Seagate

Barracuda 9 Disc Drive

ST19171N/W/WD/WC/DC

Product Manual, Volume 1

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Product Manual, Volume 1

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Rev. C	06/26/97	D. Ashby/G. Olson	9, 10, 16, 18, 23, 24, 33, 34, 49, 50, 53, and 61.

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

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1.0 Scope

This manual describes Seagate Technology®, Inc. Barracuda 9™ disc drives.

Barracuda 9 drives support the small computer system interface (SCSI) as described in the ANSI SCSI, SCSI-2, and SCSI-3 (Fast-20) 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 Barracuda 9 models is referred to as “the drive” (unless references to individual models are necessary).

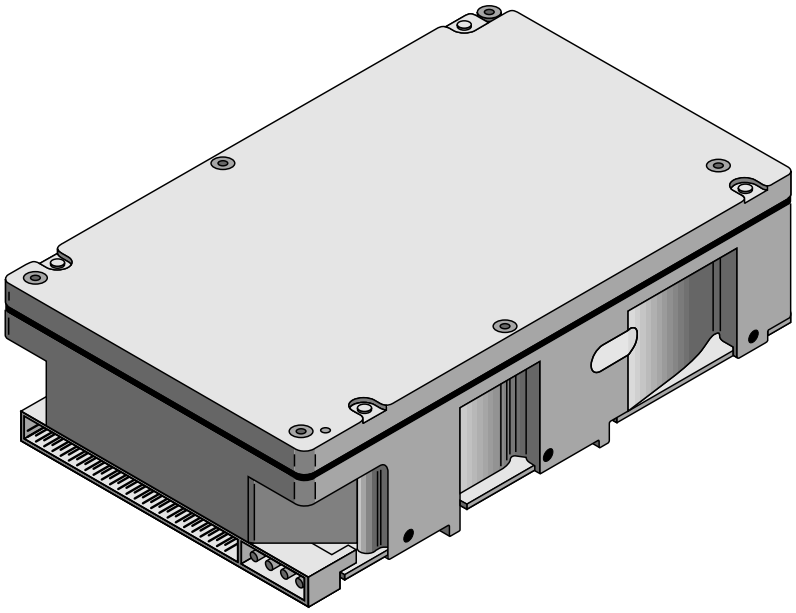


Figure 1. Barracuda 9 disc drive (ST19171N drive shown)

2.0 Applicable standards and reference documentation

The drive is a system peripheral developed to the highest standards of design and construction. The drive depends on its host equipment to provide adequate power and environment to achieve optimum performance and compliance with applicable industry and government regulations. Special attention must be given in the areas of safety, power distribution, shielding, audible noise control, and temperature regulation. Also, the drive must be securely mounted to guarantee the specified performance characteristics. If you mount the drive using the bottom holes, ensure that you meet the requirements provided in Section 8.4.

2.1 Standards

The Barracuda 9 family complies with Seagate standards as noted in the appropriate sections of this manual and the Seagate *SCSI Interface Product Manual* (volume 2), part number 77738479.

The Barracuda 9 disc drive is a UL recognized component 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 physical design characteristics of the drive serve to minimize radiation when installed in an enclosure that provides reasonable shielding. As such, the drive is capable of meeting the Class B limits of the FCC Rules and Regulations of the Canadian Department of Communication 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 both 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 2, 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

Barracuda 9 Installation Guide Seagate part number: 83329020

SCSI Interface Product Manual (Volume 2) Seagate part number: 77738479

ANSI small computer system interface (SCSI) document numbers:

X3.131-1994	SCSI-2
X3T10/855D rev. 15a	SPI
X3T10/1071D rev. 6	Fast-20 (also called "Ultra SCSI")

SFF-8046 Specification for 80-pin SCA connector for SCSI disk drives

Performance testing of shipping containers and systems: Seagate P/N 30190-001 (under 100 lb.) and Seagate P/N 30191-001 (over 100 lb.)

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

3.0 General description

Barracuda 9 drives combine magnetoresistive (MR) heads, partial response/maximum likelihood (PRML) read channel electronics, embedded servo technology, and a SCSI-3 (Fast-20) interface to provide high performance, high capacity data storage for a variety of systems including engineering workstations, network servers, mainframes, and supercomputers.

Fast-20 (also known as Ultra SCSI) is a negotiated transfer rate. This transfer rate will occur only if your host adapter also supports Fast-20 data transfer rates. This drive also operates at SCSI-1 and SCSI-2 data transfer rates for backward compatibility with non-Fast-20 capable SCSI host adapters.

Table 1 lists the features that differentiate the various Barracuda 9 SCSI-3 Fast-20 (Ultra SCSI) models.

Table 1: Drive model number vs. differentiating features

Model number	I/O circuit type	Number of I/O connector pins	Number of I/O data bus bits
ST19171N	single-ended	50	8 (fast)
ST19171W	single-ended	68	16 (fast/wide)
ST19171WD	differential	68	16 (fast/wide)
ST19171WC	single-ended	80	16 (fast/wide)
ST19171DC	differential	80	16 (fast/wide)

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 interface specifications to the extent described in this manual (volume 1), which defines the product performance characteristics of the Barracuda 9 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, self-configuring host software, and automatic features that relieve the host from the necessity of knowing the physical characteristics of the targets (logical block addressing is used).

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.

Barracuda 9 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.

Barracuda 9 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.

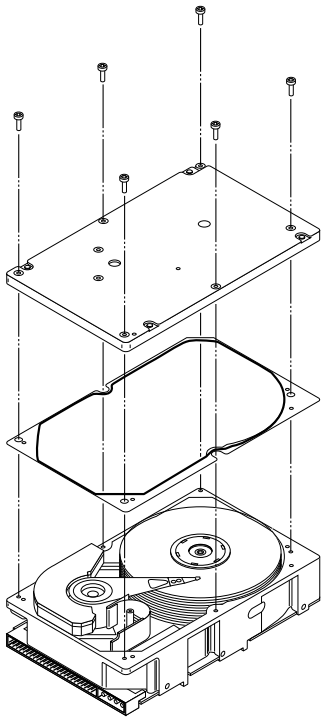


Figure 2. Barracuda 9 family drive

3.1 Standard features

Barracuda 9 drives have the following standard features:

- Integrated SCSI controller
- Single-ended or differential SCSI drivers and receivers
- 8-bit and 16-bit I/O data bus models available
- Asynchronous and synchronous data transfer protocols
- Firmware downloadable using a SCSI interface
- Programmable drive capacity
- Selectable sector size from 180 to 4,096 bytes per sector
- Flawed sector reallocation using sector slipping at format time
- Programmable sector reallocation scheme
- Programmable auto write and read reallocation
- Reallocation of defects on command (post format)
- 128-bit Reed-Solomon error-correction code for header and data fields
- Sealed head and disc assembly (HDA)
- 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
- Zone bit recording (ZBR)
- Vertical, horizontal, or top-down mounting
- Dynamic spindle brake
- Active IC terminators enabled by jumper (“N” and “W” models only)
- 512 Kbyte data buffer (2 Mbyte data buffer available as an option). See Section 4.5
- Hot plug compatibility (Section 9.6.4.3 lists proper host connector needed) for “WC” and “DC” model drives
- SCAM (SCSI Configured Auto Magically) Plug-n-Play Level 2 compliant
- Low audible noise for office environment
- Low power consumption

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”) [1]
- Programmable multi-segmentable cache buffer
- 7,200 RPM spindle; average latency = 4.17 msec
- Command queuing of up to 64 commands
- Background processing of queue
- Supports start and stop commands (spindle stops spinning)

Note.

[1] Some host adapter companies support the term “Fast-20 SCSI.”

3.4 Reliability

- 1,000,000 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.)
- Incorporates Seek To Improve Reliability algorithm (STIR)
- Dithering algorithm
- 5-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 standard OEM model capacities:

	Formatted [1]	**Unformatted**
ST19171	9.1 Gbytes [2]	11.7 Gbytes

Notes.

[1] Standard OEM models are formatted to have 512-byte sectors. Sector size selectable at format time. Users having the necessary equipment may modify the data block size before issuing a format command and obtain different formatted capacities than those listed. User available capacity depends on spare reallocation scheme selected. See Mode Select Command and Format Command in the *SCSI Interface Product Manual*, part number 77738479.

[2] The number of data tracks per sparing zone and the number of alternate sectors (LBAs) per sparing zone can be determined by using the Mode Sense command and reading Mode page 03h.

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, number of blocks field. A value of zero in the number of blocks field indicates that the drive shall not change the capacity it is currently formatted to have. A number in the number of blocks field that is less than the maximum number of LBAs changes the total drive capacity to the value in the block descriptor number of blocks field. A value greater than the maximum number of LBAs is rounded down to the maximum capacity.

3.7 Factory installed accessories

The *Barracuda 9 Installation Guide*, part number 83329020, is shipped with each standard OEM drive (unless otherwise specified). A small bag of jumpers are also shipped with the drive. Use these jumpers to configure the option headers (J2 and J6).

3.8 Options (factory installed)

All options that a customer may request 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 other sparing schemes and sector sizes.
- 2 Mbyte data buffer.
- 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.
- The *Barracuda 9 Installation Guide*, part number 83329020, is usually included with each standard OEM drive. Additional copies may be ordered.

3.9 Accessories (user installed)

The following accessories are available. Qualified individuals can install these accessories in the field.

- Front panel kit (with green rectangular LED lens), part number 73501451.
- Single-unit shipping pack.
- *Barracuda 9 Installation Guide*, part number 83329020.

4.0 Performance characteristics

4.1 Internal drive characteristics (transparent to user)

	ST19171
Drive capacity	11.7 Gbyte (unformatted) [1]
Read/write heads	20
Bytes/track	102,000 Bytes (average, unformatted) [1]
Bytes/surface	585 Mbytes (unformatted)
Tracks/surface, total	5,274 Tracks (user accessible)
Tracks/inch	5,555 TPI
Bits/inch, minimum	91,500 BPI
Bits/inch, maximum	124,500 BPI
Internal data rate	80-124 Mbits/sec (variable with zone)
Disc rotational speed	7,200 ± 0.5% r/min
Average rotational latency	4.17 msec

[1] Rounded off values

4.2 SCSI seek performance characteristics (visible to user)

The values given in Section 4.2.1 apply to all Barracuda 9 models unless otherwise specified. Refer to Section 9.10 and to the *SCSI Interface Product Manual* (part number 77738479) for additional timing details.

4.2.1 Access time [7]

			Including controller overhead (without disconnect) [2] [3]	
			Drive level	
			Read	Write
			msec	
Average	Typical	[2]	9.7	10.7
Single track	Typical	[2]	0.8	1.4
Full stroke	Typical	[2]	19.2	20.2

4.2.2 Format command execution time

Maximum (with verify)	≤3 hours
Maximum (no verify)	≤2 hours

4.2.3 General performance characteristics

Minimum sector interleave 1 to 1

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

Minimum	[3]	10 Mbytes/sec
Average	[3]	13.5 Mbytes/sec
Maximum	[3]	15.5 Mbytes/sec

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

Minimum	[3]	7.8 Mbytes/sec divided by (interleave factor)
Average	[3]	10.5 Mbytes/sec divided by (interleave factor)
Maximum	[3]	12.2 Mbytes/sec divided by (interleave factor)

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

SCSI interface data transfer rate (asynchronous) [4]:	
Maximum instantaneous	5.0 Mbytes/sec [5]
Maximum average	10.0 Mbytes/sec [6]
Synchronous transfer rate for SCSI Fast-20 (Ultra SCSI) (8 bit data bus models)	2.5 to 20 Mbytes/sec
Synchronous transfer rate for SCSI Fast-20 (Ultra SCSI) (16 bit data bus models)	5.0 to 40 Mbytes/sec
Synchronous transfer rate for fast SCSI-2 (8 bit data bus models)	1.25 to 10 Mbytes/sec
Synchronous transfer rate for fast SCSI-2 (16 bit data bus models)	2.5 to 20 Mbytes/sec
Sector sizes:	
Default	512-byte data blocks
Variable in even-sector sizes	180 to 4,096 bytes per sector
Read/write consecutive sectors on a track	Yes
Flaw reallocation performance impact (for flaws reallocated at format time using the spare tracks per volume reallocation scheme)	35 msec (typical)
Overhead time for head switch (512-byte sectors) in sequential mode	0.8 msec
Overhead time for one track cylinder switch in sequential mode	1.2 msec (typical)
Average rotational latency	4.17 msec

Notes for Sections 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] Typical access times are measured under nominal conditions of temperature, voltage, and horizontal orientation as measured on a representative sample of drives. These access times do not include average rotational latency time.
[3] Assumes no errors and no sector reallocations.
[4] Rate measured from the start of the first sector transfer to or from the host.
[5] Assumes system ability to support the rates listed 1 byte wide and no cable loss.
[6] Assumes system ability to support the rates listed 2 bytes wide and no cable loss.
[7] Access time = controller overhead + average seek time.
Access data time = controller overhead + average seek time + latency.

4.3 Start/stop time

Disabling the Motor Start option causes the drive to become ready within 30 seconds after DC power is applied at nominal voltage. This means the motor starts as soon as power is applied. If a recoverable error condition is detected during the start sequence, the drive will execute a recovery procedure and may cause the time to become ready to be as much as 60 seconds. During this time the drive responds to some commands over the SCSI interface. Stop time is less than 30 seconds (maximum) from removal of DC power.

Enabling the Motor Start option causes the internal controller to accept the commands listed in the *SCSI Interface Product Manual* (77738479) less than 3 seconds after applying DC power. After receiving the Motor Start command, the drive becomes ready for normal operations within 30 seconds (excluding an error recovery procedure). The Motor Start command can also be used to command the drive to stop the spindle in less than 30 seconds (see the Start/Stop command information in the *SCSI Interface Product Manual).*

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*). 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 Table 9.

4.5 Cache operation

Of the 512 Kbytes physical buffer space, approximately 442 Kbytes can be used as a cache. If you have the 2,048 Kbyte buffer space option, approximately 1,915 Kbytes can be used as a cache. The cache can be divided into logical segments (Mode Select page 08h, byte 13) from which data is read and to which data is written.

The drive keeps track of the logical block addresses of the data stored in each segment of the cache. If the cache is enabled (see RCD bit = 0 in Mode page 08h, byte 2, bit 0 in the *SCSI Interface Product Manual),* data requested by the host with a read command is retrieved from the cache, if possible, 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*.

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

Case A - Read command is received and the first logical block is already in the cache.

