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Medalist Pro
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ST39140N/W/WC/LW/LC
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ST36530N/W/WC
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ST34520N/W/WC/LW/LC
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Product Manual, Volume 1
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ST39140N/W/WC/LW/LC
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ST36530N/W/WC
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ST34520N/W/WC/LW/LC
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Product Manual, Volume 1
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Notice.

This manual is volume 1 of a two-volume document with the SCSI interface information in the Volume 2 *SCSI Interface Product Manual*, part number 77738479.

If you need the SCSI interface information, order the volume 2 *SCSI Interface Product Manual*, part number 77738479.

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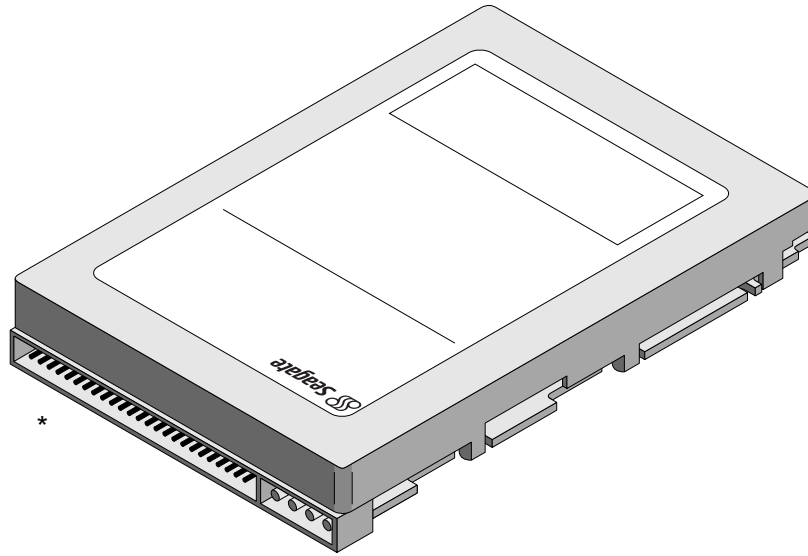
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1.0 Scope

This manual describes the Seagate Technology®, Inc. Medalist Pro™ disc drives.

Medalist Pro drives support the small computer system interface (SCSI) as described in the ANSI SCSI, SCSI-2, and SCSI-3 (Fast-20 and Fast-40) interface specifications to the extent described in this manual. The *SCSI Interface Product Manual* (part number 77738479) describes general SCSI interface characteristics of this and other families of Seagate drives.

From this point on in this product manual the reference to Medalist Pro models is referred to as “the drive” (unless references to individual models are necessary).



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

Figure 1. Medalist Pro family drive

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

Medalist Pro family drives comply with Seagate standards as noted in the appropriate sections of this manual and the Seagate *SCSI Interface Product Manual*, part number 77738479 (Vol. 2).

Medalist Pro disc drives are UL recognized components per UL1950, CSA certified to CSA C22.2 No. 950-M89, and VDE certified to VDE 0805 and EN60950.

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 B of Part 15 of the FCC Rules and Regulations nor the Radio Interference Regulations of the Canadian Department of Communications.

The 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 Communications when properly packaged. 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 and to the host controller.

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 2a, DC power requirements.

2.2 Electromagnetic compliance

Seagate uses an independent laboratory to confirm compliance to the directives/standard(s) for CE Marking and C-Tick Marking. 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
- Printer
- External modem
- Mouse

Although the test system with this Seagate model complies to the directives/standard(s), we cannot guarantee that all systems will comply. The computer manufacturer or system integrator shall confirm EMC compliance and provide CE Marking and C-Tick Marking for their product.

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.

Australian C-Tick

If this model has the C-Tick Marking it complies with the Australia/New Zealand Standard AS/NZS3548 1995 and meets the Electromagnetic Compatibility (EMC) Framework requirements of Australia's Spectrum Management Agency (SMA).

2.3 Reference documents

Medalist Pro Installation Guide, Seagate P/N 32663-001

SCSI Interface Product Manual, Seagate P/N 77738479

ANSI Small Computer System Interface (SCSI): ANSI3.131-1986 (X3T9/84.40 Rev. 1B), (X3T9.2/82-2 Rev. 17B), X3T9.2/86-109 Revision 10H (SCSI-2), X3T9.2/91/010 Rev. 10 (SCSI-3) parallel interface, X3T9.2-184 Rev. 4 (SCSI-3) and ANSI SCSI-3 Fast-20, X3T10/1071D

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

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

Specification, Acoustic Test Requirements, Seagate P/N 30553-001

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

3.0 General description

Medalist Pro drives combine magnetoresistive (MR) heads, partial response/maximum likelihood (PRML) read channel electronics, embedded servo technology, and a SCSI-3 (Fast-20 and Fast-40) interface to provide high performance, high capacity data storage for a variety of systems including high-end desktop systems, workstations, and entry level servers.

Fast-20 and Fast-40 (also known as Ultra SCSI and Ultra-2 SCSI) are negotiated transfer rates. These transfer rates will occur only if your host adapter also supports Fast-20 and Fast-40 data transfer rates. This drive also operates at SCSI-2/SCSI-3 data transfer rates for backward compatibility with non-Fast-20/Fast-40 capable SCSI host adapters.

Table 1 lists the features that differentiate the various Medalist Pro SCSI-3 Fast-20 and Fast-40 models.

Table 1: Drive model number vs. I/O features

Model number	Number of heads	I/O circuit type	Number of I/O connector pins	Number of I/O data bus bits
ST39140N	8	single-ended	50	8
ST39140W	8	single-ended	68	16
ST39140LW	8	multimode (SE/LVD) [1]	68	16
ST39140WC	8	single-ended	80	16
ST39140LC	8	multimode (SE/LVD) [1]	80	16
ST36530N	8	single-ended	50	8
ST36530W	8	single ended	68	16
ST36530WC	8	single-ended	80	16
ST34520N	8	single-ended	50	8
ST34520W	8	single-ended	68	16
ST34520LW	8	multimode (SE/LVD) [1]	68	16
ST34520WC	8	single-ended	80	16
ST34520LC	8	multimode (SE/LVD) [1]	80	16

Note.

[1] See Section 9.7.2, “Multimode—SE or LVD alternative.”

The drive records and recovers data on 3.5-inch (86 mm) non-removeable discs.

The drive supports the Small Computer System Interface (SCSI) as described in the ANSI SCSI-2 and SCSI-3 interface specifications to the extent described in this manual (volume 1), which defines the product performance characteristics of the Medalist Pro family of drives, and the *SCSI Interface Product Manual* (volume 2), part number 77738479, which describes the general interface characteristics of this and other families of Seagate SCSI drives.

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

The head and disc assembly (HDA) is sealed at the factory. Air circulates within the HDA through a non-replaceable filter to maintain a contamination-free HDA environment.

Refer to Figure 2 for an exploded view of the drive. This exploded view is for information only—never disassemble the HDA and do not attempt to service items in the sealed enclosure (heads, media, actuator, etc.) as this requires special facilities. The drive contains no replaceable parts. Opening the HDA voids your warranty.

Medalist Pro 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 power is removed.

An automatic shipping lock prevents potential damage to the heads and discs that results from movement during shipping and handling. The shipping lock automatically disengages when power is applied to the drive and the head load process begins.

Medalist Pro drives decode track 0 location data from the servo data embedded on each surface to eliminate mechanical transducer adjustments and related reliability concerns.

A high-performance actuator assembly with a low-inertia, balanced, patented, straight-arm design provides excellent performance with minimal power dissipation.

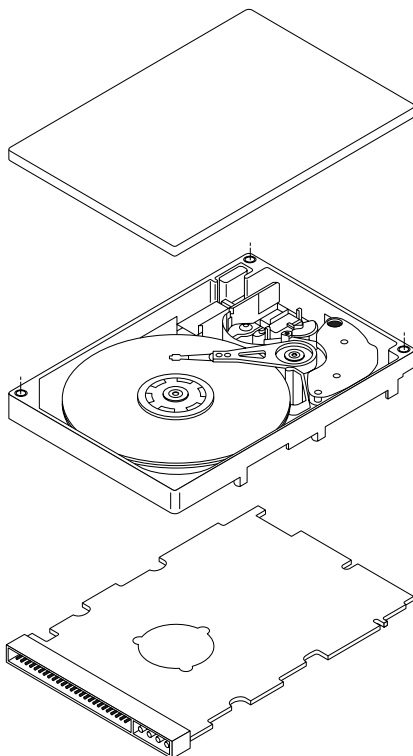


Figure 2. Medalist Pro family drive (50-pin I/O connector version)

3.1 Standard features

The Medalist Pro family has the following standard features:

- Integrated SCSI controller
- Single-ended and multimode single-ended/low voltage differential SCSI drivers and receivers
- 8 bit and 16 bit I/O data bus models available
- Asynchronous and synchronous data transfer protocol
- Firmware downloadable via SCSI interface
- Sector size 512 bytes/sector
- Programmable drive capacity
- Flawed sector reallocation at format time
- Programmable auto write and read reallocation
- Reallocation of defects on command (Post format)
- 256-bit Reed-Solomon error correcting code
- Sealed head and disc assembly
- No preventative maintenance or adjustment required
- Dedicated laser textured head landing zone
- Embedded servo data rather than a separate servo data surface
- Self diagnostics performed when power is applied to the drive
- 1:1 Interleave
- Zoned bit recording (ZBR)
- Vertical, horizontal, or top down mounting
- Dynamic spindle brake
- Active IC terminators enabled by jumpers (“N” and “W” models only)
- 512 K byte data buffer
- Hot plug compatibility (Section 9.6.4.3 lists the proper host connector needed) for “WC” and “LC” drives
- SCAM (SCSI Configured Automatically) plug-n-play level 2 compliant, factory set to level 1 (not user selectable)
- Low audible noise for office environment
- Low power consumption
- Audio Visual (A/V) ready

3.2 Media characteristics

The media used on the drive has a diameter of approximately 3.5 inches (86 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

- Supports industry standard Ultra SCSI interface (also called “Fast-20 SCSI”) and Ultra-2 SCSI (“Fast-40”)
- Programmable 1 or 3 segment cache buffer
- 7200 RPM spindle. Average latency = 4.17 ms
- Command queuing of up to 64 commands
- Background processing of queue
- Supports start and stop commands (spindle stops spinning)

3.4 Reliability

- 800,000 hour MTBF
- LSI circuitry
- Balanced low mass rotary voice coil actuator
- Incorporates industry-standard Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.)
- 3-year warranty

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 the standard OEM model read capacity data. Total LBAs = read capacity data shown below + 1.

Model	Formatted data block size	User LBAs	Sparing
	512 byte/sector		
ST39140	9.100 GB	17,783,240	8,033 spares for both P and G lists
ST36530	6.5 GB	12,715,920	8,033 spares for both P and G lists
ST34520	4.55 GB	8,888,924	8,033 spares for both P and G lists

3.6 Programmable drive capacity

Using the Mode Select command, the drive can change its capacity to something less than maximum. See Table 5.2.1-13 in the *SCSI Interface Product Manual* (part number 77738479). Refer to the Parameter list block descriptor, bytes 1, 2 and 3. A value of zero in bytes 1, 2 and 3 indicates that the drive shall not change the capacity it is currently formatted to have. A number in bytes 1, 2 and 3 that is less than the maximum number of LBAs changes the total drive capacity to the value in the block descriptor bytes 1, 2 and 3. A value greater than the maximum number of LBAs is rounded down to the maximum capacity. Byte 0 is not used as the density code, but as the MSB of number of LBAs.

3.7 Factory installed accessories

The drive ships with a small bag of the two jumper plug types used for the J6, J2, and J1-Aux option select jumper headers.

3.8 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:

- The capacities shown in Section 3.5. You can order other capacities by selecting a maximum LBA as shown in Section 3.6.
- Single unit shipping pack. The drive normally ships in bulk packaging to provide maximum protection against transit damage. Units shipped individually require additional protection as provided by the single unit shipping pack. Specify this option if you are planning to ship single units to your customers.
- ESD and physical protection is accommodated by a protective plate called SeaShield which attaches to the PCB.

3.9 Accessories (user installed)

No accessories offered.

4.0 Performance characteristics

4.1 Internal drive characteristics (transparent to user)

	ST39140	ST36530	ST34520	
Read/Write Heads	8	6	4	
Tracks/Surface, Total	9,006	9,006	9,006	Tracks (user accessible)
Tracks/Inch	9,570	9,570	9,570	TPI
Peak Bits/Inch	1,715.2	1,715.2	1,715.2	Mbits/in ²
Internal Data Rate	110-193.88	110-193.88	110-193.88	Mbits/sec (variable with zone)
Disc Rotational Speed	7,200	7,200	7,200	r/min ($\pm 0.05\%$)
Average Rotational Latency	4.17	4.17	4.17	msec

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

The values given in Section 4.2.1 apply to all models of the Medalist Pro family unless otherwise specified. Refer to Section and to the *SCSI Interface Product Manual* (part number 77738479) for additional timing details.

4.2.1 Access time [8]

				Including Controller Overhead (without disconnect) [1] [4] Drive Level	
				Read	Write
				msec	
Average	–	Typical	[3]	9.5	10.5
Single Track	–	Typical	[3]	2.5	3.5
Full Stroke	–	Typical	[3]	21.0	23.5

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

4.2.2 Format command execution time (minutes) [1]*

	ST39140	ST36530	ST34520
Maximum (with verify)	36	24	18
Maximum (no verify)	18	12	9

4.2.3 Generalized performance characteristics

Sector interleave 1 to 1

Data buffer transfer rate to/from disc media (one 512-byte sector):

Min.	[4]*	13.7	MByte/sec
Avg.	[4]	19.9	MByte/sec
Max.	[4]	23.8	MByte/sec

Data buffer transfer rate to/from disc media: (< 1 track):

Min.	[4]	10.5	MByte/sec
Avg.	[4]	15.2	MByte/sec
Max.	[4]	18.3	MByte/sec

SCSI interface data transfer rate (asynchronous) [5]:

Maximum instantaneous	6.0 Mbytes/sec [6]
Maximum average	6.0 Mbytes/sec [7]

Synchronous transfer rate for SCSI-3 Fast-20 (Ultra-1 SCSI):

(8 bit data bus models)	20 Mbytes/sec
(16 bit data bus models)	40 Mbytes/sec

Synchronous transfer rate for SCSI-3 Fast-40 (Ultra-2 SCSI):

(8 bit data bus models)	40 Mbytes/sec
(16 bit data bus models)	80 Mbytes/sec

Synchronous transfer rate for fast SCSI-2:
(8 bit data bus models) 5 to 10 Mbytes/secSynchronous transfer rate for fast SCSI-2:
(16 bit data bus models). 10 to 20 Mbytes/sec

Sector Sizes: 512 byte user data blocks

Read/write consecutive sectors on a track Yes

Flaw reallocation performance impact (for flaws reallocated at format time, all P and G list entries will be slipped). No performance hit

Overhead time for head switch (512 byte sectors) in sequential mode	2.5 msec (typical)
Overhead time for one track cylinder seek (cylinder skew)	<3.5 msec (typical)
Average rotational latency	4.17 msec

*[] Notes listed at end of Section 4.2.3.

Notes for Section 4.2.

- [1] Execution time is 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 rates listed and no cable loss.
- [7] Simulated.
- [8] Access time = controller overhead + average seek time
Access to data = controller overhead + average seek time + latency time

4.3 Start/stop time

After DC power at nominal voltage 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). If a recoverable error condition is detected during the start sequence, the drive executes a recovery procedure which may cause the time to become ready to exceed 20 seconds. During spin up to ready time the drive responds to some commands over the SCSI interface in less than 3 seconds after application of power. Stop time is less than 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 (excluding an error recovery procedure). The Motor Start Command can also be used to command the drive to stop the spindle (see *SCSI Interface Product Manual*, part number 77738479).

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 (see *SCSI Interface Product Manual*, part number 77738479). 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 Section 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 9, 10, and 11.

4.5 Cache operation

In general, 380 Kbytes of the 512 Kbytes (860.5 Kbytes of 1,024 Kbytes for "LC" and "LW" drives) of physical buffer space in the drive can be used as storage space for cache operations. The buffer contains memory 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* (part number 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 data transfers 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* (part number 77738479).

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 LBs from the disc and puts them in a segment of the cache. The drive transfers the remaining requested LBs 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 LBs from the disc and transfers them into a segment, and then the segment to the host.
2. If the prefetch feature is enabled, refer to Section 4.5.2 for operation from this point.

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 buffer segment.

Write caching is enabled independently from 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 then 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 9, 10, and 11 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).

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 disc 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.

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]	
Recovered Data	Less than 1 errors in 10^{10} bits transferred (default settings)
Unrecovered Data	Less than 1 sector in 10^{14} bits transferred (default settings)
Miscorrected Data	Less than 1 sector in 10^{21} bits transferred
MTBF	800,000 hours
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:

- The drive is operated per this specification using DC power as defined in this manual (see Section 6.2).
- The drive has been formatted with the SCSI FORMAT commands.
- Errors caused by media defects or host system failures are excluded from error rate computations.

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:

- Is not detected and corrected by the drive itself;
- Is not capable of being detected from the error or fault status provided through the drive or SCSI interface; or
- 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:

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

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 errors in 10⁷ physical seek operations. After detecting an initial seek error, the drive automatically reseek 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 the *SCSI Interface Product Manual* (part number 77738479) for Request Sense information. Appendix A of this manual lists the sense keys and additional sense codes supported by the drives of this manual.

5.2 Reliability and service

You can enhance the reliability of Medalist Pro disc drives by ensuring that the drive receives adequate cooling. Section 6.4.1 provides temperature measurements and other information that may be used to enhance the service life of the drive. Section 8.3.1 provides recommended air-flow information.

5.2.1 Mean time between failure

The production disc drive shall achieve an MTBF of 800,000 hours when operated in an environment that ensures the case temperatures specified in Section 6.4.1 are not exceeded. 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 Hot plugging Medalist Pro disc drives

The ANSI SPI-2 (T10/1142D) document defines the physical requirements for removal and insertion of SCSI devices on the SCSI bus. Four cases are addressed. The cases are differentiated by the state of the SCSI bus when the removal or insertion occurs.

- Case 1 All bus devices powered off during removal or insertion
- Case 2 RST signal asserted continuously during removal or insertion
- Case 3 Current I/O processes not allowed during insertion or removal
- Case 4 Current I/O process allowed during insertion or removal, except on the device being changed

Seagate Medalist Pro disc drives support four hot plugging cases. Provision shall be made by the system such that a device being inserted makes power and ground connections prior to the connection of any device signal contact to the bus. A device being removed shall maintain power and ground connections after the disconnection of any device signal contact from the bus (see SFF-8046, SCA-2 specification).

It is the responsibility of the systems integrator to assure that no hazards from temperature, energy, voltage, or ESD potential are presented during the hot connect/disconnect operation.

All I/O processes for the SCSI device being inserted or removed shall be quiescent. All SCSI devices on the bus shall have receivers that conform to the SPI-2 standard.

