutive read operations were not for physically contiguous blocks of data (e.g. “software interleave”). ARLA disables prefetch when it decides that a prefetch “hit” will not likely occur. If the host is not using software interleave, and if two sequential read operations are not for contiguous blocks of data, ARLA disables prefetch, but as long as sequential read operations request contiguous blocks of data, ARLA keeps prefetch enabled.

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5.0 Reliability specifications

The following reliability specifications assume correct host/drive operational interface, including all interface timings, power supply voltages, environmental requirements and drive mounting constraints (see Section 8.4)

Seek Errors	Less than 1 in 10^7 seeks
Read Error Rates [1]	
Unrecovered Data	Less than 1 sector in 10^{14} bits transferred
Miscorrected Data	Less than 1 sector in 10^{21} bits transferred
MTBF	800,000
Service Life	5 years
Preventive Maintenance	None required

Note.

[1] Error rate specified with automatic retries and data correction with ECC enabled and all flaws reallocated.

5.1 Error rates

The error rates stated in this specification assume the following:

a. The drive is operated per this specification using DC Power as defined in this Manual (see Section 6.2).

b. The drive has been formatted with the SCSI FORMAT commands.

c. Errors caused by media defects or host system malfunctions are excluded from error rate computations. Refer to Section 3.2, “Media Characteristics.”

5.1.1 Environmental interference

When evaluating systems operation under conditions of Electromagnetic Interference (EMI), the performance of the drive within the system shall be considered acceptable if the drive does not generate an unrecoverable condition.

An unrecoverable error, or unrecoverable condition, is defined as one that:

1. Is not detected and corrected by the drive itself;
2. Is not capable of being detected from the error or fault status provided through the drive or SCSI interface; or
3. Is not capable of being recovered by normal drive or system recovery procedures without operator intervention.

5.1.2 Read errors

Before determination or measurement of read error rates:

a. The data that is to be used for measurement of read error rates must be verified as being written correctly on the media.

b. All media defect induced errors must be excluded from error rate calculations.

5.1.3 Write errors

Write errors can occur as a result of media defects, environmental interference, or equipment malfunction. Therefore, write errors are not predictable as a function of the number of bits passed.

If an unrecoverable write error occurs because of an equipment malfunction in the drive, the error is classified as a malfunction affecting MTBF. Unrecoverable write errors are those which cannot be corrected within two attempts at writing the record with a read verify after each attempt (excluding media defects).

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5.1.4 Seek errors

A seek error is defined as a failure of the drive to position the heads to the addressed track. There shall be no more than one recoverable seek error in 10^7 physical seek operations. After detecting an initial seek error, the drive automatically reseeks to the addressed track up to 3 times. If a reseek is successful, the Extended Sense reports a seek positioning error (15h), no seek complete error (02h), or track follow error (09h), and the sense key reports a recovered error (1h). If all three reseeks fail, a seek positioning error (15h) is reported with a Medium error (3h) or Hardware error (4h) reported in the Sense Key. This is an unrecoverable seek error. Unrecoverable seek errors are classified as failures for MTBF calculations. Refer to Section 5.1.1.2 of SCSI-2 Interface Product Manual P/N 77738479 for Request Sense information.

5.2 Reliability and service

5.2.1 Mean time between failure

The production disc drive shall achieve an MTBF of 800,000 hours when operated in a benign atmosphere at an average disc drive ambient temperature of 95°F (35°C) or less as measured per this Product Manual, Section 6.4.1. Short-term excursions up to the specification limits of the operating environment will not affect MTBF performance.

The following expression defines MTBF

$$\text{MTBF per measurement period} = \frac{\text{Estimated power-on operating hours in the period}}{\text{Number of drive failures in the period}}$$

Estimated power-on operation hours means power-up hours per disc drive times the total number of disc drives in service. Each disc drive shall have accumulated at least nine months of operation. Data shall be calculated on a rolling average base for a minimum period of six months.

Drive failure means any stoppage or substandard performance caused by drive malfunction.

5.2.2 Preventive maintenance

No routine scheduled preventive maintenance shall be required.

5.2.3 Service life

The drive shall have a useful service life of five years. Depot repair or replacement of major parts is permitted during the lifetime (see Section 5.2.4).

5.2.4 Service philosophy

Special equipment is required to repair the drive HDA. In order to achieve the above service life, repairs must be performed only at a properly equipped and staffed service and repair facility. Troubleshooting and repair of PCBs in the field is not recommended, because of the extensive diagnostic equipment required for effective servicing. Also, there are no spare parts available for this drive. Drive warranty is voided if the HDA is opened.

5.2.5 Service tools

No special tools are required for site installation or recommended for site maintenance. Refer to Section 5.2.4. The depot repair philosophy of the drive precludes the necessity for special tools. Field repair of the drive is not practical since there are no user purchasable parts in the drive.

5.2.6 Product warranty

Beginning on the date of shipment to customer and continuing for a period of five years, Seagate warrants that each product (including components and subassemblies) or spare part that fails to function properly under normal use due to defect in materials on workmanship or due to nonconformance to the applicable specifications will be repaired or replaced, at Seagate's option and at no charge to customer, if returned by customer at customer's expense to Seagate's designated facility in accordance with Seagate's Warranty Procedure. Seagate will pay for transporting the repair or replacement item to customer. For more detailed warranty information refer to the Standard terms and conditions of Purchase for Seagate products.

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Shipping:

When transporting or shipping a drive, a Seagate approved container must be used. Keep your original box. They are easily identified by the Seagate Approved Package label. Shipping a drive in a non-approved container voids the drive warranty.

Seagate repair centers may refuse receipt of components improperly packaged or obviously damaged in transit. Contact your Authorized Seagate Distributor to purchase additional boxes. Seagate recommends shipping by an air-ride carrier experienced in handling computer equipment.

Product repair and return information

Seagate customer service centers are the only facilities authorized to service Seagate drives. Seagate does not sanction any third-part repair facilities. Any unauthorized repair or tampering with the factory-seal voids the warranty.

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6.0 Physical/electrical specifications

6.1 AC power requirements

Not applicable to this drive.

6.2 DC power requirements

The voltage and current requirements for a single drive are shown in the following table. Values indicated apply at the drive power connector. The single ended power requirements includes the internal disc drive SCSI I/O termination.1

Table 2: DC power requirements

	ST32151/ST32155		ST31051/ST31055	
Voltage	+5 V	+12 V	+5 V	+12 V
Regulation [4] [2]	±5%	±5%	±5%	±5%
Average Idle Current [1]	0.32 A	0.34 A	0.32 A	0.34 A
Maximum Starting Current (Peak)[2]	0.57 A	1.8 A	0.57 A	1.8 A
Delayed Motor Start (Max) [3]	0.52 A	0.22 A	0.52 A	0.22 A
Operating Current [5]				
Typ. [1]	0.65 A	0.40 A	0.65 A	0.40 A
Max. [1]	0.69 A	0.42 A	0.69 A	0.42 A
Max. (Peak)	1.0 A	1.8 A	1.0 A	1.8 A

[1] Measured with average reading DC ammeter. Instantaneous current peaks will exceed these values.
[2] A droop of up to -10% is permissible during the T2 portion of +12 V power up (see Figure 3).
[3] This condition occurs when the Motor Start Option is enabled and the drive has not yet received a Start Motor command.
[4] See Section 6.2.1 “Conducted Noise Immunity”.
[5] Instantaneous peaks less than 5 msec in duration are allowed.

General Notes from Table 2:

1. At power-up, the motor current regulator limits the 12 volt current to a peak value of less than 1.8 amperes, although instantaneous peaks may occur as stated in [5] above.
2. Operating condition is defined as random seek read of 64 blocks.
3. Minimum operating current loading for each supply voltage is not less than 38% of the maximum operating current shown.
4. The +5 and +12 volt supplies shall employ separate ground returns. Where power is provided to multiple drives from a common supply, careful consideration for individual drive power requirements should be noted. Where multiple units are powered on simultaneously, the peak starting current must be available to each device.

6.2.1 Conducted noise immunity

Noise is specified as a periodic and random distribution of frequencies covering a band from DC to 10 mHz. Maximum allowed noise values given below are peak to peak measurements and apply at the drive power connector.

+5 V = 150 mV pp from 0 to 50 kHz and 45 mA pp from 50 kHz to 10 MHz.
+12 V = 150 mV pp from 0 to 50 kHz and 60 mA pp from 50 kHz to 10 MHz.

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6.2.2 Power sequencing

The drive does not require power sequencing. The drive protects against inadvertent writing during power-up and down. Daisy-chain operation requires that power be maintained on the terminated drive to ensure proper termination of the peripheral I/O cables. For the benefit of the system power supply, the drive power-up can be delayed using the motor start delay option.

6.2.3 Current profile

Figure 3 identifies the drive +5 V and +12 V current profile. The current during the various times is as shown:

T - Power is applied to the drive.
T1 - Controller self tests are performed.
T2 - Spindle begins to accelerate under current limiting after performing drive internal diagnostics. See Note 1 of Table 2.
T3 - The heads move from the landing zone to the data area.
T4 - The adaptive servo calibration sequence is performed.
T5 - Calibration is complete and the drive is ready for reading and writing.

Note. All times and currents are typical. See Table 2 for maximum current requirements.

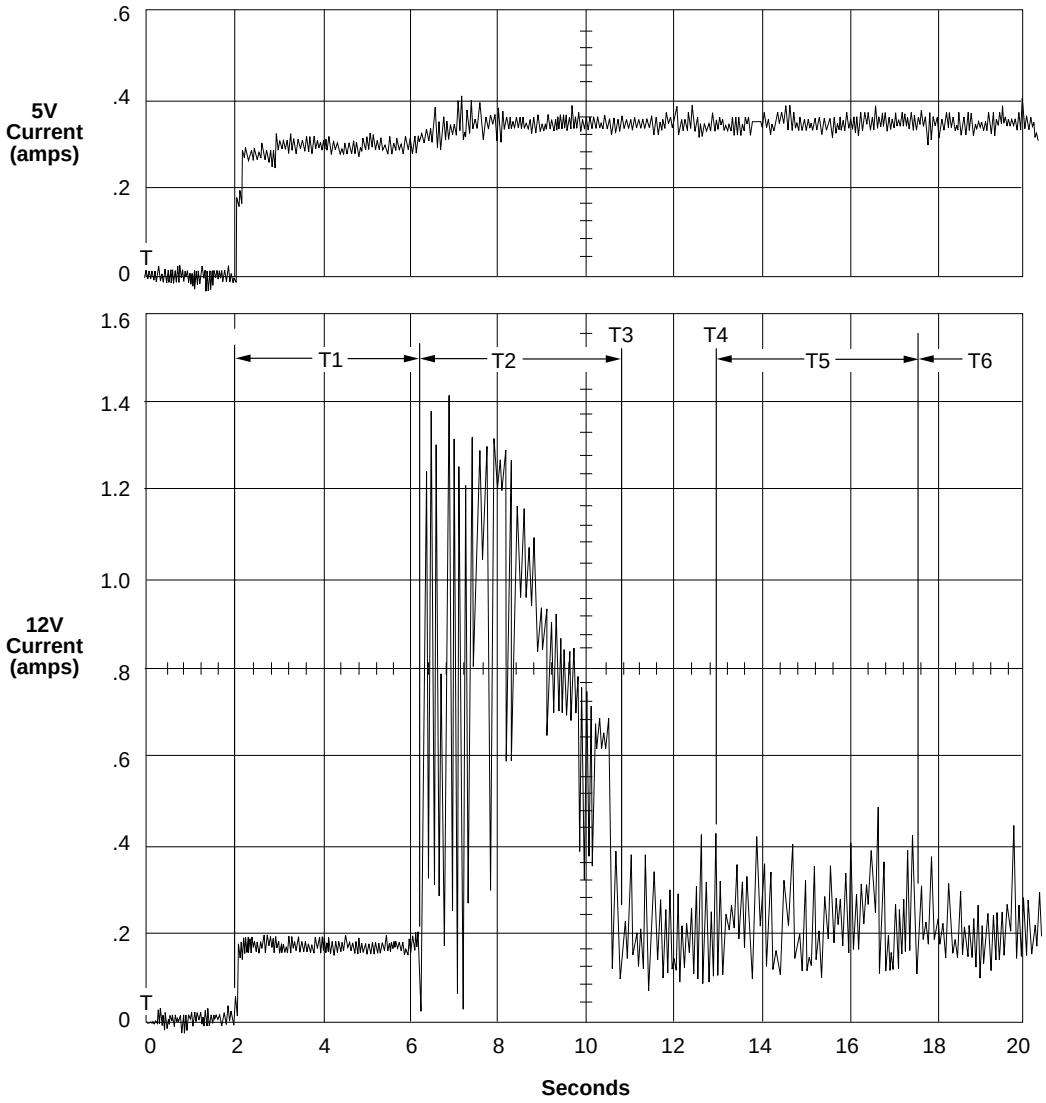


Figure 3. Typical Hawk 2XL family drive +5 V and +12 V current profile

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6.3 Power dissipation

For drives with single ended interface circuits, typical operating random read power dissipation is 7.5 watts (25.6 BTUs per hour) of DC power average at nominal voltages. Typical power dissipation under idle conditions is 6.0 watts (20.5 BTUs per hour).

6.4 Environmental limits

Temperature and humidity values experienced by the drive must be such that condensation does not occur on any drive part. Altitude and atmospheric pressure specifications are referenced to a standard day at 58.7°F (14.8°C). Maximum Wet Bulb temperature is 82°F (28°C).

6.4.1 Temperature

a. Operating

The drive meets all specifications over a 41°F to 131°F (5°C to 55°C) drive ambient temperature range with a maximum temperature gradient of 36°F (20°C) per hour. The enclosure for the drive should be designed such that the temperatures at the locations specified in Table 3, column 1 are not exceeded. Air flow may be needed to achieve these temperature values. Operation at case temperatures [4] above these values may adversely affect the drives ability to meet specifications.

The MTBF specification for the drive is based on operating at an ambient temperature of 95°F (35°C). Occasional excursions to drive ambient temperatures of 55°C or 5°C may occur without impact to specified MTBF. To achieve the specified MTBF, the values of Table 3, column 2 must be considered maximum average operating case temperatures. Air flow may be needed to achieve these temperatures. See Section 8.3. Continual or sustained operation at case temperatures above these values may degrade MTBF.

Table 3: Temperatures PCB and HDA (see Figure 4)

Items in Figure 4	Component on PCB Number	Column 1 Maximum Case [4] Temperatures (°C) Operating (55° Ambient) [2]	Column 2 Typical Case [4] Temperatures (°C) at 35°C Ambient [1]
HDA [3]		65	45
U2	1,2,3	91	63
U4	1,2,3	98	52
U5	1,2,3	84	57
U13	1,2,3	96	53

Note.

[1] The temperatures shown in Column 2 were measured on an unmounted drive lying on its side during random write/reads at 100% duty cycle in still air.
[2] The temperatures in Column 1 are calculated and may not reflect actual operating values. Sufficient cooling air may be required to ensure that these values are not exceeded.
[3] Measure HDA temp at point labeled “HDA” on Figure 4.
[4] PCB mounted Integrated circuit case.

b. Non-Operating

-40° to 158°F (-40° to 70°C) package ambient with a maximum gradient of 45°F (25°C) per hour. This specification assumes that the drive is packaged in the shipping container designed by Seagate for use with drive.