1. Drive transfers to the initiator the first logical block requested plus all subsequent contiguous logical blocks that are already in the cache. This data may be in multiple segments.
2. When a requested logical block is reached that is not in any segment, the drive fetches it and any remaining requested logical block addresses from the disc and puts them in a segment of the cache. The drive transfers the remaining requested logical blocks from the cache to the initiator in accordance with the “buffer-full” ratio specification given in Mode Select Disconnect/Reconnect parameters, page 02h (see the *SCSI Interface Product Manual).*
3. The drive prefetches additional logical blocks contiguous to those transferred in step 2 above and stores them in the segment. The drive stops filling the segment when the maximum prefetch value has been transferred (see the *SCSI Interface Product Manual).*

Case B - Read command is received and the first logical block address requested is not in any segment of the cache.

1. The drive fetches the requested logical blocks from the disc and transfers them into a segment, then from there to the initiator in accordance with the “buffer-full” ratio specification given in Mode Select Disconnect/ Reconnect parameters, page 02h (see the *SCSI Interface Product Manual)*.
2. The drive prefetches additional logical blocks contiguous to those transferred in Case A, step 2 above and stores them in the segment. The drive stops filling the segment when the maximum prefetch value has been transferred.

During a prefetch, the drive crosses a cylinder boundary to fetch data only if the Discontinuity (DISC) bit is set to 1 in bit 4 of byte 2 of the Mode Select parameters page 08h. Default is zero for bit 4 (see the *SCSI Interface Product Manual).*

Each buffer segment is actually a self-contained circular storage (wrap-around occurs), the length of which is an integer number of disc medium sectors. The wrap-around capability of the individual segments greatly enhances the buffer’s overall performance as a cache storage, allowing a wide range of user selectable configurations, which includes their use in the prefetch operation (if enabled), even when cache operation is disabled (see Section 4.5.2). The number of segments may be selected using the Mode Select command, but the size cannot be directly selected. Size is selected only as a by-product of selecting the segment number specification. The size in Kbytes of each segment is not reported by the Mode Sense command page 08h, bytes 14 and 15. These bytes read 0xFFFF, regardless of the number of segments setting. If a size specification is sent by the host in a Mode Select command (bytes 14 and 15) no new segment size is set up by the drive, and if the “STRICT” bit in Mode page 00h (byte 2, bit 1) is set to one, the drive responds as it does for any attempt to change unchangeable parameters (see *SCSI Interface Product Manual).* The drive supports operation of any integer number of segments from 1 to 16. Divide the 434,080 bytes in the buffer (or 1,915,392 bytes if you have the 2,048 kbyte buffer option) by the number of segments to calculate the segment size. The default is three segments.

4.5.1 Caching write data

When the WCE (Write Cache Enable) bit is enabled, the drive uses a drive buffer storage area where the data to be written to the drive is stored in one or more segments while the drive performs the Write command. The write cache uses the same buffer space and segmentation as the read cache. 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.

If a 10-byte CDB write command (2Ah) is issued with the DPO (Data Page Out) bit set to one, no write data is cached but the cache segments are still checked and cleared (if needed) for any logical blocks that are being written.

When a write command is issued, the cache is first checked to see if any logical blocks that are to be written are already stored in the cache from a previous read or write command. If there are, the respective cache segments are cleared. The new data is cached for subsequent read commands.

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

Table 9 shows Mode default settings for the drives.

Note. The WCE bit is disabled by default on OEM drives. To enable the WCE bit, change Mode Sense Page 08h, byte 2, bit 2 to a value of 1.

4.5.2 Prefetch operation

If the Prefetch feature is enabled, data in contiguous logical blocks on the disc immediately beyond that which was requested by a read command can be retrieved and stored in the buffer for immediate transfer from the buffer to the host on subsequent read commands that request those logical blocks (this is true even if “cache” operation is disabled). Though the prefetch operation uses the buffer as a “cache,” finding the requested data in the buffer is a prefetch “hit,” not a “cache” operation “hit.” Prefetch is enabled using Mode Select page 08h, byte 12, bit 5 (Disable Read Ahead - DRA bit). DRA bit = 0 enables prefetch. Since data that is prefetched

replaces data already in some buffer segment(s), the host can limit the amount of prefetch data to optimize system performance. The max prefetch field (bytes 8 and 9) limits the amount of prefetch. The drive does not use the prefetch “ceiling” field (bytes 10 and 11).

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

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

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 10 errors in 10^{11} bits transferred (OEM default settings)
Unrecovered data	Less than 1 sector in 10^{14} bits transferred (OEM default settings)
Miscorrected data	Less than 1 sector in 10^{21} bits transferred
MTBF	1,000,000 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. Refer to Section 3.2, “Media Characteristics.”

5.1.1 Environmental interference

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

An unrecoverable error, or 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 should not be more than 1 recoverable seek error in 10^7 physical seek operations. After detecting an initial seek error, the drive automatically performs an error recovery process. If the error recovery process fails, a seek positioning error (15h) is reported with a Medium (3h) or Hardware error (4h) reported in the Sense Key. This is an unrecoverable seek error. Unrecoverable seek errors are classified as failures for MTBF calculations. Refer to Section 5.1.1.2 of *SCSI Interface Product Manual* (part number 77738479).

5.2 Reliability and service

You can enhance the reliability of Barracuda 9 disc drives by ensuring that the drive receives adequate cooling. Section 6.0 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 achieves an MTBF of 1,000,000 hours when operated in an environment that ensures that the case temperatures specified in column 2 of Table 3 (Section 6.4.1) are not exceeded. Short-term excursions up to the specification limits of the operating environment (given in Table 3, column 1) will not affect MTBF performance. Continual or sustained operation at case termperatures above the values shown in Table 3, column 2, may degrade product reliability.

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 drive shall have accumulated at least nine months of operation. Data shall calculate 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 has 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. To achieve the five-year 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. The 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 because users cannot purchase individual parts for the drive.

5.2.6 Hot plugging Barracuda 9 disc drives

Caution: Hot-plug drives are not designed for simultaneous power disconnection and physical removal.

During power-up and power-down periods, the hot SCSI connect/disconnect capability does not produce glitches or any corruptions on an active SCSI bus. Barracuda 9 drives conform to the SCSI-3 standard requirements for glitch-free power-on and power-off. The drive maintains the high-impedance state of the device connector contacts during a power cycle until the transceiver is enabled.

Note. The systems integrator must ensure that no temperature, energy, voltage hazard, or ESD potential is presented during the hot connect/disconnect operation.

Procedure:

1. Configure the drive with no connection between the drive and the TRMPWR signal on the SCSI bus. To accomplish this, remove all jumpers from connector J2 pins 1, 2, 3, and 4.
2. Ensure that all SCSI devices on the bus have receivers that conform to the SCSI-3 standard.
3. Eliminate all I/O processes for the drive.
4. Wait until the drive motor and discs have come to a complete stop prior to changing the plane of operation, ensuring data integrity.
5. Insert or remove the drive after meeting the following conditions:

Caution: Do not hot-plug the first or last device on the SCSI bus (the SCSI bus termination must be external to the drive you are inserting or removing).

   a. If you are inserting the drive, connect its power ground and logic ground at least 1 millisecond before coming into contact with the bus connector. Maintain these ground connections during and after connecting the device to the bus.

   b. If you are removing the device, maintain its power ground and logic ground connection for at least 1 millisecond after disconnecting the device from the bus.

   c. You may simultaneously switch the power to the electronics and mechanics of the drive with the bus contacts, if the power distribution system is able to maintain adequate power stability to other devices during the transition and if you have met the grounding requirements given in steps 5a and 5b.

   d. Ensure that the drive carrier discharges all static electricity prior to inserting the drive into the system.

Note. Do not remove or add terminator power or resistance to the SCSI bus while hot plugging a disc drive.

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 a drive failure and is designed to provide sufficient warning of a failure to allow data back-up before an actual failure occurs.

Note. The firmware will monitor specific attributes for degradation over time but cannot predict instantaneous drive failures.

Each 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 bit and the PERF bit of the “Informational Exceptions Control Mode Page” (1Ch). The DEXCPT bit is used to enable or disable the S.M.A.R.T. process. Setting the DEXCPT bit will disable all S.M.A.R.T. functions. When enabled, S.M.A.R.T. will collect on-line data as the drive performs normal read/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.

The process of measuring off-line attributes and saving data can be forced by the RTZ command. Forcing S.M.A.R.T. will reset the timer so that the next scheduled interrupt will be two hours.

The drive can be interrogated by the host to determine the time remaining before the next scheduled measurement and data logging process will occur. This is accomplished by a log sense command to log page 0x3E.

The purpose is to allow the customer to control when S.M.A.R.T. interruptions occur. As described above, forcing S.M.A.R.T by the RTZ command will reset the timer.

Performance impact

S.M.A.R.T. attribute data will be saved to the disc for the purpose of recreating the events that caused a predictive failure. The drive will measure and save parameters once every two hours subject to an idle period on the SCSI bus. The process of measuring off-line attribute data and saving data to the disc is uninterruptable and the maximum delay is summarized below:

Maximum processing delay

	On-line only delay DEXCPT = 0, PERF = 1	**Fully enabled delay DEXCPT = 0, PERF = 0**
S.M.A.R.T. delay times	60 milliseconds	450 milliseconds

Reporting control

Reporting is controlled in the “Informational Exceptions Control Page” (1Ch). Subject to the reporting method, the firmware will issue to the “host” an 01-5D00 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 error rate 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 rate, hence for each attribute the occurrence of an “error” is 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 simply 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 the interval. If the number of errors exceeds the threshold before the interval expires, then the error rate is considered to be unacceptable. If the number of errors does not exceed the threshold before the interval expires, then 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 whenever the error rate is unacceptable and decremented (not to exceed zero) whenever the error rate is acceptable. Should the counter continually be incremented 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 five years, Seagate warrants that each product (including components and subassemblies) or spare part that fails to function properly under normal use due to defect in materials on workmanship or due to nonconformance to the applicable specifications will be repaired or replaced, at Seagate’s option and at no charge to customer, if returned by customer at customer’s expense to Seagate’s designated facility in accordance with Seagate’s Warranty Procedure. Seagate will pay for transporting the repair or replacement item to customer. For more detailed warranty information, refer to the Standard Terms and Conditions of Purchase for Seagate products.

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.

6.0 Physical/electrical specifications

This section provides information relating to the physical and electrical characteristics of Barracuda 9 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's power connector. The power requirements for single-ended models includes the internal disc drive SCSI I/O termination. Current values are in Amperes.

Table 2: DC power requirements

	Notes	ST19171N/W/WC Single-ended		ST19171WD/DC Differential	
Voltage		+5 V [8]	+12 V	+5 V [8]	+12 V
Regulation	[5]	±5%	±5% [2]	±5%	±5% [2]
Maximum operating current DC3σ	[1]	0.93	0.89	1.17	0.89
Average idle current DC$\overline{X}$	[1] [9]	0.84	0.73	0.96	0.73
Maximum starting current (peak DC) DC3σ (peak AC) AC3σ	 [3] [6] [3]	 0.92	 2.18 3.1	 1.04	 2.18 3.1
Delayed motor start (max) DC3σ	[1] [4]	0.82	0.08	0.90	0.08
Peak operating current Typical DC$\overline{X}$ Maximum DC3σ Maximum (Peak) DC3σ	 [1] [7] [1]	 0.92 0.93 1.00	 0.84 0.89 1.8	 1.12 1.17 1.89	 0.84 0.89 1.8
Track following at OD DC$\overline{X}$ ID DC$\overline{X}$	 [1] [1]	 0.84 0.83	 0.73 0.76	 0.96 0.94	 0.73 0.76
Read Track OD DC3σ AC3σ	 [1] [11]	 0.96 1.10	 0.78 0.97	 1.49 1.99	 0.78 0.97
Seeking (Typical) DC$\overline{X}$ Maximum DC3σ Maximum (Peak) AC3σ	 [1] [10] [1]	0.91 0.92 0.96	1.06 1.1 1.8	0.99 1.05 1.77	1.06 1.1 1.8

[1] Measured with average reading DC ammeter. Instantaneous +12V 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 completed and that the drive is able to accept selection by the host initiator.

[3] See +12V current profile in Figure 3.

[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] At power-up, the motor current regulator limits the 12 volt current to an average value of less than 2.5 amperes, although instantaneous peaks may exceed this value. These peaks should measure 5 msec duration or less.

[7] Operating condition is defined as a third-stroke seek at OD and Read One track. A command is issued every 0.062 seconds.

[8] No terminator power. See Section 9.9.

[9] Track following at track 0.
[10] Seeking is defined as a third-stroke seek at OD. A command is issued every 20 msec.
[11] Read track is defined as repeat reads of track 15 with a duty cycle of 92% for narrow single-ended and 54% for wide differential.

General Notes from Table 2:

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

T0 - Power is applied to the drive.
T1 - Controller self-tests are performed.
T2 - Spindle begins to accelerate under current limiting after performing drive internal diagnostics. See Note 6 of Table 2.
T3 - The spindle is up to speed and the head-arm restraint is unlocked.

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

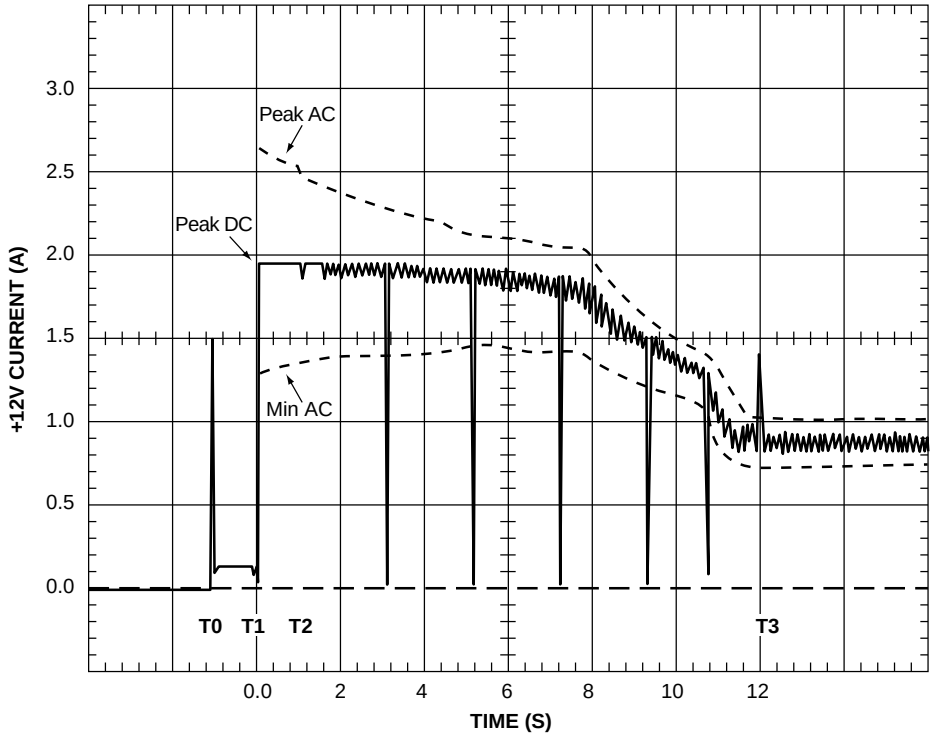


Figure 3. Typical Barracuda 9 drive +5 V and +12 V current profile

6.3 Power dissipation

ST19171N/W/WC

For drives with single-ended interface circuits, typical operating random read power dissipation is 14.7 watts (50 BTUs per hour) of DC power average at nominal voltages. Typical power dissipation under idle conditions is 13 watts (44 BTUs per hour).