If the device being hot plugged uses single-ended (SE) drivers and the bus is currently operating in low voltage differential (LVD) mode, then all I/O processes for all devices on the bus must be completed, and the bus quiesced, before attempting to hot plug. Following the insertion of the newly installed device, the SCSI host adapter must issue a Bus Reset, followed by a synchronous transfer negotiation. Failure to perform the SCSI Bus Reset could result in erroneous bus operations.

The SCSI bus termination and termination power source shall be external to the device being inserted or removed.

End users should not mix devices with high voltage differential (HVD) drivers and receivers and devices with SE, LVD, or multimode drivers and receivers on the same SCSI bus since the common mode voltages in the HVD environment may not be controlled to safe levels for SE and LVD devices (see ANSI SPI-2).

The disc drive spindle must come to a complete stop prior to completely removing the drive from the cabinet chassis. Use of the Stop Spindle command or partial withdrawal of the drive, enough to be disconnected from the power source, prior to removal are methods for insuring that this requirement is met. During drive insertion, care should be taken to avoid exceeding the limits stated in Section 6.4.4, "Shock and vibration," of this manual.

5.2.7 S.M.A.R.T.

S.M.A.R.T. is an acronym for Self-Monitoring Analysis and Reporting Technology. This technology is intended to recognize conditions that indicate imminent drive failure and is designed to provide sufficient warning of a failure to allow you to back up the data before an actual failure occurs.

Note. The drive's firmware will monitor specific attributes for degradation over time but can't predict instantaneous drive failures.

Each monitored attribute has been selected to monitor a specific set of failure conditions in the operating performance of the drive and the thresholds are optimized to minimize "false" and "failed" predictions.

Controlling S.M.A.R.T.

The operating mode of S.M.A.R.T. is controlled by the DEXCPT and PERF bits on the Informational Exceptions Control mode page (1Ch). Use the DEXCPT bit to enable or disable the S.M.A.R.T. feature. Setting the DEXCPT bit disables all S.M.A.R.T. functions. When enabled, S.M.A.R.T. collects on-line data as the drive performs normal read and write operations. When the PERF bit is set, the drive is considered to be in "On-line Mode Only" and will not perform off-line functions.

You can measure off-line attributes and force the drive to save the data by using the Rezero command. Forcing S.M.A.R.T. resets the timer so that the next scheduled interrupt is in two hours.

You can interrogate the drive through the host to determine the time remaining before the next scheduled measurement and data logging process occurs. To accomplish this, issue a Log Sense command to log page 0x3E. This allows you to control when S.M.A.R.T. interruptions occur. Forcing S.M.A.R.T. with the RTZ command resets the timer.

Performance impact

S.M.A.R.T. attribute data is saved to the disc so that the events that caused a predictive failure can be recreated. The drive measures and saves parameters once every two hours subject to an idle period on the interface. The process of measuring off-line attribute data and saving data to the disc is uninterruptible. The maximum on-line only (DESCPT = 0; PERF = 1) processing delay is 60 ms. The maximum fully-enabled (DEX-CPT = 0, PERF = 0) processing delay is 450 ms.

Reporting control

Reporting is controlled in the Informational Exceptions Control mode page (1Ch). Subject to the reporting method, the firmware will issue to the host an 01-5DXX sense code. The error code is preserved through bus resets and power cycles.

Determining rate

S.M.A.R.T. monitors the rate at which errors occur and signals a predictive failure if the rate of degraded errors increases to an unacceptable level. To determine rate, error events are logged and compared to the number of total operations for a given attribute. The interval defines the number of operations over which to measure the rate. The counter that keeps track of the current number of operations is referred to as the Interval Counter.

S.M.A.R.T. measures error rates. All errors for each monitored attribute are recorded. A counter keeps track of the number of errors for the current interval. This counter is referred to as the Failure Counter.

Error rate is the number of errors per operation. The algorithm that S.M.A.R.T. uses to record rates of error is to set thresholds for the number of errors and their interval. If the number of errors exceeds the threshold before the interval expires, the error rate is considered to be unacceptable. If the number of errors does not exceed the threshold before the interval expires, the error rate is considered to be acceptable. In either case, the interval and failure counters are reset and the process starts over.

Predictive failures

S.M.A.R.T. signals predictive failures when the drive is performing unacceptably for a period of time. The firmware keeps a running count of the number of times the error rate for each attribute is unacceptable. To accomplish this, a counter is incremented each time the error rate is unacceptable and decremented (not to exceed zero) whenever the error rate is acceptable. If the counter continually increments such that it reaches the predictive threshold, a predictive failure is signaled. This counter is referred to as the Failure History Counter. There is a separate Failure History Counter for each attribute.

5.2.8 Product warranty

Beginning on the date of shipment to customer and continuing for a period of three 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 or 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.

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-party repair facilities. Any unauthorized repair or tampering with the factory seal voids the warranty (see Section 10.0).

6.0 Physical/electrical specifications

This section provides information relating to the physical and electrical characteristics of Medalist Pro drives.

6.1 AC power requirements

None.

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. The table shows current values in Amperes.

Table 2a: DC power requirements for N/W/WC models

	Notes	ST39140		ST36530		ST34520	
		N/W/WC Single-ended		N/W/WC Single-ended		N/W/WC Single-ended	
Voltage		+5 V	+12 V	+5 V	+12 V	+5 V	+12 V
Regulation	[5]	±5%	±5%[2]	±5%	±5%[2]	±5%	±5%[2]
Maximum operating current DC	[1]	0.55	2.4	0.55	2.4	0.55	2.4
Average idle current DC \bar{X}	[1]	0.51	0.81	0.51	0.81	0.51	0.81
Maximum starting current (peak DC) DC (peak AC) AC	[3] [3]		2.5		2.5		2.5
Delayed motor start (max) DC	[1][4]	0.51	0.13	0.51	0.13	0.51	0.13
Peak operating current Typical DC \bar{X} Maximum DC Maximum (Peak)	[1][6] [1]	0.51 0.55	0.96 1.17	0.51 0.55	0.96 1.17	0.51 0.55	0.96 1.17

Table 2b: DC power requirements for LW/LC models

	Notes	ST39140		ST34520	
		LW/LC LVD		LW/LC LVD	
Voltage		+5 V	+12 V	+5 V	+12 V
Regulation	[5]	±5%	±5%[2]	±5%	±5%[2]
Maximum operating current DC	[1]	0.81	2.4	0.81	2.4
Average idle current DC \bar{X}	[1]	0.53	0.90	0.53	0.90
Maximum starting current (peak DC) DC (peak AC) AC	[3] [3]		2.5		2.5
Delayed motor start (max) DC	[1][4]	0.51	0.16	0.51	0.16
Peak operating current Typical DC \bar{X} Maximum DC Maximum (Peak)	[1][6] [1]	0.58 0.81	1.0 1.53	0.58 0.81	1.0 1.37

Notes for Tables 2a and 2b.

- [1] Measured with average reading DC ammeter. Instantaneous +12 V current peaks will exceed these values.
- [2] A -10% droop is permissible during initial start of spindle, and must return to ±5% before 7,200 rpm is reached. The ±5% must be maintained after the drive signifies that its power-up sequence has been com-

pleted and that the drive is able to accept selection by the host initiator.

- [3] See +12 V current profile in Figure 3a.
- [4] This condition occurs when the Motor Start Option is enabled and the drive has not yet received a Start Motor command.
- [5] See Section 6.2.1 “Conducted Noise Immunity.” Specified voltage tolerance is inclusive of ripple, noise, and transient response.
- [6] Operating condition is defined as random seek read operations with a block count of 64.

General Notes from Table 2a:

1. Minimum current loading for each supply voltage is not less than 4% of the maximum operating current shown.
2. The +5 and +12 volt supplies shall employ separate ground returns.
3. 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 100 kHz and 100 mV pp from 100 kHz to 10 MHz.
- +12 V = 150 mV pp from 0 to 100 kHz and 100 mV pp from 100 kHz to 10 MHz.

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. To automatically delay motor start based on the target ID (SCSI ID) enable the Delay Motor Start option and disable the Enable Motor Start option on the J2 connector. See Section 8.1 for pin selection information. To delay the motor until the drive receives a Start Unit command, enable the Enable Motor Start option on the J2 connector.

6.2.3 12 V - Current profile

Figure 3a 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 and spindle position sense is 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 - Drive is ready for reading and writing.

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

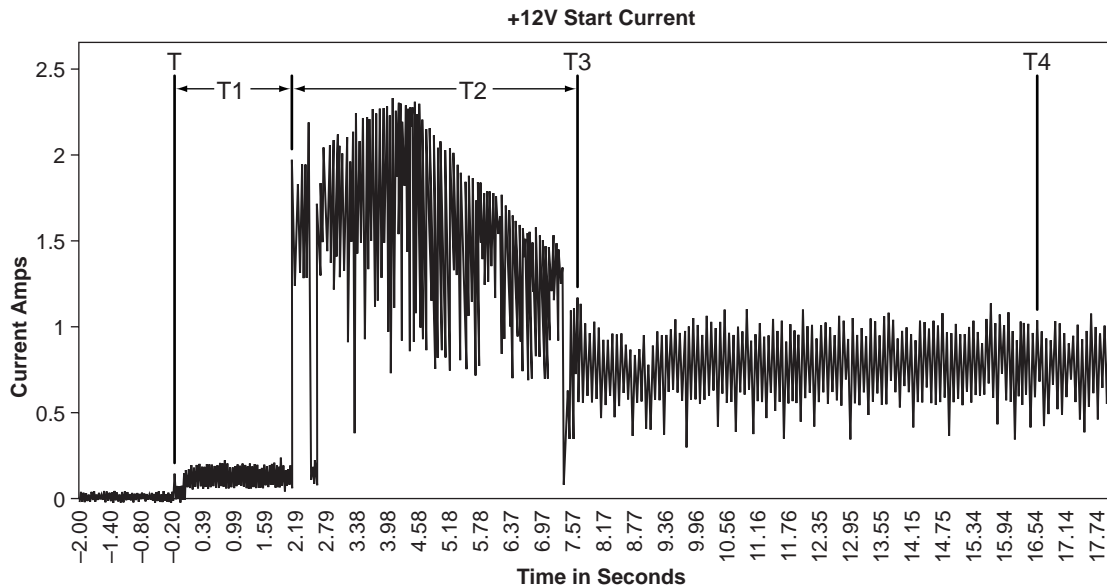


Figure 3a. Typical Medalist Pro family drive +12 V current profile

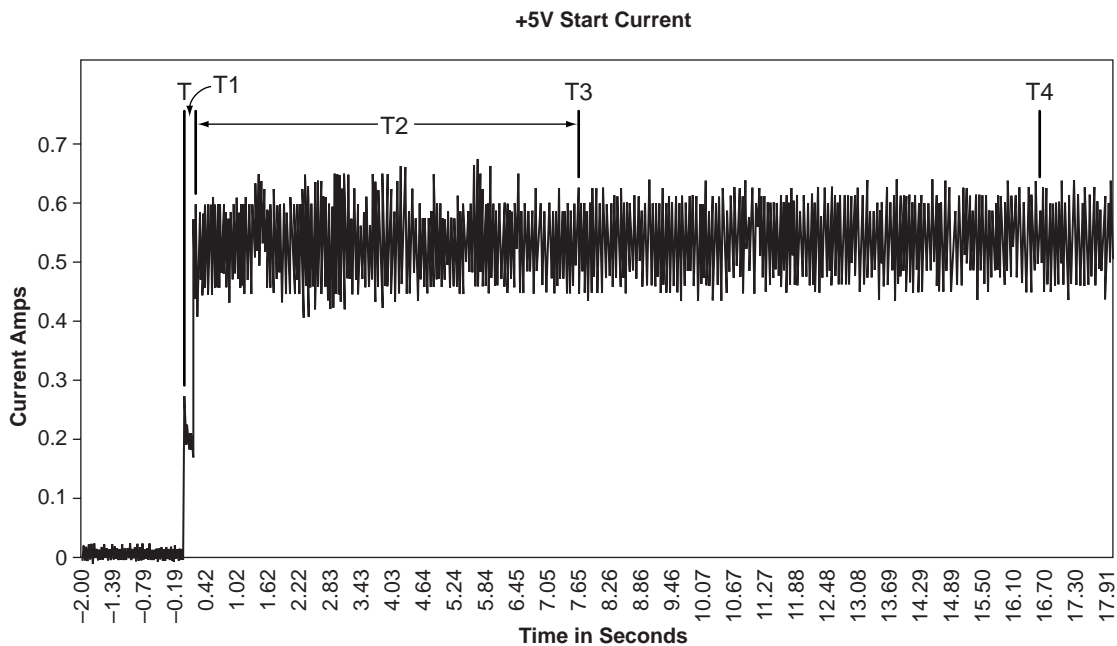


Figure 3b. Typical Medalist Pro family drive +5 V current profile

6.3 Power dissipation

For drives with single-ended interface circuits, typical operating random read/write power dissipation is 14.1 watts (48.1 BTUs per hour) of DC power average at nominal voltages. Typical power dissipation under idle conditions is 12.3 watts (42.0 BTUs per hour). Standby power is 4.1 watts (14.0 BTUs per hour).

For drives with low voltage differential interface circuits (LVD), typical operating random read/write power dissipation is 14.6 watts (49.8 BTUs per hour) of DC power average at nominal voltages. Typical power dissipation under idle conditions is 13.5 watts (46.0 BTUs per hour). Standby power is 4.5 watts (15.3 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 [3] above these values may adversely affect the drives ability to meet specifications.

The MTBF specification for the drive is based on operating in an environment that ensures that the case temperatures specified in Table 3, column 2 are not exceeded. Occasional excursions to drive ambient temperatures of 131°F (55°C) or 41°F (5°C) may occur without impact to specified MTBF. Air flow may be needed to achieve these temperatures. Continual or sustained operation at case temperatures above these values may degrade MTBF.

To confirm that the required cooling for the Medalist Pro electronics and HDA is provided, place the drive in its final mechanical configuration, perform random write/read operations. After the temperatures stabilize, measure the case temperature of the components listed in Table 3.

Operation of the drive at the maximum case temperature is intended for short time periods only. Continuous operation at the elevated temperatures will reduce product reliability.

Table 3: PCB and HDA temperatures

Items in Figure 4	Column 1 maximum case [3] temperatures operating (55°C ambient) [1]	Column 2 maximum allowable case [3] temperature (°C) to meet MTBF spec.
U4	105°C	85°C
U60	100°C	80°C
U80	90°C	70°C
U90	95°C	75°C
U94	80°C	60°C
HDA	60°C	50°C

Note.

- [1] 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. Large thermal gradients should be avoided.
- [2] No point anywhere on the HDA surface should exceed this value.
- [3] 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.

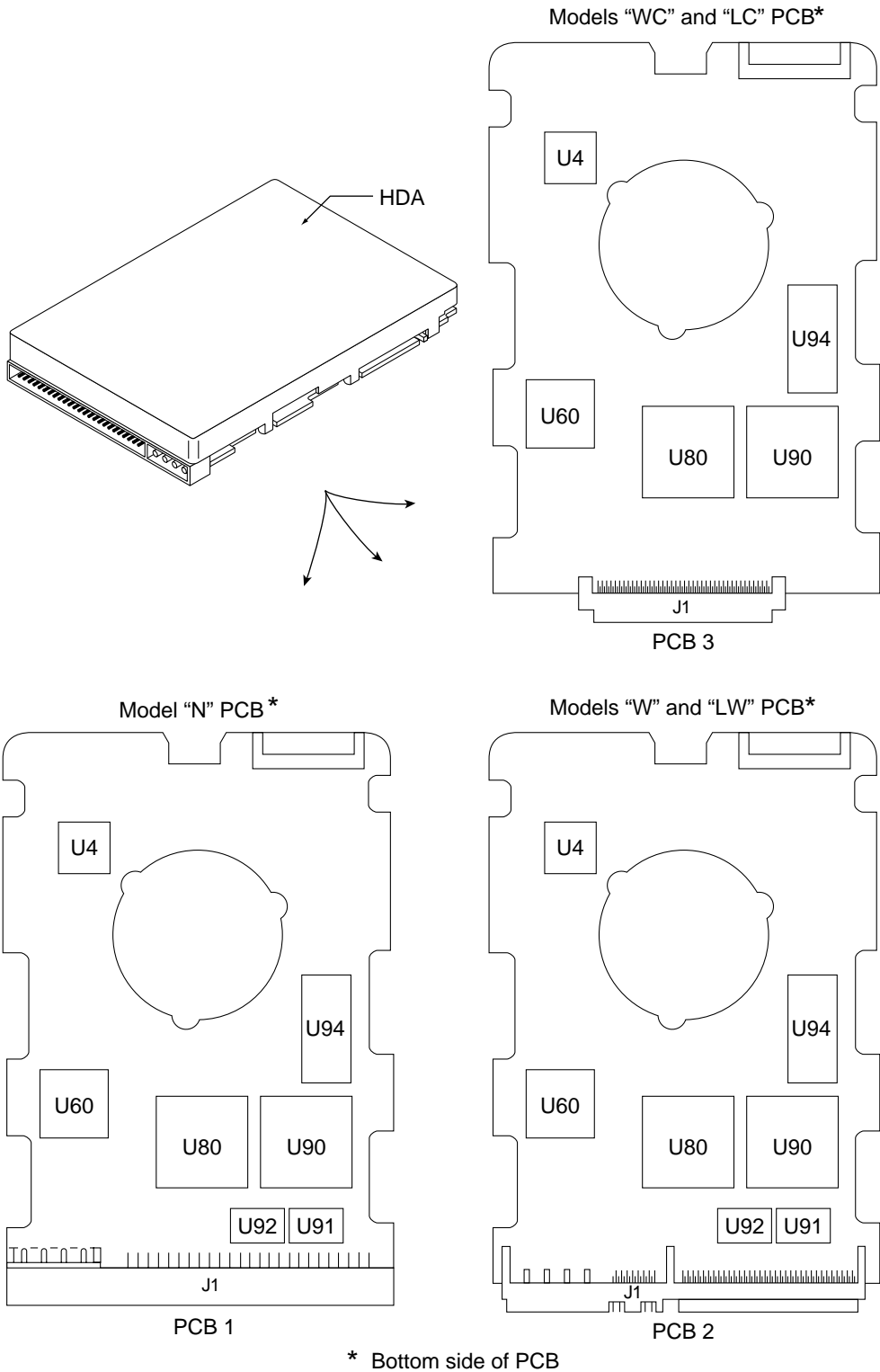


Figure 4. Locations of printed circuit board (PCB) components listed in Table 3

6.4.2 Relative humidity

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

a. Operating

8% to 90% relative humidity with a maximum gradient of 30% per hour.

b. Non-operating

5% to 95% relative humidity.

6.4.3 Effective altitude (sea level)

a. Operating

–1,000 to +10,000 feet (–305 to +3,048 meters)

b. Non-operating

–1,000 to +40,000 feet (–305 to +12,210 meters)

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—normal

The drive, as installed for normal operation, shall operate error free while subjected to intermittent shock not exceeding 10 g 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 non-operating 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 at a maximum duration of 11 ms (half sine-wave) shall not exhibit device damage or performance degradation. Shock may be applied in the X, Y, or Z axis.

Maximum 2 msec rotary shock (half sinewave) 12,000 radians/sec².