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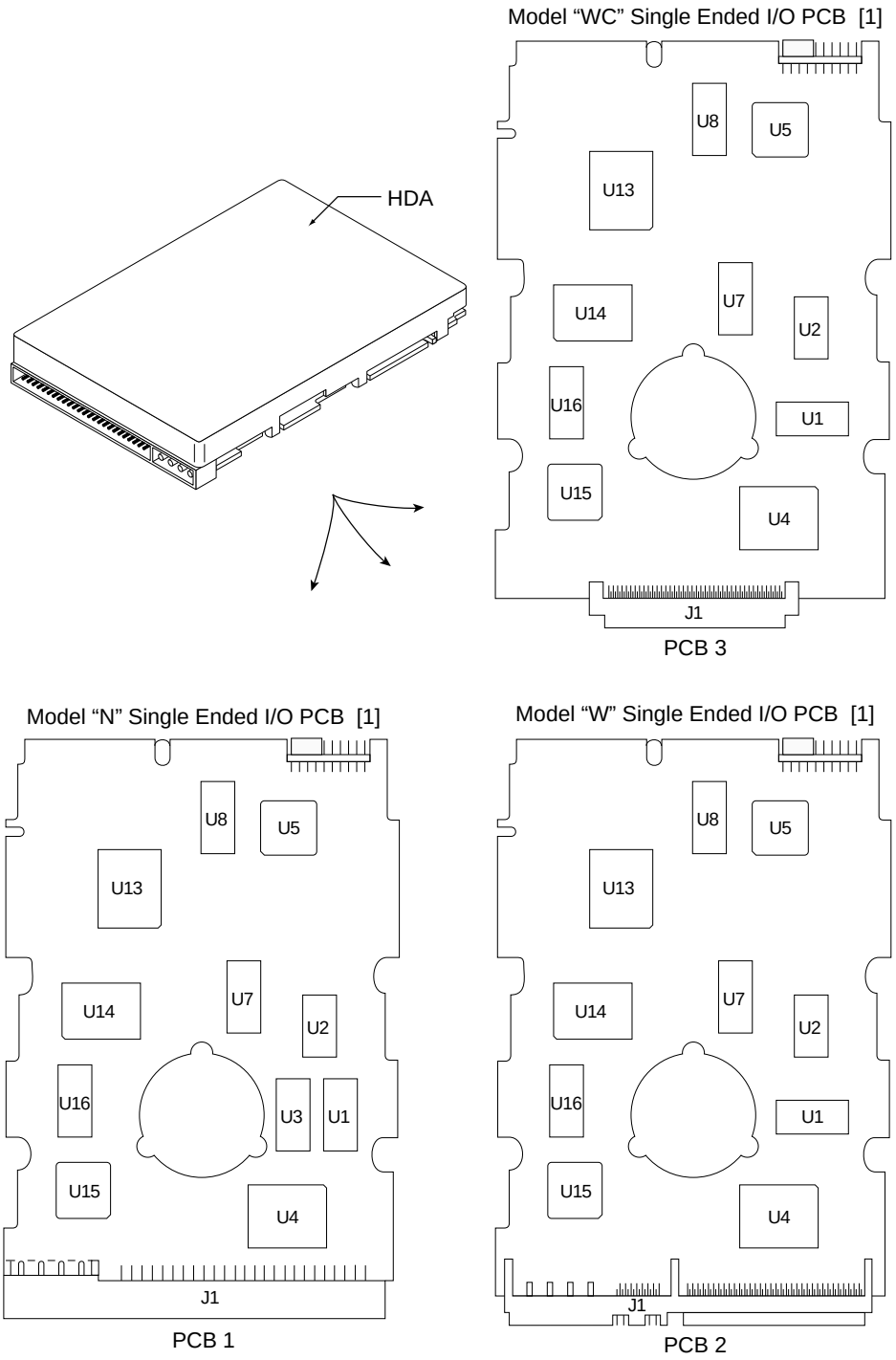


Figure 4. Locations of components (listed in Table 3)

6.4.2 Relative humidity

The values below assume that no condensation on the drive occurs.

a. Operating

8% to 80% relative humidity with a maximum gradient of 10% per hour.

b. Non-Operating

5% to 95% relative humidity.

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6.4.3 Effective altitude (sea level)

a. Operating

-1000 to +10,000 feet (-305 to +3048 metres)

b. Non-Operating

-1000 to +40,000 feet (-305 to +12,210 metres)

6.4.4 Shock and vibration

Shock and vibration limits specified in this document are measured directly on the drive chassis. If the drive is installed in an enclosure to which the stated shock and/or vibration criteria is applied, resonances may occur internally to the enclosure resulting in drive movement in excess of the stated limits. If this situation is apparent, it may be necessary to modify the enclosure to minimize drive movement.

The limits of shock and vibration defined within this document are specified with the drive mounted by any of the four methods shown in Figure 5, and in accordance with the restrictions of Section 8.4. Orientation of the side nearest the LED may be up or down.

6.4.4.1 Shock

a. Operating

The drive, as installed for normal operation, shall operate error free while subjected to intermittent shock not exceeding 10 g's at a maximum duration of 11 ms (half sinewave). Shock may be applied in the X, Y, or Z axis.

b. Non-operating

The limits of nonoperating shock shall apply to all conditions of handling and transportation. This includes both isolated drives and integrated drives.

The drive subjected to nonrepetitive shock not exceeding 75 g's at a maximum duration of 11 ms (half sinewave) shall not exhibit device damage or performance degradation. Shock may be applied in the X, Y, or Z axis.

c. Packaged

Disc drives shipped as loose load (not palletized) general freight will be packaged to withstand drops from heights as defined in the table below. For additional details refer to specifications 30190-001 (under 100 lbs) or 30191-001 (over 100 lbs).

Package Size (Cu.In.)	Packaged/Product Weight lb. (kg)	Drop Height in. mm
<600	Any	60 (1524)
600-1800	0-20 (0 to 9.1)	48 (1219)
>1800	0-20 (0 to 9.1)	42 (1067)
>600	20-40 (9.1 to 18.1)	36 (914)

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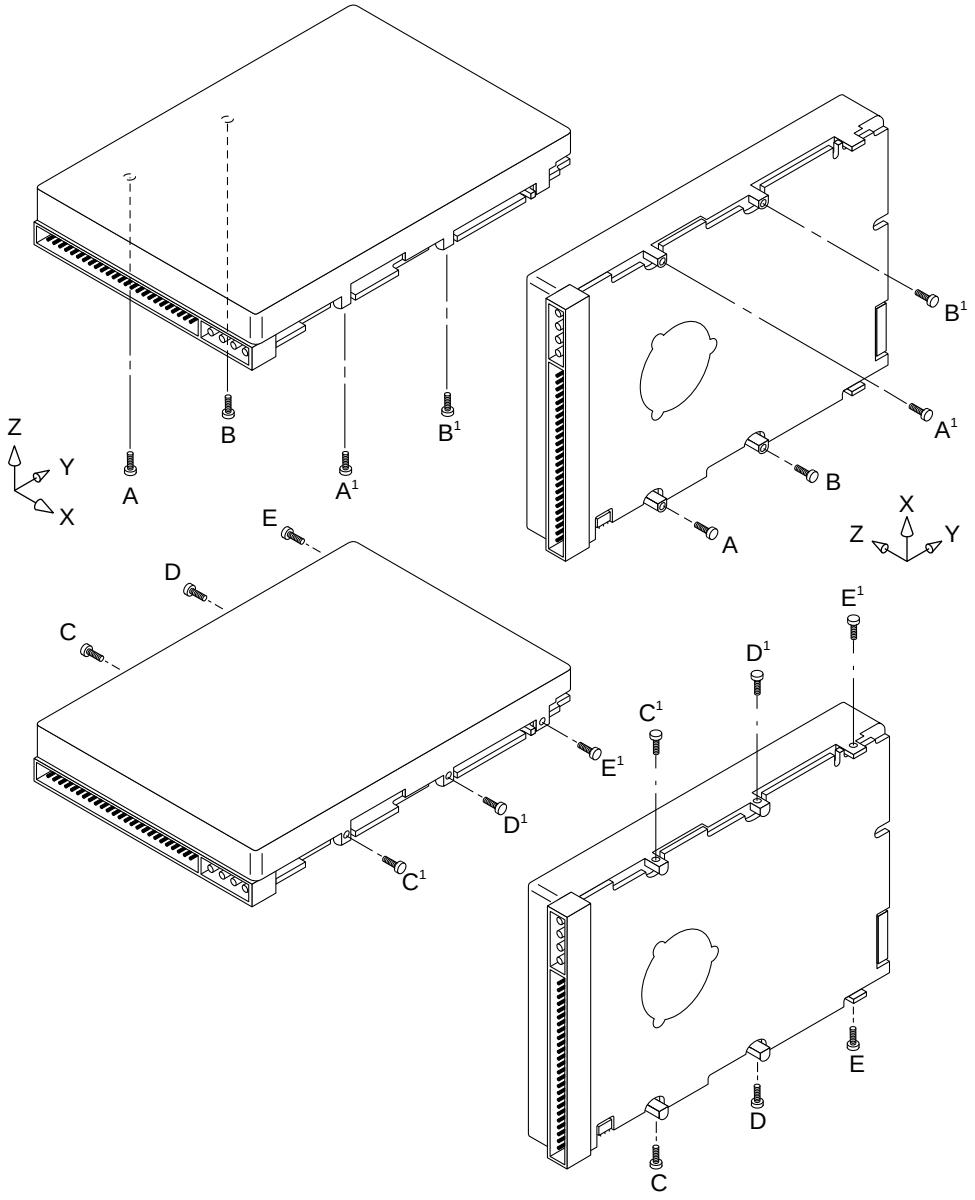


Figure 5. Recommended mounting (Applicable to all Hawk 2XL family models)

6.4.4.2 Vibration

a. Operating

The drive as installed for normal operation, shall comply with the complete specified performance while subjected to continuous vibration not exceeding

5-22 Hz @ 0.020 inches (0.51 mm) displacement
22-400 Hz @ 0.5 g

Vibration may be applied in the X, Y, or Z axis.

b. Non-operating

The limits of non-operating vibration shall apply to all conditions of handling and transportation. This includes both isolated drives and integrated drives.

The drive shall not incur physical damage or degraded performance as a result of continuous vibration not exceeding

5-22 Hz @ 0.081 inches (2.05 mm) displacement
22-400 Hz @ 2.00 g

Vibration may be applied in the X, Y, or Z axis.

6.4.5 Air cleanliness

The drive is designed to operate in a typical office environment with minimal environmental control.

6.4.6 Electromagnetic susceptibility

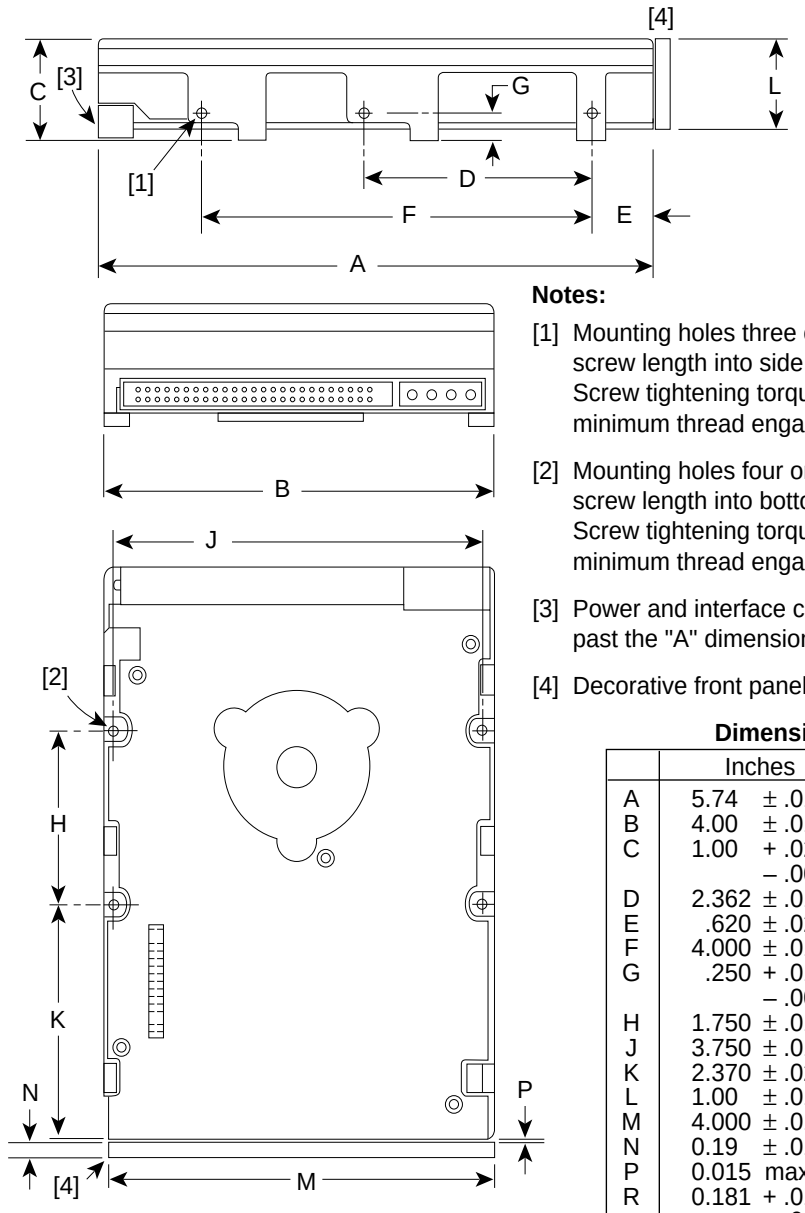
See Section 2.1.2.

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6.5 Mechanical specifications

The following nominal dimensions are exclusive of the decorative front panel accessory. However, dimensions of the front panel are shown in figure below. Refer to Figures 6a, 6b and 6c for detailed mounting configuration dimensions. See Section 8.4, “Drive mounting.”

Height:	1.00 in	25.4	mm
Width:	4.00 in	101.6	mm
Depth:	5.74 in	145.8	mm
Weight:	1.5 pounds	0.68	kilograms



Notes:

[1] Mounting holes three on each side, 6-32 UNC. Max screw length into side of drive 0.15 in. (3.81 mm). Screw tightening torque 6.0 in-lb (.675 NM) max with minimum thread engagement of 0.12 in. (3.05 mm).

[2] Mounting holes four on bottom, 6-32 UNC. Max screw length into bottom of drive 0.20 in. (5.08 mm). Screw tightening torque 6.0 in-lb (.675 NM) max with minimum thread engagement of 0.12 in. (3.05 mm).

[3] Power and interface connectors can extend past the "A" dimension by 0.040 in. (1.02 mm).

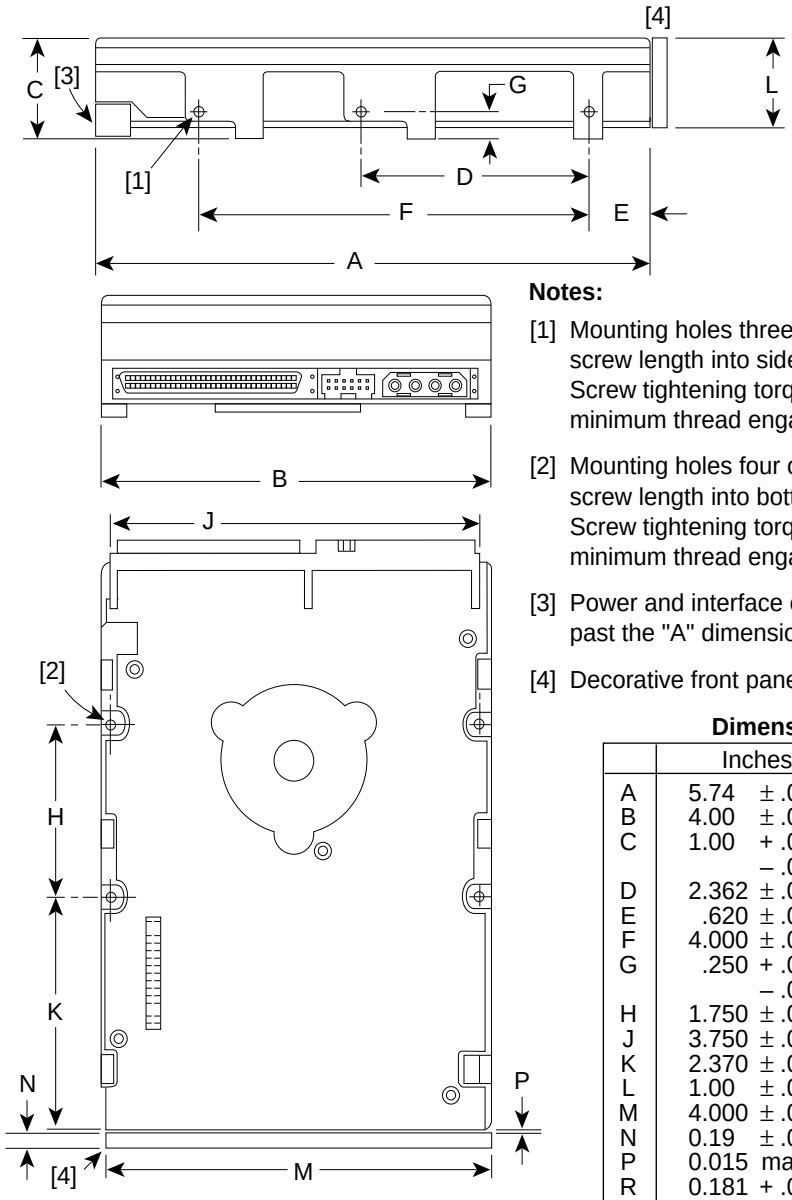
[4] Decorative front panel (optional).