ST19171WD/DC

For drives with differential interface circuits, typical operating random read power dissipation is 15.7 watts (54 BTUs per hour) of DC power average at nominal voltages. Typical power dissipation under idle conditions is 13.6 watts (47 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

With cooling designed to maintain the case temperatures of Table 3, column 2, the drive meets all specifications over a 41°F to 113°F (5°C to 50°C) drive ambient temperature range with a maximum 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 (Section 8.3 and 8.3.1). Operation at case temperatures above these values may adversely affect the drives ability to meet specifications.

The MTBF specification for the drive is based on operating at a local ambient temperature of 86°F (30°C). Occasional excursions to drive ambient temperatures of 122°F (50°C) or 41°F (5°C) may occur without impact to specified MTBF. To achieve the specified MTBF, the enclosure for the drive should be designed such that the temperature values of Table 3, column 2 are not exceeded. Air flow may be needed to achieve

these temperatures. See Section 8.3.1. Continual or sustained operation at case temperatures above these values may degrade MTBF.

To confirm that the required cooling for the Barracuda electronics and HDA is provided, place the drive in its final mechanical configuration, perform operations that represent typical drive usage and, after the temperatures stabilize, measure the case temperature of the components listed in Table 3 (see notes [2] and [3]).

To obtain the maximum temperature for each of the reference components listed (Column 1), 36°F (20°C) was added to the temperatures of Column 2. The maximum HDA case temperature is 140°F (60°C).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

Component	Figure 4a reference	Figure 4b reference	Column 1 Maximum case [4] temperature (°C) operating (50°C drive ambient) [2]	Column 2 Maximum allowable case [4] temperature (°C) to meet MTBF spec. [1]
OP Amp	1	1	149°F (66°C)	114°F (46°C)
SCSI Controller	2	2	182°F (83°C)	146°F (63°C)
Servo DSP	3		155°F (68°C)	119°F (48°C)
Servo/SCSI/RW		3	178°F (81°C)	142°F (61°C)
Motor Controller	4	4	178°F (81°C)	142°F (61°C)
HDA housing [3]			140°F (60°C)	113°F (45°C)

Notes.

[1] Section 8.3.1 describes the air-flow patterns used when generating the 1 million hours MTBF guidelines in column 2. Air flow was opposite that shown in Section 8.3.1. Local air velocity was 0.61 msec (120 lfpm). Inlet air temperature to the drive was 77°F (25°C), plus 9°F (5°C) temperature rise in the test enclosure (86°F/30°C ambient local to the drive).

[2] The temperatures in Column 1 are calculated and may not reflect actual operating values. Sufficient cooling air may be required to ensure that these values are not exceeded.

[3] Measure HDA temperature at point labeled “HDA Temp. Checkpoint” on Figures 4a and 4b.

[4] PCB mounted integrated circuit case.

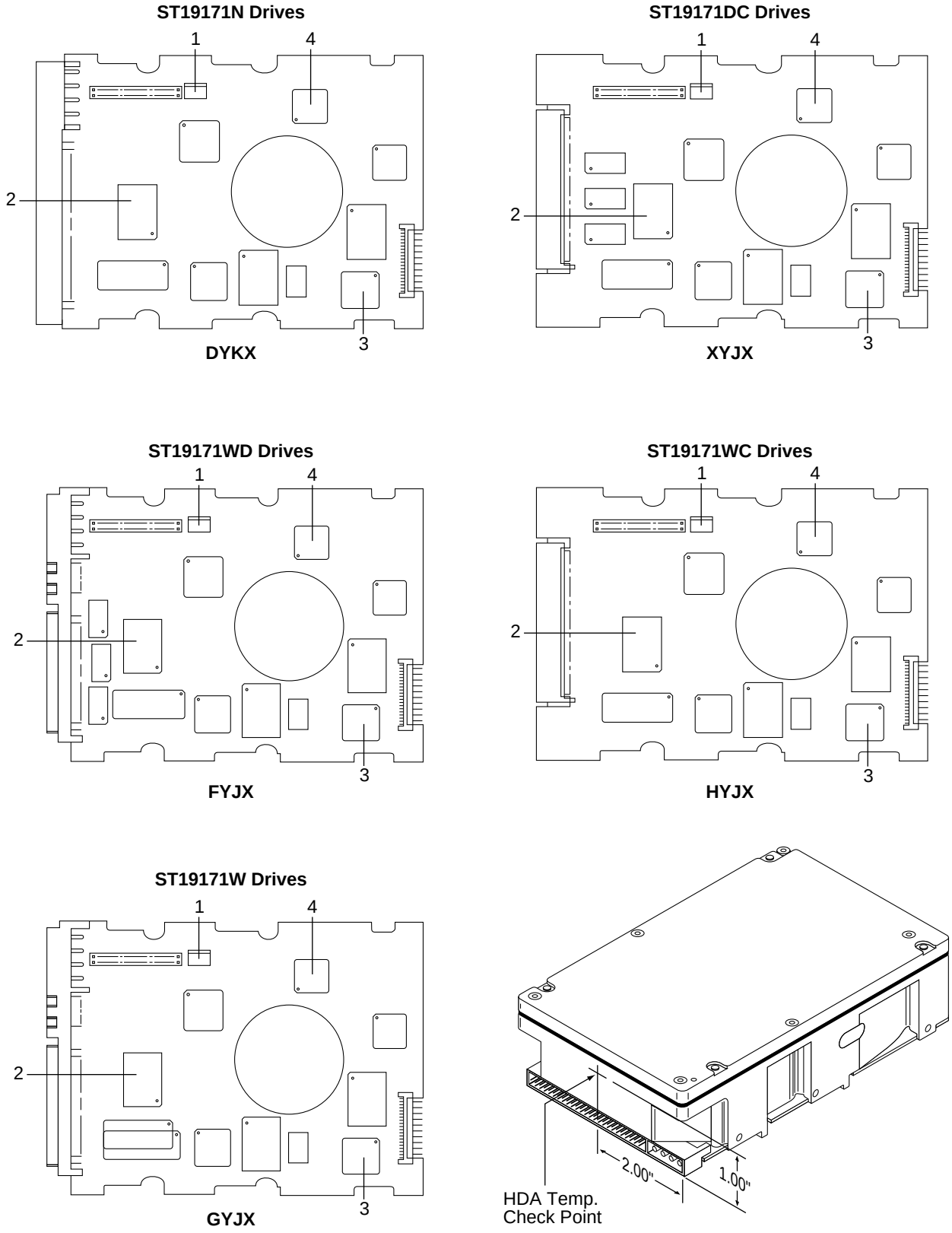


Figure 4a. Location of PCB components listed in Table 3

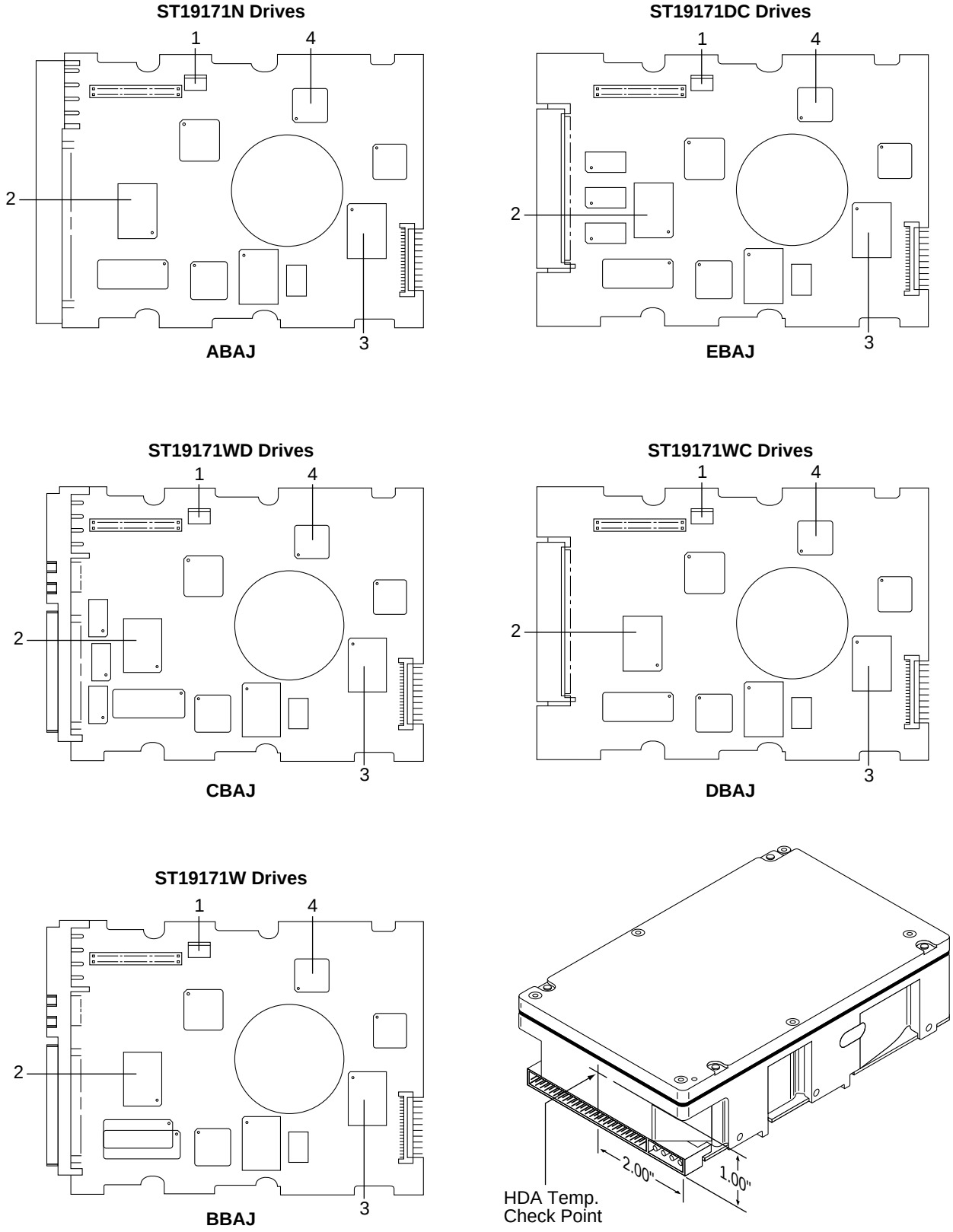


Figure 4b. Location of PCB components listed in Table 3

b. Non-operating

Non-operating temperature should remain between –40° to 158°F (–40° to 70°C) package ambient with a maximum gradient of 36°F (20°C) per hour. This assumes that the drive is packaged in the shipping container designed by Seagate.

6.4.2 Relative humidity

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

a. Operating

5% to 90% non-condensing relative humidity with a maximum gradient of 10% per hour.

b. Non-operating/transit

5% to 95% non-condensing relative humidity with a maximum gradient of 10% per hour.

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, will operate error-free while subjected to intermittent shock not exceeding 2.0 g at a maximum duration of 11 msec (half sinewave). Shock may be applied in the X, Y, or Z axis.

b. Operating—abnormal

Equipment, as installed for normal operation, does not incur physical damage while subjected to intermittent shock not exceeding 10 g at a maximum duration of 11 ms (half sinewave). Shock occurring at abnormal levels may promote degraded operational performance during the abnormal shock period. Specified operational performance will continue when normal operating shock levels resume. Shock may be applied in the X, Y, or Z axis. Shock is not to be repeated more than two times per second.

c. Non-operating

The limits of non-operating shock applies to all conditions of handling and transportation. This includes both isolated drives and integrated drives.

The drive subjected to non-repetitive shock not exceeding 50 g at a maximum duration of 11 msec (half sinewave) does not exhibit device damage or performance degradation. Shock may be applied in the X, Y, or Z axis.