The drive subjected to nonrepetitive shock not exceeding 200 g at a duration of 2 msec (half sinewave) does 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 Seagate specifications 30190-001 (under 100 lbs/45 kg) or 30191-001 (over 100 lbs/45 Kg).

Package size	Packaged/product weight	Drop height
<600 cu in (<9,800 cu cm)	Any	60 in (1524 mm)
600-1800 cu in (9,800-19,700 cu cm)	0-20 lb (0 to 9.1 kg)	48 in (1219 mm)
>1800 cu in (>19,700 cu cm)	0-20 lb (0 to 9.1 kg)	42 in (1067 mm)
>600 cu in (>9,800 cu cm)	20-40 lb (9.1 to 18.1 kg)	36 in (914 mm)

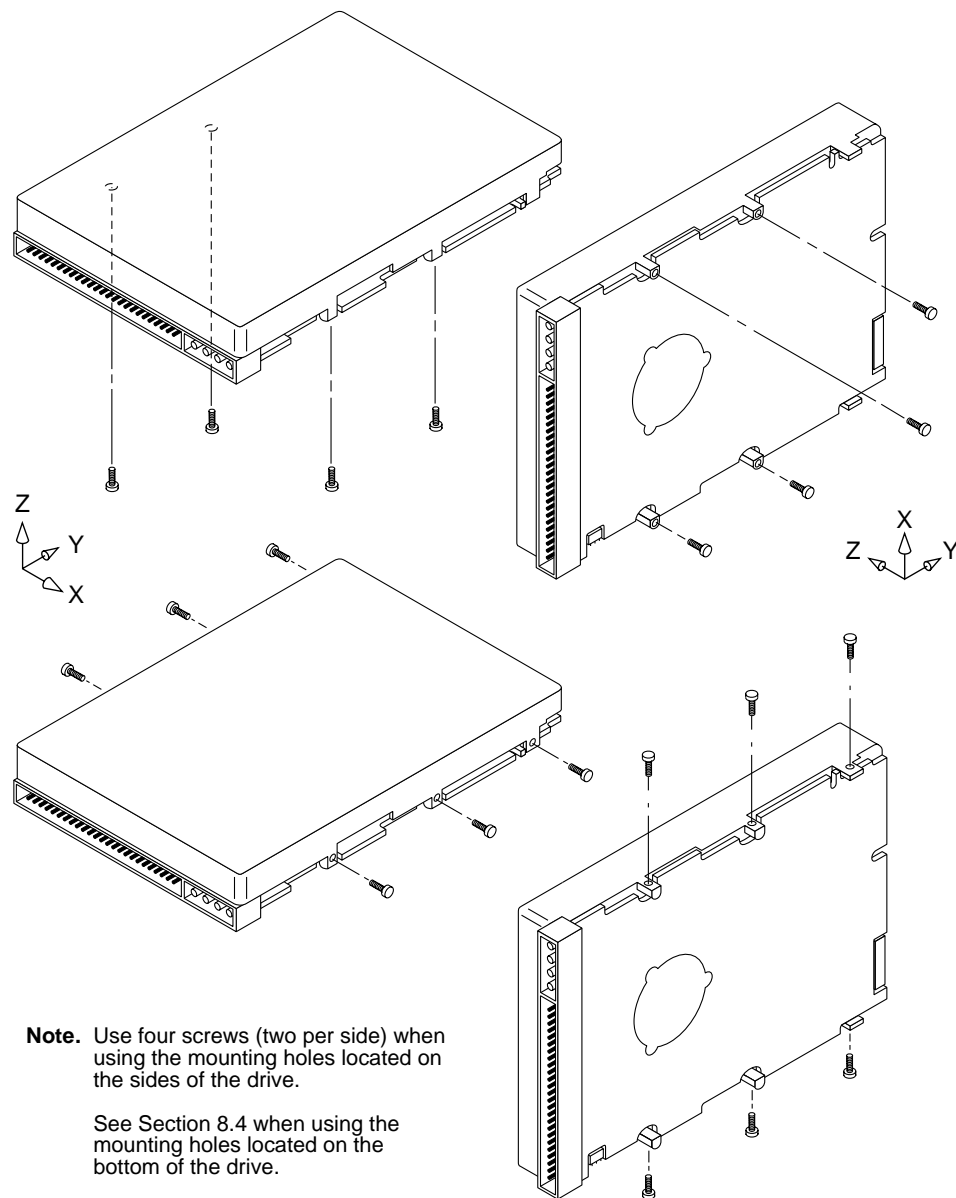


Figure 5. Recommended mounting

6.4.4.2 Vibration

a. Operating - normal

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 inch displacement (peak to peak)

22-300 Hz @ 0.5 g acceleration (zero to peak)

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

b. Operating - abnormal

22-300 Hz @ TBD g (X, Y, or Z axis)

c. 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 @ 0.81 inch displacement

22-350 Hz @ 2.0 g acceleration (zero to peak)

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 Acoustics

Sound power during idle mode shall be 3.9 bels (4.2 max) typical when measured to Seagate's 30553-001 specification.

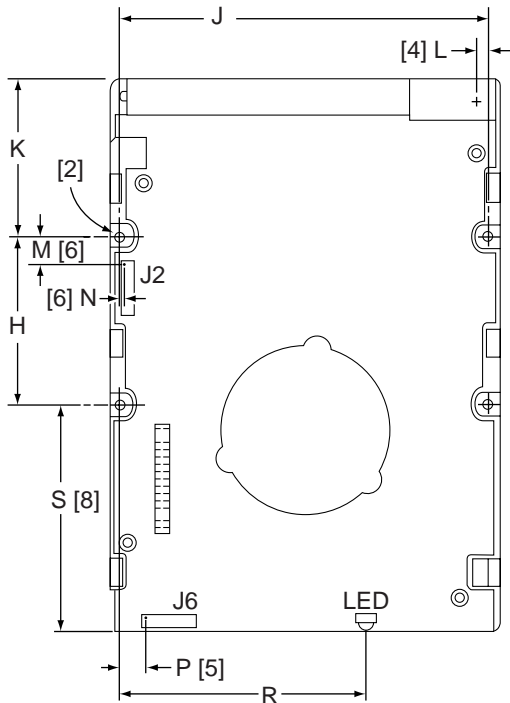
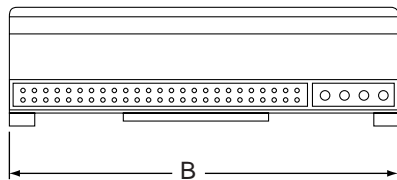
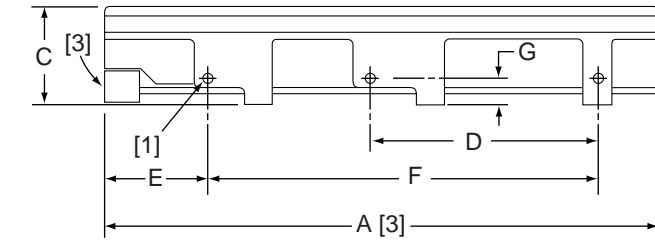
6.4.7 Electromagnetic susceptibility

See Section 2.1.2.

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 6, 7, and 8 for detailed mounting configuration dimensions. See Section 8.4, "Drive mounting."

Height:	1.007 in	26.9 mm
Width:	4.000 in	101.6 mm
Depth:	5.754 in	146.15 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 0.15 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).
- [3] Power and interface connectors can extend past the "A" dimension by 0.040 in. (1.02 mm).
- [4] Centerline of pad for Pin 1 of power connector.
- [5] Centerline of pad for Pin 1 of J6.
- [6] Centerline of pad for Pin 1 of J2. Dimensions indicated are for reference only.
- [7] Dimensions to Pin 1 of each connector are nominal values.
- [8] To pin ends on J6. Pin ends on J6 are nominally flush with end of drive.

Dimension Table

	Inches	Millimeters
A	5.754 ± .026	146.15 ± .66
B	4.000 ± .015	101.6 ± .38
C	1.007 ± .013	25.6 ± .33
D	2.362 ± .010	60.00 ± .25
E	1.120 ± .020	28.45 ± .51
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	1.625 ± .020	41.28 ± .51
L	0.143	3.63
M	0.26	6.60
N	0.061	1.55
P	0.405	10.29
R	2.265	57.53
S	2.350	59.69

Figure 6. Mounting configuration dimensions for "N" models

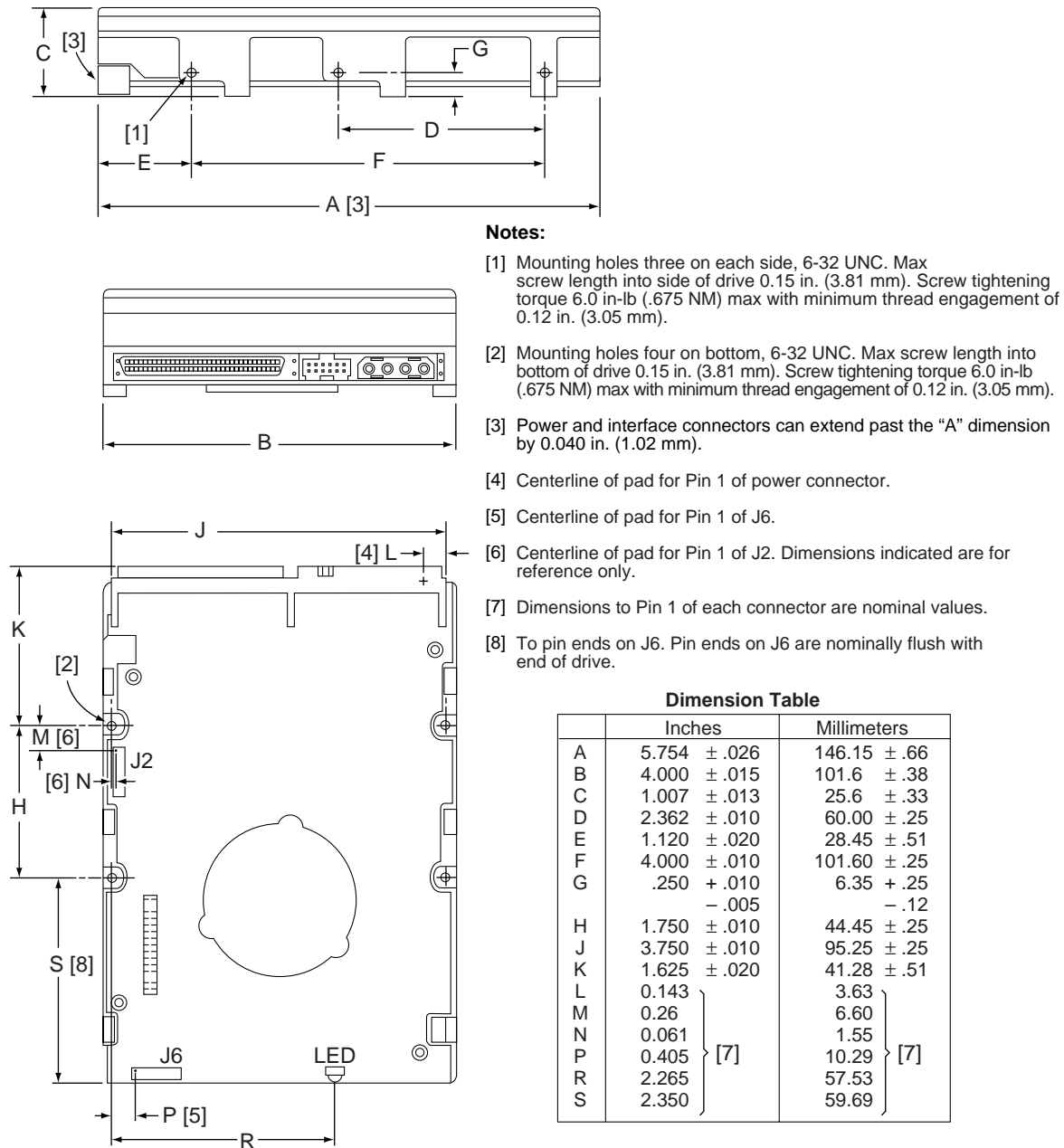


Figure 7. Mounting configuration dimensions for "W" and "LW" models

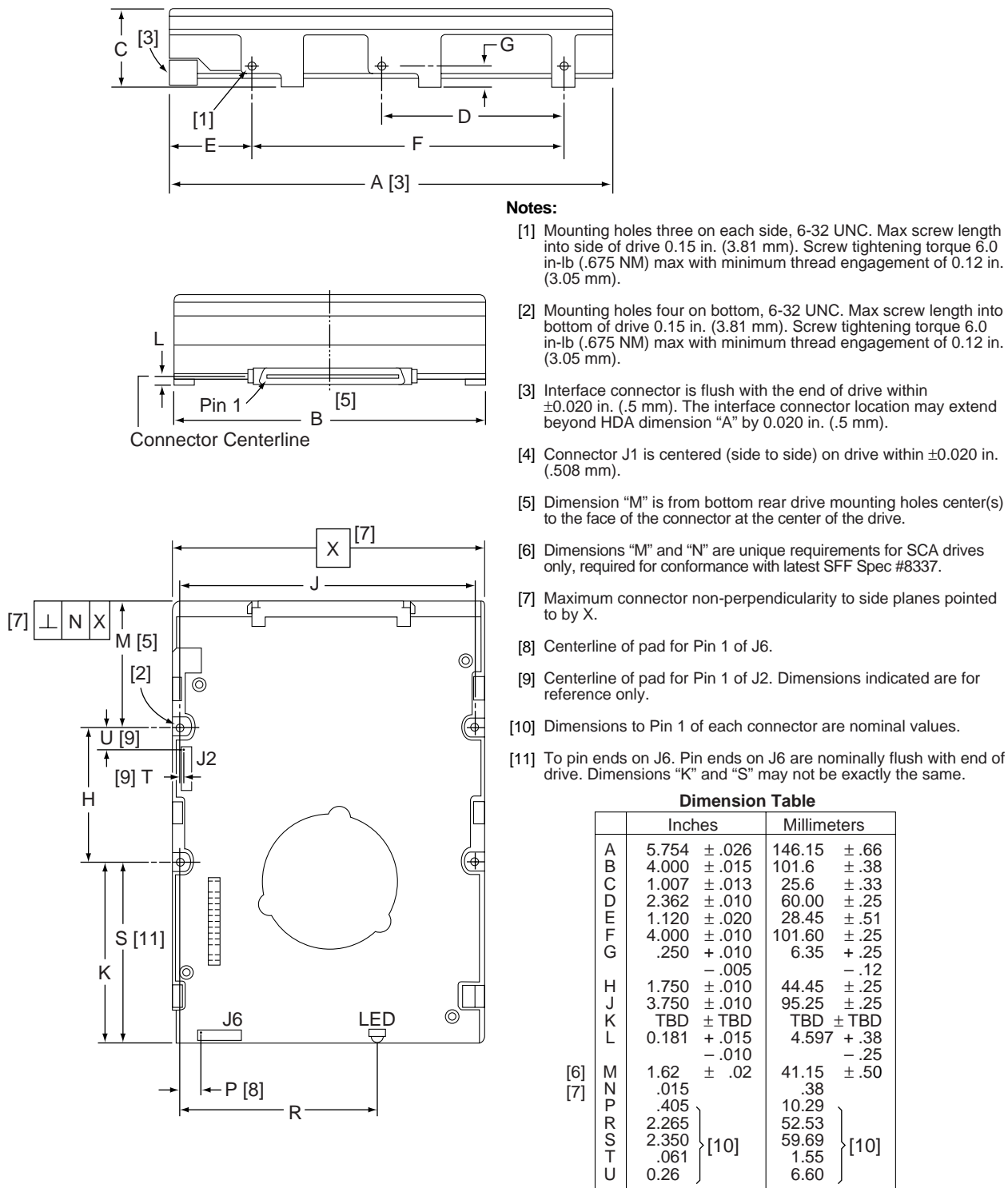


Figure 8. Mounting configuration dimensions for "WC" and "LC" models

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 5.2.1.2, "Format Unit command" in the *SCSI Interface Product Manual*, part number 77738479). 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 Interface Product Manual*.

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*. 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. Appendix A of this manual lists the sense keys and additional sense codes supported by the drives of this manual. 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 Product Manual*. 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.

8.0 Installation

The first thing to do when installing a drive is to set the drive ID (select) on the SCSI bus and set up certain operating options. This is usually done by installing small shorting jumpers on the pins of connector J2 on the PCB (or J1-Auxiliary on the “W” and “LW” models), or via the drive to host I/O signals on “WC” and “LC” models. Some users connect cables to J6 or J1-Auxiliary and perform the set-up using remote switches.

If your system is “SCAM” (SCSI Configured Auto Magically) compliant, the system assigns the drive ID over the interface, so there is no need to be concerned about drive ID. Setting the drive ID jumpers doesn’t hurt anything, but is not necessary.

If your system is not “SCAM” compliant you need to set the drive ID using the ID jumpers.

Configure drive options

For option jumper locations and definitions refer to Figures 9, 10, 11, 12, 13, and 14. 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. ID 7 is the highest priority on both 8 and 16 bit data buses.
- 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** if termination is not provided by the host equipment. On “WC,” “LC,” and “LW” models, 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 Sections 9.8 and 9.9.

- 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 for Seagate support services telephone numbers.
- Do not remove the manufacturer’s installed labels from the drive and do not cover with additional labels, as the manufacturer labels contain information required when servicing the product.

Formatting

- It is not necessary to low level format this drive. The drive is shipped from the factory low level formatted in 512 byte sectors.
- High level format the drive 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.
- Systems that have Windows 95 Operating System version 950B (this has FAT 32) or later do not need to partition the drive.

8.1 Drive ID/option select header

Figures 9 through 11 show views of the drive ID select jumper connectors. Figure 12 shows the option select jumper connector for all models. Figure 10 shows a rear view of model drives for the purpose of showing J1-auxiliary 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. See your local drive sales representative for suggested part number. A bag containing jumper plugs is shipped with standard OEM drives.