Dimension Table

	Inches	Millimeters
A	5.74 ± .010	145.80 ± .25
B	4.00 ± .010	101.60 ± .25
C	1.00 + .021 – .009	25.40 + .53 – .22
D	2.362 ± .010	60.00 ± .25
E	.620 ± .020	15.75 ± .50
F	4.000 ± .010	101.60 ± .25
G	.250 + .010 – .005	6.35 + .25 – .12
H	1.750 ± .010	44.45 ± .25
J	3.750 ± .010	95.25 ± .25
K	2.370 ± .020	60.20 ± .50
L	1.00 ± .010	25.4 ± .25
M	4.000 ± .010	101.6 ± .25
N	0.19 ± .010	4.83 ± .25
P	0.015 max	0.381 max
R	0.181 + .015 – .010	4.597 + .38 – .25

Figure 6a. Mounting configuration dimensions for model “N”

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Notes:

[1] Mounting holes three on each side, 6-32 UNC. Max screw length into side of drive 0.15 in. (3.81 mm). Screw tightening torque 6.0 in-lb (.675 NM) max with minimum thread engagement of 0.12 in. (3.05 mm).

[2] Mounting holes four on bottom, 6-32 UNC. Max screw length into bottom of drive 0.20 in. (5.08 mm). Screw tightening torque 6.0 in-lb (.675 NM) max with minimum thread engagement of 0.12 in. (3.05 mm).

[3] Power and interface connectors can extend past the "A" dimension by 0.040 in. (1.02 mm).

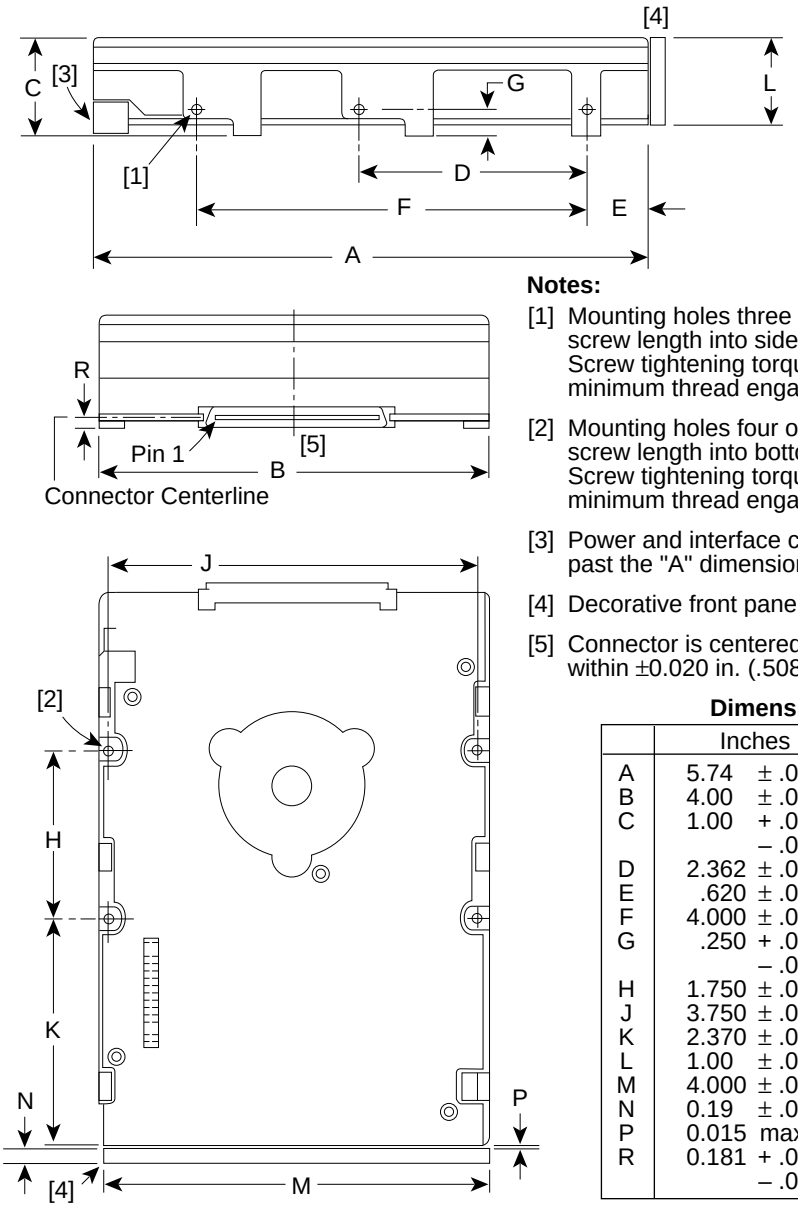
[4] Decorative front panel (optional).

Dimension Table

	Inches	Millimeters
A	5.74 ± .010	145.80 ± .25
B	4.00 ± .010	101.60 ± .25
C	1.00 + .021 – .009	25.40 + .53 – .22
D	2.362 ± .010	60.00 ± .25
E	.620 ± .020	15.75 ± .50
F	4.000 ± .010	101.60 ± .25
G	.250 + .010 – .005	6.35 + .25 – .12
H	1.750 ± .010	44.45 ± .25
J	3.750 ± .010	95.25 ± .25
K	2.370 ± .020	60.20 ± .50
L	1.00 ± .010	25.4 ± .25
M	4.000 ± .010	101.6 ± .25
N	0.19 ± .010	4.83 ± .25
P	0.015 max	0.381 max
R	0.181 + .015 – .010	4.597 + .38 – .25

Figure 6b. Mounting configuration dimensions for model “W”

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Notes:

[1] Mounting holes three on each side, 6-32 UNC. Max screw length into side of drive 0.15 in. (3.81 mm). Screw tightening torque 6.0 in-lb (.675 NM) max with minimum thread engagement of 0.12 in. (3.05 mm).

[2] Mounting holes four on bottom, 6-32 UNC. Max screw length into bottom of drive 0.20 in. (5.08 mm). Screw tightening torque 6.0 in-lb (.675 NM) max with minimum thread engagement of 0.12 in. (3.05 mm).

[3] Power and interface connectors can extend past the "A" dimension by 0.040 in. (1.02 mm).

[4] Decorative front panel (optional).

[5] Connector is centered (side to side) on drive within ±0.020 in. (.508 mm).

Dimension Table

	Inches	Millimeters
A	5.74 ± .010	145.80 ± .25
B	4.00 ± .010	101.60 ± .25
C	1.00 + .021 – .009	25.40 + .53 – .22
D	2.362 ± .010	60.00 ± .25
E	.620 ± .020	15.75 ± .50
F	4.000 ± .010	101.60 ± .25
G	.250 + .010 – .005	6.35 + .25 – .12
H	1.750 ± .010	44.45 ± .25
J	3.750 ± .010	95.25 ± .25
K	2.370 ± .020	60.20 ± .50
L	1.00 ± .010	25.4 ± .25
M	4.000 ± .010	101.6 ± .25
N	0.19 ± .010	4.83 ± .25
P	0.015 max	0.381 max
R	0.181 + .015 – .010	4.597 + .38 – .25

Figure 6c. Mounting configuration dimensions for model “WC”

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7.0 Defect and error management

The drive, as delivered, complies with this specification. The read error rate and specified storage capacity are not dependent upon use of defect management routines by the host (initiator).

Defect and error management in the SCSI system involves the drive internal defect/error management and SCSI systems error considerations (errors in communications between Initiator and the drive). Tools for use in designing a defect/error management plan are briefly outlined in this section, with references to other sections where further details are given.

7.1 Drive internal defects and errors

Identified defects are recorded on the drive defects list tracks (referred to as the primary or ETF defect list). These known defects are reallocated during the initial drive format operation at the factory. (See Section “Format Unit command in SCSI Interface Product Manual). Data correction by ECC will be applied to recover data from additional flaws if they occur.

Details of the SCSI commands supported by the drive are described in SCSI Product Interface Manual P/N 77738479.

7.2 SCSI systems errors

Information on the reporting of operational errors or faults across the interface is given in the SCSI Interface Product Manual. Message Protocol System is described in the SCSI Interface Product Manual P/N 77738479. Several of the messages are used in the SCSI systems error management system. The Request Sense command returns information to the host about numerous kinds of errors or faults. The Receive Diagnostic Results reports the results of diagnostic operations performed by the drive.

Status returned by the drive to the Initiator is described in the SCSI Interface Manual P/N 77738479. Status reporting plays a role in the SCSI systems error management and its use in that respect is described in sections where the various commands are discussed.

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8.0 Installation

The first thing to do when installing a drive is to set the drive ID on the SCSI bus and set up (select) certain operating options. This is usually done by installing small shorting jumpers on the pins of connector J6 on the PCB (or J1-Auxiliary on the “W” and “WD” models), or via the drive to host I/O signals on “WC” and “DC” models. Some users connect cables to J6 or J1-Auxiliary and perform the set-up using remote switches.

For option jumper locations and definitions refer to Figures 7a, b, c and d. Drive default mode parameters are not normally needed for installation. Refer to Section 9.3.2 for default mode parameters if they are needed.

- Ensure that the SCSI ID of the drive is not the same as the host adapter. Most host adapters use SCSI ID 7.
- If multiple devices are on the bus set the drive SCSI ID to one that is not presently used by other devices on the bus.
- If the drive is the only device on the bus, attach it to the end of the SCSI bus cable. Permanently installed terminators must be enabled on the drive for “N” and “W” models using jumper plug **TE**. On model “WC” external terminators must be provided by the user, systems integrator or host equipment manufacturer.
- If the drive is attached to a bus that contains other devices, and the new drive is not attached to the end of the bus, the Terminator Enable jumper (**TE**) should be removed from the new drive.

Note. For additional information about terminator requirements, refer to Section 9.7. Terminator power is discussed in Section 9.8.

- Set all appropriate option jumpers for desired operation prior to power on. If jumpers are changed after power has been applied, recycle the drive power to make the new settings effective.
- Installation instructions are provided by host system documentation or with any additionally purchased drive installation software. If necessary see Section 10.0 for Seagate support services telephone numbers.
- The manufacturer’s installed labels must not be removed from the drive or covered with additional labels, as they contain information required when servicing the product.

Formatting

- It is not necessary to low level format this drive. The standard OEM drive is shipped from the factory low level formatted in 512 byte sectors. Other formats must be established only at time of drive manufacturer.
- High level format the drive. This involves assigning one or more partitions or logical drives to the drive volume. Follow the instructions in the system manuals for the system into which the drive is to be installed.

8.1 Drive ID/option select header

Figures 7a through 7c show views of the drive ID select jumper connectors. Figure 7d shows the option select jumper connector for all models. Figure 7b shows a rear view of model drives for the purpose of showing J1-auxiliary which has a duplicate pin configuration and purpose of J6 (Figure 7a) on the rear of the drive. Both J1-auxiliary and J6 have pins for selecting drive ID and for connecting the remote LED cable. Only one or the other should be used, although using both at the same time would not damage the drive. The notes following the figures describe the functions of the various jumper positions on the connectors J2, J1-Auxiliary and J6. Suggested part numbers for the jumpers used on J2 is Molex 52747-0211 (Seagate P/N 77679052). A bag with the two jumper plug types is shipped with the standard OEM drives.

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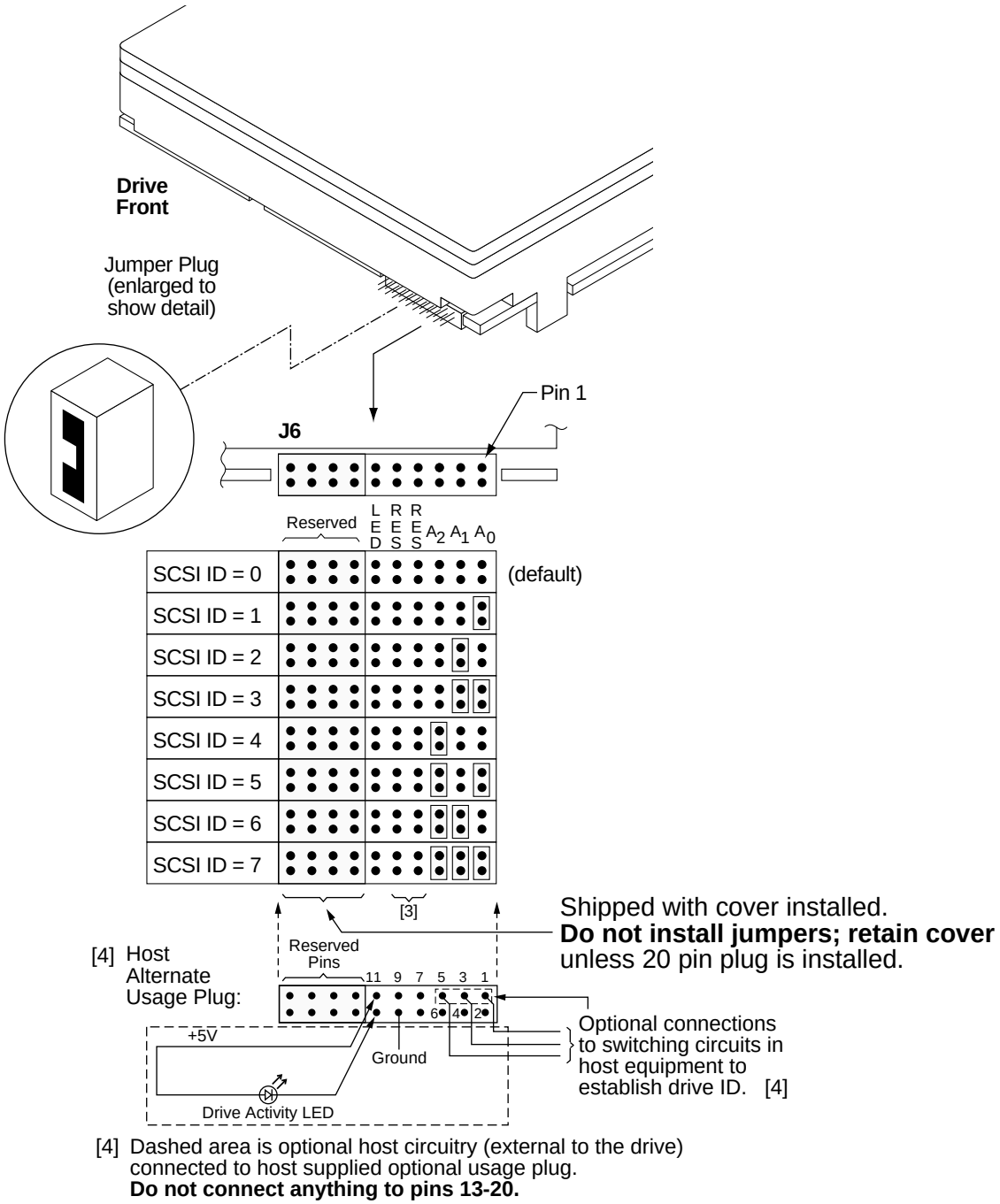


Figure 7a. Hawk 2XL family drive ID select header for model "N"

[ ] Notes for Figures 7a through 7c are in Section 8.1.1.