The drive subjected to non-repetitive shock not exceeding 100 g at a maximum 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.

d. 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 (1,524 mm)
600-1,800 cu in (9,800-19,700 cu cm)	0-20 lb (0-9.1 kg)	48 in (1,219 mm)
>1,800 cu in (>19,700 cu cm)	0-20 lb (0-9.1 kg)	42 in (1,067 mm)
>600 cu in (>9,800 cu cm)	20-40 lb (9.1-18.1 kg)	36 in (914 mm)

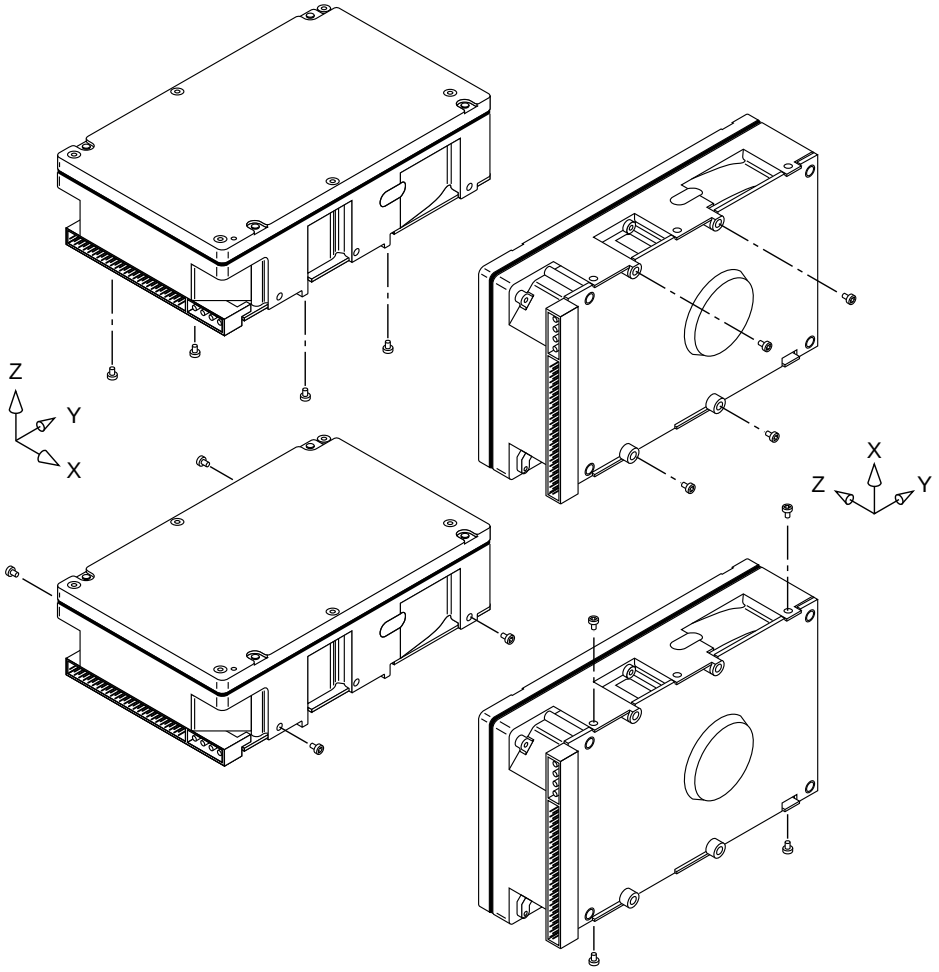


Figure 5. Recommended mounting

6.4.4.2 Vibration

a. Operating—normal

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

5–400 Hz @ 0.5 g (X, Y or Z axis)

b. Operating—abnormal

Equipment, as installed for normal operation, does not incur physical damage while subjected to periodic vibration not exceeding:

5-400 Hz @ 0.75 g (X, Y or Z axis)
15 minutes of duration at major resonant frequency

Vibration occurring at these levels may degrade operational performance during the abnormal vibration period. Specified operational performance will continue when normal operating vibration levels are resumed. This assumes system recovery routines are available.

c. Non-operating

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

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

5–22 Hz @ 0.040 inches (1.02 mm) displacement
22–400 Hz @ 2.00 Gs

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 4.6 bels typical when measured to ISO 7779 specification.

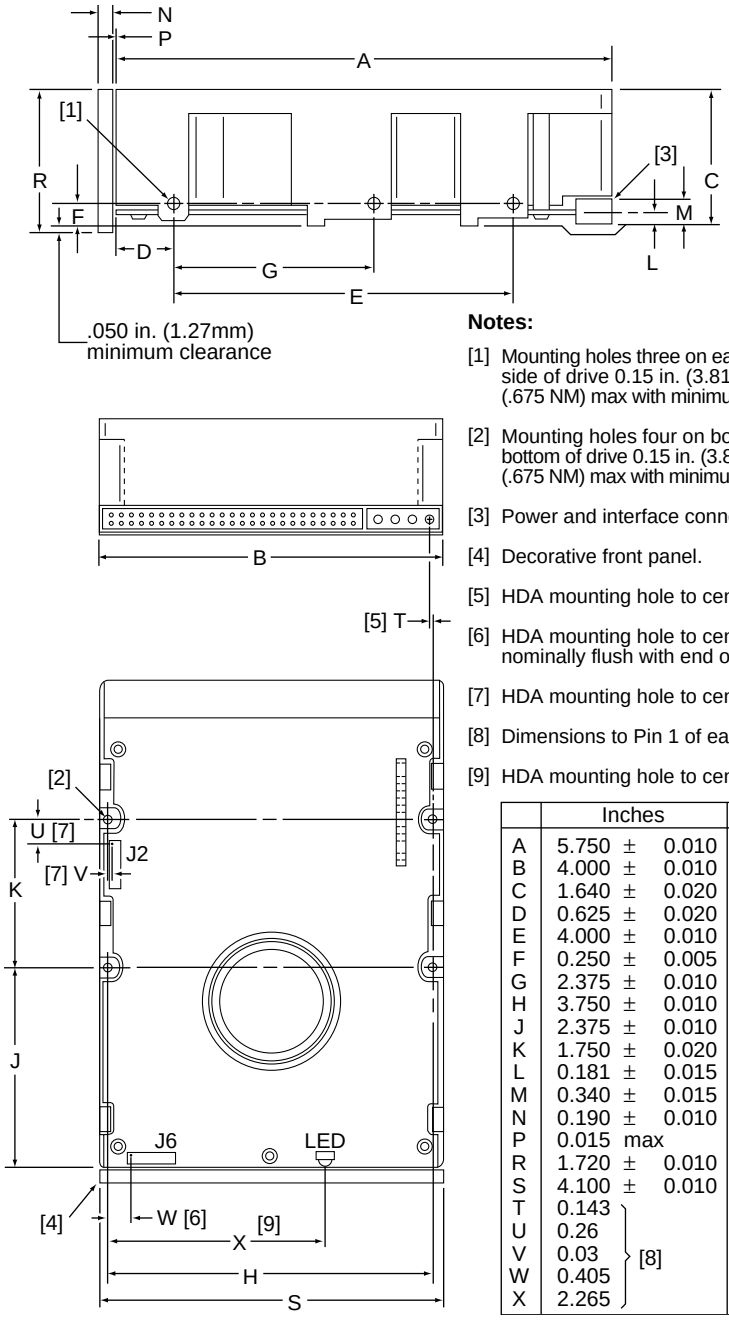
6.4.7 Electromagnetic susceptibility

See Section 2.1.

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 the figure below. Refer to Figures 6, 7, and 8 for detailed mounting configuration dimensions. See Section 8.4, “Drive mounting.”

	Typical		Maximum	
Height:	1.62 in	41.1 mm	1.654 in	42.0 mm
Width:	4.00 in	101.6 mm	4.01 in	101.9 mm
Depth:	5.75 in	146.05 mm	5.787 in	147 mm
Weight:	2.3 pounds	1.04 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 connections.

[4] Decorative front panel.

[5] HDA mounting hole to centerline of Pin 1 of power connector.

[6] HDA mounting hole to centerline of Pin 1 of J6. Pin ends on J6 are nominally flush with end of drive.

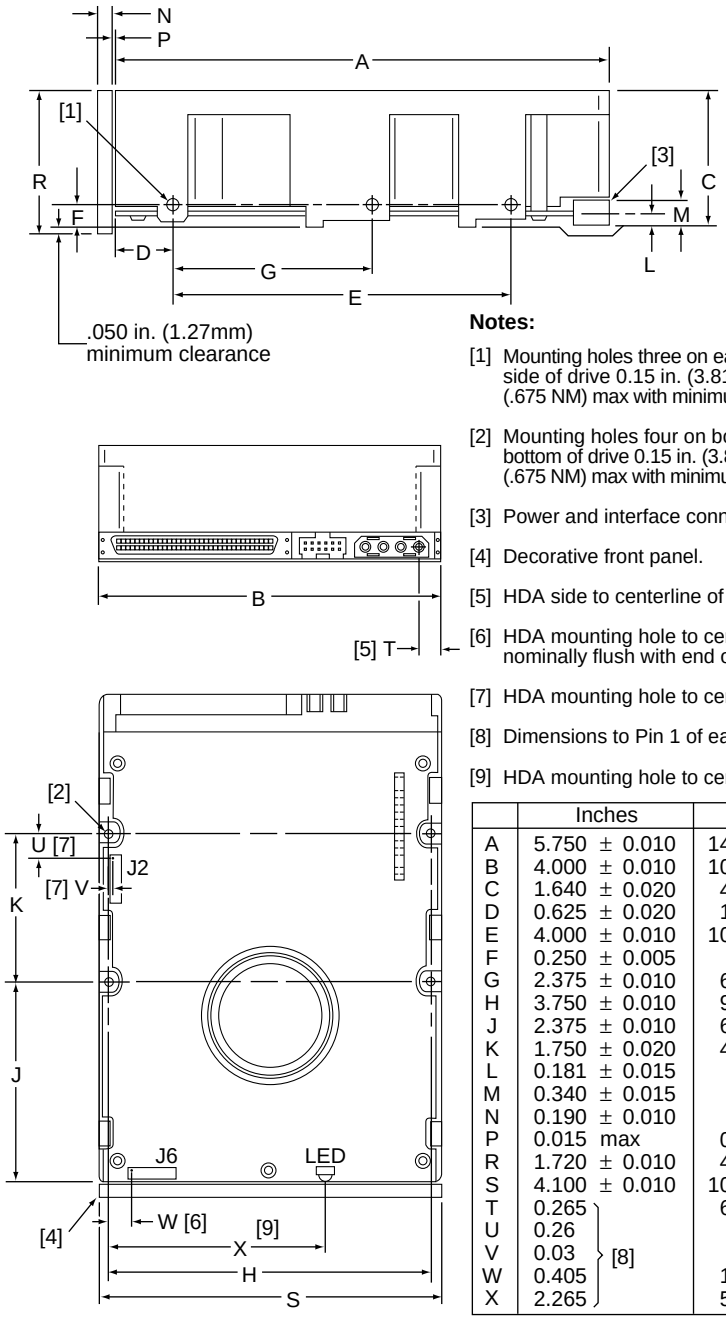
[7] HDA mounting hole to centerline of Pin 1 of J2.

[8] Dimensions to Pin 1 of each connector are nominal values.

[9] HDA mounting hole to centerline of LED lens.

	Inches	Millimeters
A	5.750 ± 0.010	146.05 ± .25
B	4.000 ± 0.010	101.60 ± .25
C	1.640 ± 0.020	41.66 ± .51
D	0.625 ± 0.020	15.87 ± .50
E	4.000 ± 0.010	101.60 ± .25
F	0.250 ± 0.005	6.35 ± .13
G	2.375 ± 0.010	60.32 ± .25
H	3.750 ± 0.010	95.25 ± .25
J	2.375 ± 0.010	60.32 ± .25
K	1.750 ± 0.020	44.45 ± .50
L	0.181 ± 0.015	4.60 ± .38
M	0.340 ± 0.015	8.64 ± .38
N	0.190 ± 0.010	4.83 ± .25
P	0.015 max	0.381 max
R	1.720 ± 0.010	43.69 ± .25
S	4.100 ± 0.010	104.14 ± .25
T	0.143	3.63
U	0.26	6.60
V	0.03 [8]	0.76 [8]
W	0.405	10.28
X	2.265	57.53

Figure 6. Mounting configuration dimensions for “N” models



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 connections.

[4] Decorative front panel.

[5] HDA side to centerline of Pin 1 of power connector.

[6] HDA mounting hole to centerline of Pin 1 of J6. Pin ends on J6 are nominally flush with end of drive.

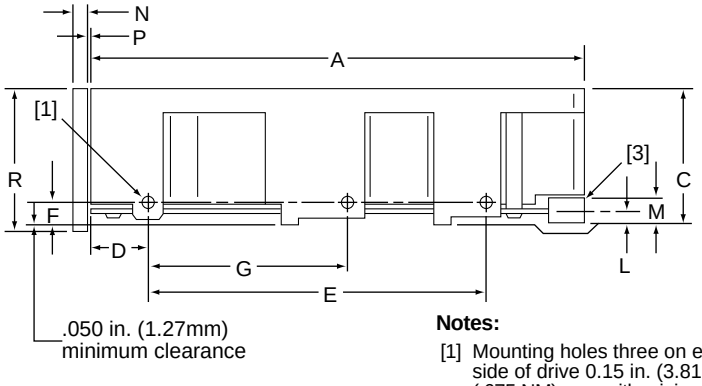
[7] HDA mounting hole to centerline of Pin 1 of J2.

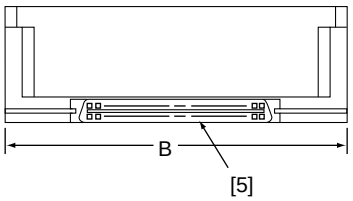
[8] Dimensions to Pin 1 of each connector are nominal values.

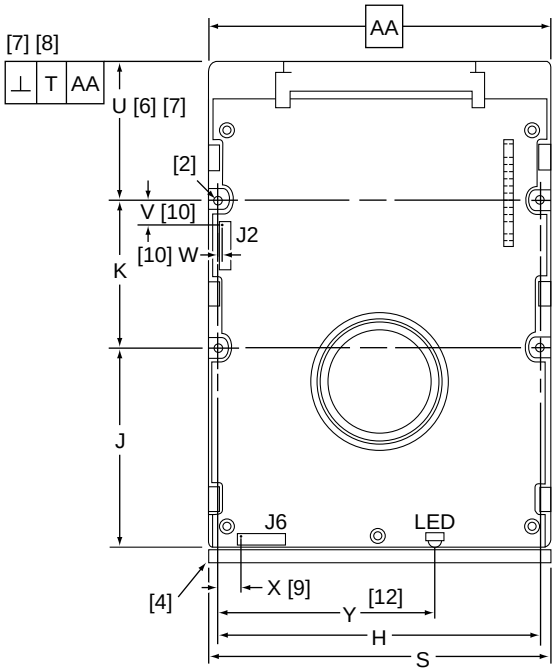
[9] HDA mounting hole to centerline of LED lens.

	Inches	Millimeters
A	5.750 ± 0.010	146.05 ± .25
B	4.000 ± 0.010	101.60 ± .25
C	1.640 ± 0.020	41.66 ± .51
D	0.625 ± 0.020	15.87 ± .50
E	4.000 ± 0.010	101.60 ± .25
F	0.250 ± 0.005	6.35 ± .13
G	2.375 ± 0.010	60.32 ± .25
H	3.750 ± 0.010	95.25 ± .25
J	2.375 ± 0.010	60.32 ± .25
K	1.750 ± 0.020	44.45 ± .50
L	0.181 ± 0.015	4.60 ± .38
M	0.340 ± 0.015	8.64 ± .38
N	0.190 ± 0.010	4.83 ± .25
P	0.015 max	0.381 max
R	1.720 ± 0.010	43.69 ± .25
S	4.100 ± 0.010	104.14 ± .25
T	0.265	6.731
U	0.26	6.60
V	0.03 [8]	0.76 [8]
W	0.405	10.28
X	2.265	57.53

Figure 7. Mounting configuration dimensions for “W” and “WD” models







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] Interface connector is flush with the end of drive within ±0.020 in. (.5 mm). The interface connector location may extend beyond HDA dimension "A" by 0.020 in. (.5 mm).

[4] Decorative front panel (optional).

[5] Connector J1 is centered (side to side) on drive within ±0.020 in. (.508 mm).

[6] Dimension "U" is from bottom rear drive mounting holes center(s) to the face of the connector at the center of the drive.

[7] Dimensions "T" and "U" are unique requirements for SCA drives only, required for conformance with latest ANSI SFF Spec #8337.