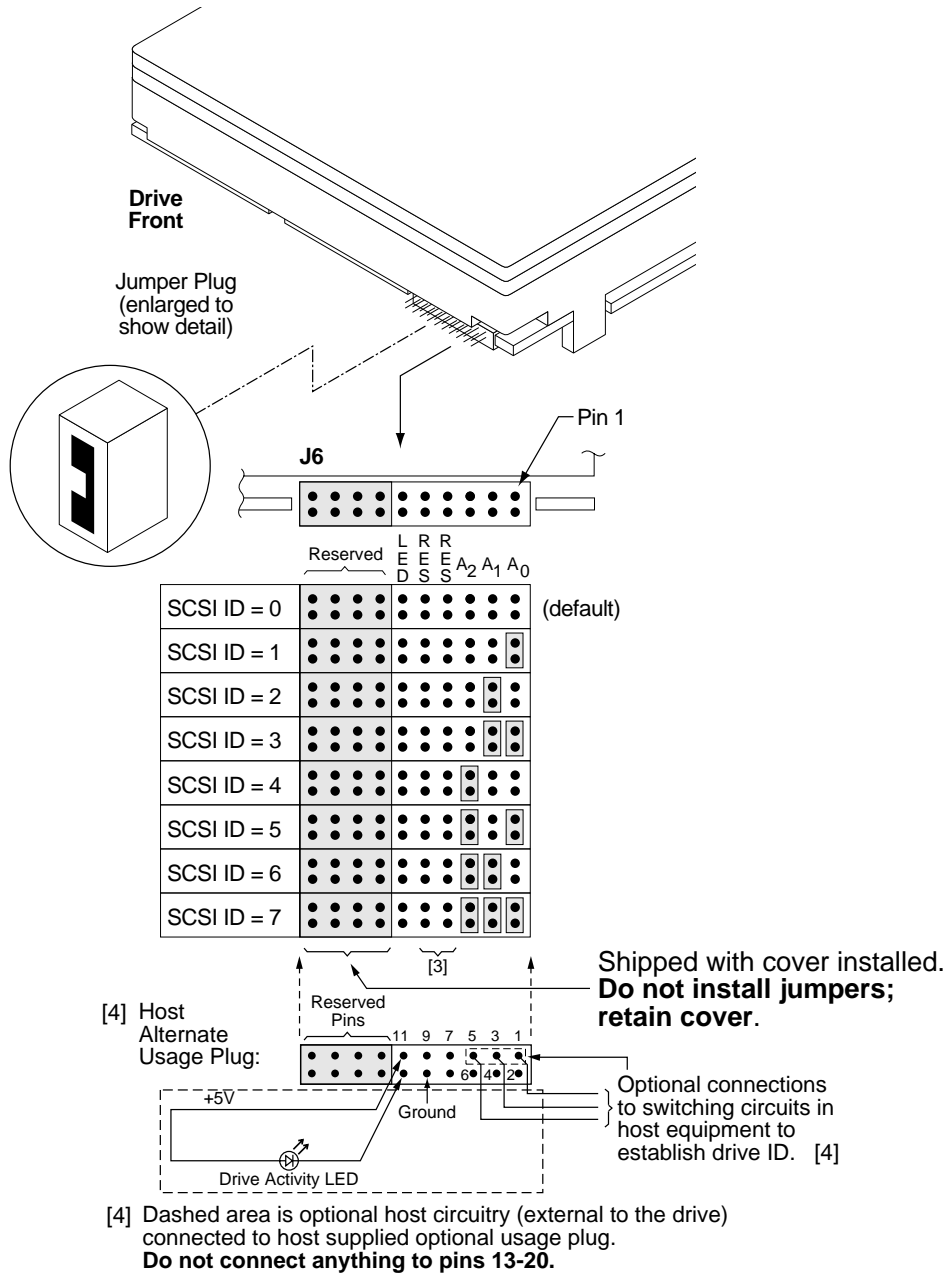


Figure 9. Medalist Pro family drive ID select header for "N" models

Notes for Figures 9 through 14 are in Section 8.1.1.

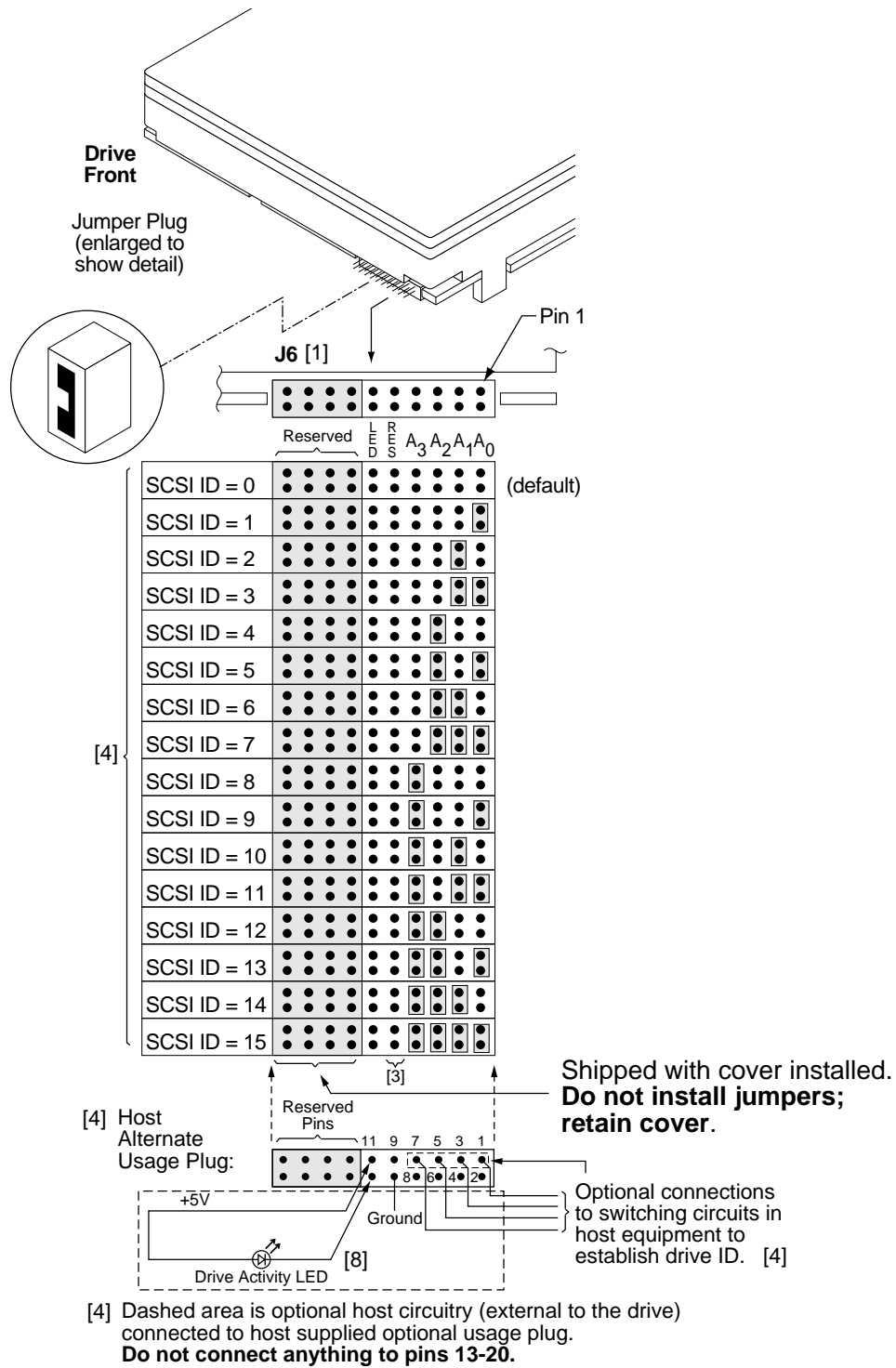


Figure 10. Medalist Pro family drive ID select for "W," "WC," "LW," and "LC" models

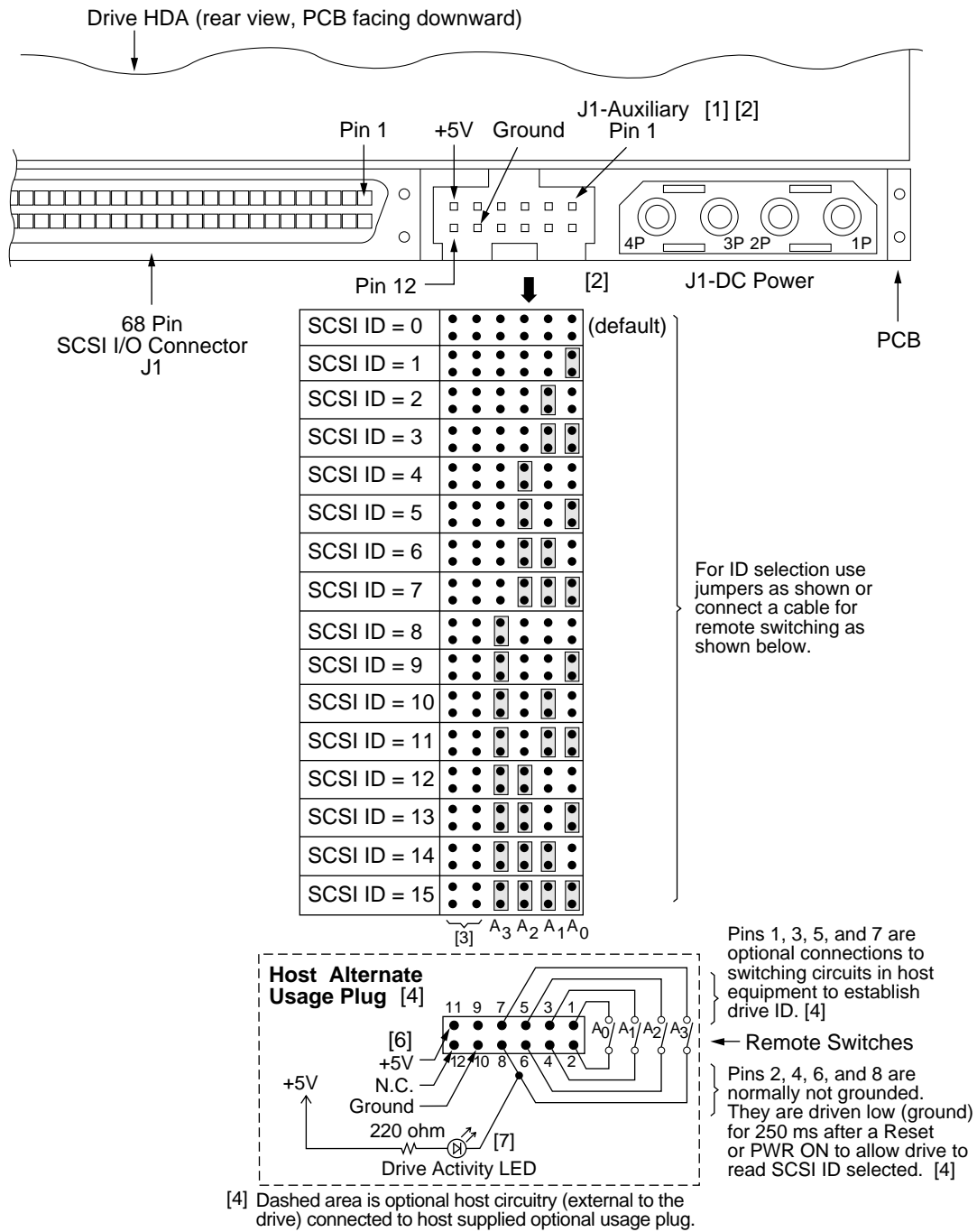


Figure 11. Medalist Pro family drive ID select header J1-auxiliary for “W” and “LW” models (J1-Auxiliary Pins 1A - 12A)

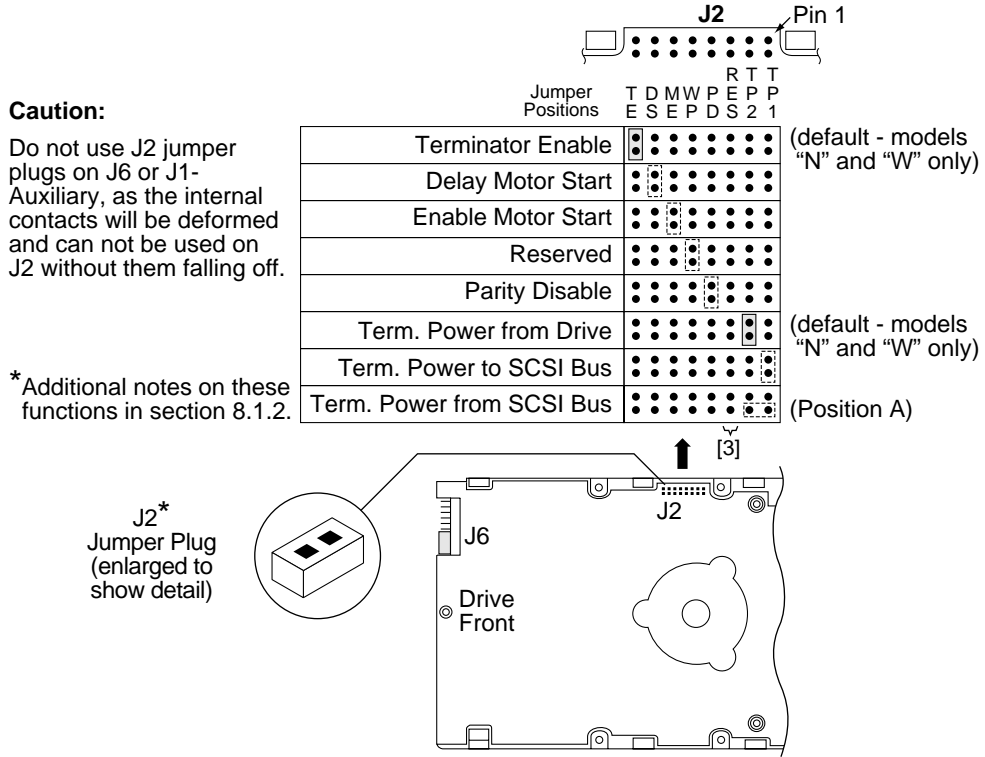


Figure 12. Medalist Pro family drive option select header for "N" and "W" models

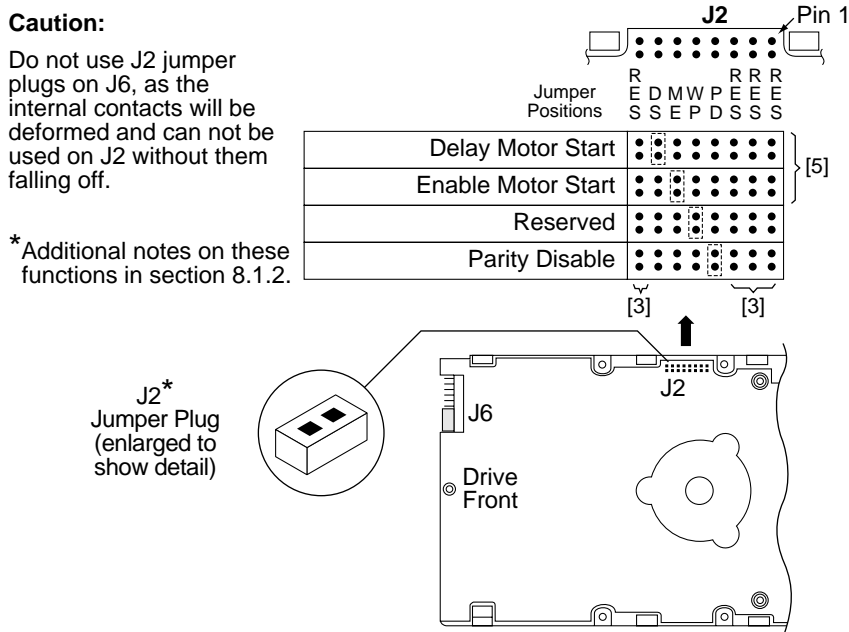


Figure 13. Medalist Pro family drive option select header for "WC" models

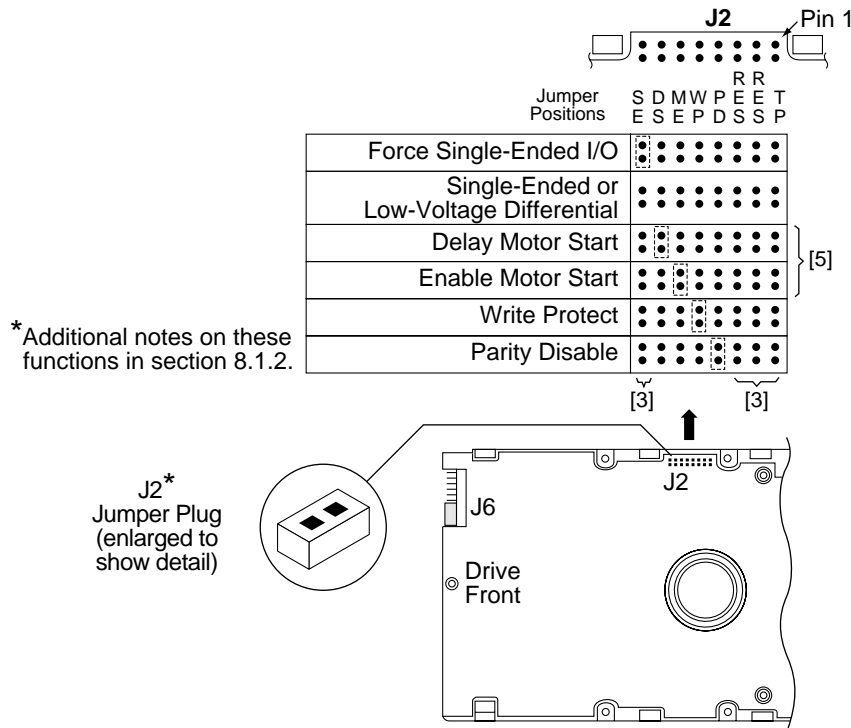


Figure 14. Medalist Pro family drive option select header for models “LW” and “LC”

8.1.1 Notes for Figures 9, 10, 11, 12, 13, and 14.

- [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,” “WC,” and “LC” 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. See note [4].
- [3] Reserved usage. Do not install any jumpers.
- [4] Table 4 summarizes the configuration selection possibilities available on the different Medalist Pro model drives.
- [5] These signals are also on 80 pin J1. See Table 19.
- [6] Voltage supplied by the drive.
- [7] J1A Drive Activity LED—with series resistor built-in pin 12, is the open collector driver that drives the external LED minus side low to turn it on. This output is capable of driving > 20mA. This is the same signal as on J6 pin 12, except J1A pin 8 goes through a 220 Ohm resistor. Tie the minus side of the external LED to this pin.
- [8] J6 Drive Activity LED—without series resistor built-in pin 8, is the open collector driver that drives the external LED minus side low to turn it on. This output is capable of driving > 20mA. This is the same signal as on J1A pin 8, except J6 pin 12 does not go through a 220 Ohm resistor. Tie the minus side of the external LED to this pin.

Table 4: Drive configuration selections summary

Interface type	Function	Connector				Applicable figure
		J1	J6	J1-AUX	J2	
N	Drive ID		X, Y	none		9
N	Drive Activity LED		Y [3]	none		9
N	Option select			none	X	12
W, LW	Drive ID		X, Y	X, Y [5]		10, 11 [1]
W, LW	Drive Activity LED		Y [3]	Y [3]		10, 11 [1]
W, LW	Option select				X	12
WC, LC	Drive ID	Y[6]	X, Y	none		10 [4]
WC, LC	Drive Activity LED	Y[2][3]	Y [3]	none		10 [4]
WC, LC	Option select:					
	Delayed Mtr Start	Y[2]		none	X	13
	Enable Mtr Start	Y[2]		none	X	13
	Write Protect			none	X	13
	Parity Disable			none	X	13
LW, LC	SE (force single-ended)				X	14

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

Notes 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 19.
- [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 host selects drive ID through J1.

8.1.2 Function description

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 enabled (not connected to I/O lines).

SE

(Applies only to “LW” and “LC” models)

On

Forces drive to use single-ended I/O drivers/receivers only.

Off

Drive can operate on the interface in low voltage differential mode or single-ended, depending on the voltage state of the I/O “DIFFSENS” line. **Default** is no jumper on.

DS ME

(Applies to all models)

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.