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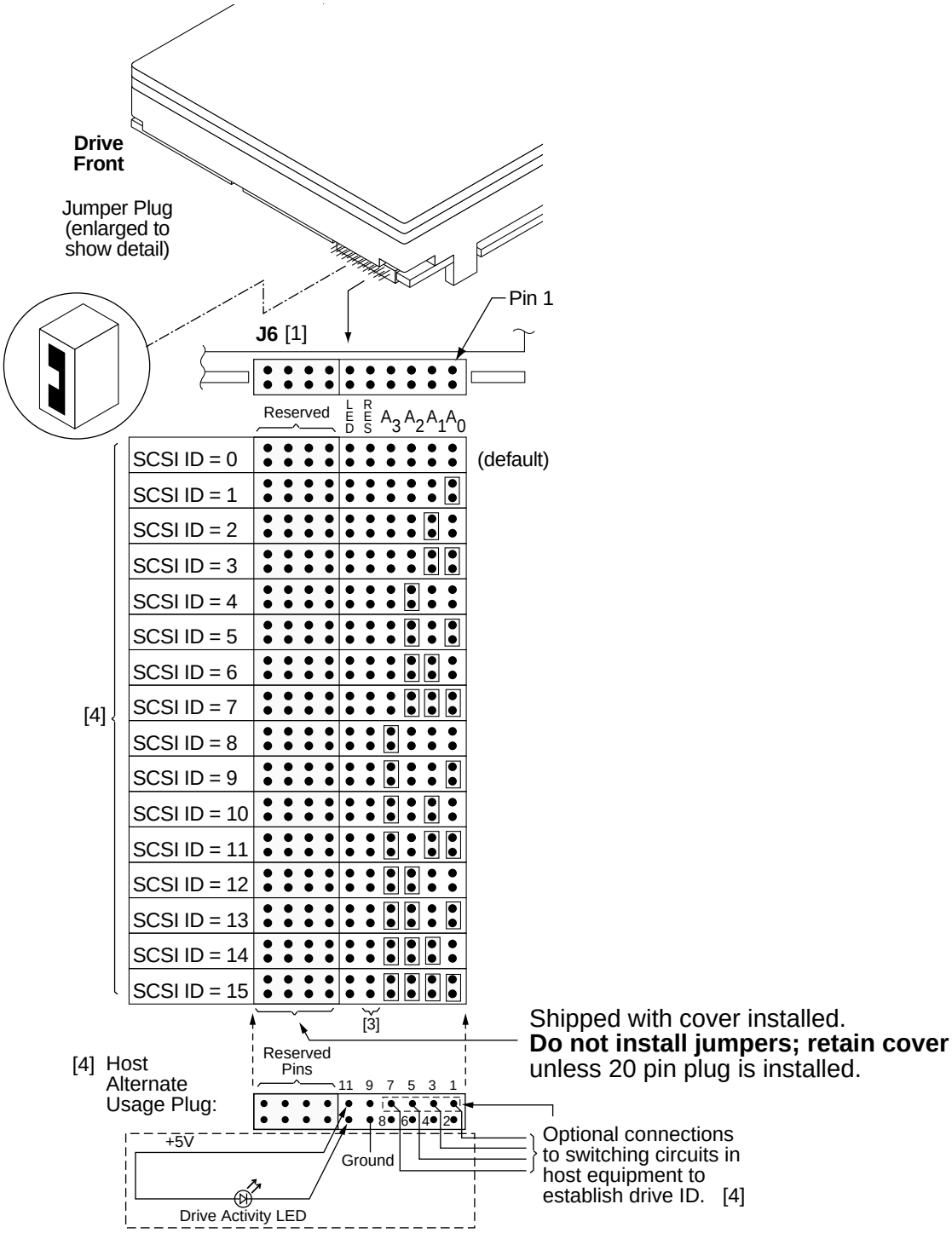


Figure 7b. Hawk 2XL family drive ID select for models “W” and “WC”

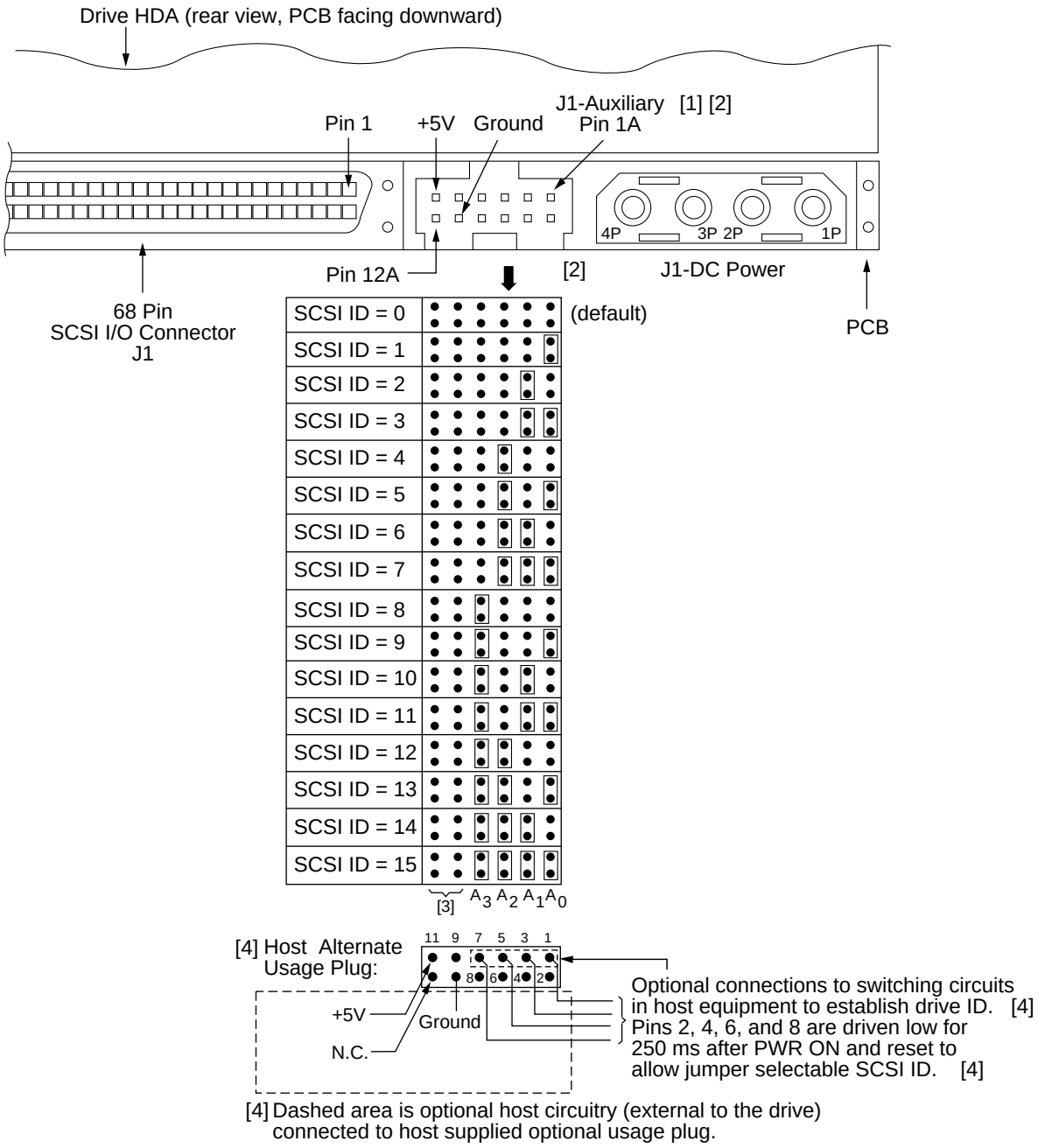


Figure 7c. Hawk 2XL family drive ID select header J1-auxiliary for model “W” (J1-Aux. Pins 1A-12A)

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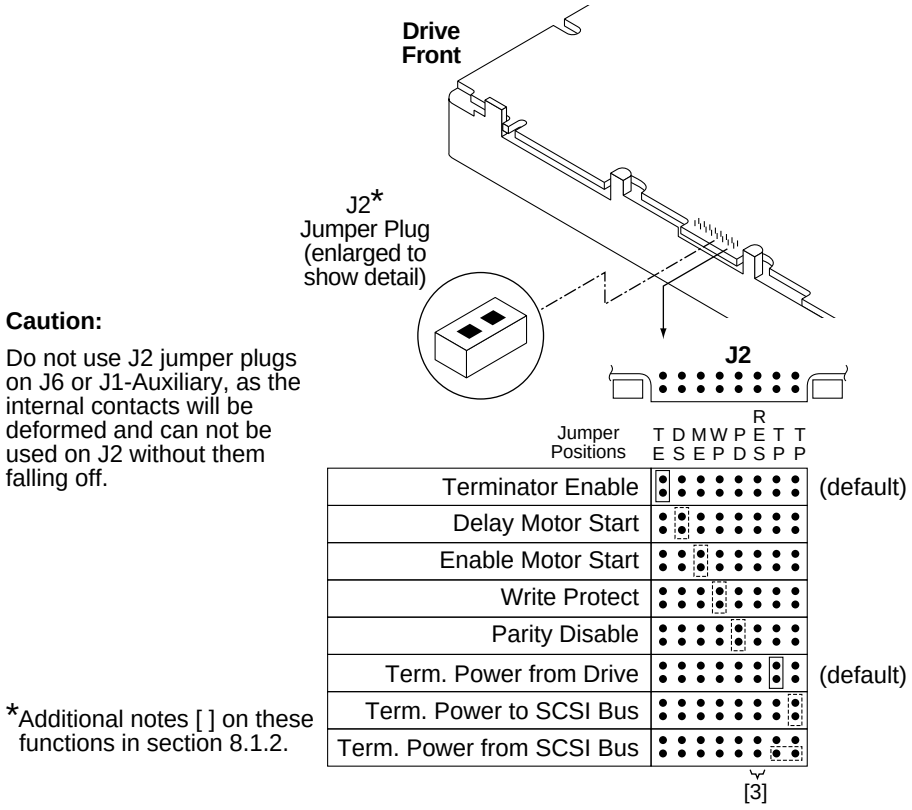


Figure 7d. Hawk 2XL family drive option select header for models “N” and “W”

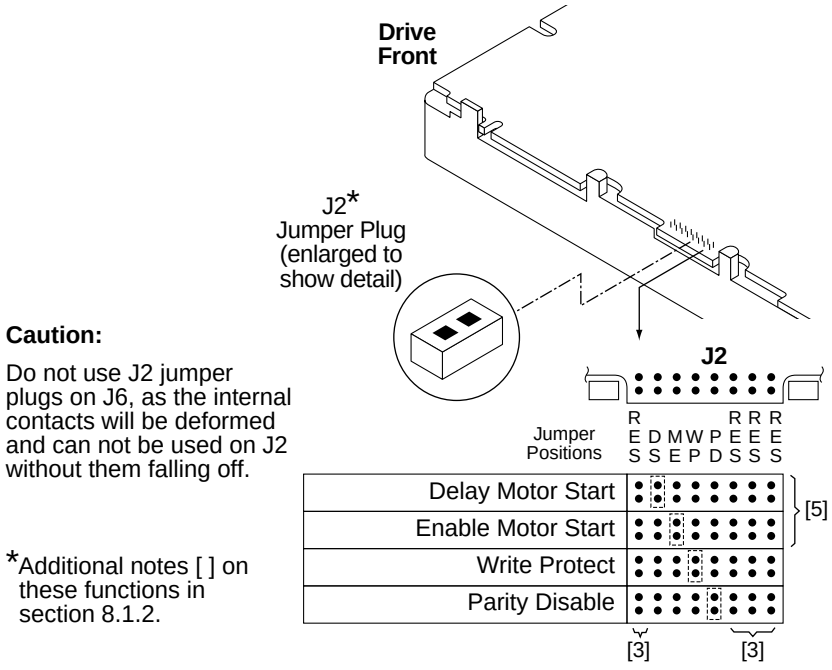


Figure 7e. Hawk 2XL family drive option select header for model “WC”

8.1.1 Notes for Figures 7a, 7b, 7c, 7d and 7e.

[1] Notes explaining the functions of the various jumpers on jumper header connectors J2, J1-Auxiliary and J6 are given here and in Section 8.1.2. The term "**default**" means as standard OEM units are configured with a jumper on those positions when shipped from factory. "Off" means no jumper is installed; "On" means a jumper is installed. OFF or ON underlined is factory **default** condition.

[2] The PCB on "N" and "WC" model drives does not have connector J1-Auxiliary. The J1-Auxiliary connector signals conform to SFF-8009 Revision 2.0, Unitized Connector for Cabled Drives, signal assignments for auxiliary connectors.

[3] Reserved useage. Do not install any jumpers.

[4] Table 4 summarizes the configuration selection possibilities available on the different Hawk 2XL model drives

[5] These signals are also on 80 pin J1 (see Table 11c)..

Table 4: Drive configuration selections summary

ST32151/ ST31051 Model	Function	Connector				Applicable Figure
		J1	J6	J1-AUX	J2	
N	Drive ID		X, Y	none		7a
N	Drive Activity LED		Y[3]	none		7a
N	Option select			none	X	7d
W	Drive ID		X, Y	X, Y[5]		7b, 7c[1]
W	Drive Activity LED		Y[3]			7b
W	Option select				X	7d
WC	Drive ID	Y[2][6]	X, Y	none		7b[4]
WC	Drive Activity LED	Y[2][3]	Y[3]	none		7b[4]
WC	Option select:					
	Delayed Mtr Start	Y[2]		none	X	7e
	Enable Mtr Start	Y[2]		none	X	7e
	Write Protect			none	X	7e
	Parity Disable			none	X	7e

("X" means the function selection can be made with jumpers on that connector;
"Y" means the signal is available to host through that connector.)

Note. [ ] for Table 4:

[1] Use either J6 or J1-Aux, but not both.

[2] I/O connector J1 plugs directly into host. No jumper can be installed on J1. The host supplies the logic state of these function signals; causing the selection of these functions. See pinout Table 11c.

[3] The host can drive a remotely located Drive Activity LED using signal.

[4] Use either J1 or J6, but not both.

[5] The drive reads the ID (asserted low) from J1-Auxiliary pins 1, 3, 5 and 7 for 250 ms after power-on or drive reset. Jumper plugs can be used on J1-Auxiliary pins 1-2, 3-4, 5-6 and 7-8 to set drive ID if desired, but usually a connector/cable is plugged to J1-Auxiliary to run these signals to the host for remote ID selection.

[6] The drive ID signals in the 80 pin J1 connector are asserted low by the host for 250 msec after power-on or drive reset.

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8.1.2 Function description

Notes for Figures 7d and 7e

J2 Jumper Installation		Jumper Function Description
TE		**(Applies only to "N" and "W" models)**
On		With the jumper installed, the On-board (non-removable) terminator circuits are enabled (connected to the I/O lines). **Default** is jumper installed.
Off		Terminator circuits not connected to I/O lines.
DS	**ME**	
Off	Off	Spindle starts immediately after power up - **Default** setting.
Off	On	Drive spindle does not start until Start Unit command received from host.
On	Off	Spindle Startup is delayed by SCSI ID times 12 seconds after power is applied, i.e., drive 0 spindle starts immediately when DC power connected, drive 1 starts after 12 second delay, drive 2 starts after 24 second delay, etc.
On	On	Drive spindle starts when Start Unit command received from host. Delayed start feature is overridden and does not apply when **ME** jumper is installed.
WP		
On		Entire drive is write protected.
Off		Drive is not write protected. **Default** is no **WP** jumper installed.
PD		
On		Parity checking and parity error reporting by the drive is disabled.
Off		Drive checks for parity and reports result of parity checking to host. **Default** is **PD** jumper not installed.
SS		
Off		Reserved jumper position. Default is no jumper installed.
TP	**TP**	**(Does not apply to "WC" model)**
Off	Off	No terminator power is connected to drive terminators or SCSI bus I/O cable [1].
On	Off	Drive supplies its own terminator power only. Jumper on this position is factory **default**.
Off	On	Drive supplies power to SCSI bus I/O cable [1]; none to internal terminators.
On	On	Drive supplies terminator power to itself (internal connection) and to SCSI bus I/O cable [1] . This is a legal jumper setting.
TP Position A		**(Does not apply to "WC" model)**
On		This horizontally positioned jumper across the two **TP** positions nearest PCB edge, connects terminator power from SCSI bus I/O cable [1] to the drive's internal terminators (for single-ended I/O only).
Off		See above explanations for **TP**

[1] See Tables 11a and 11b for pins used for Termpower

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8.2 Drive orientation

The balanced rotary arm actuator design of the drive allows it to be mounted in any orientation. All drive performance characterization, however, has been done with the drive in horizontal (discs level) and vertical (drive on its side) orientations, and these are the two preferred mounting orientations.

8.3 Cooling

Cabinet cooling must be designed by the customer so that the ambient temperature immediately surrounding the drive will not exceed temperature conditions specified in Section 6.4.1, “Temperature.” Specific consideration should be given to make sure adequate air circulation is present around the printed circuit board (PCB) to meet the requirements of Section 6.4.1, “Temperature.”

8.3.1 Air flow

The rack, cabinet, or drawer environment for the Hawk 2XL drive must provide cooling of the electronics and head and disc assembly (HDA). You should confirm that adequate cooling is provided using the temperature measurement guidelines described below.

The drive should be oriented, or air flow directed, so that the least amount of air flow resistance is created while providing air flow to the electronics and HDA. Also, the shortest possible path between the air inlet and exit should be chosen to minimize the travel length of air heated by the drive and other heat sources within the rack, cabinet, or drawer environment.

Possible air-flow patterns are shown in Figure 8. The air-flow patterns are created by one or more fans, either forcing or drawing air as shown in the illustrations. Other air-flow patterns are acceptable as long as the temperature measurement guidelines of Section 6.4.1 are met.