[8] Maximum connector non-perpendicularity to side planes pointed to by AA.

[9] HDA mounting hole to centerline of Pin 1 of J6. Pin ends on J6 are nominally flush with end of drive.

[10] HDA mounting hole to centerline of Pin 1 of J2. Dimensions indicated are for reference only.

[11] Dimensions to Pin 1 of each connector are nominal values.

[12] HDA mounting hole to centerline of LED lens.

	Inches	Millimeters
A	5.750 ± 0.010	146.05 ± .25
B	4.000 ± 0.010	101.60 ± .25
C	1.640 ± 0.020	41.66 ± .51
D	0.625 ± 0.020	15.87 ± .50
E	4.000 ± 0.010	101.60 ± .25
F	0.250 ± 0.005	6.35 ± .13
G	2.375 ± 0.010	60.32 ± .25
H	3.750 ± 0.010	95.25 ± .25
J	2.375 ± 0.010	60.32 ± .25
K	1.750 ± 0.020	44.45 ± .50
L	0.181 ± 0.015	4.60 ± .38
M	0.340 ± 0.015	8.64 ± .38
N	0.190 ± 0.010	4.83 ± .25
P	0.015 max	0.381 max
R	1.720 ± 0.010	43.69 ± .25
S	4.100 ± 0.010	104.14 ± .25
T	0.15	0.38
U	1.62 ± 0.02	41.15 ± .50
V	0.26	6.60
W	0.03	0.76
X	0.405 [11]	10.28 [11]
Y	2.265	57.53

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

7.0 Defect and error management

The drive, as delivered, complies with this product manual. The read error rate and specified storage capacities are not dependent on using 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

During the initial drive format operation at the factory, media defects are identified, tagged as being unusable, and their locations recorded on the drive primary defects list (referred to as the “P” list and also as the EFT defect list). At factory format time, these known defects are also reallocated, that is, reassigned to a new place on the medium and the location listed in the defects reallocation table. The “P” list is not altered after factory formatting. Locations of defects found and reallocated during error recovery procedures after drive shipment are listed in the “G” list (defects growth list). The “P” and “G” lists may be referenced by the initiator using the Read Defect Data command (see Section 5.2.1.2 in the *SCSI Interface Product Manual,* part number 77738479).

7.2 Drive error recovery procedures

Whenever an error occurs during drive operation, the drive, if programmed to do so, performs error recovery procedures to attempt to recover the data. The error recovery procedures used depend on the options previously set up in the error recovery parameters mode page. Error recovery and defect management may involve the use of several SCSI commands, the details of which are described in the *SCSI Interface Product Manual.* The drive implements selectable error recovery time limits such as are required in video applications. For additional information on this, refer to Table 5.2.1-22 in the *SCSI Interface Product Manual* which describes the Mode Select/Mode Sense Error Recovery parameters.

The error recovery scheme supported by the drive provides a means to control the total error recovery time for the entire command in addition to controlling the recovery level for a single LBA. The total amount of time spent in error recovery for a command can be limited via the Recovery Time Limit bytes in the Error Recovery Mode Page. The total amount of time spent in error recovery for a single LBA can be limited via the Read Retry Count or Write Retry Count bytes in the Error Recovery Mode Page.

The drive firmware error recovery algorithms consist of 16 levels for read recoveries and 12 levels for writes. Each level may consist of multiple steps, where a step is defined as a recovery function involving a single re-read or re-write attempt. The maximum level used by the drive in LBA recovery is determined by the Read and Write Retry Counts.

Table 4 equates the Read and Write Retry Count with the maximum possible recovery time for read and write recovery of individual LBAs. The times given do not include time taken to perform reallocations, if reallocations are performed. Reallocations are performed when the ARRE bit (for reads) or AWRE bit (for writes) is one, the RC bit is zero, and the Recovery Time Limit for the command has not yet been met. Time needed to perform reallocation is not counted against the Recovery Time Limit.

When the RC bit is one, reallocations are disabled even if the ARRE or AWRE bits are one. The drive will still perform data recovery actions within the limits defined by the Read Retry Count, Write Retry Count, and Recovery Time Limit parameters. However, the drive does not report any unrecovered errors.

Table 4: Read and write retry count maximum recovery times

Read retry count [1]	Maximum recovery time per LBA (cumulative, msec)
0	42
1	67
2	92
3	125
4	184
5	217
6	267
7	367
8	400
9	450
10	525
11	675
12	884
13	1384
14	2384
15	3384
16 (default)	3534

Write retry count [1]	Maximum recovery time per LBA (cumulative, msec)
0	42
1	67
2	92
3	142
4	175
5	184
6	217
7	267
8	342
9	442
10	942
11	1942
12 (default)	2942

[1] Setting these retry counts to a value below the default setting could result in degradation of the unrecovered error rate below the product specification.

For example, suppose the read/write recovery page has the RC bit = 0, the read retry count set to 4, and the recovery time limit set to 450. A 4-block read command can take up to 184 msec recovery time for each block and a maximum of 450 msec recovery for all 4 blocks. If either of these limits is reached and a block has not yet been recovered, the command will end with CHECK CONDITION status and an unrecoverable read error will be reported.

7.3 SCSI systems errors

Information on the reporting of operational errors or faults across the interface is given in the *SCSI Interface Product Manual,* part number 77738479. 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. 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 connectors J2 and J6 on the PCB (or J1-Auxiliary on the “W” and “WD” models), or via the drive to host I/O signals on “WC” and “DC” models. Some users connect cables to J6 or J1-Auxiliary and perform the set-up using remote switches.

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 do need to set the drive ID using the ID jumpers.

Configure drive options

For option jumper locations and definitions refer to Figures 9, 10, and 11. 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,” “WD,” and “DC” 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 10.0 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.
- Reformat the drive if a different spare sector allocation scheme is selected.
- 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 FAT32) or later do not need to partition the drive.

8.1 Drive ID/option select header

Figures 9, 10, and 11 show views of the drive ID select and option select jumper connectors. 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. Suggested part number for the jumpers used on J2 is Molex 52747-0211(Seagate P/N 70935865). A bag with the two jumper plug types is shipped with the standard OEM drives.