PD

(Applies to all models)

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.

RES

(Applies to all models)

Off

Reserved jumper position. Default is no jumper installed.

TP2 TP1

(Does not apply to “WC” models)

Off Off

No terminator power is connected to drive terminators or SCSI bus I/O cable*.

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*; none to internal terminators. When drives have differential I/O circuits, a jumper on the **TP1** position may be needed to power external terminators (see system documentation).

On On

Drive supplies terminator power to itself (internal connection) and to SCSI bus I/O cable*. This is a legal jumper setting.

TP1 and TP2

“Position A”

(Applies only to “N” and “W”)

On

This horizontally positioned jumper across the two **TP** positions furthest from the PCB edge, connects terminator power from SCSI bus I/O Termpower cable* to the drive’s internal terminators (for single-ended I/O only).

Off

See above explanations for **TP** jumpers.

TP

(Applies only to “LW” model)

Off

No terminator power is connected to SCSI bus I/O cable.* **Default** is no jumpers on.

On

Drive supplies power to SCSI bus I/O cable.* A jumper on the **TP1** position may be needed to power external terminators (see Section 9.8 and Figure 10).

*See Figure 12 for pins used for Termpower.

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

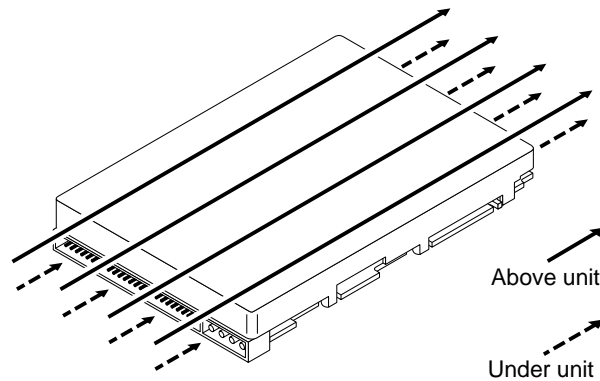
Cabinet cooling must be designed by the customer so that the ambient temperature immediately surrounding the drive will not exceed temperature conditions specified in Section 6.4.1, "Temperature." Specific consideration should be given to make sure adequate air circulation is present around the printed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

8.3.1 Air flow

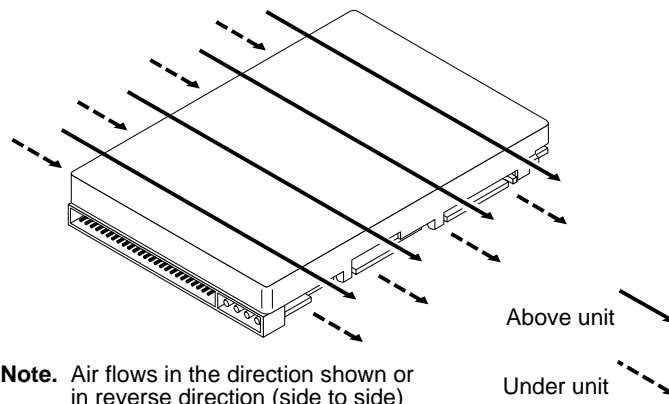
The rack, cabinet, or drawer environment for the Medalist Pro drive must provide heat removal from the electronics and head and disc assembly (HDA). You should confirm that adequate heat removal is provided using the temperature measurement guidelines described in Section 6.4.1.

Forced air flow may be required to keep temperatures at or below the specified case temperatures of Table 3, Column 2, in which case 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.

If forced air is determined to be necessary, possible air-flow patterns are shown in Figure 15. The air-flow patterns are created by one or more fans, either forcing or drawing air as shown in the illustrations. Conduction, convection, or other forced air-flow patterns are acceptable as long as the temperature measurement guidelines of Section 6.4.1 are met.



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 15. Air flow (suggested)

8.4 Drive mounting

Refer to Figure 5 on page 25 for an illustration of the recommended mounting orientations

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:

$$K = \frac{F}{x} = 80\text{lb/in (14.0 N/mm)}$$

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 four 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.

Note. Before mounting the drive in any kind of 3.5-inch to 5.25-inch adapter frame, verify with Seagate Technology that the drive can meet the shock and vibration specifications given herein while mounted in such an adapter frame. Adapter frames that are available may not have a mechanical structure capable of mounting the drive so that it can meet the shock and vibration specifications listed in this manual.

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.

Increased radiated emissions may result if you do not provide the maximum surface area ground connection between system ground and drive ground. This is the system designer's and integrator's responsibility.

9.0 Interface requirements

This section describes Medalist Pro 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 *SCSI Interface Product Manual* (part number 77738479). This section has tables that give the Medalist Pro 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 Medalist Pro family drives.

Table 5: SCSI messages supported by Medalist Pro family drives

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

Notes.

[1] Extended messages (see *SCSI Interface Product Manual*, part number 77738479).

[2] Not applicable to "N" models.

9.3 SCSI interface commands supported

Table 6 following lists the SCSI interface commands that are supported in the SCSI-2, and SCSI-3 modes of the drive.

Table 6: Commands supported by Medalist Pro family drive

Command name	Command code	Supported by Medalist Pro
Change definition	40h	N
Compare	39h	N
Copy	18h	N
Copy and verify	3Ah	N
Format unit [1]	04h	Y
Block Format		N
Bytes from index		N
Physical sector format		Y
DPRY bit supported		Y
DCRT bit supported		Y
STPF bit supported		Y
IP bit supported (w/o embedded LBA)		Y
DSP bit supported		N
IMMED bit supported		Y
VS (vendor specific)		N
Inquiry	12h	Y
Date code page (C1h)		Y
Device Behavior page (C3h)		Y
Firmware numbers page (C0h)		Y
Implemented operating def page (81h)		Y
Jumper settings page (C2h)		Y
Supported Vital product data page (00h)		Y
Unit serial number page (80h)		Y
Lock-unlock cache	36h	N
Log select	4Ch	N
DU bit		N
DS bit		N
TSD bit		N
ETC bit		N
TMC bit		N
LP bit		N
Log sense	4Dh	Y
Cache statistics page (37h)		Y
Non-medium error page (06h)		Y
Pages supported list (00h)		Y
Power-on time page (3Eh)		Y
Read error counter page (03h)		Y
Verify error counter page (05h)		Y
Write error counter page (02h)		Y
Mode select (same pages as Mode Sense command)	15h	Y [2]
Mode select (10)	55h	Y
Capacity Programming		Y
Mode sense	1Ah	Y [2]
Caching parameters page (08h)		Y

Table 6: Commands supported by Medalist Pro family drive (Continued)

Command name	Command code	Supported by Medalist Pro
Control mode page (0Ah)		Y
Disconnect/reconnect (02h) (DTDC, DIMM not used)		Y
Error recovery page (01h)		Y
Format page (03h)		Y
Information exceptions control page (1Ch)		Y
Notch and Partition Page (0Ch)		N
Power condition page (1Ah)		N
Rigid disc drive geometry page (04h)		Y
Unit attention page (00h)		Y
Verify error recovery page (07h)		Y
Xor Control page (10h)		N
Mode sense (10)	5Ah	Y
Prefetch	34h	N
Read	08h	Y
Read buffer (modes 0, 2 supported)	3Ch	Y
Read capacity	25h	Y
Read defect data	37h	Y
Read extended	28h	Y
DPO bit supported		Y
FUA bit supported		Y
Read long	3Eh	Y
Reassign blocks	07h	Y
Rebuild	81h	N
Receive diagnostic results	1Ch	Y
Supported diagnostics pages (00h)		Y
Translate page (40h)		Y
Regenerate	82h	N
Release	17h	Y
Release (10)	57h	Y
Request sense	03h	Y
Actual retry count bytes		N
Deferred error supported		Y
Extended sense		Y
Field pointer bytes		Y
Reserve	16h	Y
3rd party reserve		Y
Extent reservation		N
Reserve (10)	56h	Y
3rd part reserve		Y
Extent reservation		N
Rezero unit	01h	Y
Search data equal	31h	N
Search data high	30h	N
Search data low	32h	N
Seek	0Bh	Y
Seek extended	2Bh	Y
Send diagnostics	1Dh	Y

Table 6: Commands supported by Medalist Pro family drive (Continued)

Command name	Command code	Supported by Medalist Pro
Supported diagnostics pages (00h)		Y
Translate page (40h)		Y
Set limits	33h	N
Start unit/stop unit (spindle ceases rotating) (1CH)	1Bh	Y
Synchronize cache	35h	Y
Test unit ready	00h	Y
Verify	2Fh	Y
DPO bit supported		N
BYTCHK bit supported		N
Write	0Ah	Y
Write and verify	2Eh	Y
DPO bit supported		N
BYTCHK bit supported		N
Write buffer (modes 0, 2, supported)	3Bh	Y
Firmware download option (mode 5 supported) [3]		Y
Write extended	2Ah	Y
DPO bit supported		Y
FUA bit support		Y
Write long	3Fh	Y
Write same	41h	Y
XDRead	52h	N
XDWrite	50h	N
XDWrite extended	80h	N
XPWrite	51h	N

[1] The drive is factory formatted to 512 bytes per sector, and that is not changeable.

[2] Tables 9, 10, and 11 show how individual bits are set and which are changeable by the host.

[3] **WARNING:** A power loss during flash programming can result in firmware corruption. This usually makes the drive inoperable.

Table 7 lists the Standard Inquiry command data that the drive should return to the initiator per the format given in the *SCSI Interface Manual* (part number 77738479), section 5.1.1.3.

Table 7: Medalist Pro family drive Standard Inquiry data

Bytes	Data (HEX)																
0-15	00	00	02	[02] ¹	8F	00	[00] ⁵	[1E] ²	53	45	41	47	41	54	45	20	VENDOR ID
16-31	53	54	[3X]	[3X]	[3X]	[3X]	[3X]	[4E]	[00] ³	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]	[37] ⁴	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 01 means response data in SCSI-1 format which this drive does not support.
02 means response data in SCSI-2/SCSI-3 format (default is 02).
- []² For “N” models, this value is 12.
For “W” and “WC” models, this value is 32.
- 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.
- []³ Bytes 18 through 22 reflect the drive’s model number in hex values. Bytes 23 and 24 reflect the drive’s interface type as follows:

Model	Inquiry Data	Byte 23	Byte 24
STxxxxxN	STxxxxxN	4E	20
STxxxxxW	STxxxxxW	57	20
STxxxxxWC	STxxxxxWC	57	43
STxxxxxLW	STxxxxxLW	4C	57
STxxxxxLC	STxxxxxLC	4C	43

- []⁴ Copyright Year - changes with actual year.
- []⁵ For “N” models, this value is 00.
For models “W,” “WC,” “LW,” and “LC,” this value is 01.

9.3.1 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 Interface Manual* (part number 77738479), section 5.1.1.3.1 lists the Vital Product Data pages 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.

Table 8 shows the Vital Product Data pages for the drives of this product manual. “Y” means reporting that particular parameter is supported, but it may be different for each drive.

Table 8: Vital product data pages

Byte	Page	Supported
Unit serial number page 80h		
0	Peripheral qualifier/peripheral device type	—
1	Page code number	80
2	Reserved	00
3	Page length	08
4-11	Product serial number	Y
Implemented operating definition page 81h		
0	Peripheral qualifier/peripheral device type	—
1	Page code number	81
2	Reserved	00
3	Page length	03
4	SAVIMP=0, current operating definition	Y
5	SAVIMP=0, default operating definition	Y
6	SAVIMP=0, supported operating definition	Y
7	SAVIMP, supported operating condition	N/A
Firmware numbers page C0h		
0	Peripheral qualifier/peripheral device type	—
1	Page code number	C0
2	Reserved	00
3	Page length	10
4-7	Controller firmware number	N/A
4-11	SCSI firmware release number	Y
8-11	Boot firmware number	N/A
12-19	Servo RAM release number	Y
12-15	Servo firmware number	N/A
20-27	Servo ROM release number	Y
28-31	Servo RAM release date	N
32-35	Servo ROM release date	N
Data code page C1h		
0	Peripheral qualifier/peripheral device type	Y
1	Page code number	C1
2	Reserved	00
3	Page length	03
4	Year	N
5	Week	N
4-6	DCD data, MMDDYY	Y
Jumper settings page C2h		
0	Peripheral qualifier/peripheral device type	Y
1	Page code number	C2
2	Reserved	00
3	Page length	02
4	Motor start, parity enable, SCSI ID	—
4	Delayed motor start, motor start, write protect, parity enable, SCSI ID	Y
5	Terminator enable	N

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 9 refer to Mode page 01, in the row entitled "CHG". These are hex numbers representing the changeable values for Mode page 01. Note that bytes 04, 05, 06, and 07 are not changeable, because those fields are all zeros. If some changeable code had a hex value EF, that equates to the binary pattern 1110 1111. If there is 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.

Though the drive always reports non-zero values in bytes 00 and 01, those particular bytes are never changeable.

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

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.

The following tables list the values of the data bytes returned by the drive in response to the Mode Sense command pages. See the *SCSI Interface Product Manual*.

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

Table 9: Mode sense data, ST39140 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	93	00	10	08																					
Mode Page	<-----Mode Page Headers and Parameter Data Bytes----->																								
01 SAV	81	0A	C8	20	79	00	00	00	20	00	FF	FF													
01 DEF	81	0A	C8	20	79	00	00	00	20	00	FF	FF													
01 CHG	81	0A	FF	FF	00	00	00	00	FF	00	00	00													
02 SAV	82	0E	E0	E0	00	00	00	00	00	00	00	00	00	00	00	00									
02 DEF	82	0E	E0	E0	00	00	00	00	00	00	00	00	00	00	00	00									
02 CHG	82	0E	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00									
03 SAV	83	16	00	00	1F	61	00	00	00	00	00	F6	02	00	00	01	00	24	00	34	40	00	00	00	
03 DEF	83	16	00	01	1F	61	00	00	00	00	00	F6	02	00	00	01	00	24	00	34	40	00	00	00	
03 CHG	83	16	FF	FF	FF	FF	FF	FF	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
04 SAV	84	16	00	23	2E	08	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00	
04 DEF	84	16	00	23	2E	08	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00	
04 CHG	84	16	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
07 SAV	87	0A	08	20	79	00	00	00	00	00	FF	FF													
07 DEF	87	0A	08	20	79	00	00	00	00	00	FF	FF													
07 CHG	87	0A	0F	FF	00	00	00	00	00	00	00	00													
08 SAV	88	12	94	00	FF	FF	00	00	FF	FF	FF	FF	80	01[2]	00	00	00	00	00	00					
08 DEF	88	12	94	00	FF	FF	00	00	FF	FF	FF	FF	80	01[2]	00	00	00	00	00	00					
08 CHG	88	12	07	00	FF	FF	FF	FF	FF	FF	FF	FF	20[1]	FF	00	00	00	00	00	00					
0A SAV	8A	0A	00	10	00	00	00	00	FF	FF	00	00													
0A DEF	8A	0A	00	10	00	00	00	00	FF	FF	00	00													
0A CHG	8A	0A	00	F3	00	00	00	00	00	00	00	00													
1C SAV	9C	0A	80	00	00	00	00	00	00	00	00	01													
1C DEF	9C	0A	80	00	00	00	00	00	00	00	00	01													
1C CHG	9C	0A	8C	0F	00	00	00	00	00	00	00	00													
00 SAV	80	02	02	00																					
00 DEF	80	02	02	00																					
00 CHG	80	02	71	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.
 [2] "LW" and "LC" setting is "03."

Table 10: Mode sense data, ST36530 default values

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	93	00	10	08																					
Mode Page	00	C2	07	90	00	00	02	00																	
	<-----Mode Page Headers and Parameter Data Bytes----->																								
01 SAV	81	0A	C8	20	79	00	00	00	20	00	FF	FF													
01 DEF	81	0A	C8	20	79	00	00	00	20	00	FF	FF													
01 CHG	81	0A	FF	FF	00	00	00	00	FF	00	00	00													
02 SAV	82	0E	E0	E0	00	00	00	00	00	00	00	00	00	00	00	00									
02 DEF	82	0E	E0	E0	00	00	00	00	00	00	00	00	00	00	00	00									
02 CHG	82	0E	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00									
03 SAV	83	16	00	00	1F	61	00	00	00	00	00	EB	02	00	00	01	00	24	00	34	40	00	00	00	
03 DEF	83	16	00	00	1F	61	00	00	00	00	00	EB	02	00	00	01	00	24	00	34	40	00	00	00	
03 CHG	83	16	FF	FF	FF	FF	FF	FF	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
04 SAV	84	16	00	23	2E	06	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00
04 DEF	84	16	00	23	2E	06	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00
04 CHG	84	16	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
07 SAV	87	0A	08	20	79	00	00	00	00	00	FF	FF													
07 DEF	87	0A	08	20	79	00	00	00	00	00	FF	FF													
07 CHG	87	0A	0F	FF	00	00	00	00	00	00	00	00													
08 SAV	88	12	94	00	FF	FF	00	00	FF	FF	FF	FF	80	01[2]	00	00	00	00	00	00	00				
08 DEF	88	12	94	00	FF	FF	00	00	FF	FF	FF	FF	80	01[2]	00	00	00	00	00	00	00				
08 CHG	88	12	07	00	FF	FF	FF	FF	FF	FF	FF	FF	20[1]	FF	00	00	00	00	00	00	00				
0A SAV	8A	0A	00	10	00	00	00	00	FF	FF	00	00													
0A DEF	8A	0A	00	10	00	00	00	00	FF	FF	00	00													
0A CHG	8A	0A	00	F3	00	00	00	00	00	00	00	00													
1C SAV	9C	0A	80	00	00	00	00	00	00	00	00	01													
1C DEF	9C	0A	80	00	00	00	00	00	00	00	00	01													
1C CHG	9C	0A	8C	0F	00	00	00	00	00	00	00	00													
00 SAV	80	02	02	00																					
00 DEF	80	02	02	00																					
00 CHG	80	02	71	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.
 [2] "LW" and "LC" setting is "03."