8.4 Drive mounting

When mounting the drive using the bottom holes (x-y plane in Figure 5) care must be taken to ensure that the drive is not physically distorted due to a stiff non-flat mounting surface. The allowable mounting surface stiffness is 80 lb/in (14.0 N/mm). The following equation and paragraph define the allowable mounting surface stiffness:

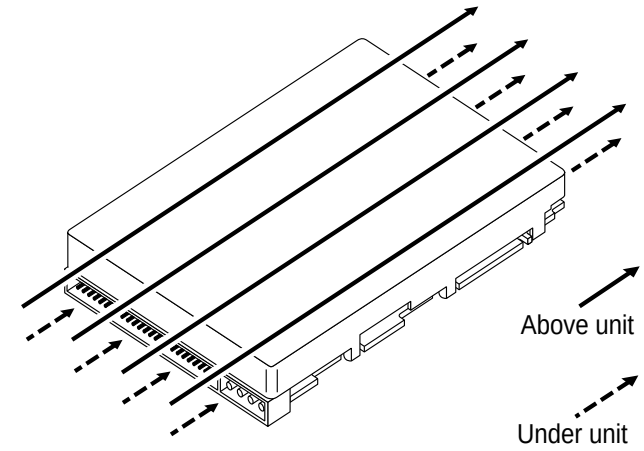
$$k * x = 80 \text{ lb } (14.0 \text{ N})$$

where ‘k’ represents the mounting surface stiffness (units of lb/in or N/mm), and, ‘x’ represents the out-of-plane mounting surface distortion (units of inches or millimeters). The out-of-plane distortion (‘x’) is determined by defining a plane with three of the for mounting points fixed and evaluating the out-of-plane deflection of the fourth mounting point when a known force is applied to the fourth point.

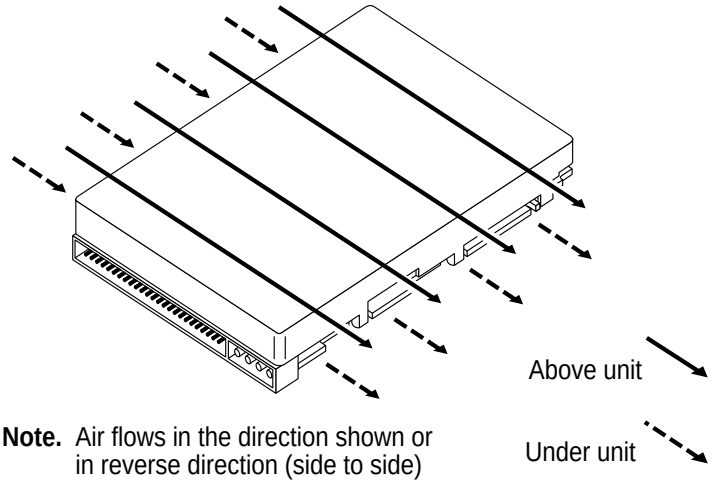
8.5 Grounding

Signal ground (PCB) and HDA ground are connected together in the drive and cannot be separated by the user. The equipment in which the drive is mounted is connected directly to the HDA and PCB with no electrically isolating shock mounts. If it is desired for the system chassis to not be connected to the HDA/PCB ground, the systems integrator or user must provide a nonconductive (electrically isolating) method of mounting the drive in the host equipment.

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Note. Air flows in the direction shown (front to back) or in reverse direction (back to front)



Note. Air flows in the direction shown or in reverse direction (side to side)

Figure 8. Air flow (suggested)

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9.0 Interface requirements

9.1 General description

This section partially describes the interface requirements as implemented on the drives. The major portion of the interface requirements/implementation is described in the Seagate SCSI Interface Product Manual, P/N 77738479. This section has tables that give the Hawk 2XL Family drive's version of the SCSI implementation described in the SCSI Interface Product Manual.

9.2 SCSI interface messages supported

Table 5 lists the messages supported by the SCSI-2 and SCSI-3 modes of the Hawk 2XL family drives.

Table 5: SCSI messages supported by Hawk 2XL family drives

Message Code	Supported by: SCSI-2/3	Message Name
01h[1]	Y	Extended messages
06h	Y	Abort
0Dh	Y	Abort-tag
0Ch	Y	Bus device reset
0Eh	Y	Clear queue
00h	Y	Command complete
12h	Y	Continue I/O process
04h	Y	Disconnect
80h-FFh	Y	Identify
23h	Y	Ignore wide residue (two bytes) (W & WC models only)
0Fh	N	Initiate recovery
05h	Y	Initiator detected error
0Ah	N	Linked command complete [2]
0Bh	N	Linked command complete with flag [2]
09h	Y	Message parity error
07h	Y	Message reject
[1]	N	Modify data pointer
08h	Y	No operation
		Queue tag messages (two bytes)
21h	Y	Head of queue tag
22h	Y	Ordered queue tag
20h	Y	Simple queue tag
10h	N	Release recovery
03h	Y	Restore pointers
02h	Y	Save data pointer
[1]	Y	Synchronous data transfer req.
13h	Y	Target transfer disable
11h	N	Terminate I/O process
[1]	[3]	Wide data transfer request

Notes.

[1] Extended messages (see P/N 77738479 SCSI Interface Product Manual).
[2] Customer unique.
[3] “N” models do not support.
“W” and “WC” models do support.

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9.3 SCSI interface commands supported

Table 6 lists the SCSI interface commands that are supported in the SCSI-2 and SCSI-3 modes of the drive. OEM standard drives are shipped set to operate in SCSI-2/SCSI-3 mode.

Table 6: Commands supported by Hawk 2XL family drive

Command Code	Supported by: SCSI-2/3	Command Name
00h	Y	Test unit ready
01h	Y	Rezero unit
03h	Y	Request sense
	Y	Extended sense
	Y	Field pointer bytes
	Y	Actual retry count bytes
	Y	Deferred error supported
04h	Y	Format unit [1]
	N	Block format
	Y	Bytes from index format
	Y	Physical sector format
	N	DPRY bit supported
07h	Y	Reassign blocks
08h	Y	Read
0Ah	Y	Write
0Bh	Y	Seek
12h	Y	Inquiry
	Y	Vital product data page
	Y	Unit serial number page
	Y	Implemented operating definition page
	Y	Firmware numbers page
	Y	Date code page
	Y	Jumper settings page
	Y	Device Behavior page
15h	Y [2] [3]	Mode select (same pages as mode Sense command, see below)
16h	Y	Reserve
	Y	3rd party reserve
	N	Extent reservation
17h	Y	Release
18h	N	Copy
1Ah	Y [2] [3]	Mode sense
	Y	Boot page (00h)
	Y	Error recovery page (01h)
	Y	Disconnect/reconnect (02h) (DTDC, DIMM not used)
	Y	Format page (03h)
	Y	Rigid disc drive geometry page (04)
	Y	Verify error recovery page (07h)
	Y	Caching parameters page (08h)
	N	IC bit controllable
	Y	Control mode page (0Ah)
	N	Notch and Partition Page (0C)
	N	Power condition page (1A)
1Bh	Y	Start unit/stop unit (spindle ceases rotating)

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Table 6: Commands supported by Hawk 2XL family drive (continued)

Command Code	Supported by: SCSI-2/3	Command Name
1Ch	Y	Receive diagnostic results
	Y	Supported diagnostics pages
	Y	Translate page
1Dh	Y	Send diagnostics page
	Y	Supported diagnostics pages
	Y	Translate page
25h	Y	Read capacity
28h	Y	Read extended
2Ah	Y	Write extended
2Bh	Y	Seek extended
2Eh	Y	Write and verify
2Fh	Y	Verify
30h	N	Search data high
31h	N	Search data equal
32h	N	Search data low
33h	N	Set limits
34h	N	Prefetch
35h	Y	Synchronize cache
36h	N	Lock-unlock cache
37h	Y	Read defect data
39h	N	Compare
3Ah	N	Copy and verify
3Bh	Y	Write buffer (modes 6 & 7 not supported)
3Ch	Y	Read buffer
3Eh	Y	Read long
3Fh	Y	Write long
40h	N	Change definition
41h	N	Write same
42-4Bh	N	Not used
4Ch	Y	Log select
4Dh	Y	Log sense
4E-54h	N	Not used
55h	Y	Mode select (10)
56h	Y	Reserve (10)
57h	Y	Release (10)
58-59h	N	Not used
5Ah	Y	Mode sense (10)
5B-5Fh	N	Not used
60-BFh	N	Not used
C0-DFh	N	Not used
E0-FFhN	N	Not used

[1] The drive can format to any even number of bytes per sector from 180 to 4096 (established at factory only)
[2] Supports both 6 byte and 10 byte versions
[3] Table 8a and 8b show how individual bits are set and which are changeable by the host.

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9.3.1 Inquiry data

Table 7 following lists the Standard Inquiry command data that the drive should return to the initiator per the format given in the SCSI-2 Interface Product Manual P/N 77738479, section 5.1.1.3.

Table 7: Hawk 2XL family drive Standard Inquiry data

Bytes	Data (HEX)																
0-15	00	00	02	02	8F	00	00	[16][1]	53	45	41	47	41	54	45	20	VENDOR ID
16-31	53	54	[33][2]	[32][2]	[31][2]	[35][2]	[31][2]	[4E][2]	20	20	20	20	20	20	20	20	PRODUCT ID
32-47	R#	R#	R#	R#	S#	S#	S#	S#	S#	S#	S#	S#	00	00	00	00	
48-63	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
64-79	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
80-95	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
96-111	00	43	6F	70	79	72	69	67	68	74	20	28	63	29	20	[31]	COPYRIGHT
112-127	[39]	[39]	[35][3]	20	53	65	61	67	61	74	65	20	41	6C	6C	20	NOTICE
128-143	72	69	67	68	74	73	20	72	65	73	65	72	76	65	64	20	

Notes.

[ ][1] For “W” and “WC” models this value is 36.

R# Four ASCII digits representing the last four digits of the product Firmware Release number. This information is also given in the Vital Product data page C0h, together with servo RAM and ROM release numbers.

S# Eight ASCII digits representing the eight digits of the product serial number.

[ ][2] Bytes 18 through 24 will reflect model of drive. Shown here are hex values for Model ST32151N. Values for ST31051N are 33 31 30 35 31 4E.

For models “W” and “WC” byte 23 is 57 (W) instead of 4E, since these are the both wide data bus drives. The host does not care about the “C” in “WC”.

[ ][3] Copyright Year - changes with actual year.

9.3.1.1 Inquiry Vital Product data

Instead of the Standard Inquiry data shown in Table 7, the initiator can request several Vital Product Data pages by setting the Inquiry command EVPD bit to one. The SCSI, Version 2 Interface Product Manual P/N 77738479, section 5.1.1.3.1 lists the Vital Product Data pages supported and describes their formats. A separate Inquiry command must be sent to the drive for each Vital Product Data page the initiator wants the drive to send back.

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9.3.2 Mode Sense data

The Mode Sense command provides a means for the drive to report its operating parameters to the initiator. The drive maintains four sets of Mode parameters, Default values, Saved values, Current values and Changeable values.

Default values are hard coded in the drive firmware that is stored in flash EPROM nonvolatile memory on the drive PCB. Default values can be changed only by downloading a complete set of new firmware into the flash EPROM. An initiator can request and receive from the drive a list of Default values and use those in a Mode Select command to set up new Current and Saved values, where the values are changeable.

Saved values are stored on the disk media using a Mode Select command. Only parameter values that are allowed to be changed can be changed by this method. See “Changeable values” defined below. Parameters in the Saved values list that are not changeable by the Mode Select command get their values from the Default values storage.

Current values are volatile values currently being used by the drive to control its operation. A Mode Select command can be used to change these values (only those that are changeable). Originally, they are installed from Saved or Default values after a power on reset, hard reset, or Bus Device Reset message.

Changeable values form a bit mask, stored in nonvolatile memory, that dictates which of the Current values and Saved values can be changed by a Mode Select command. A “one” allows a change to a corresponding bit; a “zero” allows no change. For example, in Table 8a refer to Mode page 01, in the first row entitled “CHG”. These are hex numbers representing the changeable values for Mode page 01. Note in columns 1 and 2 (bytes 00 and 01), there is 00h, which indicates that in bytes 00 and 01 none of the bits are changeable. Note also that bytes 04, 05, 06 and 07 are not changeable, because those fields are all zeros. In bytes 02, hex value EF equates to the binary pattern 1110 1111. If there were a zero in any bit position in the field, it means that bit is not changeable. Bits 7, 6, 5, 3, 2, 1 and 0 are changeable, because those bits are all ones. Bit 4 is not changeable. In this particular example, it indicates 7 of 8 error recovery control bits are all changeable. FF in column 4 indicates all bits in byte 3 are changeable.

The Changeable values list can only be changed by downloading new firmware into the flash EPROM.

On drives requiring unique Saved values, the required unique Saved values are stored into the Saved values storage location on the media prior to shipping the drive. Some drives may have unique firmware with unique Default values also.

On standard OEM drives the Saved values are taken from the Default values list and stored into the Saved values storage location on the media prior to shipping.

When a drive is powered up, it takes Saved values from the media and stores them to the Current values storage in volatile memory. It is not possible to change the Current values (or the saved values) with a Mode Select command before the drive is up to speed and is “ready.” An attempt to do so results in a “Check Condition” status being returned.

Note.

Because there may be several different versions of drive control firmware in the total population of drives in the field, the Mode Sense values given in the following tables may not exactly match those of some drives.

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The following tables list the values of the data bytes returned by the drive in response to the Mode Sense command pages for SCSI-2/SCSI-3 implementation (see SCSI Interface Product Manual, P/N 77738479).

Definitions:

DEF = Default value. Standard drives are shipped configured this way.
CHG = Changeable bits; indicates if current and saved values are changeable.

Table 8a: Mode sense data, ST32151/ST32155 default values (SCSI-2/3 implementation)

Bytes	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Mode Sense Data	87	00	10	08																				
	00	00	00	00	00	00	02	00																
Mode Page	<----------Mode Page Headers and Parameter Data Bytes---------->																							
01 DEF	81	0A	00	0D	30	00	00	00	05	00	FF	FF												
01 CHG	00	00	EF	FF	00	00	00	00	FF	00	00	00												
02 DEF	82	0E	80	80	00	0A	00	00	00	00	00	00	00	00	00	00								
02 CHG	00	00	FF	FF	00	00	00	00	00	00	00	00	87	00	00	00								
03 DEF	83	16	00	08	00	0A	00	00	00	10	00	7E	02	00	00	01	00	0C	00	00	40	00	00	00
03 CHG	00	00	FF	FF	FF	FF	00	00	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00
04 DEF	84	16	00	10	51	08	00	00	00	00	00	00	00	00	00	00	00	00	00	00	15	22	00	00
04 CHG	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
07 DEF	87	0A	00	0D	30	00	00	00	00	00	FF	FF												
07 CHG	00	00	0F	FF	00	00	00	00	00	00	00													
08 DEF	88	12	14	00	FF	FF	00	00	FF	FF	FF	FF	80	03	00	00	00	00	00	00				
08 CHG	00	00	BD	00	FF	FF	FF	FF	FF	FF	00	00	A0[1]	FF	00	00	00	00	00	00				
0A DEF	8A	0A	02	00	00	00	00	00	00	00	00	00												
0A CHG	00	00	01	F1	00	00	00	00	00	00	00													
1A DEF	9A	0A	00	00	00	00	00	00	00	00	00	00												
1A CHG	00	00	00	00	00	00	00	00	00	00	00	00												
00 DEF	80	02	00	00																				
00 CHG	00	00	77	00																				

[1] Though byte 12, bit 7 (A0) is shown as changeable, the FSW function governed by that bit is not implemented by this drive.

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Table 8b: Mode sense data, ST31051/ST31055 default values (SCSI-2/3 implementation)

Bytes	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Mode Sense Data	87	00	10	08																				
	00	00	00	00	00	00	02	00																
Mode Page	<----------Mode Page Headers and Parameter Data Bytes---------->																							
01 DEF	81	0A	00	0D	30	00	00	00	05	00	FF	FF												
01 CHG	00	00	EF	FF	00	00	00	00	FF	00	00	00												
02 DEF	82	0E	80	80	00	0A	00	00	00	00	00	00	00	00	00	00								
02 CHG	00	00	FF	FF	00	00	00	00	00	00	00	00	87	00	00	00								
03 DEF	83	16	00	04	00	04	00	00	00	08	00	TBD	02	00	00	01	00	0C	00	00	40	00	00	00
03 CHG	00	00	FF	FF	FF	FF	00	00	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00
04 DEF	84	16	00	10	51	04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	15	23	00	00
04 CHG	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
07 DEF	87	0A	00	0D	30	00	00	00	00	00	FF	FF												
07 CHG	00	00	0F	FF	00	00	00	00	00	00	00													
08 DEF	88	12	14	00	FF	FF	00	00	FF	FF	FF	FF	80	03	00	00	00	00	00	00				
08 CHG	00	00	BD	00	FF	FF	FF	FF	FF	FF	00	00	A0[1]	FF	00	00	00	00	00	00				
0A DEF	8A	0A	02	00	00	00	00	00	00	00	00	00												
0A CHG	00	00	01	F1	00	00	00	00	00	00	00													
1A DEF	9A	0A	00	00	00	00	00	00	00	00	00	00												
1A CHG	00	00	00	00	00	00	00	00	00	00	00	00												
00 DEF	80	02	00	00																				
00 CHG	00	00	77	00																				

[1] Though byte 12, bit 7 (A0) is shown as changeable, the FSW function governed by that bit is not implemented by this drive.