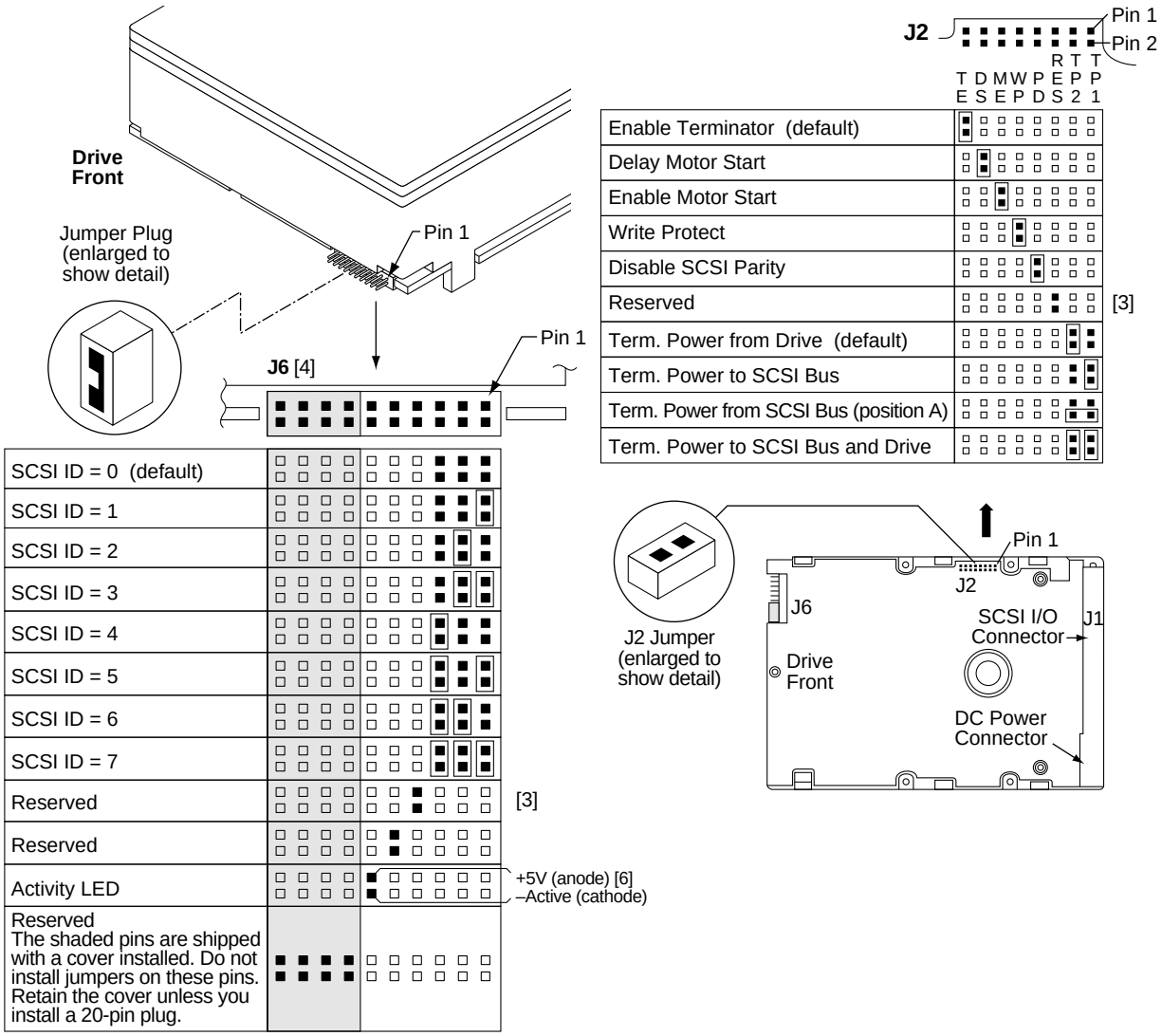


Figure 9. ST19171N option select jumper connectors

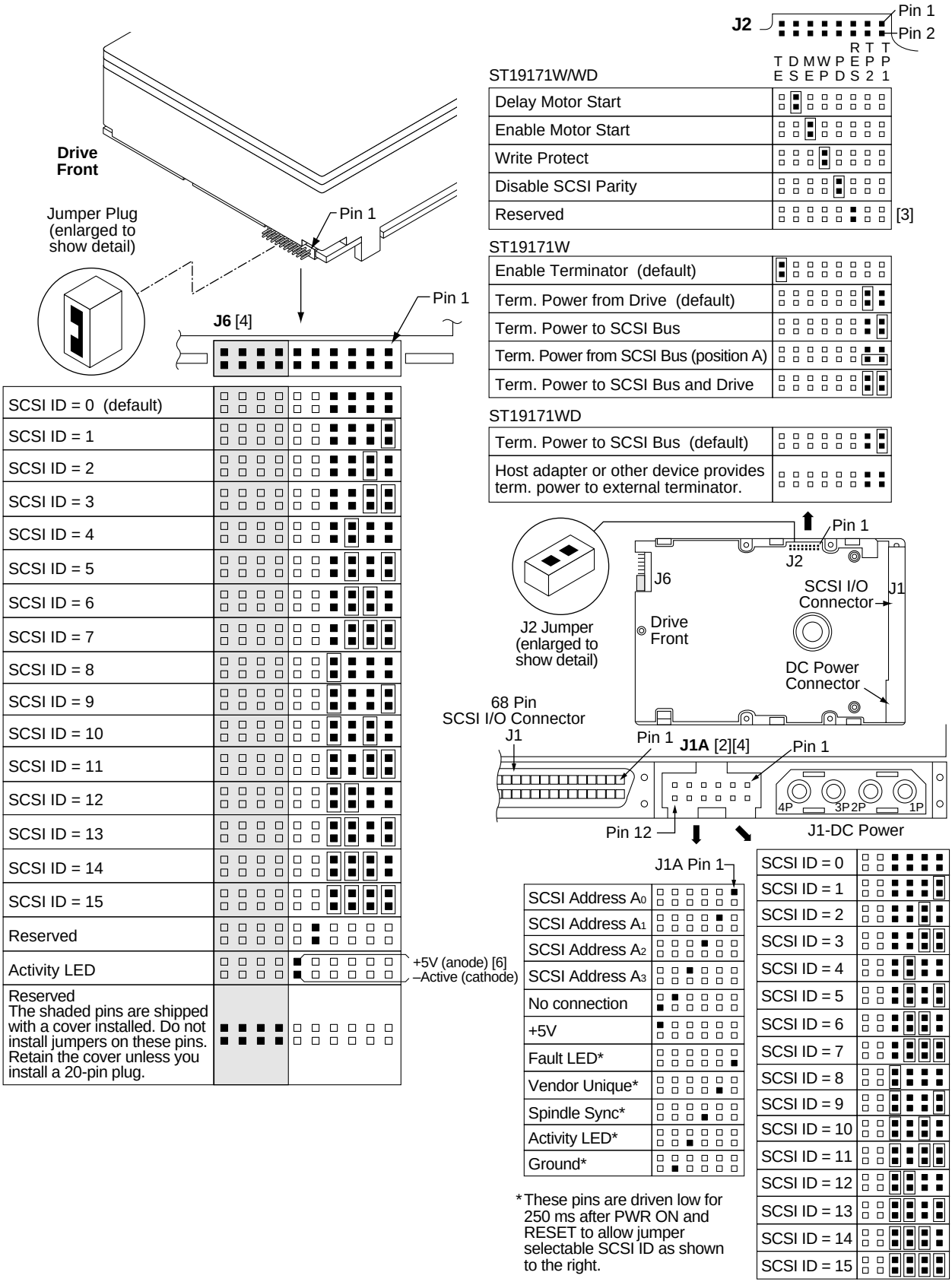


Figure 10. ST19171W/WD option select jumper connectors

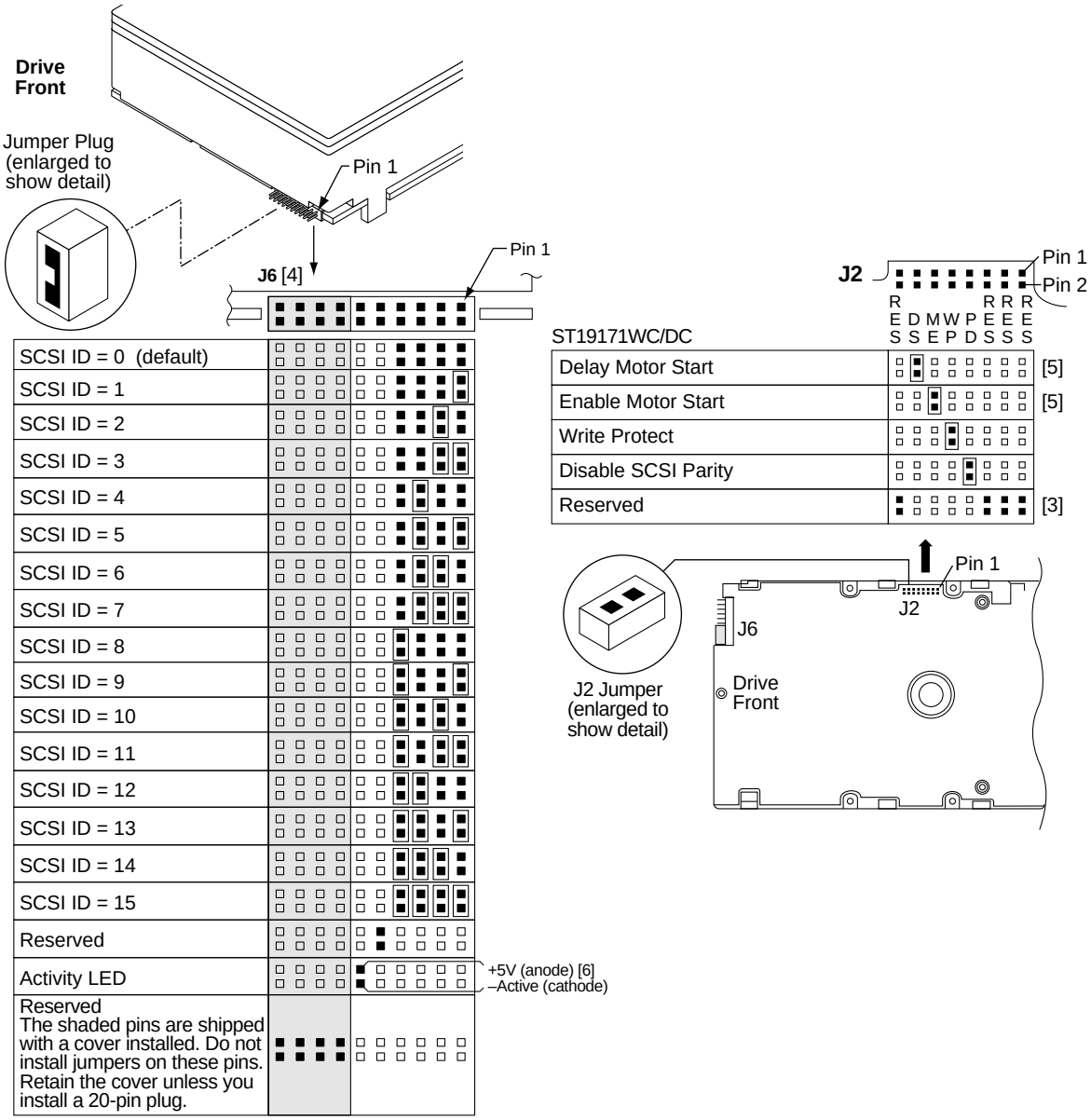


Figure 11. ST19171WC/DC option select jumper connectors

8.1.1 Notes for Figures 9, 10, and 11

[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 "DC" 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] below.

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

[4] Table 5 summarizes the configuration selection possibilities available on the different Barracuda 9 model drives.

[5] These signals are also on 80 pin J1. See Tables 16 and 17.

[6] Voltage supplied by the drive.

Table 5: 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 [c]	none		9
N	Option select			none	X	9
W, WD	Drive ID		X, Y	X, Y [e]		10 [a]
W, WD	Drive Activity LED		Y [c]	Y [c]		10 [a]
W, WD	Option select				X	10
WC, DC	Drive ID	Y[f]	X, Y	none		11 [d]
WC, DC	Drive Activity LED	Y[b][c]	Y [c]	none		11 [d]
WC, DC	Option select:					
	Delayed Mtr Start	Y[b]		none	X	11
	Enable Mtr Start	Y[b]		none	X	11
	Write Protect			none	X	11
	Parity Disable			none	X	11

("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 5 [ ]:

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

[b] 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 16 and 17.

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

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

[e] 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.

[f] The host selects drive ID through J1.

8.1.2 Function description

J2 Jumpers		Jumper Function Description
TE		**(Applies only to "N" and "W" models)**
On		On-board (non-removable) terminator circuits are enabled. (Default)
Off		On-board (non-removable) terminator circuits are disabled.
DS	**ME**	**(Applies to all models)**
Off	Off	Spindle starts immediately after power up. (Default)
Off	On	Spindle does not start until a Start Unit command is received from the host.
On	Off	Startup is delayed by SCSI ID times 12 seconds after power is applied. For example: Drive with SCSI ID of 0 starts the spindle immediately when DC power connected, drive with SCSI ID of 1 starts after a 12-second delay, drive with SCSI ID of 2 starts after 24-second delay, etc. Tolerance is plus 3 seconds, minus 0 seconds.
On	On	Spindle starts when the host sends a Start Unit command. Delayed start feature is over-ridden and does not apply when the **ME** jumper is installed.
WP		**(Applies to all models)**
On		Drive is write protected.
Off		Drive is not write protected. (Default)
PD		**(Applies to all models)**
On		SCSI parity checking and parity error reporting by the drive is disabled.
Off		Drive checks for parity and reports the results of parity checking to host. (Default)
RES		**(Applies to all models)**
Off		Reserved for spindle sync cabling. Pin 9 is the spindle sync reference. Pin 10 is spindle sync ground. Do not connect a jumper to these pins. (Default)
TP2	**TP1**	**(Applies only to "N," "W," and "WD" models)**
Off	Off	No terminator power is connected to the drive terminators or the SCSI bus I/O cable.*
On	Off	Drive supplies its own terminator power only. (Default)
Off	On	Drive supplies power to the SCSI bus I/O cable* but not to the internal terminators. When drives have differential I/O circuits (WD drives), 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 the SCSI bus I/O cable.*
TP2 and TP1 "Position A"		**(Applies only to "N," "W," and "WD" models)**
On		This horizontally-positioned jumper (across J2 pins 2 and 4) connects terminator power from SCSI bus I/O cable* to the drive's internal terminators (for single-ended I/O only). See Figures 9 and 10.
Off		See above explanations for **TP** jumpers.

*See Tables 13, 14, and 15 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

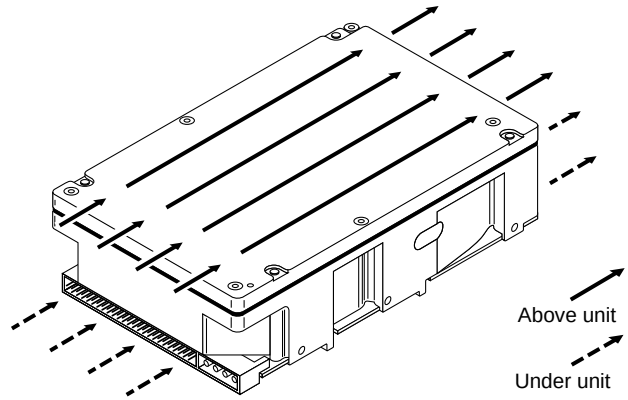
Cabinet cooling must ensure that the ambient temperature immediately surrounding the drive will not exceed temperature conditions specified in Section 6.4.1. Specific consideration should be given to make sure adequate air circulation is present around the printed circuit board (PCB) to meet the requirements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

8.3.1 Air flow

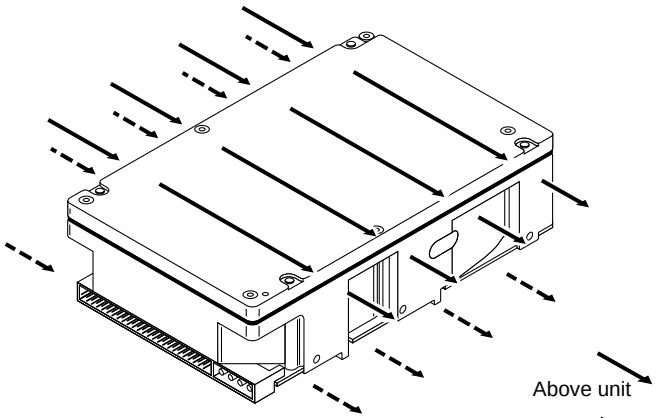
The rack, cabinet, or drawer environment for the drive must provide cooling of the electronics and head and disc assembly (HDA). You should confirm that adequate cooling is provided using the temperature measurement guidelines described below.

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

Possible air-flow patterns are shown in Figure 12. The air-flow patterns are created by one or more fans, either forcing or drawing air as shown in the illustrations. Other air-flow patterns are acceptable as long as the temperature measurement guidelines of Section 6.4.1 are met.



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



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

Figure 12. Suggested air flow

8.4 Drive mounting

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

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

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 (‘F’) is applied to the fourth point.

Note. Before mounting the drive in any kind of 3.5-inch to 5.26-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 you do not want the system chassis to be connected to the HDA/PCB ground, you 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 Barracuda 9 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 Barracuda 9 family drive's version of the SCSI implementation described in the *SCSI Interface Product Manual*.

9.2 SCSI interface messages supported

Table 6 lists the messages supported by the SCSI-2 and SCSI-3 modes of the Barracuda 9 family drives.

ASA II is Seagate's second generation of Advanced SCSI Architecture firmware.

Table 6: SCSI messages supported by Barracuda 9 family drives

Message Name	Message Code	Supported by ESP SCSI-2
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	Y
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	Y
Linked command complete with flag	0Bh	Y
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	Y
Terminate I/O process	11h	N
Wide data transfer request	[1] [2]	Y

Notes.

[1] Extended message (refer to the *SCSI Interface Product Manual*, part number 77738479).
[2] Not applicable to "N" models.

9.3 SCSI interface commands supported

Table 7 lists the SCSI interface commands that are supported in the SCSI-2 and SCSI-3 modes of the drive. OEM standard drives are shipped set to operate in SCSI-2/SCSI-3 mode. Barracuda family drives can be changed back and forth between SCSI-1, SCSI-2, and SCSI-3 modes using the Change Definition command.

Table 7: Commands supported by Barracuda 9 family drive

Command Name	Command Code	Supported by ESP SCSI-2/3
Change definition	40h	Y
Compare	39h	N
Copy	18h	N
Copy and verify	3Ah	N
Format unit [1]	04h	Y
Block format		N
Bytes from index		Y
Physical sector format		Y
DPRY bit supported		Y
DCRT bit supported		Y
STPF bit supported		Y
IP bit supported		Y
DSP bit supported		Y
IMMED bit supported		Y
VS (vendor specific) bit		N
Inquiry	12h	Y
Date code page (C1h)		Y
Device behavior page (C3h)		Y
Firmware numbers page (C0h)		Y
Implemented operating definitions page (81h)		Y
Jumper settings page (C2h)		Y
Supported vital product data pages (0h)		Y
Unit serial number page (80h)		Y
Lock-unlock cache	36h	N
Log select	4Ch	Y
DU bit		N
DS bit		Y
TSD bit		Y
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
S.M.A.R.T. status log page (2Fh)		N
S.M.A.R.T. attribute log page (30h)		N
Verify error counter page (05h)		Y
Write error counter page (02h)		Y

Table 7: Commands supported by Barracuda 9 family drive (continued)

Command Name	Command Code	Supported by ESP SCSI-2/3
Mode select (same pages as Mode Sense command, see below)	15h	Y [2]
Mode select (10)	55h	Y
Mode sense	1Ah	Y [2]
Caching parameters page (08h)		Y
Control mode page (0Ah)		Y
Disconnect/reconnect (02h)		Y
Error recovery page (01h)		Y
Format page (03h)		Y
Information exceptions control page (1Ch)		Y
Notch and partition page (0C)		N
Power condition page (1Ah)		Y
Rigid disc drive geometry page (04h)		Y
Unit attention page (00h)		Y
Verify error recovery page (07h)		Y
Xor Control Page (10h)		Y
Mode sense (10)	5Ah	Y
Prefetch	34h	N
Read	08h	Y
Read buffer (modes 0, 2, 3 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		Y
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 party reserve		Y
Extent reservation		N
Rezero unit	01h	Y

Table 7: Commands supported by Barracuda 9 family drive (continued)

Command Name	Command Code	Supported by ESP SCSI-2/3
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
Supported diagnostics pages (00h)		Y
Translate page (40h)		Y
Set limits	33h	N
Start unit/stop unit (start/stop spindle)	1Bh	Y
Synchronize cache	35h	Y
Test unit ready	00h	Y
Verify	2Fh	Y
DPO bit supported		Y
BYTCHK bit supported		Y
Write	0Ah	Y
Write and verify	2Eh	Y
DPO bit supported		Y
BYTCHK bit supported		Y
Write buffer (modes 0, 2 supported)	3Bh	Y
Firmware download option (modes 5, 7 supported) [3]		Y
Write extended	2Ah	Y
DPO bit supported		Y
FUA bit supported		Y
Write long	3Fh	Y
Write same	41h	Y
XD read	52h	Y
XD write	50h	Y
XD write extended	80h	N
XP write	51h	Y

[1] The drive can format to any even number of bytes per sector from 180 to 4096.
[2] Table 9 shows how individual bits are set that are changeable by the host.
[3] **Warning:** A power loss during flash programming can result in firmware corruption. This usually makes the drive inoperable.

9.3.1 Inquiry data

Table 8 following lists the Standard Inquiry command data that the drive returns to the initiator per the format given in the *SCSI Interface Product Manual,* part number 77738479, section 5.1.1.3.

Table 8: Barracuda 9 family drive Standard Inquiry data

Bytes	Data (HEX)																
0-15	00	00	[02][1]	[02][2]	8F	00	[00][6]	[1E][3]	53	45	41	47	41	54	45	20	VENDOR ID
16-31	53	54	[31]	[39]	[31]	[37]	[31]	[4E][4]	20	20	20	20	20	20	20	20	PRODUCT ID
32-47	R#	R#	R#	R#	S#	S#	S#	S#	S#	S#	S#	S#	00	00	00	00	
48-63	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
64-79	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
80-95	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
96-111	00	43	6F	70	79	72	69	67	68	74	20	28	63	29	20	[31]	COPYRIGHT
112-127	[39]	[39]	[37][5]	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] The drive can be changed between these two configurations:
01 = SCSI-1 implemented.
02 = SCSI-2/SCSI-3 implemented (default is 02).

[ ][2] The drive can be changed between these two configurations:
01 = Response data is in SCSI-1 format and has compatibility with Common Command Set data.
02 = Response data is in SCSI-2/SCSI-3 format (default).