Table 11: Mode sense data, ST34520 default values

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	93	00	10	08																				
Mode Page	<-----Mode Page Headers and Parameter Data Bytes----->																							
01 SAV	81	0A	C8	20	79	00	00	00	20	00	FF	FF												
01 DEF	81	0A	C8	20	79	00	00	00	20	00	FF	FF												
01 CHG	81	0A	FF	FF	00	00	00	00	FF	00	00	00												
02 SAV	82	0E	E0	E0	00	00	00	00	00	00	00	00	00	00	00	00								
02 DEF	82	0E	E0	E0	00	00	00	00	00	00	00	00	00	00	00	00								
02 CHG	82	0E	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00								
03 SAV	83	16	00	00	1F	61	00	00	00	00	00	F6	02	00	00	01	00	24	00	34	40	00	00	00
03 DEF	83	16	00	00	1F	61	00	00	00	00	00	F6	02	00	00	01	00	24	00	34	40	00	00	00
03 CHG	83	16	FF	FF	FF	FF	FF	FF	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00
04 SAV	84	16	00	23	2E	04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00
04 DEF	84	16	00	23	2E	04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00
04 CHG	84	16	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
07 SAV	87	0A	08	20	79	00	00	00	00	00	FF	FF												
07 DEF	87	0A	08	20	79	00	00	00	00	00	FF	FF												
07 CHG	87	0A	0F	FF	00	00	00	00	00	00	00	00												
08 SAV	88	12	94	00	FF	FF	00	00	FF	FF	FF	FF	80	01[2]	00	00	00	00	00	00				
08 DEF	88	12	94	00	FF	FF	00	00	FF	FF	FF	FF	80	01[2]	00	00	00	00	00	00				
08 CHG	88	12	07	00	FF	FF	FF	FF	FF	FF	FF	FF	20[1]	FF	00	00	00	00	00	00				
0A SAV	8A	0A	00	10	F3	00	00	00	FF	FF	00	00												
0A DEF	8A	0A	00	10	F3	00	00	00	FF	FF	00	00												
0A CHG	8A	0A	00	F3	00	00	00	00	00	00	00	00												
1C SAV	9C	0A	80	00	00	00	00	00	00	00	00	01												
1C DEF	9C	0A	80	00	00	00	00	00	00	00	00	01												
1C CHG	9C	0A	8C	0F	00	00	00	00	00	00	00	00												
00 SAV	80	02	02	00																				
00 DEF	80	02	02	00																				
00 CHG	80	02	71	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.
 [2] "LW" and "LC" setting is "03."

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 the *SCSI Interface Product Manual* (part number 77738479).

Table 12: SCSI bus conditions and other miscellaneous features

Supported	Conditions or feature
Y	SCSI-3 SPI compliant
Y	SCAM PnP level 2 compliant, factory set to level 1 (not user selectable)
Y (interface only)	S.M.A.R.T. (Self-Monitoring Analysis and Reporting Technology)
Y	Interface connectors (50, 68, and 80 pins)
Y	RPS (Rotational position seek/sort)
Y	Ultra SCSI-2, 40/80 Mbytes/sec.
Y	Ultra SCSI, 20 Mbytes/sec.
Y	Fast SCSI, 10 Mbytes/sec.
Y	ASYNCR burst rate of 5 Mbytes/sec.—single-ended
Y	Sustained transfer rate of 3 Mbytes/sec.—single-ended
Y	Command overhead less than 500 USEC, typ.
N	Zero latency read
Y	Firmware downloadable via SCSI interface
Y	Sector size, 512
N	Sector size, 180 to 4,096, even number of bytes
Y	Full automatic read and write reallocation
Y	Read look ahead crossing cylinder boundaries
N	Automatic adaptive cache (customer unique option)
Y	Tagged command queuing 64 deep
N	Power management, SCSI-3
Y	SCSI ID accessibility to front end (J6)
SCA-2	SCA connector (optional)
N	HVD SCSI
Y	LVD SCSI (optional)
Y	Multi-initiator
N	Linked commands—customer unique options
Y	Target initiated SDTR
N	Relative addressing—customer unique options
N	Sparing scheme per track
N	Sparing scheme per cylinder
Y	Sparing scheme per volume
N	Sparing scheme per zone (every 6 cylinders)
Y	Hot plugging, with bus active
Jumper required	Active termination enabled
Y	Active termination disabled via jumper
Y	Terminator power from SCSI I/O cable pin 26
Y	Terminator power from drive power connector option
Y	Terminator power from SCSI bus pin 26 option
Y	Terminator power from drive power connector and to SCSI bus option

Supported	Conditions or feature
N	TTD/CIOP
Y	Embedded servo
Y	512K data buffer
Y	Motor start enable
Y	Delayed motor start
Y	Write protected
Y	Immediate status on Format Unit command
Y	Format progress indication
N	Sync spindles
N	Sync spindles—rotational position offset
N	Parameter rounding
N (always strict)	Strict bit support
N	S2 bit
Y (not implemented)	Audio video recovery scheme
Y	Segmented caching (1 and 3 supported)
Y	Good
Y	Check Condition
N	Condition Met/Good
Y	Busy
N	Intermediate/Good
N	Intermediate/Condition Met/Good
Y	Reservation Conflict
Y	Queue Full

9.5 Synchronous data transfer

9.5.1 Synchronous data transfer periods supported

Table 13 and Section 9.5.2 list 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 Product Manual*, part number 77738479.

Table 13: Synchronous data transfer periods for drive

M (decimal)	Transfer period (M times 4 nanoseconds)
12 [1]	50 [1]
25	100
50	200
10 [2]	25 [2]

Note.

[1] Fast-20 SCSI transfer period.

[2] Fast-40 SCSI transfer period.

9.5.2 REQ/ACK offset

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

9.6 Physical interface

Figure 16 shows the locations of the drive physical interface components for the N drives. Shown are the locations of the DC power connector, the SCSI interface connector, the I/O line terminators, 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*, part number 77738479.

This section describes the connectors, cables, signals, terminators and bus timing of the DC and SCSI I/O interface. See Section 9.8 and Section 9.9 for additional terminator information.

9.6.1 DC cable and connector

“N,” “W,” and “LW” model drives receive DC power through a 4 pin connector (see Figures 16 and 17 for pin assignments) mounted at the rear of the main PCB. Recommended part numbers of the mating 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)

“WC” model drives receive power through the 80 pin I/O connector. See Table 19.

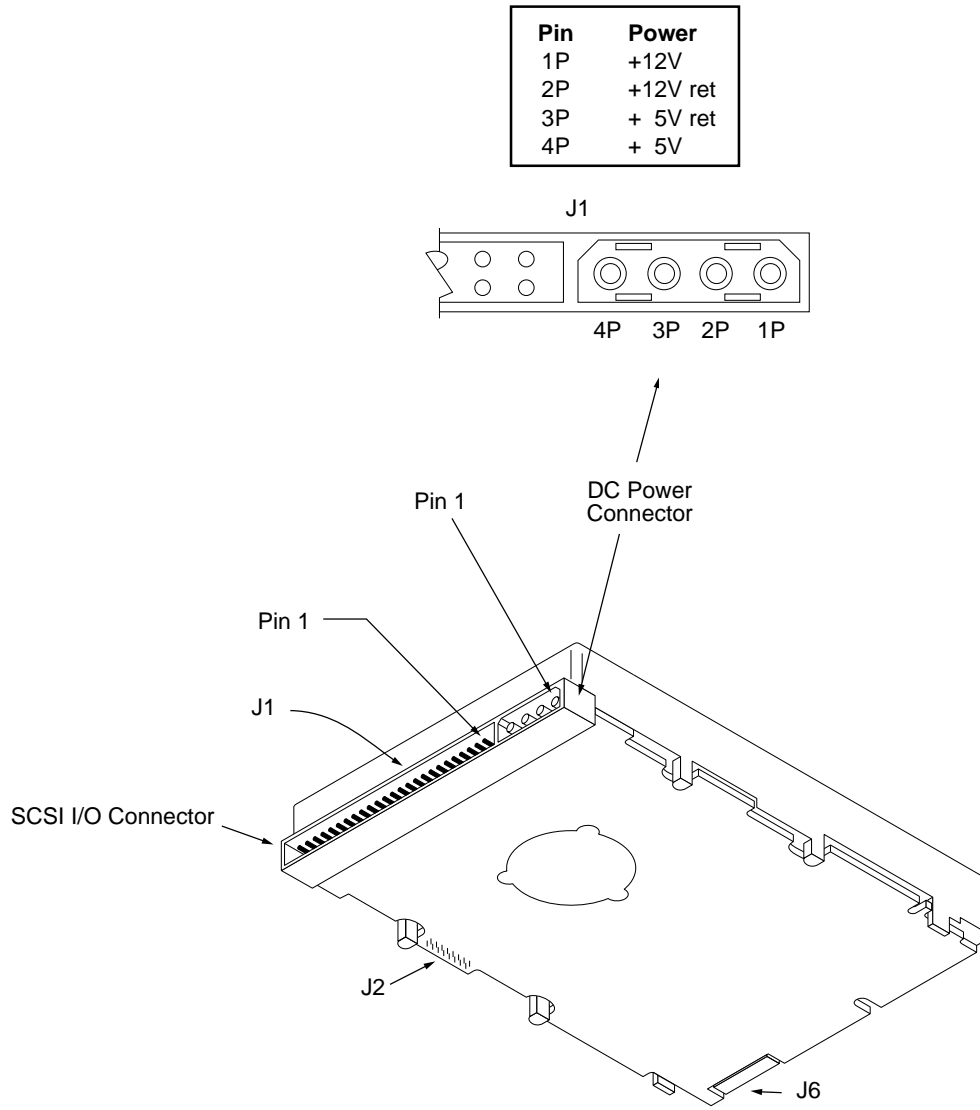


Figure 16. Physical interface for "N" model drives

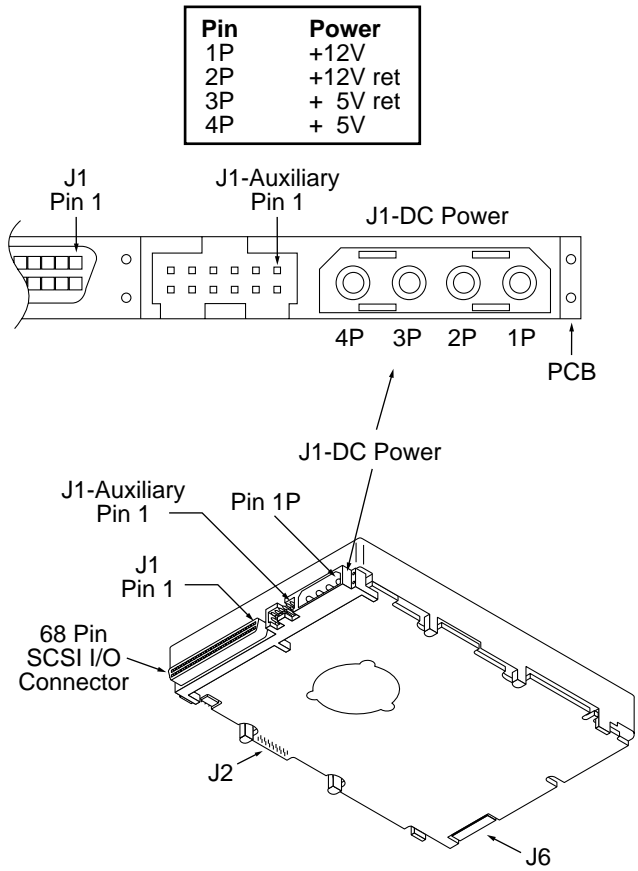
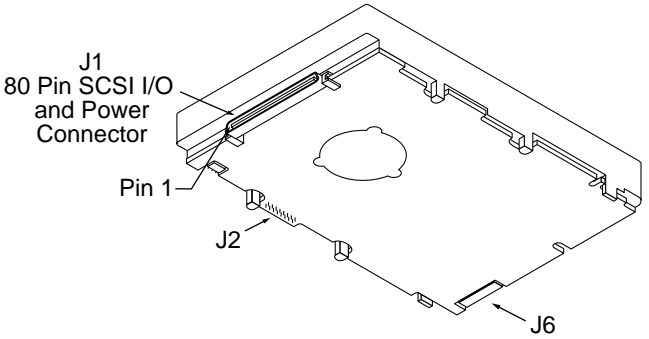


Figure 17. Physical interface for “W” and “LW” model drives



Note: See Table 19 for DC power pin assignments.

Figure 18. Physical interface for “WC” and “LC” model drives

9.6.2 SCSI interface physical description

The drive models described by this product manual support the physical interface requirements of the SCSI-3 Parallel Interface-2 (SPI-2) standards as defined in American National Standard document X3T10/1142D, and operate compatibly at the interface with devices that only support earlier SCSI-2 and SCSI-3 standards. It should be noted that this is only true if the systems engineering has been correctly done, and if earlier SCSI-2 and SCSI-3 devices respond in an acceptable manner (per applicable SCSI Standards) to reject newer SCSI-3 protocol extensions that they don't support.

The family of drives in this manual supports the single-ended and low voltage differential physical interconnects (hereafter referred to as SE and LVD, respectively) as described in the ANSI SPI-2 standard. Drive models whose model numbers end with "N," "W," and "WC" implement SE drivers and receivers. Drive models whose model numbers end with "LC" and "LW" implement driver and receiver circuits that can operate either SE or LVD (but never HVD).

The drives typically operate on a daisy-chain interface in which other SCSI devices are also operating. Devices on the daisy chain must all operate in the same mode, either SE or LVD, but not a mixture of these. On the interface daisy chain, all signals are common between all devices on the chain, or bus, as it is also called. This daisy chain of SCSI devices must be terminated at both ends with the proper impedance in order to operate correctly. Intermediate SCSI devices shall not be terminated. In some cases, the SCSI devices at each end have onboard termination circuits that can be enabled by installation of a jumper plug (**TE**) on the device. These termination circuits receive power from either a source internal to the device, or from a line in the interface cable specifically powered for that purpose. On SE drive models "N" and "W," terminator power source can be selected using the **TP** jumpers on the option select header J2. **TE** is also on the option select header J2 for models "N" and "W." See Section 8.1 for details. Models "WC," "LC," and "LW" have no onboard termination circuits. Some type of external termination circuits must be provided for these drives by the end user or designers of the equipment into which the drives will be integrated. See Standard X3T10/1142D, sections 6.4 and 6.5 for the maximum number of devices that can successfully operate at various interface transfer rates on SE and LVD daisy chains.

"LC" and "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 cable 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.

Table 14 shows the interface transfer rates supported by the various drive models defined in this manual.

Table 14: Interface transfer rates supported

Interface type/ drive models		Maximum transfer rate				
		Asynchronous	Fast-5	Fast-10	Fast-20	Fast-40
SE	"N," "W," "LC," "LW"	yes	yes	yes	yes	no
LVD	"LC," "LW"	yes	yes	yes	yes	yes

9.6.3 SCSI interface cable requirements

The characteristics of cables used to connect SCSI-3 parallel interface devices are discussed in detail in section 6 of ANSI Standard X3T10/1142D. The cable characteristics that must be considered when interconnecting the drives described in this manual in a SCSI-3 parallel, daisy-chain interconnected system are:

- characteristic impedance (see section 6.1)
- propagation delay (see section 6.1)
- cumulative length (see sections 6.4 and 6.5)
- stub length (see sections 6.4 and 6.5)
- device spacing (see sections 6.4 and 6.5)

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, number of loads and spacing, 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-20 and FAST-40 SCSI transfer rates.

For “WC” and “LC” 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. In such installations, all backplane wiring segments are subject to the electro-magnetic concepts presented in Standard X3T10/1142D, section 6. For “WC” and “LC” model drives, installations with connectors on cables are not recommended.

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

The maximum total cable length allowed with drives having single-ended I/O driver and receiver circuits depends on several factors. Table 15 lists the maximum lengths allowed for different configurations of drive usage. These values are from the ANSI SCSI-3 Fast-20 (also called Ultra SCSI) specification X3T10/1071D. All device I/O lines must have equal to or less than 25 pf capacitance to ground, measured at the beginning of the stub.

Table 15: Cable characteristics for single-ended circuits

I/O transfer rate	Maximum number of devices on line	Maximum cable length allowed	Transmission line impedance	
			REQ/ACK	Other signals
≤ 10 M transfers/s	8 (reg. SCSI bus)	6 meters (19.7 ft.)	90 ± 6 Ohms	90 ± 10 Ohms
≤ 10 M transfers/s	16 (wide SCSI bus)	6 meters (19.7 ft.)	90 ± 6 Ohms	90 ± 10 Ohms
≤ 20 M transfers/s	4 (reg./wide SCSI bus)	3 meters (9.8 ft.)	90 ± 6 Ohms	90 ± 10 Ohms
≤ 20 M transfers/s	8 (reg./wide SCSI bus)	1.5 meters (4.9 ft.)	90 ± 6 Ohms	90 ± 10 Ohms

A stub length of no more than 0.1 meter (0.33 foot) is allowed off the mainline interconnection with any connected equipment. The stub length is measured from the transceiver to the connection to the mainline SCSI bus.

Single-ended I/O pin assignments are shown in Tables 16, 17, and 19.

9.6.4 Mating connectors

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

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 female contacts with adjacent contacts 0.1 inches (2.54 mm) 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 19.

The drive device connector is a nonshielded 50 conductor connector consisting of two rows of 25 male pins with adjacent pins 0.1 inches (2.54 mm) apart. The connector is keyed (see Figure 20).

Mating panel mount connector: 3M-CHE-2050-J01A10-KLE.

9.6.4.2 Mating connectors for “W” and “LW” models

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

Recommended mating flat cable connector part numbers are:

Amp Model 786096-7	Female, 68-pin, panel mount
Amp Model 786090-7	Female, 68-pin, cable mount
Amp Model 749925-5	(0.050 inches (1.27mm, 50 mil) conductor centers, 28 or 30 AWG wire). Use two, 34 conductor, 0.050 inches (1.27 mm, 50 mil) center flat cable with this connector. This type connector can only be used on cable ends. [1]
Amp Model 88-5870-294-5	W/O Strain Relief, 0.025 68es (0.68 mm, 25 mil) conductor centers, 30 AWG wire. Use either on cable ends or in cable middle section for daisy-chain installations [1].
Amp Model 1-480420-0	Power connector 4 circuit housing
Berg 69307-012	12-position, 2 x 6, 2 mm receptacle housing

[1] See Figure 19.

The drive device connector is a nonshielded 68 conductor connector consisting of two rows of 34 female pins with adjacent pins 0.050 inches (1.27 mm) apart. The connector is keyed by means of its shape (see Figure 21).

9.6.4.3 Mating connectors for “WC” and “LC” models

The nonshielded connector shall be an 80 conductor connector consisting of two rows of 40 contacts with adjacent contacts 0.050 inches (1.27 mm) 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.

Small Form Factor Specification SSF-8046, Rev. 2.7 details mating requirements.