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9.4 SCSI bus conditions and miscellaneous features supported

Asynchronous SCSI bus conditions supported by the drive are listed below. These conditions cause the SCSI device to perform certain actions and can alter the SCSI bus phase sequence. Other miscellaneous operating features supported are also listed here. Refer to SCSI I/O Product manual P/N 77738479 for details.

Table 9: SCSI bus conditions and other misc. features

Condition/Feature Supported by:

SCSI-2/SCSI-3	Conditions or Feature
Y	Attention Condition
Y	Reset Condition
Y	Contingent Allegiance Condition
N	Asynchronous Event Notification
Y	Arbitrating System
Y	Disconnect/Reconnect
Y	Asynchronous Data Transfer
Y	Synchronous Data Transfer
N	Synchronized (locked) Spindle Operation
N	Differential Interface Circuits available
Y	Segmented Caching
N	Zero Latency Read
Y	Queue tagging (up to 64 Que tags supported)
Y	Deferred Error Handling
Y	Parameter Rounding
Y	Reporting actual retry count in Extended Sense bytes 15, 16 and 17.
N	Adaptive Caching
Y	Adaptive Read Look-ahead
[1]	Flag and Link bits in Control Byte supported
Y	Immediate status on Start/Stop command
Y	Immediate status on Format unit command
N	Immediate status on Synchronize Cache command
Y	Format progress indication
SCSI-2/SCSI-3	**Status Supported**
Y	Good
Y	Check Condition
N	Condition Met/Good
Y	Busy
[1]	Intermediate/Good
N	Intermediate/Condition Met/Good
Y	Reservation Conflict
Y	Queue Full

Notes.

[1] Customer unique

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9.5 Synchronous data transfer

9.5.1 Synchronous data transfer periods supported

Table 10 lists Synchronous Data transfer periods supported by the drive. The data transfer period to be used by the drive and the initiator is established by an exchange of messages during the Message Phase of operation. See the section on message protocol in the SCSI Interface Manual P/N 77738479.

Table 10: Synchronous data transfer periods for drive

M (Decimal)	Transfer period (M times 4 nanoseconds)
12 [1]	50 [1]
15 [1]	62.5 [1]
18 [1]	75 [1]
25	100
31	125
37	150
50	200
62	250
75	300
87	350
100	400

9.5.2 REQ/ACK offset

The maximum value supported by the Hawk 2XL family drives for REQ/ACK offset is 15 (0Fh).

9.6 Physical interface

Figures 9a, 9b and 9c show the locations of the drive physical interface components. Shown are the locations of the DC power connector, the SCSI interface connector, and the drive select and option select headers.

Details of the physical, electrical and logical characteristics are given in sections following, while the SCSI operational aspects of Seagate drive interfaces are given in the Seagate SCSI Interface Product Manual, P/N 77738479.

This section describes the connectors, cables, signals, terminators and bus timing of the DC and SCSI I/O Interface. See Sections 9.7 and 9.8 for additional terminator information.

9.6.1 DC cable and connector

With the exception of “WC” model drives, the drive receives DC power through a 4 pin connector (see Figure 9a for pin assignment) mounted at the rear of the main PCB. Recommended part numbers of the mating DC power connector are listed below, but equivalent parts may be used.

Type of Cable	Connector	Contacts (20-14 AWG)
14 AWG	MP 1-480424-0	AMP 60619-4 (Loose Piece) AMP 61117-4 (Strip)

Model “WC” receives power through the 80 pin I/O connector. See Table 11c.

[1] ULTRA SCSI transfer periods. Applies only to models ST32155/ST31055.

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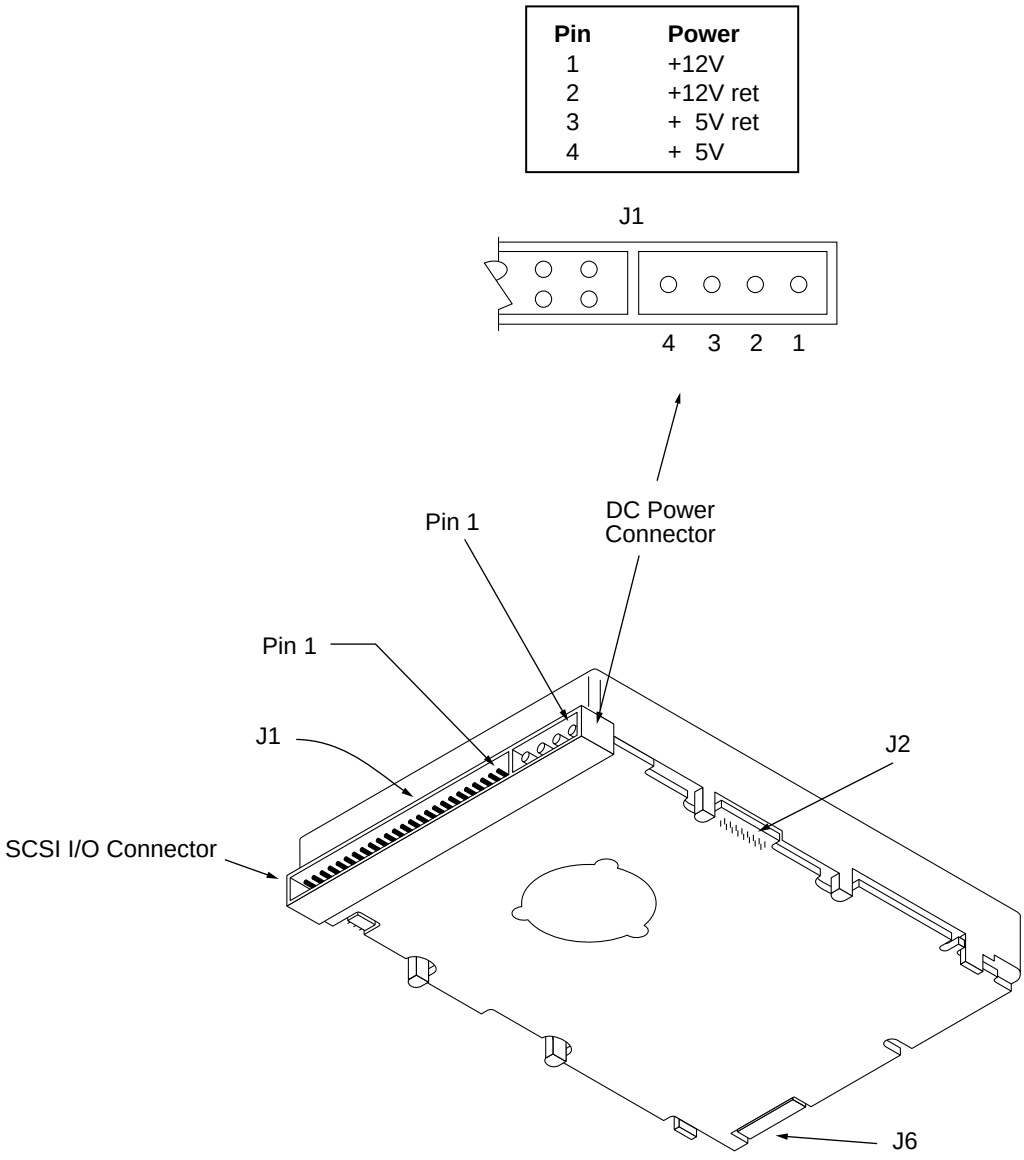


Figure 9a. Physical interface for “N” model drives

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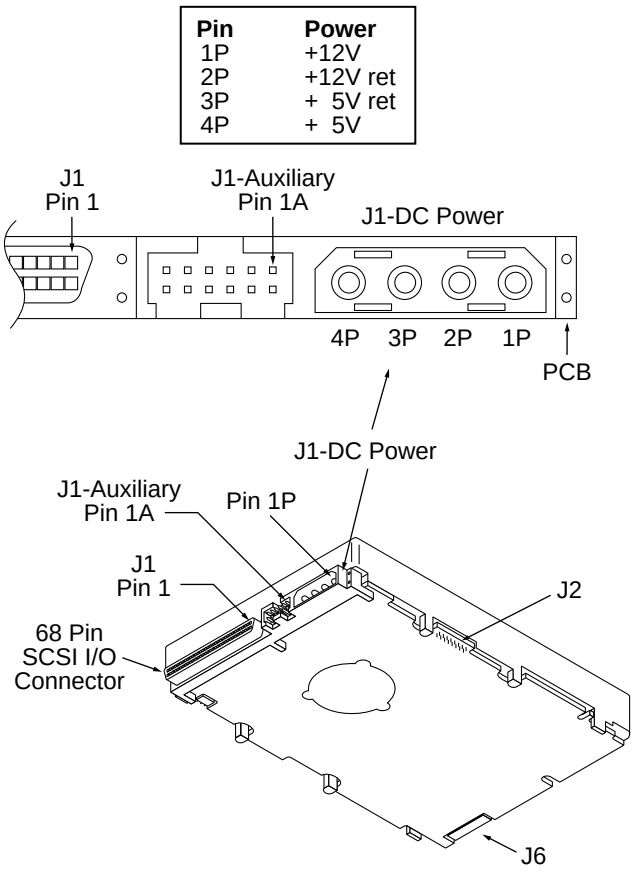
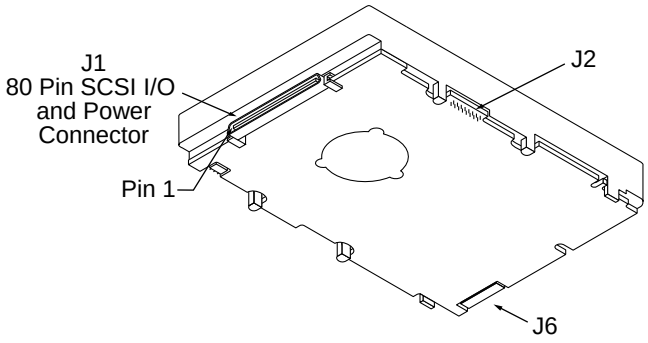


Figure 9b. Model “W” drive physical interface (68 pin J1 SCSI I/O connector)



Note: See Table 11c for DC power pin assignments.

Figure 9c. Model “WC” drive physical interface (80 pin J1 SCSI I/O connector / DC power connector)

9.6.2 SCSI Interface physical description

The drives may be daisy chained together or with other compatible SCSI devices. Both ends of the cable must be terminated. The “N”, “W” and “WC” model drives implement single-ended drivers and receivers. All signals are common between all SCSI devices. The drive may be daisy chained only with SCSI devices having the same type drivers and receivers. Devices having single-ended interface circuits cannot be on the same daisy-chain with devices having differential interface circuit. A maximum of 8 (“N” models) or 16 (“W” and “WC”) SCSI devices (including the Host) may be daisy chained together. The SCSI devices at both ends of the daisy-chain are to be terminated. Intermediate SCSI devices shall not be terminated (see Figure 10). Remove the terminator enable jumper **TE** on J2 select header (“N” and “W” models), or the external terminators (“WC” model), not the terminator power source selector jumper **TP** (Figure 7d).

“WC” model drives plug into PCB or bulkhead connectors in the Host. They may be connected in a daisy-chain by the host backplane wiring or PCB circuit runs that have adequate DC current carrying capacity to support the number of drives plugged into the PCB or bulkhead connectors. A single 80 pin I/O connector cannot support the DC current needs of several drives, so no daisy chain cables beyond the bulkhead connectors should be used. A single drive connected via a cable to a host 80 pin I/O connector is not recommended.

9.6.3 SCSI Interface Cable requirements

In general, cables having the characteristic impedances given in Section 9.6.3.1 are not available; however, impedance’s that are somewhat lower are satisfactory. A characteristic impedance of 100 ohm ±10% is recommended for unshielded flat cable or twisted pair ribbon cable. However, most available cables have a somewhat lower characteristic impedance. To minimize discontinuances and signal reflections, cables of different impedances should not be used in the same bus. Implementations may require trade-offs in shielding effectiveness, cable length, the number of loads, transfer rates, and cost to achieve satisfactory system operation. If shielded and unshielded cables are mixed within the same SCSI bus, the effect of impedance mismatch must be carefully considered. Proper impedance matching is especially important in order to maintain adequate margin at FAST SCSI transfer rates.

Model “N” uses nonshielded cable connectors. A 50 conductor flat cable or 25 twisted pair cable shall be used. A minimum conductor size of 28 AWG should be used to minimize noise effects.

Suggested nonshielded flat cable part numbers are:
Flat cable - 35M-3365-50 Twisted pair - Spectra Twist in flat 455-248-50

Model “W” uses nonshielded cable connectors. A 68 conductor flat cable or 34 twisted pair cable shall be used with connectors listed in 9.6.4. A minimum conductor size of 28 AWG should be used to minimize noise effects.

Suggested nonshielded flat cable part numbers are:
Flat cable - 35M-3365-68 Twisted pair - Spectra Twist in flat 455-248-68

For WC models:

The 80 pin connector option is intended for use on drives that plug directly into a PCB or wall/bracket mounted connector in the host equipment. Installations with connectors on cables are not recommended.

9.6.3.1 Single-ended I/O circuits (“N”, “W” and “WC” models)

The maximum total cable length for use with drives having single-ended I/O driver and receiver circuits shall be 6 metres (19.7 ft.) when operating at line data transfer rates of 5 Mbytes/sec or less, and 3 metres (9.85 ft.) when operating at transfer rates greater than 5 Mbytes/sec (FAST SCSI). A stub length of no more than 0.1 metre (0.33 ft.) is allowed off the mainline interconnection with any connected equipment. An ideal impedance match with cable terminators implies a cable characteristic impedance of 132 ohms. Single-ended I/O cable pin assignments are shown in Table 11a, 11b and 11c.

9.6.3.2 Differential I/O circuits (“ND”, “WD” and “DC” models)

The Hawk 2XL has no differential I/O models available.

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9.6.4 Mating connectors

Part numbers for the different type connectors that mate with the various Hawk 2XL I/O connectors are given in the sections following.

9.6.4.1 Mating connectors for “N” models

The nonshielded cable connector shall be a 50 conductor connector consisting of two rows of 25 male contacts with adjacent contacts 100 mils apart.

Recommended mating flat cable connector part numbers are:

Closed end (for cable ends)[1]	3M-3425-7000	W/O Strain Relief, No Center Key
	3M-3425-7050	With Strain Relief, No Center Key
	Dupont-66900-290	With Strain Relief, With Center Key
Open end (In daisy-chain) [1]	3M-3425-6000	W/O Strain Relief, No Center Key
	3M-3425-6050	With Strain Relief, No Center Key
	Dupont-66900-250	With Strain Relief, With Center Key

[1] See Figure 10

The drive device connector is a nonshielded 50 conductor connector consisting of two rows of 25 female pins with adjacent pins 100 mils apart. The connector is keyed (see Figure 11a).

9.6.4.2 Mating connectors for W models

The nonshielded cable connector shall be a 68 conductor connector consisting of two rows of 34 male contacts with adjacent contacts 0.050 inch (1.27 mm) apart.

Recommended mating flat cable connector part numbers are:

Closed end (for cable ends) [1]	Amp Model 749925-5	(50 mil conductor centers, 28 or 30 AWG wire) Use two, 34 conductor, 50 mil center flat cable with this connector. This type connector can only be used on cable ends.
Open end (In daisy-chain)[1]	Amplimite 88-5870-294-5	W/O Strain Relief, (25 mil conductor centers, 30 AWG for daisy-chain installations.

[1] See Figure 10.

The drive device connector is a nonshielded 68 conductor connector consisting of two rows of 34 female pins with adjacent pins 50 mils apart. The connector is keyed by means of its shape (see Figure 11b).