[ ][3] For “N” models this value is 1E.
For “W,” “WD,” “WC,” and “DC” models this value is 3E.

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.

[ ][4] Bytes 18 through 23 reflect model of drive. Shown here are hex values for Model ST19171N.

For models “W,” “WD,” “WC,” and “DC,” byte 23 is 57 (W), since these are wide data bus drives and that is the only fact the host needs to discover from byte 23.

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

[ ][6] For “N” models, this value is 00. For models “W,” “WD,” “WC,” and “DC,” this value is 01.

9.3.1.1 Inquiry Vital Product Data pages

Instead of the Standard Inquiry data shown in Table 8, the initiator can request several Vital Product Data pages by setting the Inquiry command EVPD bit to one. The *SCSI Interface Product 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.

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. “Changeable values” are 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 *SCSI Interface Product Manual,* part number 77738479).

Definitions:

SAV = Saved values are stored on the disk media using a Mode Sense command.
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, ST19171 default values (ESP firmware, 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	B7	00	10	08	01	0F	59	48	00	00	02	00												
Mode Page	<----------Mode page headers and parameter data bytes---------->																							
SAV 01	81	0A	CC	10	30	00	00	00	0C	00	FF	FF												
DEF 01	81	0A	CC	10	30	00	00	00	0C	00	FF	FF												
CHG 01	81	0A	FF	FF	00	00	00	00	FF	00	FF	FF												
SAV 02	82	0E	80	80	00	0A	00	00	00	00	00	00	00	00	00	00								
DEF 02	82	0E	80	80	00	0A	00	00	00	00	00	00	00	00	00	00								
CHG 02	82	0E	FF	FF	00	00	00	00	00	00	00	00	87	00	00	00								
SAV 03	83	16	00	78	00	60	00	00	00	00	00	A8	02	00	00	01	00	14	00	32	40	00	00	00
DEF 03	83	16	00	78	00	60	00	00	00	00	00	A8	02	00	00	01	00	14	00	32	40	00	00	00
CHG 03	83	16	00	00	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
SAV 04	84	16	00	14	94	14	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00
DEF 04	84	16	00	14	94	14	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1C	20	00	00
CHG 04	84	16	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
SAV 07	87	0A	00	10	30	00	00	00	00	00	FF	FF												
DEF 07	87	0A	00	10	30	00	00	00	00	00	FF	FF												
CHG 07	87	0A	0F	FF	00	00	00	00	00	00	00	00												
SAV 08	88	12	10	00	FF	FF	00	00	FF	FF	FF	FF	80	03	00	00	00	00	00	00				
DEF 08	88	12	10	00	FF	FF	00	00	FF	FF	FF	FF	80	03	00	00	00	00	00	00				
CHG 08	88	12	B5	00	00	00	FF	FF	FF	FF	00	00	A0[1]	FF	00	00	00	00	00	00				
SAV 0A	8A	0A	02	00	00	00	00	00	00	00	00	00												
DEF 0A	8A	0A	02	00	00	00	00	00	00	00	00	00												
CHG 0A	8A	0A	03	F3	00	00	00	00	00	00	00	00												
SAV 10	90	16	00	00	00	00	01[2]	1A[2]	00	00	00	00	00	00	00	00	00	00	00	00	00	00	40	00
DEF 10	90	16	00	00	00	00	01[2]	1A[2]	00	00	00	00	00	00	00	00	00	00	00	00	00	00	40	00
CHG 10	90	16	02	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

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
SAV 1A	9A	0A	00	00	00	00	00	01	00	00	00	04												
DEF 1A	9A	0A	00	00	00	00	00	01	00	00	00	04												
CHG 1A	9A	0A	00	03	00	00	00	00	00	00	00	00												
SAV 1C	9C	0A	00	04	00	00	00	00	00	00	00	01												
DEF 1C	9C	0A	00	04	00	00	00	00	00	00	00	01												
CHG 1C	9C	0A	8C	0F	00	00	00	00	00	00	00	00												
SAV 00	80	02	00	00																				
DEF 00	80	02	00	00																				
CHG 00	80	02	77	02																				
Read Capacity Data	01	0F	59	47	00	00	42	00																

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

[2] Default and saved values for page 10h, bytes 6 and 7 (varies depending on cache size):

½ megabyte cache = 01 1a
01 1a

2 megabyte cache = 04 da
04 da

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 for details.

Table 10: SCSI bus conditions and other miscellaneous features

ESP	Conditions or feature
N	Adaptive caching
Y	Arbitrating system
Y	Asynchronous data transfer
N	Asynchronous event notification
Y	Attention condition
Y	Contingent allegiance condition
Y	Capacity programming
Y	Deferred error handling
Y	Differential interface circuits available
Y	Disconnect/reconnect
Y	Flag and link bits in control byte supported
Y	Format progress indication
Y	Immediate status on format unit command
Y	Immediate status on start/stop command
Y	Immediate status on synchronize cache command
Y	Parameter rounding (controlled by the round bit in the Mode Select Page 0)
Y	Queue tagging (up to 64 queue tags supported)
Y	Reporting actual retry count in extended sense bytes 15, 16 and 17
Y	Reset condition
Y	Segmented caching
Y	Synchronous data transfer
N	Synchronized (locked) spindle operation
N	Zero latency read

ESP	Status supported
Y	Good
Y	Check condition
Y	Condition met/good
Y	Busy
Y	Intermediate/good
Y	Intermediate/condition met/good
Y	Reservation conflict
Y	Queue full

9.5 Synchronous data transfer

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.*

9.5.1 Synchronous data transfer periods supported

Table 11 lists synchronous data transfer periods supported by the drive.

Table 11: Synchronous data transfer periods supported

M (Decimal)	Transfer period (M times 4 nanoseconds)	Transfer rate (mega transfers/second)
12 [1]	50 [1]	20.0 [1]
15 [1]	62.5 [1]	16.0 [1]
18 [1]	75 [1]	13.33 [1]
25	100	10.0
31	125	8.0
37	150	6.66
50	200	5.0
62	250	4.0
75	300	3.33
87	350	2.86
100	400	2.5

[1] Fast-20 (Ultra SCSI) transfer rates.

9.5.2 REQ/ACK offset

The maximum REQ/ACK value supported by Barracuda 9 SCSI drives is 15 (0Fh).

9.6 Physical interface

Figures 13, 14 and 15 show the locations of the drive physical interface components. The locations of the DC power connector, the SCSI interface connector, and the drive select and option select headers are shown.

Details of the physical, electrical and logical characteristics are given in sections following, while the SCSI operational aspects of Seagate drive interfaces are provided in the *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 Sections 9.8 and 9.9 for additional terminator information.

9.6.1 DC cable and connector

With the exception of “WC” and “DC” model drives, the drive receives DC power through a 4-pin connector (see Figure 13 for pin assignments) mounted at the rear of the main PCB. Recommended part numbers of the mating DC power connector are listed below, but equivalent parts may be used.

Type of Cable	Connector	Contacts (20-14 AWG)
14 AWG	AMP 1-480424-0	AMP 60619-4 (loose piece)
		AMP 61117-4 (strip)

Models “WC” and “DC” receive power through the 80-pin I/O connector. See Tables 16 and 17.

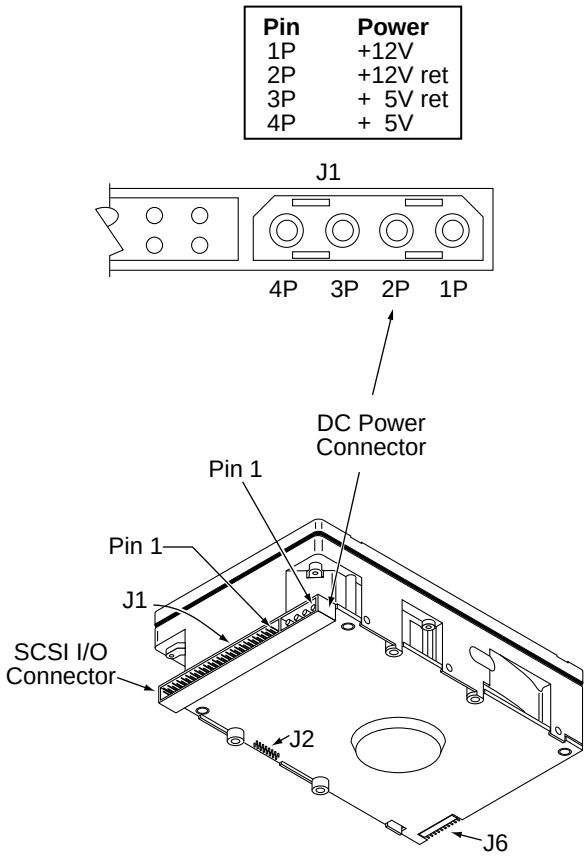


Figure 13. Physical interface for “N” model drives

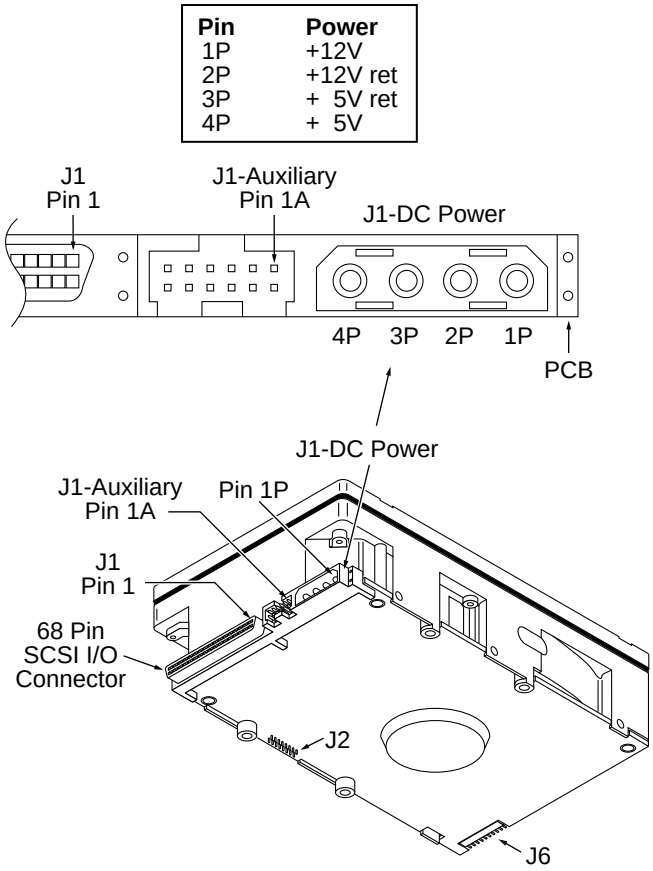
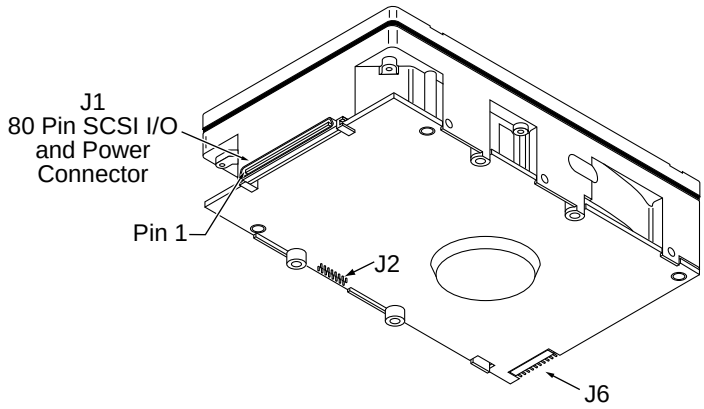


Figure 14. Physical interface for “W” and “WD” model drives (68-pin J1 SCSI I/O connector)



Note: See Table 16 and 17 for DC power pin assignments.

Figure 15. Physical interface for “WC” and “DC” model drives (80-pin J1 SCSI I/O and DC power connector)

9.6.2 SCSI interface physical description

The drives may be daisy-chained together or with other compatible SCSI devices. Both ends of the cable must be terminated. The “N,” “W,” and “WC” model drives implement single-ended drivers and receivers. All signals are common between all SCSI devices. The drive may be daisy-chained only with SCSI devices having the same type drivers and receivers. Devices having single-ended interface circuits cannot be on the same daisy chain with devices having differential interface circuits. A maximum of 8 (“N” models) or 16 (“W” and “WC”) SCSI devices (including the host) may be daisy-chained together. However, please note the restrictions described in Section 9.6.3 about the number of devices allowed in a daisy chain. The SCSI devices at both ends of the daisy chain are to be terminated. Intermediate SCSI devices shall not be terminated (see Figure 16). Remove the terminator enable jumper **TE** on J2 select header (“N” and “W” models), or the external terminators (“WD” model), not the terminator power source selector jumper **TP** (Figures 9 and 10).

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

9.6.3 SCSI interface cable requirements

A characteristic impedance as listed in Table 12 is recommended for unshielded flat or twisted pair ribbon cable. To minimize discontinuances and signal reflections, cables of different impedances should not be used in the same bus. Implementations may require trade-offs in shielding effectiveness, cable length, the number of loads, transfer rates, and cost to achieve satisfactory system operation. If you mix shielded and unshielded cables within the same SCSI bus, the effect of impedance mismatch must be carefully considered. Proper impedance matching is especially important to maintain adequate margin at Fast-20 (Ultra SCSI) and transfer rates.

“N” models use non-shielded cable connectors. Use a 50-conductor flat cable or 25 twisted pair cable. Use a minimum conductor size of 28 AWG to minimize noise effects.

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

“W” and “WD” models use non-shielded cable connectors. Use a 68-conductor flat cable or 34 twisted pair cable with connectors listed in 9.6.4.2. Use a minimum conductor size of 28 AWG to minimize noise effects.

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

“WC” and “DC” models do not require an I/O cable. They are designed to be connected directly to a back panel. Use an 80-pin connector that plugs directly into a PCB or wall/bracket mounted connector in the host equipment. Installations with connectors on cables are not recommended.

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

The maximum total cable length allowed with drives having single-ended I/O driver and receiver circuits depends on several factors. Table 12 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 12: 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)	3 meters (9.8 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]	1.5 meters (4.9 ft.)	90 ± 6 Ohms	90 ± 10 Ohms

Notes:

[1] The spacing of devices on the mainline SCSI bus should be at least three times the stub length (defined below) to avoid clustering (Refer to Annex C of X3T10/1071D). Based on this criteria, it may be that 8 devices will not actually work on 1.5 meters of line (.1m x 3 x 7 = 2.1 meters; 8 devices would be connected by 7 cable sections).

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 13, 14, and 16.