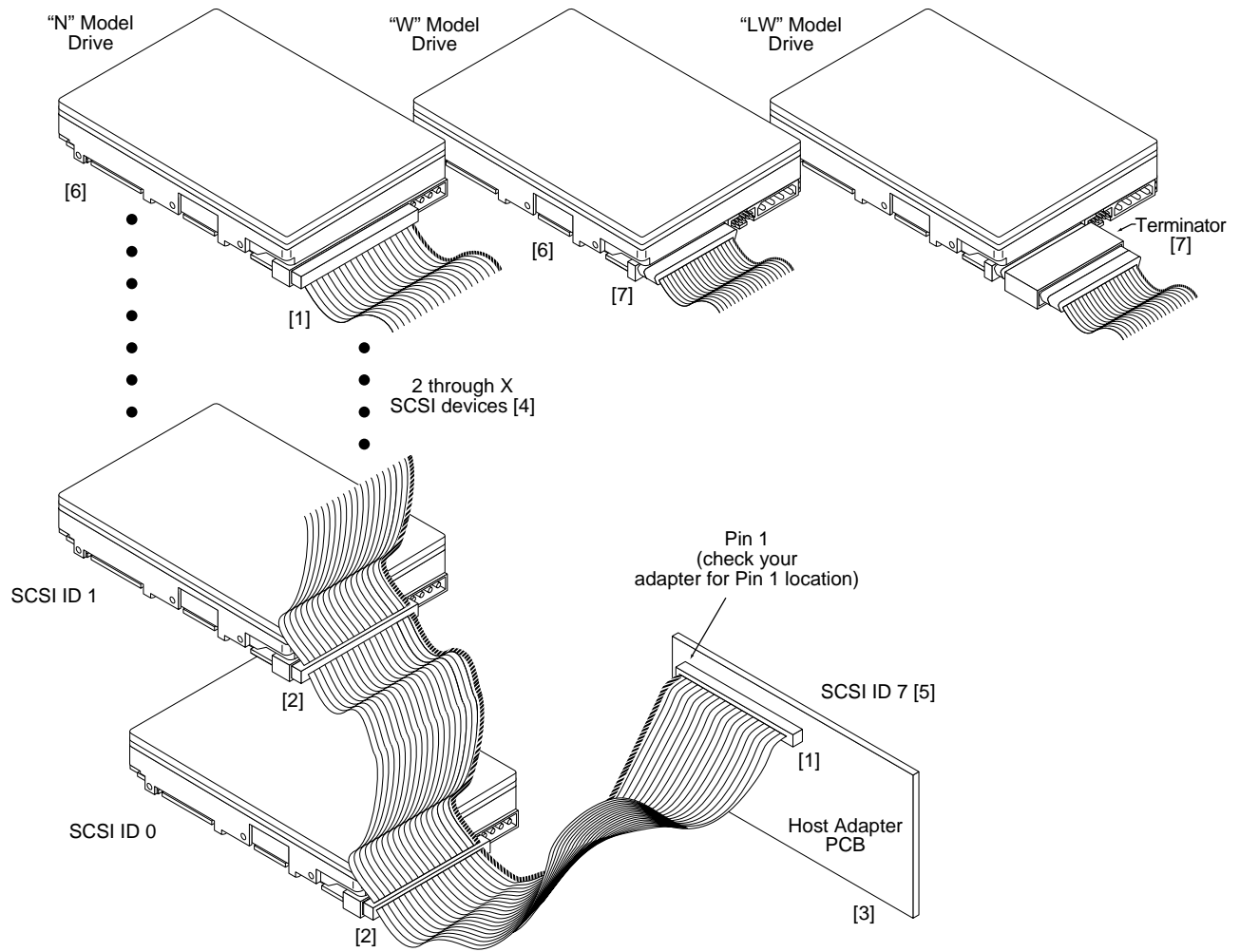
Recommended mating 80-position PCB mount connectors:

Straight-in connector		Hot Plug version (with ground guide-pin)
Seagate P/N:	77678703	
Amp US P/N:	2-557103-1	787311-1 with polarization
	or 94-0680-02-1	
Amp US P/N:	2-557103-2	787311-2 without polarization
	or 94-0680-02-2	
Amp Japan P/N:	5-175475-9	

Right-angle to PCB connectors

Seagate P/N: 77678559 Amp US P/N: 2-557101-1 Amp Japan P/N: 5-175474-9

For additional information call Amp. FAX service at 1-800-522-6752.



- [1] Closed end type 50 pin connector used. Install terminator enable (**TE**) jumper.
- [2] Open end type (in-line application) connector used. Remove terminator enable (**TE**) jumper.
- [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). The cable length restriction limits the total number of devices allowed. See Table 15.
- [5] SCSI ID7 has highest arbitration priority, ID0 has lowest for "N" models. For "W" models, priority is ID7 to ID0, then ID15 to ID8 (ID 8 very lowest).
- [6] Last drive on the daisy chain.
- [7] Open-end type 68-pin connector used. On "W" models, install terminator enable (**TE**) jumper plug. If "LW" model drive is end device on the cable daisy chain, an external terminator is required (not furnished with the drive).

Figure 19. SCSI daisy-chain interface cabling for "N" and "W" model drives

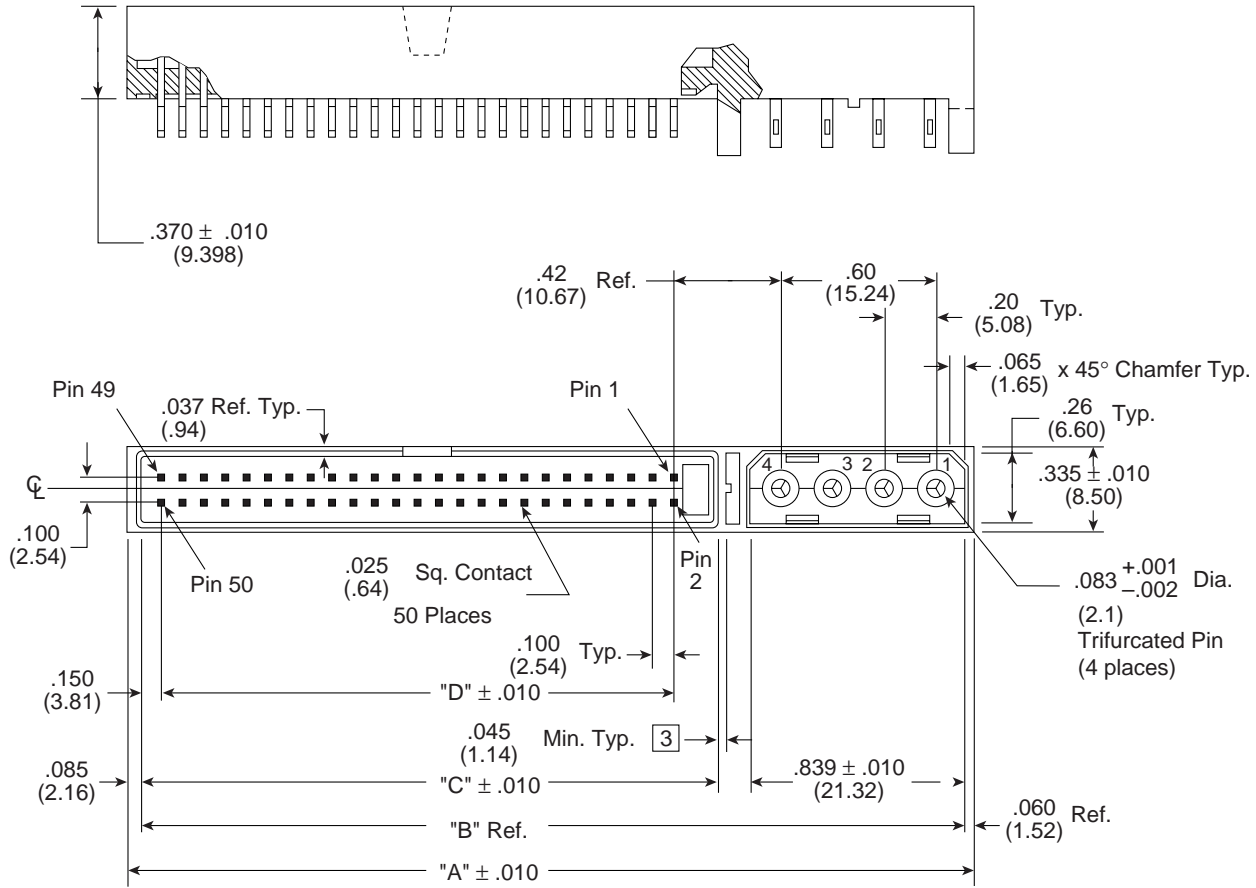


Figure 20. Nonshielded 50 pin SCSI device connector used on "N" model drives

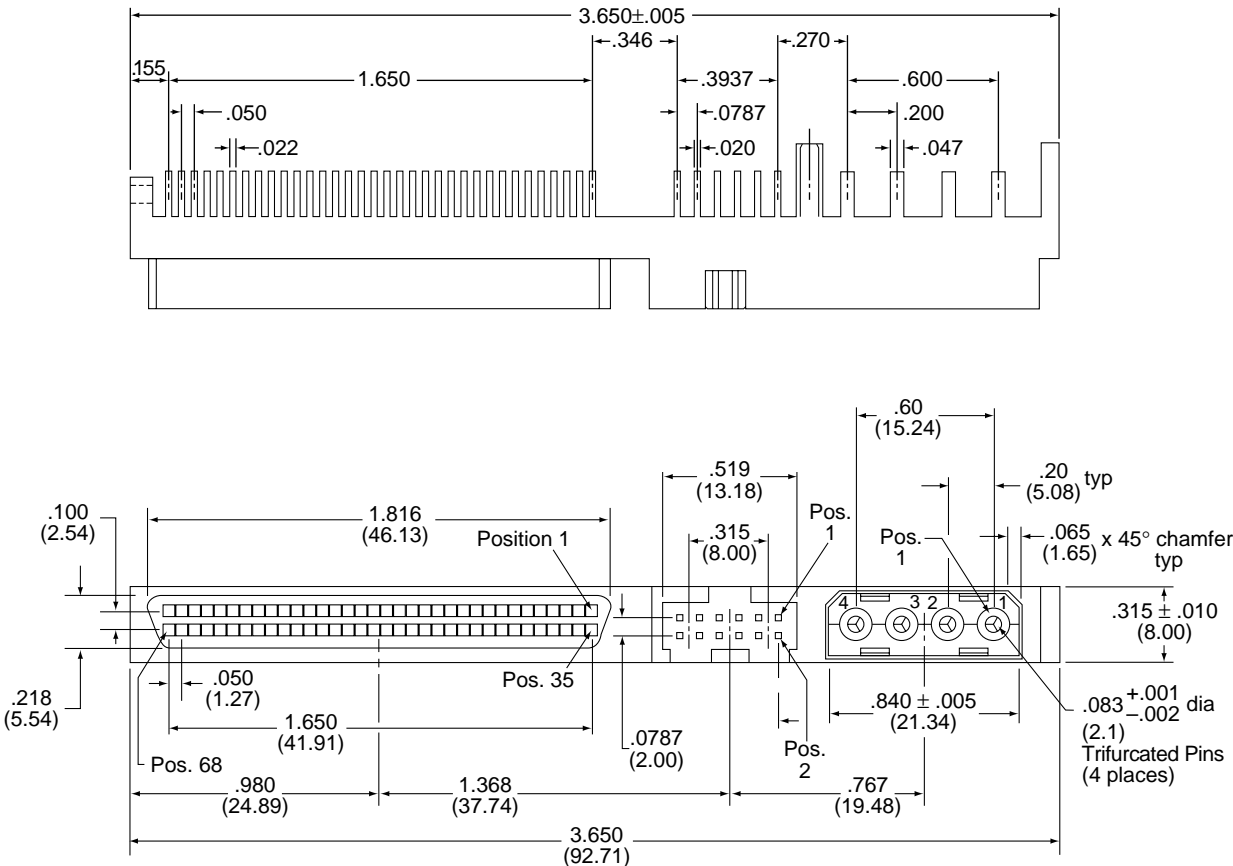


Figure 21. Non-shielded 68 pin SCSI device connector used on “W” and “LW” model drives

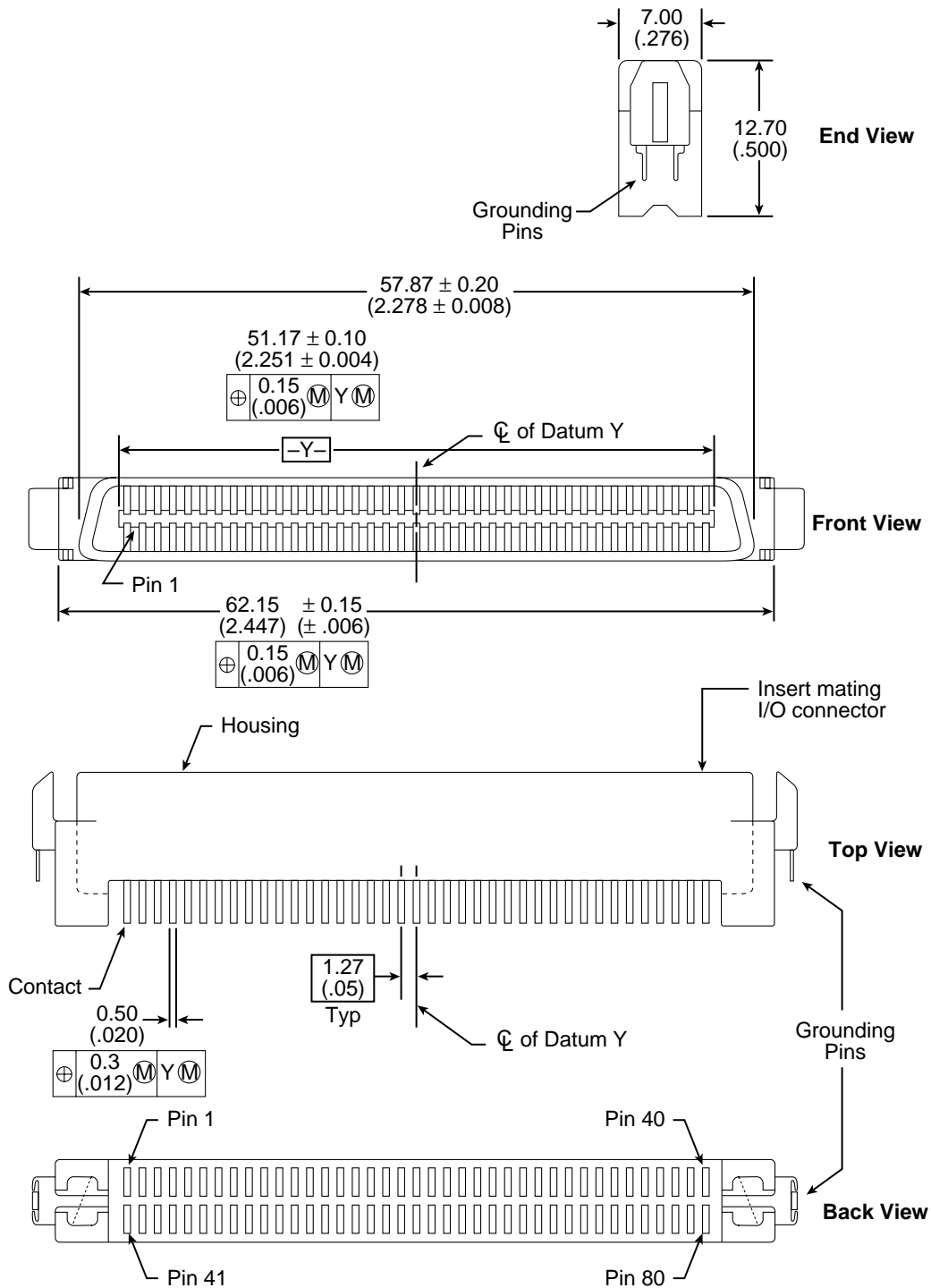


Figure 22. Non-shielded 80 pin SCSI "SCA-2" connector, used on "WC" and "LC" model drives

Table 16: Model “N,” single ended I/O, 50 conductor, signal/contact assignments

Note. The minus sign next to the signal indicates asserted state is the low voltage of the two levels used for logic signals.

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

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

Notes []: See page following Table 20.

Table 17: "W" models single ended I/O cable 68 conductor signal/contact assignments

Note. The minus sign next to the signal indicates asserted state is the low voltage of the two levels used for logic signals

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 20.

Table 18: “LW” models differential cable 68 conductor signal/pin assignments (Nonshielded connector)[13]

Note. The minus sign next to the signal indicates asserted state is the low voltage of the two levels used for logic signals.

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

Notes []: See page following Table 20.

Table 19: “WC” models single ended I/O, 80 conductor cable signal/contact assignments

Note. The minus sign next to the signal indicates asserted state is the low voltage of the two levels used for logic signals

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

Notes []: See page following Table 20.

Table 20: “LC” differential models, 80 pin I/O connector pin assignments (nonshielded connector) [13]

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

Notes []: See page following this table.

Notes [] for Tables 16 through 20.

- [1] See Section 9.7.1 or 9.6.4.2 for detailed electrical characteristics of these signals.
- [2] The conductor number refers to the conductor position when using 0.025-inches (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 inches (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 and J6. See Section 8.1.1 notes.
- [10] "NC" means no connection.
- [11] The conductor number refers to the conductor position (right to left in Figure 19) when using 0.050 inches (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 inches (2.54 mm) centers.
- [13] 8 bit devices which are connected to the 16 data bit differential I/O shall leave the following signals open:
 –DB12 –DB13 –DB14 –DB15 –DBP1 –DB8 –DB9 –DB10 –DB11,
 +DB12 +DB13 +DB14 +DB15 +DBP1 +DB8 +DB9 +DB10 +DB11.
 8 bit devices which are connected to the 16 data bit single-ended I/O shall have the following signals connected as shown:
 to ground: +DB12 +DB13 +DB14 +DB15 +DBP1 +DB8 +DB9 +DB10 +DB11,
 open circuit: –DB12 –DB13 –DB14 –DB15 –DBP1 –DB8 –DB9 –DB10 –DB11.
 All other signals should be connected as shown.

9.7 Electrical description

"N" and "W" models use single-ended interface signals. These signals must be terminated with 110-ohm active termination circuits at each end of the total cable. Single-ended circuits use open collector or three state drivers. These models can be configured to provide the SCSI termination.

"WC" and "LC" models use the single connection attachment (SCA) connector. This 80-pin connector is designed to plug directly into a back panel or plane. No external cables are required. Active terminators on the back panel must be provided by the user. This connector is not recommended where cabling is required.

"LC" and "LW" models are Multimode drives. That is, their I/O circuits can operate as either single-ended or low voltage differential drivers/receivers (selectable using the I/O "DIFFSENS" line). They require external terminators. See Section 9.7.2 for additional information on these models.

Note. The SCSI protocol chip drives the upper eight data and parity bits of the SCSI bus even when operating in narrow (eight bit) mode. This is normal operation for this chip. If the unused data bit signals are connected to conductors that extend out beyond this drive's SCSI connector, correct termination must be provided for these unused signals at the device/system at each end of the bus onto which this drive is connected. Termination is required to control radiated emissions and conducted noise on other SCSI bus signals.

See ANSI Standard X3T10/1142D for detailed electrical specifications.

9.7.1 Single-ended drivers/receivers

For "N," "W," and "WC" models which use single-ended drivers and receivers, typical circuits are shown in Figure 23. Terminator circuits (Note [1]) are to be enabled 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.

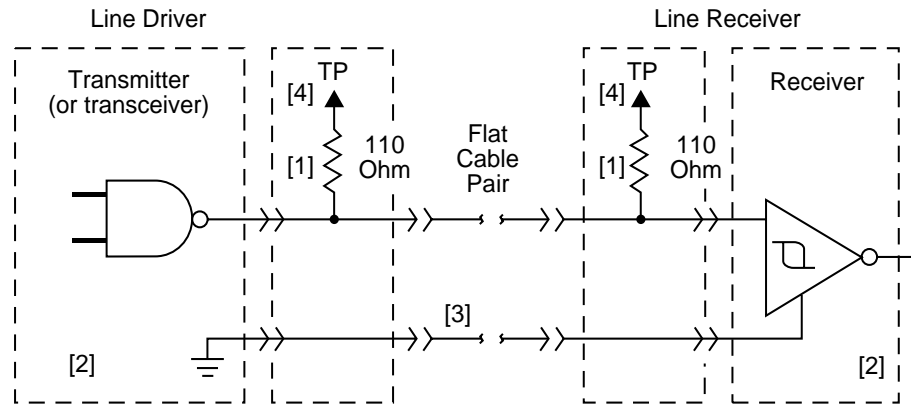


Figure 23. Single-ended transmitters and receivers

Notes.