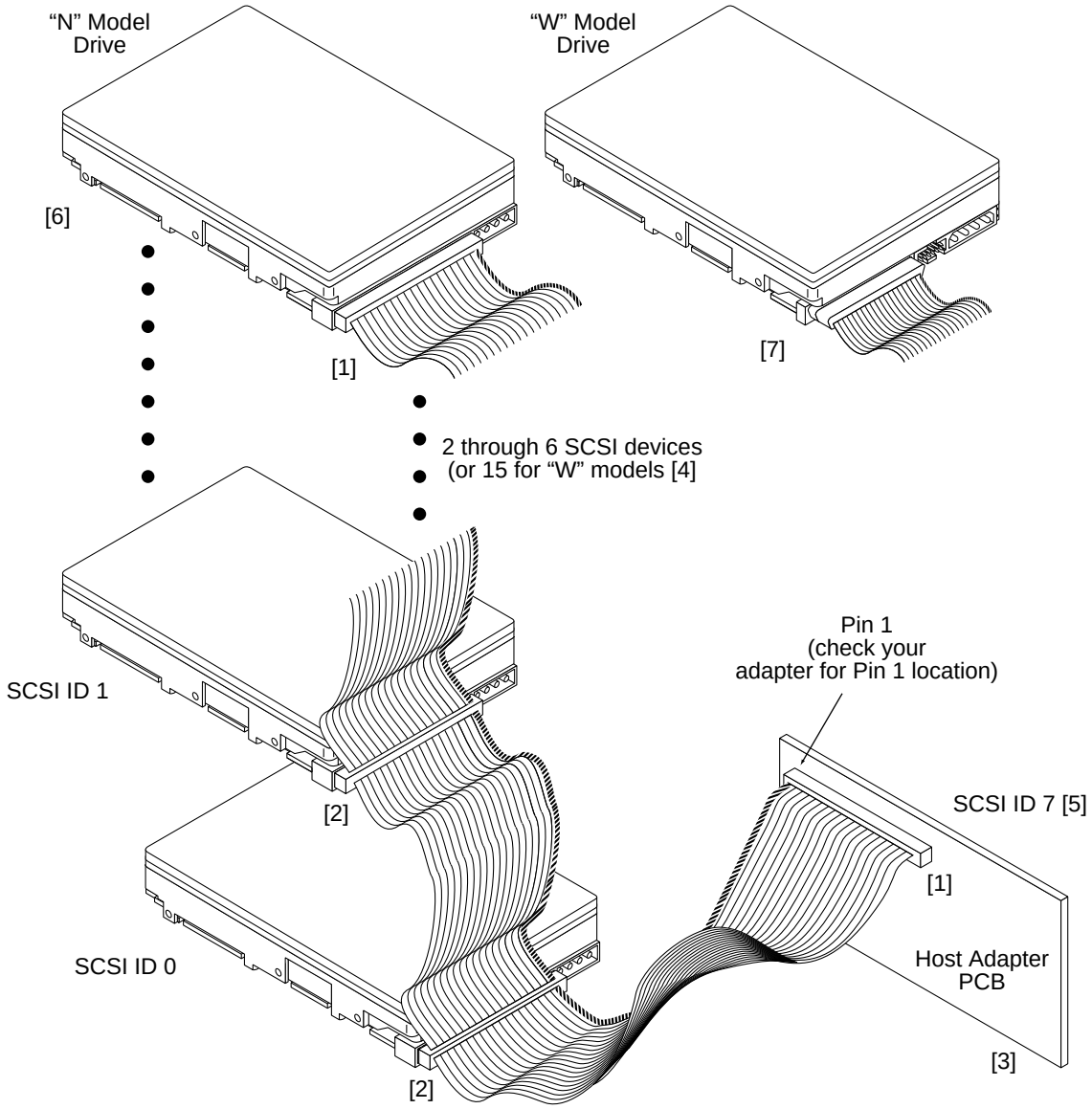
9.6.4.3 Mating connectors for WC models

The nonshielded connector shall be an 80 conductor connector consisting of two rows of 40 contacts with adjacent contacts 50 (1.27 mm) mils apart. I/O connection using a cable is not recommended. The length and size of the host equipment DC power carrying conductors from the DC power source to the host equipment 80 pin disk drive interface connector(s) should be strictly designed according to proper power transmission design concepts. No possibility for the equipment user to attach an 80 pin cable/connector should be allowed, since the length of the DC power carrying conductors could not be controlled and therefore could become too long for safe power transmission to the drive. Daisy-chain 80 conductor cables should especially not be allowed, since the power-carrying conductors on the 80 conductor interface were not intended to support a series of drives.

Recommended PCB or bulkhead mounted connectors are:

Straight-in connector		**Hot Plug version**	**Right angle to PCB connector:**	
Seagate P/N:	77678703		Seagate P/N:	77678559
Amp US P/N:	2-557103-1	787311-1	Amp US P/N:	2-557101-1
Amp Japan P/N:	5-175475-9		Amp Japan P/N:	5-175474-9

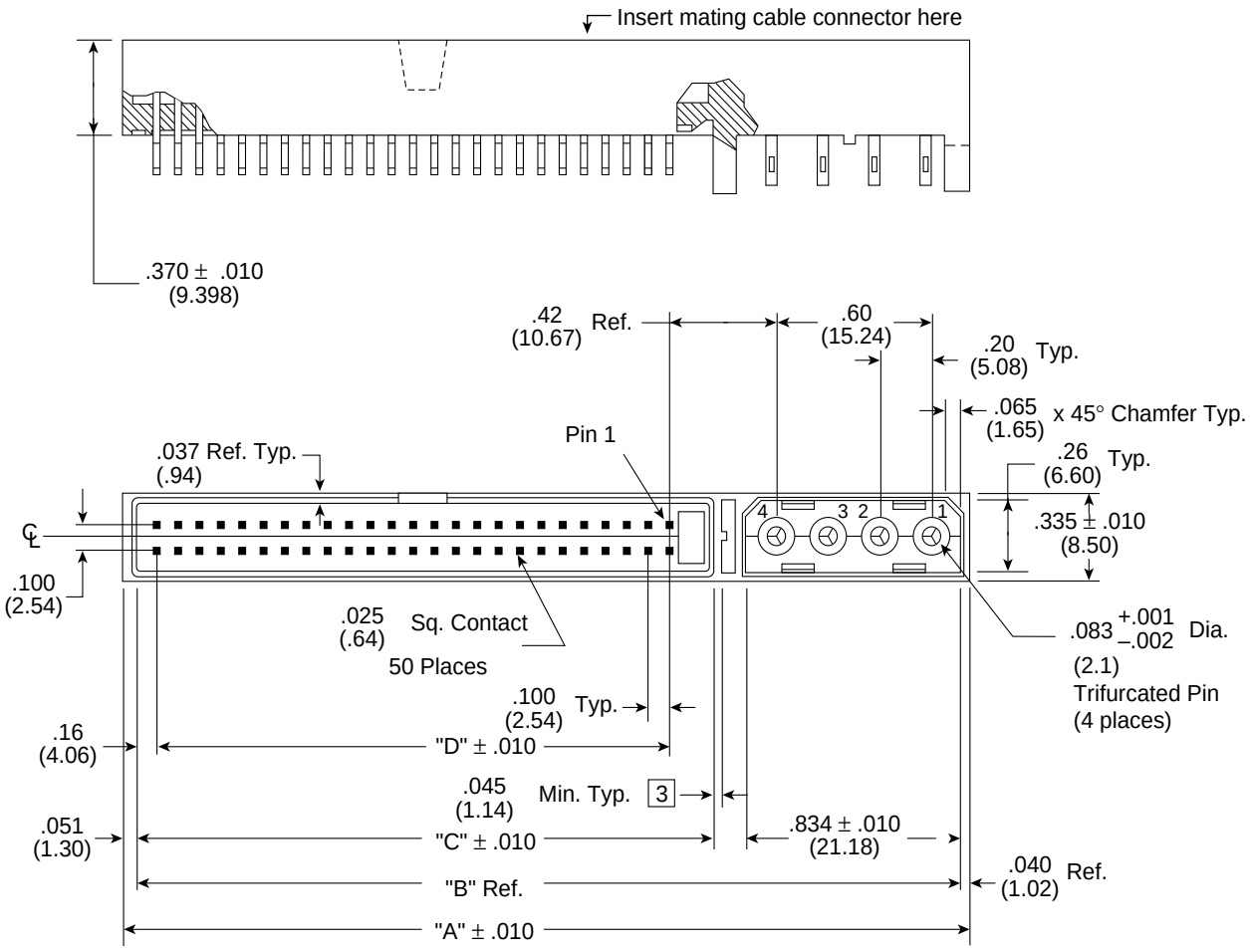
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[1] Closed end type 50 pin connector used. Install terminator enable **(TE)** jumper plug.
[2] Open end type (in-line application) connector used. Terminators disabled.
[3] Host need not be on the end of the daisy-chain. Another device can be on the end with the terminator, the host having no terminator.
[4] Total interface cable length must not exceed that specified in Section 9.6.3.1 (including host adapter/initiator).
[5] SCSI ID7 has highest arbitration priority, ID0 has lowest for "N" models. For "W" models, priority is ID 7 to ID 0, then ID 15 to ID 8. (ID8 very lowest).
[6] Last drive on daisy-chain.
[7] Open end type 68 pin connector used. Terminators disabled. If end device, closed end type 68 pin connector used. Install terminator enable **(TE)** jumper plug.

Figure 10. SCSI Daisy-chain interface cabling

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No. Pos.	"A"	"B"	"C"	"D"
50	3.767 (95.68)	3.697 (93.90)	2.720 (69.09)	2.400 (60.96)

Figure 11a. Nonshielded 50 pin SCSI device connector

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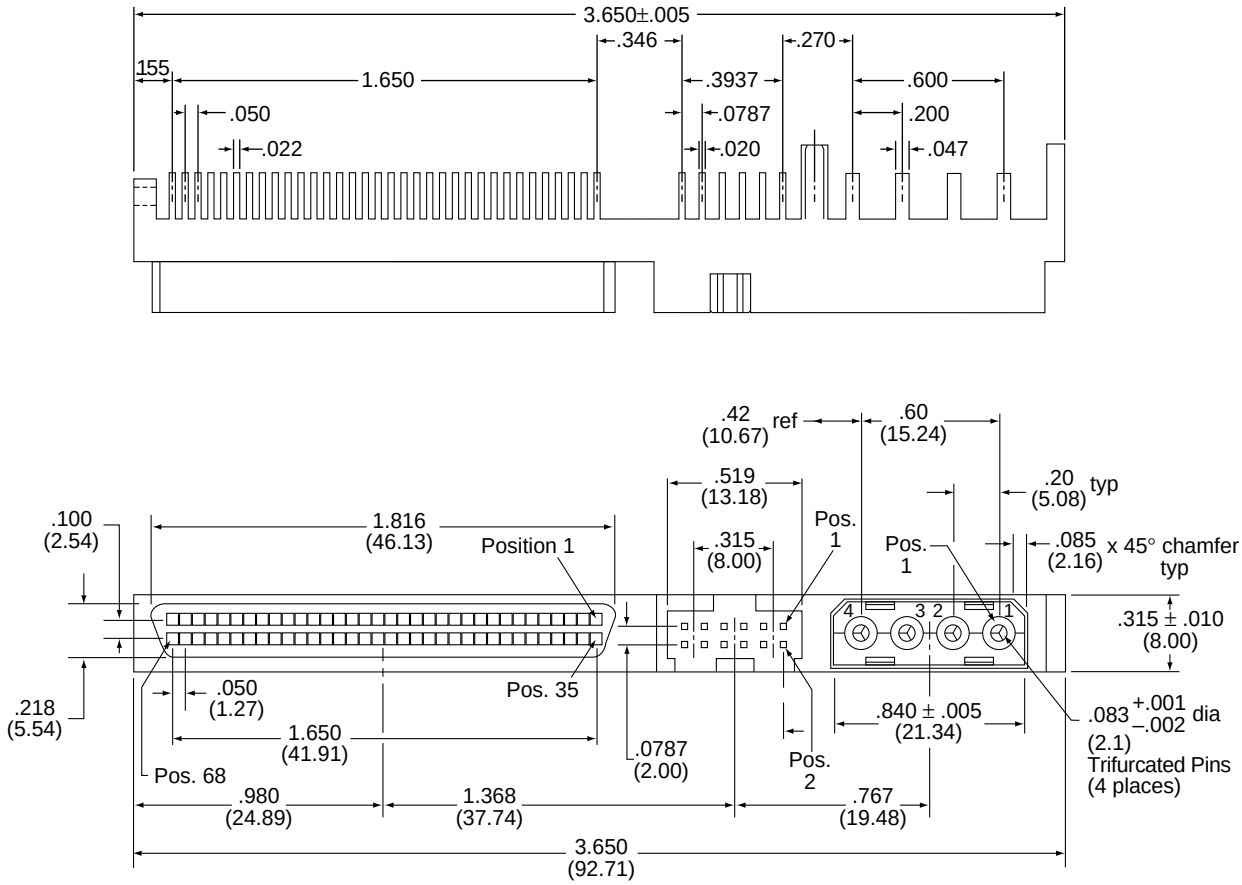


Figure 11b. Nonshielded 68 pin SCSI device connector

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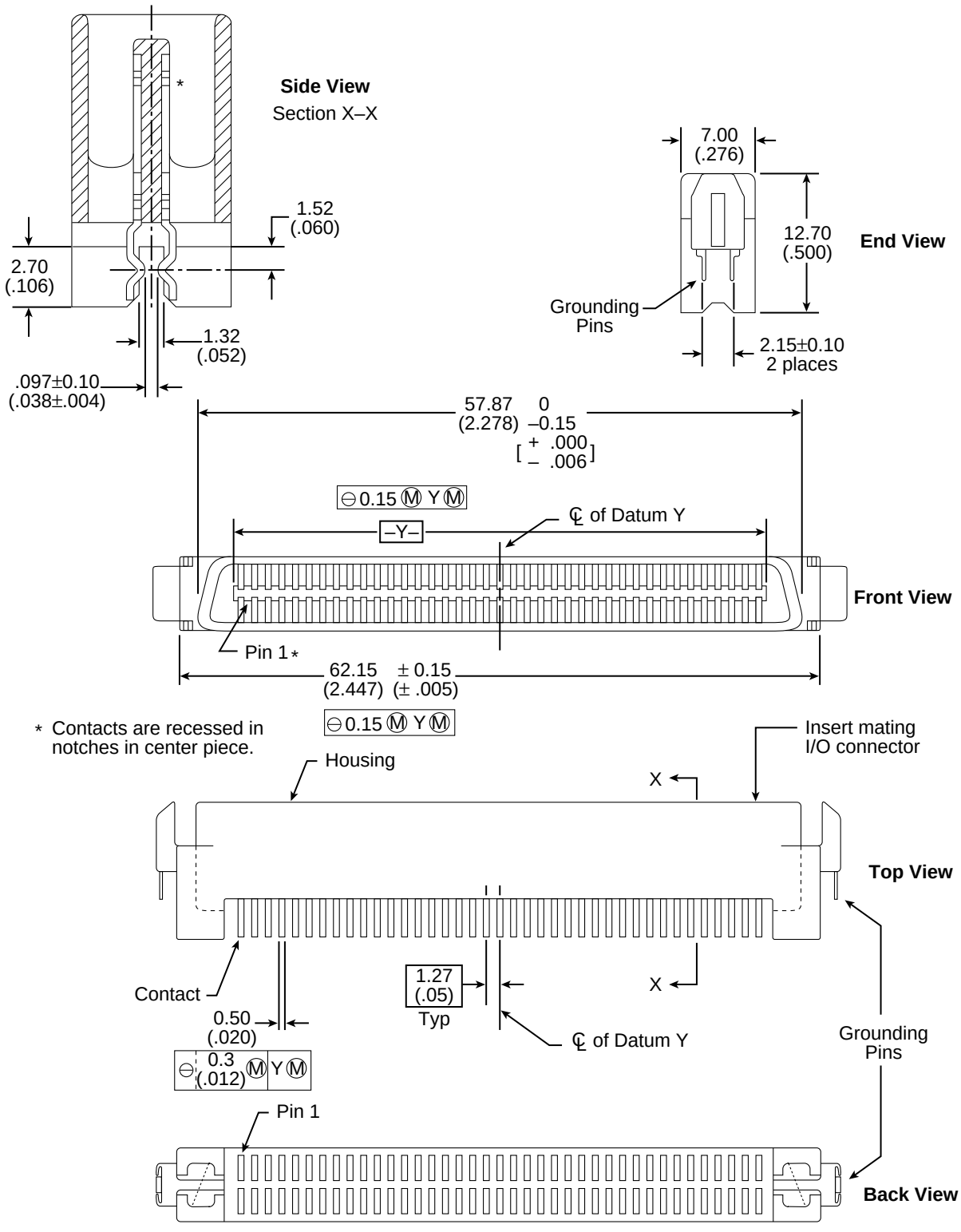


Figure 11c. Nonshielded 80 pin SCSI connector, used on “WC” model

Table 11a: Model "N", single ended I/O, 50 conductor, signal/contact assignments

Signal Name [1]	Connector Contact Number [12]	Cable Conductor Number [11]		Connector Contact Number [12]	Signal Name [1]
GND	1	1	26	26	TERMPOWER
-DB0	2	2	27	27	NC [10]
GND	3	3	28	28	GND
-DB1	4	4	29	29	GND
GND	5	5	30	30	GND
-DB2	6	6	31	31	GND
GND	7	7	32	32	-ATN
-DB3	8	8	33	33	GND
GND	9	9	34	34	GND
-DB4	10	10	35	35	GND
GND	11	11	36	36	-BSY
-DB5	12	12	37	37	NC [10]
GND	13	13	38	38	-ACK
-DB6	14	14	39	39	NC [10]
GND	15	15	40	40	-RST
-DB7	16	16	41	41	GND
GND	17	17	42	42	-MSG
-DBP	18	18	43	43	GND
GND	19	19	44	44	-SEL
GND	20	20	45	45	GND
GND [8]	21	21	46	46	-C/D
GND	22	22	47	47	GND
NC [10]	23	23	48	48	-REQ
GND	24	24	49	49	GND
NC [10]	25*	25	50	50	-I/O

***CAUTION:** Connector contact 25 must not be connected to ground at the host end or the drive end of the cable. If the I/O cable should accidently be plugged in upside down, terminator power on pin 26 will be shorted to ground.