[1] Part of active terminator circuits. Non-removable LSI terminators, enabled in the drive (models “N” and “W” only) with jumper plug **TE** when it is first or 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 12. Applies to “N” and “W” models.

9.7.2 Multimode—SE or LVD alternative

“LW” and “LC” models have I/O circuits that can operate either in single-ended (SE) or low voltage differential mode (LVD). When the interface “DIFFSENS” line is between 0 V and .6 V, the drive interface circuits operate single-ended and up to and including 20 M transfers/s (Fast-20 or Ultra-1 SCSI). When “DIFFSENS” is between +0.7 V and +1.9 V, the drive interface circuits operate low voltage differential and up to and including 40 M transfers/s or less (Fast-40 or Ultra-2 SCSI). This arrangement is not intended to allow dynamically changing transmission modes, but rather to prevent incompatible devices from attempting to interoperate. Drives must operate only in the mode for which the installation and interface cabling is designed. Multimode I/O circuits used by “LC” and “LW” devices do not operate at high voltage differential levels and should never be exposed to high voltage differential environments unless the common mode voltages in the environment are controlled to safe levels for single-ended and low voltage differential devices (see the ANSI SPI-2 specification X3T10/1142D).

Multimode signals

Multimode circuit SE alternative signal characteristics are the same as described in Section 9.7.1. The SE alternative for these circuits is selected as described above. SE cables and termination must be used.

Multimode circuit LVD alternative signal characteristics are not the same as the differential signals described in Section 9.7.2.1. The Multimode signal lines (either SE or LVD) should be terminated with 110 ohm active terminator circuits at each end of the total cable. Termination of the I/O lines must be provided for by the Host equipment designers or end users.

The SE and differential alternatives are mutually exclusive.

Output characteristics

Each signal (V_s) driven by LVD interface drivers shall have the following output characteristics when measured at the disc drive connector:

Steady state Low level output voltage* = $-0.95 \text{ V} = < V_s = < -1.55 \text{ V}$ (signal negation/logic 0)

Steady state High level output voltage* = $0.95 \text{ V} = < V_s = < 1.55 \text{ V}$ (signal assertion/logic 1)

Differential voltage = $\pm 0.6 \text{ V}$ minimum with common-mode voltage ranges $0.700 \text{ V} = < V_{cm} = < 1.800 \text{ V}$.

*These voltages shall be measured between the output terminal and the SCSI device's logic ground reference.

The output characteristics shall additionally conform to EIA RS-485.

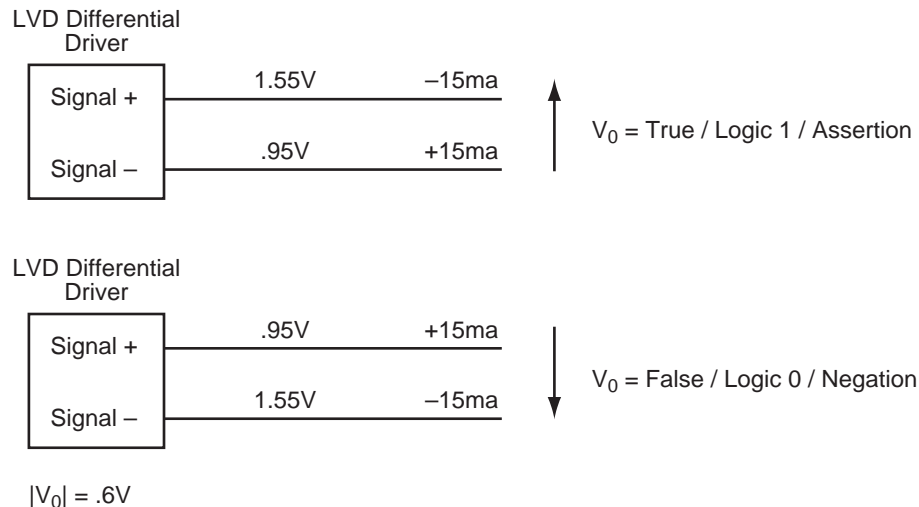


Figure 24. LVD output signals

Input characteristics

Each signal (V_s) received by LVD interface receiver circuits shall have the following input characteristics when measured at the disk drive connector:

Steady state Low level output voltage* = $0.030 \text{ V} = < V_s = < 3.6 \text{ V}$ (signal negation/logic 0)

Steady state High level output voltage* = $-3.6 \text{ V} = < V_s = < -0.030 \text{ V}$ (signal assertion/logic 1)

Differential voltage = $\pm 0.30 \text{ V}$ minimum with common-mode voltage ranges $0.700 \text{ V} = < V_{cm} = < 1.800 \text{ V}$. (X3T10/1142D revision 13, p. 152)

*These voltages shall be measured between the output terminal and the SCSI device's logic ground reference.

This requirement shall be met with the input voltage varying between 0.700 V and 1.8 V, with power on or off, and with the hysteresis equaling TBD mV, minimum.

Input characteristics shall additionally conform to EIA RS-485-983.

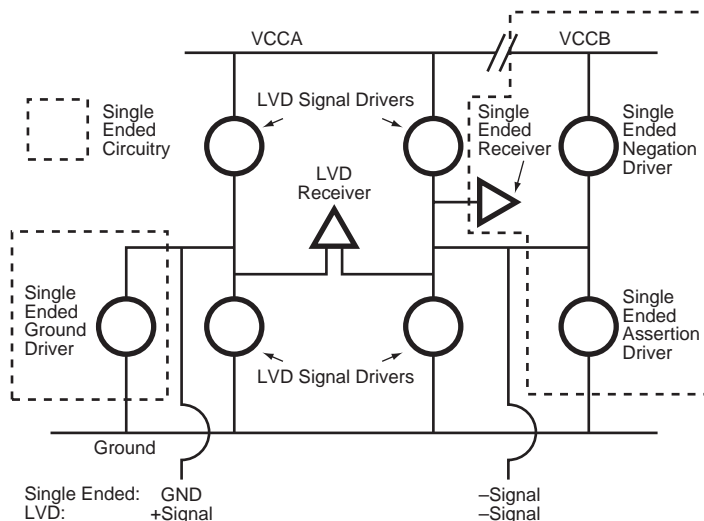


Figure 25. Typical SE-LVD alternative transmitter receiver circuits

9.8 Terminator requirements

Internal disc drive I/O termination (provided only in model “N” and “W” drives single ended I/O model 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 19).

Note. Remove drive terminator enabling jumper **TE** 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” and “W” models), especially if the bus will be operated at transfer rates above 5 Mbytes/sec. The “N” and “W” models provide on-board active termination that can be disabled by removal of the enable jumper **TE** (see Figure 7d).

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.

Drive models “WC,” “LW,” and “LC” do not have internal terminators available. The user, systems integrator or host equipment manufacturer must provide a terminator arrangement external to the drive. For “LW” models, terminator modules can be purchased that plug between the SCSI I/O cable and the drive I/O connector or on the end of a short I/O cable stub extending past the last cable connector.

Note. The SCSI protocol chip drives the upper eight data and parity bits of the SCSI bus even when operating in narrow (eight bit) mode. This is normal operation for this chip. If the unused data bit signals are connected to conductors that extend out beyond this drive’s SCSI connector, correct termination must be provided for these unused signals at the device/system at each end of the bus onto which this drive is connected. Termination is required to control radiated emissions and conducted noise on other SCSI bus signals.

ANSI Standard X3T10/1143D contains additional details about SCSI bus terminator and terminator power requirements.

9.9 Terminator power

“N” and “W” model drives

You can configure terminator power in four different ways. See Section 8.1 for illustrations that show how to place jumpers enabling each of the following terminator power configurations:

1. Drive accepts terminator power through SCSI bus pins:
 - “N” models Pin 26
 - “W” models Pins 17, 18, 51, and 52
2. Drive supplies power to the SCSI bus.
3. Drive provides terminator power for optional internal terminator resistors using the drive’s power connector.
4. Drive provides power to its own terminators and to the SCSI bus terminator power line.

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

8-bit SCSI	V TERM = 4.25 V to 5.25 V 800 mA minimum source drive capability 1.0 A maximum
16-bit SCSI	V TERM = 4.25 V to 5.25 V 1,500 mA minimum source drive capability 3.0 A maximum

“WC” and “LC” model drives

These drives cannot furnish terminator power because no conductors in the 80-pin I/O connector are devoted to terminator power.

“LW model drives

You can configure terminator power from the drive to the SCSI bus or have the host adaptor or other device supply terminator power to the external terminator. See Section 8.1 for illustrations that show how to place jumpers for this configuration.

Disc drive SCSI timing

Table 21: Disc drive SCSI timing

Description	Waveform symbol [1]	Waveform table [1]	Typical timing
Target Select Time (no Arbitration) [4]	T00	N/A	<2 μ s
Target Select Time (with Arbitration) [4]	T01	4.5-1,2	<2 μ s
Target Select to Command	T02	4.5-1	3.77 μ s
Target Select to MSG Out	T03	4.5-2	1.57 μ s
Identify MSG to Command	T04	4.5-3	3.36 μ s
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 μ s
Disconnect to Arbitration (for Reselect) This measures disconnected CMD overhead	T11	4.5-6	Command Dependent
Target win Arbitration (for Reselect)	T12	4.5-7	3.00 μ s
Arbitration to Reselect	T13	4.5-7	1.60 μ s
Reselect to Identify MSG In	T14	4.5-7	1.39 μ s
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 μ s
Command Complete MSG to Bus Free	T19	4.5-5,8,15	0.51 μ s
Data to Save Data Pointer MSG	T20	4.5-14	4.00 μ s
Save Data Pointer MSG to Disconnect MSG	T21	4.5-14	0.79 μ s
Command Byte Transfer	T22	4.5-4	0.04 μ s
Next Command Byte Access:		4.5-4	
Next CDB Byte Access (Byte 2 of 6)	T23.6.2	4.5-4	0.58 μ s
Next CDB Byte Access (Byte 3 of 6)	T23.6.3	4.5-4	0.12 μ s
Next CDB Byte Access (Byte 4 of 6)	T23.6.4	4.5-4	0.12 μ s
Next CDB Byte Access (Byte 5 of 6)	T23.6.5	4.5-4	0.12 μ s
Next CDB Byte Access (Byte 6 of 6)	T23.6.6	4.5-4	0.12 μ s
Next CDB Byte Access (Byte 2 of 10)	T23.10.2	4.5-4	0.59 μ s
Next CDB Byte Access (Byte 3 of 10)	T23.10.3	4.5-4	0.11 μ s \pm 1 μ s
Next CDB Byte Access (Byte 4 of 10)	T23.10.4	4.5-4	0.12 μ s \pm 1 μ s
Next CDB Byte Access (Byte 5 of 10)	T23.10.5	4.5-4	0.11 μ s \pm 1 μ s
Next CDB Byte Access (Byte 6 of 10)	T23.10.6	4.5-4	0.11 μ s \pm 1 μ s
Next CDB Byte Access (Byte 7 of 10)	T23.10.7	4.5-4	0.13 μ s \pm 1 μ s
Next CDB Byte Access (Byte 8 of 10)	T23.10.8	4.5-4	0.12 μ s \pm 1 μ s
Next CDB Byte Access (Byte 9 of 10)	T23.10.9	4.5-4	0.12 μ s \pm 1 μ s
Next CDB Byte Access (Byte 10 of 10)	T23.10.10	4.5-4	0.12 μ s \pm 1 μ s

Table 21: Disc drive SCSI timing (Continued)

Description	Waveform symbol [1]	Waveform table [1]	Typical timing
Data In Byte Transfer (parameter)	T24	4.5-12	0.04 μ s
Data Out Byte Transfer (parameter)	T25	4.5-13	0.04 μ s
Next Data In Byte Access (parameter)	T26	4.5-12	0.12 μ s
Next Data Out Byte Access (parameter)	T27	4.5-13	0.12 μ s
Data In Byte Transfer (media) [2]	T28	4.5-12	0.04 μ s
Data Out Byte Transfer (media) [2]	T29	4.5-13	0.04 μ s
Next Data In Byte access (media [2]	T30	4.5-12	0.12 μ s
Next Data Out Byte access (media [2]	T31	4.5-13	0.12 μ s
MSG IN Byte Transfer	T32	4.5-5,7,8,14,15	0.04 μ s
MSG OUT Byte Transfer	T33	4.5-2	0.04 μ s
STATUS Byte Transfer	T34	4.5-5,8,15	0.04 μ s
Synchronous Data Transfer Characteristics:			
Request Signal Transfer Period [3]	–	–	various

Notes.

- [1] See *SCSI Interface Product Manual* (part number 77738479), Section 4.5
- [2] Maximum SCSI asynchronous interface transfer rate is given in Section 4.2.3 of this manual.
- [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 Interface Product Manual* for a description of synchronous data transfer operation.

General timing diagrams for SCSI interface operation are shown in the *SCSI Interface Product Manual*, Section 4.5. The specific timing values that apply to this drive are listed in Table 18.

10.0 Seagate Technology support services

Online Services

Internet

For online information about Seagate products, visit www.seagate.com or e-mail your disc or tape questions to:

Presales Support:

Disc: http://www.seagate.com/support/email/email_presales.shtml or DiscPresales@Seagate.com

Tape: http://www.seagate.com/support/email/email_tape_presales.shtml or
Tape_Sales_Support@Seagate.com

Technical Support:

Disc: http://www.seagate.com/support/email/email_disc_support.shtml or DiscSupport@Seagate.com

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If you need help installing your drive, consult your dealer. Dealers are familiar with their unique system configurations and can help you with system conflicts and other technical issues. If you need additional help, you can talk to a Seagate technical support specialist. Before calling, note your system configuration and drive model number (STxxxx).

SeaTDD[™] (+1-405-936-1687) is a telecommunications device for the deaf (TDD). You can send questions or comments 24 hours daily and exchange messages with a technical support specialist from 8:00 A.M. to 12:15 P.M. and 1:30 P.M. to 6:00 P.M. (central time) Monday through Friday.

Customer Service (CSO)

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Seagate offers worldwide customer support for Seagate drives. Seagate direct OEM, Distribution and System Integrator customers should contact their Seagate service center representative for warranty information. Other customers should contact their place of purchase.

Authorized Service Centers

If you live outside the U.S., you can contact an Authorized Service Center for service or repair.

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Presales Support

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Technical Support (SeaFONE)

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SeaTDD +1-405-936-1687
SeaBOARD *Disc:* +1-405-936-1600; *Tape:* +1-405-936-1630

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Adtech +1-905-812-8099 or 1-800-624-9857 FAX: +1-905-812-7807

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For European customer support, dial the toll-free number for your specific country for presales support, technical support, SeaFAX and warranty repair.

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Appendix A. Sense keys and additional sense codes supported

Sense key	Description	Supported
0h	No sense	Y
1h	Recovered error	Y
2h	Not ready	Y
3h	Media error	Y
4h	Hardware error	Y
5h	Illegal request	Y
6h	Unit attention	Y
7h	Data protect	N
9h	Firmware error	N
Bh	Aborted command	Y
Ch	Equal	N
Dh	Volume Overflow	N
Eh	Miscompare	Y

Additional sense code and qualifier

Bytes		Description	Supported
12	13		
00	00	No additional information	Y
01	00	No index/sector signal	Y
02	00	No seek complete	Y
03	00	Write fault	Y
04	00	Drive not ready, no additional information	Y
04	01	Drive not ready, in spin-up mode	Y
04	02	Drive not ready, waiting for initialization command	Y
04	03	Drive not ready, human intervention required	Y
04	04	Drive not ready, format in process	Y
05	00	No drive response when selected	N
06	00	Track 0 not found	N
07	00	More than one drive selected	N
08	00	Drive communication failure	N
08	01	Drive communication timeout	N
08	02	Drive communication parity error	N
09	00	Track following error	Y
09	04	Head select fault	N
0A	00	Error log overrun	N
0C	00	Write error	N
0C	01	Write error recovered by autoreallocation	N
0C	02	Write error, autoreallocation failed	Y
10	00	ID CRC error	N
11	00	Unrecovered read error	Y
11	01	Read retries exhausted	N
11	02	Error too long to correct	N
11	04	Unrecoverable read error, autoreallocation failed	N

Sense key		Description	Supported
12	00	No address mark in ID field	N
13	00	No address mark in data field	N
14	00	Sector not found	Y
14	01	No record found	N
15	00	Seek positioning error	Y
15	01	Mechanical positioning error	N
15	02	Positioning error determined by reading media	N
16	00	Data synchronization mark error	Y
17	00	Data recovered without ECC or retries	Y
17	01	Data recovered with retries	N
17	02	Data recovered with positive head offset	N
17	03	Data recovered with negative head offset	N
17	05	Data recovered with previous sector ID	N
17	06	Data recovered without ECC	N
18	00	Data recovered with ECC	N
18	01	Data recovered with ECC and retries	N
18	02	Data recovered with ECC, retries, and autoreallocation	N
19	00	Error in defect list	Y
19	01	Defect list not available	N
19	02	Error in P-list	N
19	03	Error in G-list	N
1A	00	Parameter overrun	Y
1B	00	Synchronous transfer error	N
1C	00	Defect list not found	Y
1C	01	P-list not found	N
1C	02	G-list not found	N
1D	00	Compare error with verify	Y
1E	00	Recovered ID error	N
20	00	Drive received invalid operation code	Y
21	00	LDA out of range	Y
24	00	CDB with invalid bit	Y
25	00	CDB with invalid LUN	Y
26	00	CDB with invalid field	Y
26	01	CDB with unsupported parameter	N
26	02	CDB with invalid parameter	N
26	03	CDB with unsupported threshold parameter	N
27	00	Write protected	Y
29	00	Power-on or pin 40 bus reset occurred	Y
2A	00	Parameters changed by another initiator	N
2A	01	Mode select parameters changed by another initiator	Y
2A	02	Log parameters changed	Y
2F	00	Tagged commands cleared by another initiator	Y
31	00	Format command failed	Y
32	00	Defect locations not available	Y

Sense key		Description	Supported
37	00	Rounded parameter error	N
39	00	Saved parameters not supported	Y
3D	00	Identify message with invalid bits	N
3F	00	Target operation command changed	N
3F	01	Microcode changed	Y
3F	02	SCSI-1/SCSI-2 change	N
40	00	Target operating conditions have changed	Y
40	01	DRAM parity error detected	Y
40	93	Error in write to flash	Y
42	00	Power on or self test error	N
43	00	Message reject error	Y
44	00	Internal controller error	N
45	00	Selection or reselection error	N
47	00	Bus parity error	Y
48	00	Initiator detected error	Y
49	00	Initiator received invalid message from drive	Y
4E	00	Drive attempted overlapped commands	Y
5B	00	Log exception—factory option	N
5B	01	Threshold condition met—factory option	Y
5B	02	Log counter reached maximum value—factory option	N
5B	03	Log list codes all used—factory option	N
5C	00	RPL status change, drive lost synchronization	N
80	00	General firmware error qualifier	N

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