Notes [ ]: See page following Table 11c

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Table 11b: "W" models single ended I/O cable 68 conductor signal/contact assignments

Signal Name [1]	Connector Contact Number [3]	Cable Conductor Number [2]		Connector Contact Number [3]	Signal Name [1]
GND	1	1	2	35	-DB12
GND	2	3	4	36	-DB13
GND	3	5	6	37	-DB14
GND	4	7	8	38	-DB15
GND	5	9	10	39	-DBP1
GND	6	11	12	40	-DB0
GND	7	13	14	41	-DB1
GND	8	15	16	42	-DB2
GND	9	17	18	43	-DB3
GND	10	19	20	44	-DB4
GND	11	21	22	45	-DB5
GND	12	23	24	46	-DB6
GND	13	25	26	47	-DB7
GND	14	27	28	48	-DBP
GND	15	29	30	49	GND
GND	16	31	32	50	GND
TermPwr	17	33	34	51	TermPwr
TermPwr	18	35	36	52	TermPwr
Reserved	19	37	38	53	Reserved
GND	20	39	40	54	GND
GND	21	41	42	55	-ATN
GND	22	43	44	56	GND
GND	23	45	46	57	-BSY
GND	24	47	48	58	-ACK
GND	25	49	50	59	-RST
GND	26	51	52	60	-MSG
GND	27	53	54	61	-SEL
GND	28	55	56	62	-C/D
GND	29	57	58	63	-REQ
GND	30	59	60	64	-I/O
GND	31	61	62	65	-DB8
GND	32	63	64	66	-DB9
GND	33	65	66	67	-DB10
GND	34	67	68	68	-DB11

Notes [ ]: See page following Table 11c

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Table 11c: "WC" models single ended I/O, 80 conductor cable signal/contact assignments

Signal Name [1]	Connector Contact Number [3]	Cable Conductor [2]		Connector Contact Number [3]	Signal Name [1]
+12 V CHARGE	1	1	2	41	12 V GND
+12 V	2	3	4	42	12 V GND
+12 V	3	5	6	43	12 V GND
+12 V	4	7	8	44	MATED 1
NC [10]	5	9	10	45	NC [10]
NC [10]	6	11	12	46	GND [8]
-DB11	7	13	14	47	GND
-DB10	8	15	16	48	GND
-DB9	9	17	18	49	GND
-DB8	10	19	20	50	GND
-I/O	11	21	22	51	GND
-REQ	12	23	24	52	GND
-C/D	13	25	26	53	GND
-SEL	14	27	28	54	GND
-MSG	15	29	30	55	GND
-RST	16	31	32	56	GND
-ACK	17	33	34	57	GND
-BSY	18	35	36	58	GND
-ATN	19	37	38	59	GND
-DBP	20	39	40	60	GND
-DB7	21	41	42	61	GND
-DB6	22	43	44	62	GND
-DB5	23	45	46	63	GND
-DB4	24	47	48	64	GND
-DB3	25	49	50	65	GND
-DB2	26	51	52	66	GND
-DB1	27	53	54	67	GND
-DB0	28	55	56	68	GND
-DP1	29	57	58	69	GND
-DB15	30	59	60	70	GND
-DB14	31	61	62	71	GND
-DB13	32	63	64	72	GND
-DB12	33	65	66	73	GND
+5 V	34	67	68	74	MATED 2
+5 V	35	69	70	75	5 V GND
+5 V	36	71	72	76	5 V GND
NC [10]	37	73	74	77	ACTIVE LED OUT [4] [9]
SCSI ID [2] [5]	38	75	76	78	DLYD-START [6]
SCSI ID [0] [7]	39	77	78	79	SCSI ID [1] [7] [9]
RMT-START [7] [9]	40	79	80	80	SCSI ID [3] [7] [9]

Notes [ ]: See page following this Table

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Notes [ ] for Tables 11a, 11b, and 11c.

[1] See Section 9.6.4.4 for detailed electrical characteristics of these signals.
[2] The conductor number refers to the conductor position when using 0.025-inch (0.635 mm) centerline flat ribbon cable. Other cables types may be used to implement equivalent contact assignments.
[3] Connector contacts are on 0.050 inch (1.27 mm) centers.
[4] Front panel LED signal; indicates drive activity for host front panel hard drive activity indicator.
[5] Asserted by host to enable Motor Start option (enables starting motor via SCSI bus command).
[6] Asserted by host to enable Delayed Motor Start option (motor starts at power on or after a delay of 12 seconds times drive ID). This and [3] above are mutually exclusive options.
[7] Binary code on A3, A2, A1 and A0 asserted by host to set up SCSI bus ID in drive.
[8] GND provides a means for differential devices to detect the presence of a single ended device on the bus.
[9] Signals [4] through [7] are used in place of installing jumpers and cables on option select connectors J2, J5 and J6. See also notes following Figure 7d.
[10] “NC” means no connection.
[11] The conductor number refers to the conductor position when using 0.050 inch (1.27 mm) centerline flat ribbon cable. Other cable types may be used to implement equivalent contact assignments.
[12] Connector contacts are on 0.100 inch (2.54 mm) centers.

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9.6.4.4 Single-ended drivers/receivers

For “N” models which use single-ended drivers and receivers, typical circuits are shown in Figure 12. Terminator circuits (Note [1]) are to be enabled (model N) only when the disc drive is first or last in the daisy-chain.

Transmitter characteristics

Single-ended drives use an ANSI SCSI compatible open collector single-ended driver. This driver is capable of sinking a current of 48 mA with a low level output voltage of 0.4 volt.

Receiver characteristics

Single-ended drives use an ANSI SCSI single-ended receiver with hysteresis gate or equivalent as a line receiver.

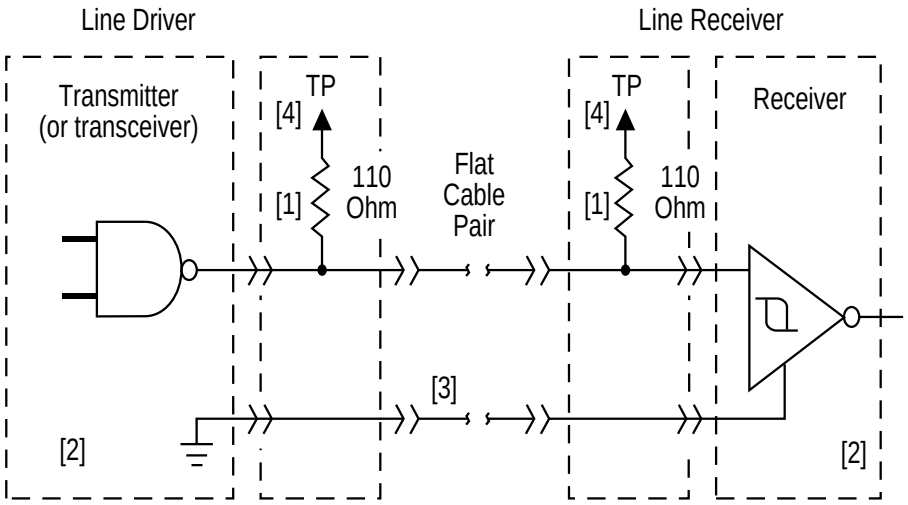


Figure 12. Single-ended transmitters and receivers

Notes.

[1] Part of active terminator circuits. Non-removable LSI terminators, enabled in the drive (model “N” and “W” models only) with jumper plug **TE** when it is first of last in the daisy-chain. Interface signals levels and logical sense at the drive I/O connector are defined as follows:

Logic Level	Driver Output	Receiver Input
NEGATED (0)	≥2.5 V: <5.25 V	≥2.0 V: ≤5.25 V
ASSERTED (1)	≤0.4 V: >0.0 V	≤0.8 V: ≥0. 0 V

The difference in the voltages between input and output signals is due to the losses in the cable.

[2] ANSI SCSI compatible circuits

[3] Total interface cable length should not exceed that specified in Section 9.6.3.1.

[4] Source of drive terminator power is an active circuit which has an input source voltage selected by jumper plug **TP**. See Figure 7d. Applies to “N” and “W” models.

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9.7 Terminator requirements

Internal disc drive I/O termination (provided only in model “N” and “W” drives) consists of active circuits in an LSI module that is permanently mounted on the PCB. All single initiator/single target (non-daisy-chain) applications require that the Initiator and disc drive be terminated. Daisy-chain applications require that only the units at each end of the daisy-chain be terminated. All other peripherals on the chain must not be terminated. (See Figure 10).

Note. Remove drive terminator enabling jumper **TE** (see Figure 7d) where terminators are not required. Removal of terminator power source selection jumper **TP** (see Figure 7d) does not disconnect the terminator resistors from the circuit.

It is highly recommended that ANSI SCSI-2 Standard’s Alternative 2 termination (active termination) be used for applications with single-ended (“N”, “W” and “WC” models), especially if the bus will be operated at transfer rates above 5 Mbytes/sec. The “N” and “W” models provides on-board active termination that can be disabled by removal of the enable jumper **TE** (see Figure 7b).

Note. ACTIVE TERMINATORS ARE HIGHLY RECOMMENDED FOR USE IN THE DAISY-CHAIN AS DESCRIBED ABOVE. ACTIVE AND PASSIVE TERMINATORS SHOULD NOT BE MIXED ON THE SAME SCSI BUS.

“WC” models do not have terminators on the PCB. The user, systems integrator or host equipment manufacturer must provide a terminator arrangement external to the drive.

9.8 Terminator power

The drive may be configured to accept terminator power from pin 26 of the SCSI bus (on “N” and “W” models), to supply power to the SCSI bus or to provide terminator power for internal termination circuits from the drive power connector. See Figure 7d. The drive can provide power both to its own terminators and to the SCSI bus terminator power line (Pin 26) if both “**TP**” jumpers are on.

SCSI devices providing terminator power (TERMPWR) shall have the following characteristics:

8-bit SCSI V TERM = 4.25 V to 5.25 V
800 mA min source drive capability
1.0 A maximum

16-bit SCSI V TERM = 4.25 V to 5.25 V
1500 mA min source drive capability
3.0 A maximum

The “WC” model drives cannot furnish terminator power, because no conductors in the 80 pin I/O connector are devoted to terminator power.

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9.9 Disc drive SCSI timing

Table 12: Disc drive SCSI timing*

Description	Waveform Symbol [1]	Waveform Table [1]	Typical Timing
Target Select Time (no Arbitration)	T00	N/A	<1 µs
Target Select Time (with Arbitration)	T01	4.5-1,2	1.93 µs
Target Select to Command	T02	4.5-1	3.77 µs
Target Select to MSG Out	T03	4.5-2	1.57 µs
Identify MSG to Command	T04	4.5-3	3.36 µs
Command to Status	T05	4.5-5	Command Dependent
Command to Data (para. In)	T06	4.5-9	Command Dependent
Command to Data (para. Out)	T07	4.5-10	Command Dependent
Command to Data (Write to Data Buffer)	T08	4.5-10	Command Dependent
Command to Disconnect MSG	T09	4.5-6	Command Dependent
Disconnect MSG to Bus Free	T10	4.5-6,14	0.52 µs
Disconnect to Arbitration (for Reselect)	T11	4.5-6	Command Dependent
This measures disconnected CMD overhead.			
Target win Arbitration (for Reselect)	T12	4.5-7	3.00 µs
Arbitration to Reselect	T13	4.5-7	1.60 µs
Reselect to Identify MSG In	T14	4.5-7	1.39 µs
Reselect Identify MSG to Status	T15	4.5-8	Command Dependent
Reselect Identify MSG to Data (media)	T16	4.5-11	Command Dependent
Data to Status	T17	4.5-15	Command Dependent
Status to Command Complete MSG	T18	4.5-5,8,15	0.98 µs
Command Complete MSG to Bus Free	T19	4.5-5,8,15	0.51 µs
Data to Save Data Pointer MSG	T20	4.5-14	4.00 µs
Save Data Pointer MSG to Disconnect MSG	T21	4.5-14	0.79 µs
Command Byte Transfer	T22	4.5-4	0.04 µs
Next CDB Byte Access (Byte 2 of 6)	T23.6.2	4.5-4	0.58 µs
Next CDB Byte Access (Byte 3 of 6)	T23.6.3	4.5-4	0.12 µs
Next CDB Byte Access (Byte 4 of 6)	T23.6.4	4.5-4	0.12 µs
Next CDB Byte Access (Byte 5 of 6)	T23.6.5	4.5-4	0.12 µs
Next CDB Byte Access (Byte 6 of 6)	T23.6.6	4.5-4	0.12 µs
Next CDB Byte Access (Byte 2 of 10)	T23.10.2	4.5-4	0.59 µs
Next CDB Byte Access (Byte 3 of 10)	T23.10.3	4.5-4	0.11 µs ±1 µs
Next CDB Byte Access (Byte 4 of 10)	T23.10.4	4.5-4	0.12 µs ±1 µs
Next CDB Byte Access (Byte 5 of 10)	T23.10.5	4.5-4	0.11 µs ±1 µs
Next CDB Byte Access (Byte 6 of 10)	T23.10.6	4.5-4	0.11 µs ±1 µs
Next CDB Byte Access (Byte 7 of 10)	T23.10.7	4.5-4	0.13 µs ±1 µs
Next CDB Byte Access (Byte 8 of 10)	T23.10.8	4.5-4	0.12 µs ±1 µs
Next CDB Byte Access (Byte 9 of 10)	T23.10.9	4.5-4	0.12 µs ±1 µs
Next CDB Byte Access (Byte 10 of 10)	T23.10.10	4.5-4	0.12 µs
Data In Byte Transfer (parameter)	T24	4.5-12	0.04 µs

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Description	Waveform Symbol [1]	Waveform Table [1]	Typical Timing
Data Out Byte Transfer (parameter)	T25	4.5-13	0.04 µs
Next Data In Byte Access (parameter)	T26	4.5-12	0.12 µs
Next Data Out Byte Access (parameter)	T27	4.5-13	0.12 µs
Data In Byte Transfer (media) [2]	T28	4.5-12	0.04 µs
Data Out Byte Transfer (media) [2]	T29	4.5-13	0.04 µs
Next Data In Byte access (media [2]	T30	4.5-12	0.12 µs
Next Data Out Byte access (media [2]	T31	4.5-13	0.12 µs
MSG IN Byte Transfer	T32	4.5-5,7,8,14,15	0.04 µs
MSG OUT Byte Transfer	T33	4.5-2	0.04 µs
STATUS Byte Transfer	T34	4.5-5,8,15	0.04 µs
Synchronous Data Transfer Characteristics:			
Request Signal Transfer Period [3]	-	-	various

Notes.

[1] See SCSI-2 Interface Manual P/N 77738479 (called Volume 2), Section 4.5
[2] Maximum SCSI asynchronous interface transfer rate is given in Section 4.2.3.
[3] Synchronous Transfer Period is determined by negotiations between an Initiator and a Drive. The Drive is capable of setting periods as given in Section 9.5. See also Sections 3.1.5.2 and 3.5.3.2 of the SCSI-2 Interface Product Manual (P/N 77738479) for a description of synchronous data transfer operation.

General timing diagrams for SCSI interface operation are shown in the SCSI-2 Interface Product Manual P/N 77738479, Section 4.5. The specific timing values that apply to this drive are listed in Table 12.

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10.0 Technical support service

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SeaFAX number: United States 408/438-2620 England 44-62-847-7080

You can use a touch-tone telephone to access Seagate's automated FAX delivery system and select technical support information by return FAX. This service is available 24 hours a day, 7 days a week.

Seagate Technical Support FAX: 408/438-8137

You can FAX specific questions or comments to Seagate technical support specialists 24 hours daily. Responses are FAXed between 8:00 a.m. and 5:00 p.m. (Pacific time), Monday through Friday.

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- Reprints of Seagate documentation.
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USA, Mexico, Latin America	408/438-8771
England	44-62-847-8011
France	33-1-40-67-1034
German	49-89-140-9331
Singapore	65-292-6973
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