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

The maximum total cable length allowed with drives having differential I/O driver and receiver circuits is 25 meters (82 feet). Twisted-pair cable (either twisted-flat or discreet wire twisted pairs) should be used with differential I/O transceiver circuits. A stub length of no more than 0.2 meter (0.66 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. The spacing of devices on the mainline SCSI bus should be at least three times the stub length to avoid clustering (Refer to Annex C of X3T10/1071D). This restriction easily allows the 16 device IDs that the SCSI 16 bit wide bus can address. These values are from the ANSI SCSI-3 Fast-20 (also called Ultra SCSI) specification X3T10/1071D.

An ideal impedance match with cable terminators implies a cable characteristic impedance of 122 ohms. Differential I/O pin assignments are shown in Tables 15 and 17.

9.6.4 Mating connectors

Part numbers for connectors that mate with the various Barracuda 9 I/O connectors are given in the sections following.

9.6.4.1 Mating connectors for ST19171N model

Use a non-shielded 50-conductor cable connector consisting of two rows of 25 female contacts with adjacent centers 100 mils apart.

Recommended mating flat cable connector part numbers are:

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

[1] See Figure 16.

The drive device connector is a non-shielded 50-conductor connector consisting of two rows of 25 male pins with adjacent pins 100 mils apart. The connector is keyed (see Figure 17). Mating panel mount connector: 3M-CHE-2050-J01A10-KLE.

9.6.4.2 Mating connectors for ST19171W and ST19171WD models

Use a non-shielded 68-conductor cable connector consisting of two rows of 34 male contacts with adjacent contacts 0.050 inch (1.27 mm) apart.

Recommended mating wide 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	(50 mil conductor centers, 28 or 30 AWG wire) Use two, 34 conductor, 50 mil center flat cable with this connector. This type connector can only be used on cable ends. [1]
Amp Model 88-5870-294-5	W/O Strain Relief (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 16.

The drive device connector is a non-shielded 68-conductor connector consisting of two rows of 34 female pins with adjacent pins 50 mils apart. The connector is keyed by means of its shape (see Figure 18).

9.6.4.3 Mating connectors for ST19171WC and ST19171DC models

Use a non-shielded 80-conductor connector consisting of two rows of 40 contacts with adjacent contacts 50 (1.27 mm) mils apart. I/O connection using a cable is not recommended. The length and size of the host equipment DC power carrying conductors from the DC power source to the host equipment 80-pin disc drive interface connector should be strictly designed according to proper power transmission design concepts. Do not allow users to attach an 80-pin cable/connector, because 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.

To insure that both drive connector and host equipment mating connector mate properly, both drive connector and host equipment mating connector must meet the provisions of “SFF-8046 Specification for 80-pin connector for SCSI Disk Drives.”

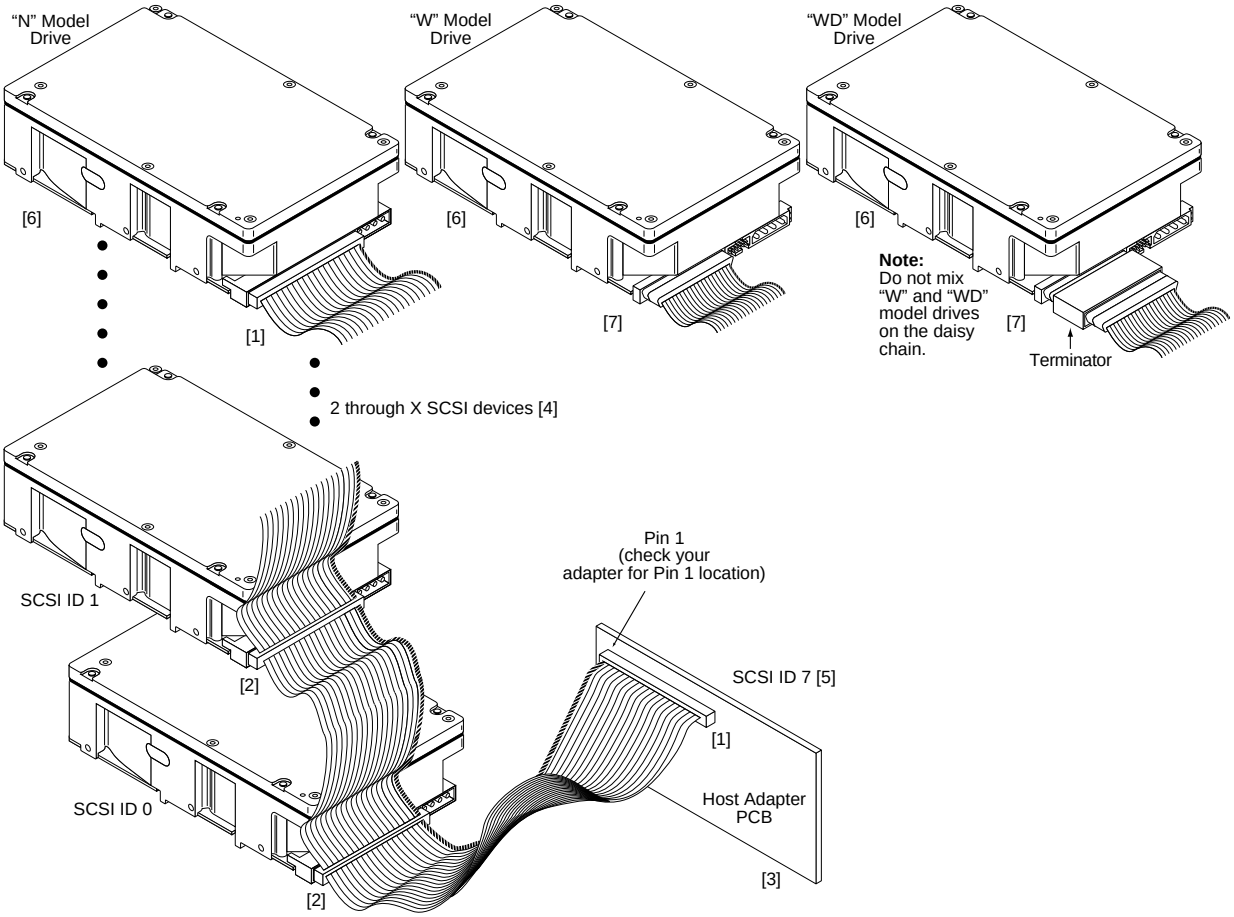
Recommended mating 80-position PCB mount connectors:

Straight-in (vertical) 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 plug.

[2] Open-end type (in-line application) connector used. Terminators disabled.

[3] Host need not be on the end of the daisy chain. Another device can be on the end with the terminator, the host having no terminator.

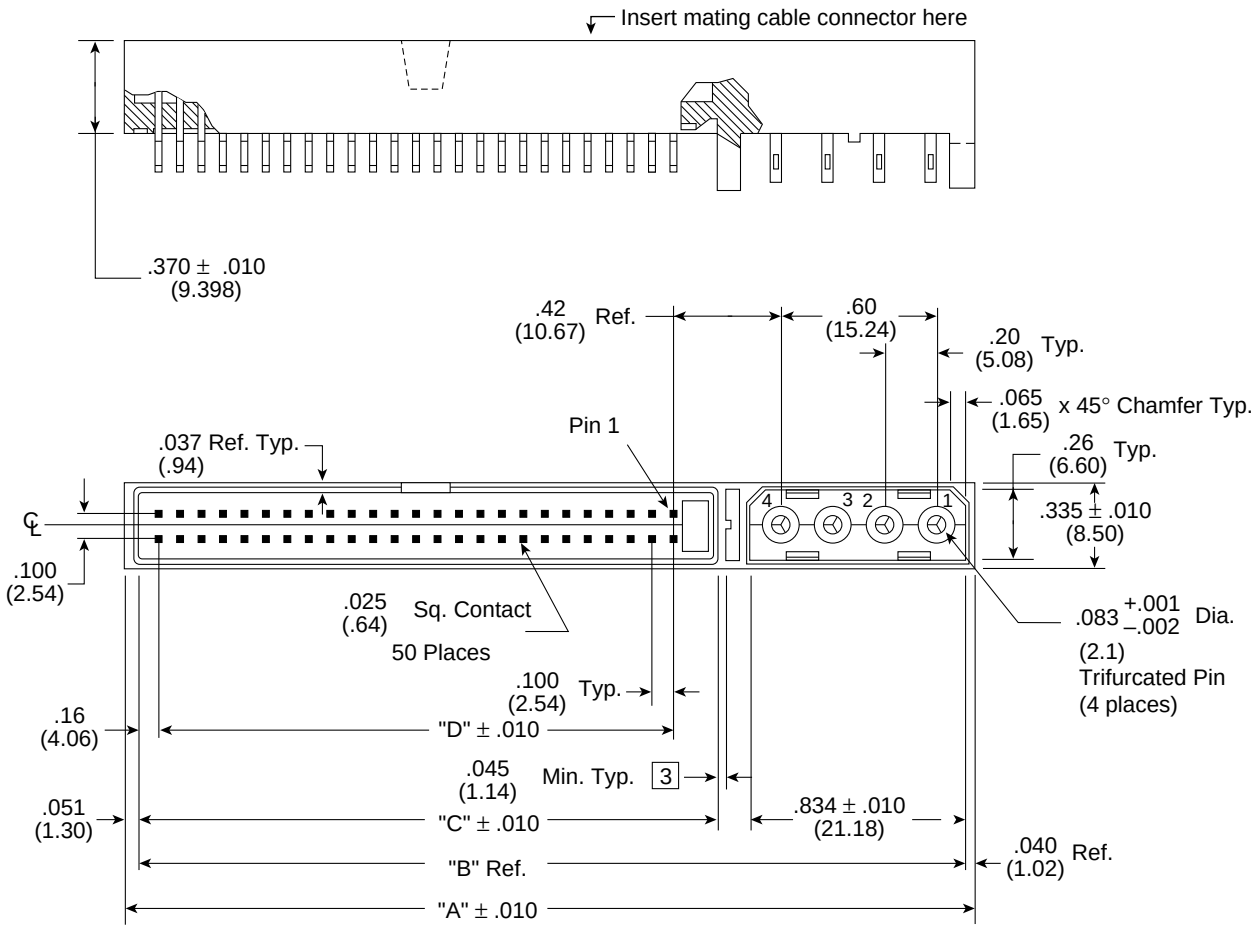
[4] Total interface cable length must not exceed that specified in Section 9.6.3.1 (including host adapter/initiator). The number of devices allowed depends on data transfer rate. See Table 12.

[5] SCSI ID7 has highest arbitration priority, ID 0 has lowest for "N" models. For "W" models, priority is ID 7 to ID 0, then ID 15 to ID 8 (ID 8 very lowest).

[6] Last drive on daisy chain.

[7] Open-end type 68-pin connector used. Terminators disabled on "WD" models. If end "WD" device, external terminator and closed-end type 68-pin connector used. On "W" models, install terminator enable **(TE)** jumper plug. "N" and "W" models do not require external terminators.

Figure 16. SCSI daisy-chain interface cabling



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

Figure 17. Non-shielded 50-pin SCSI device connector

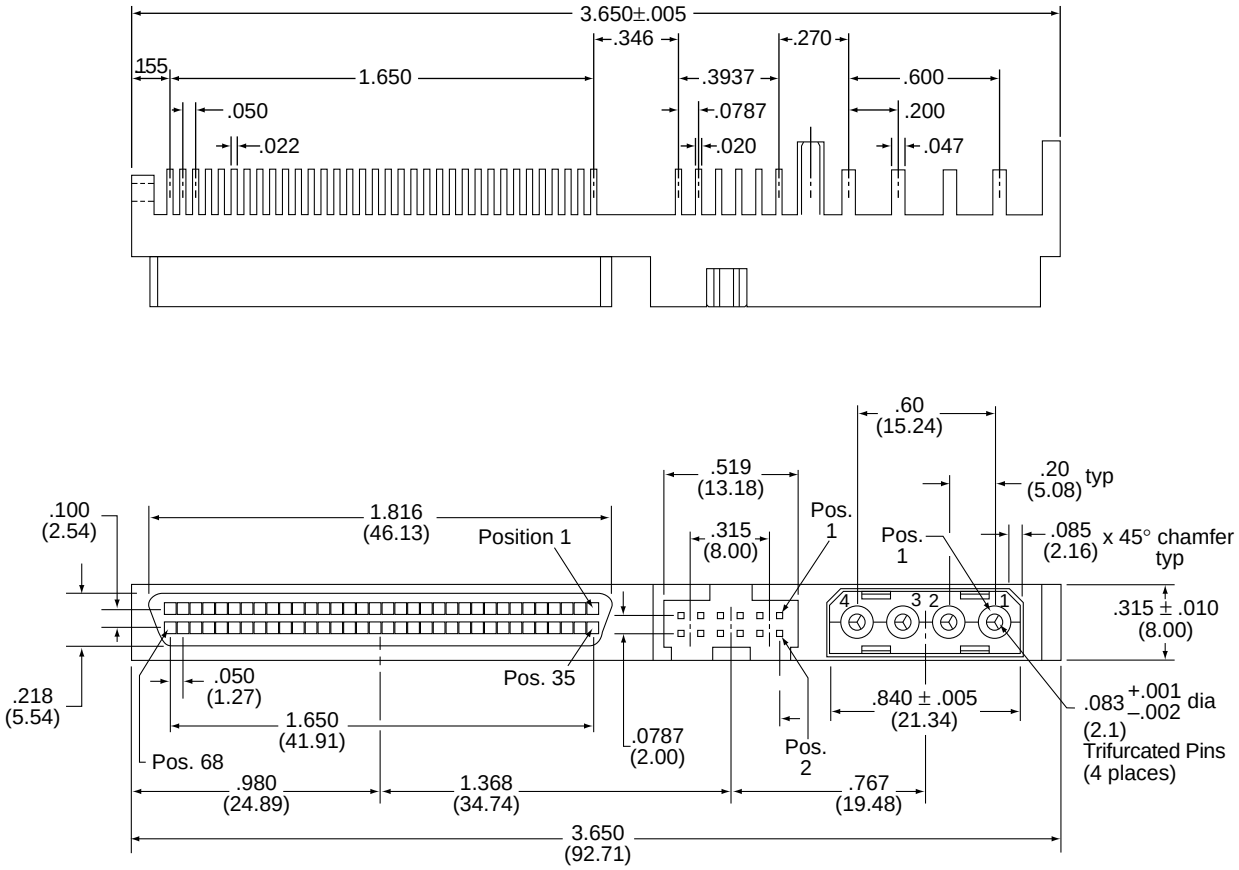


Figure 18. Non-shielded 68-pin SCSI device connector

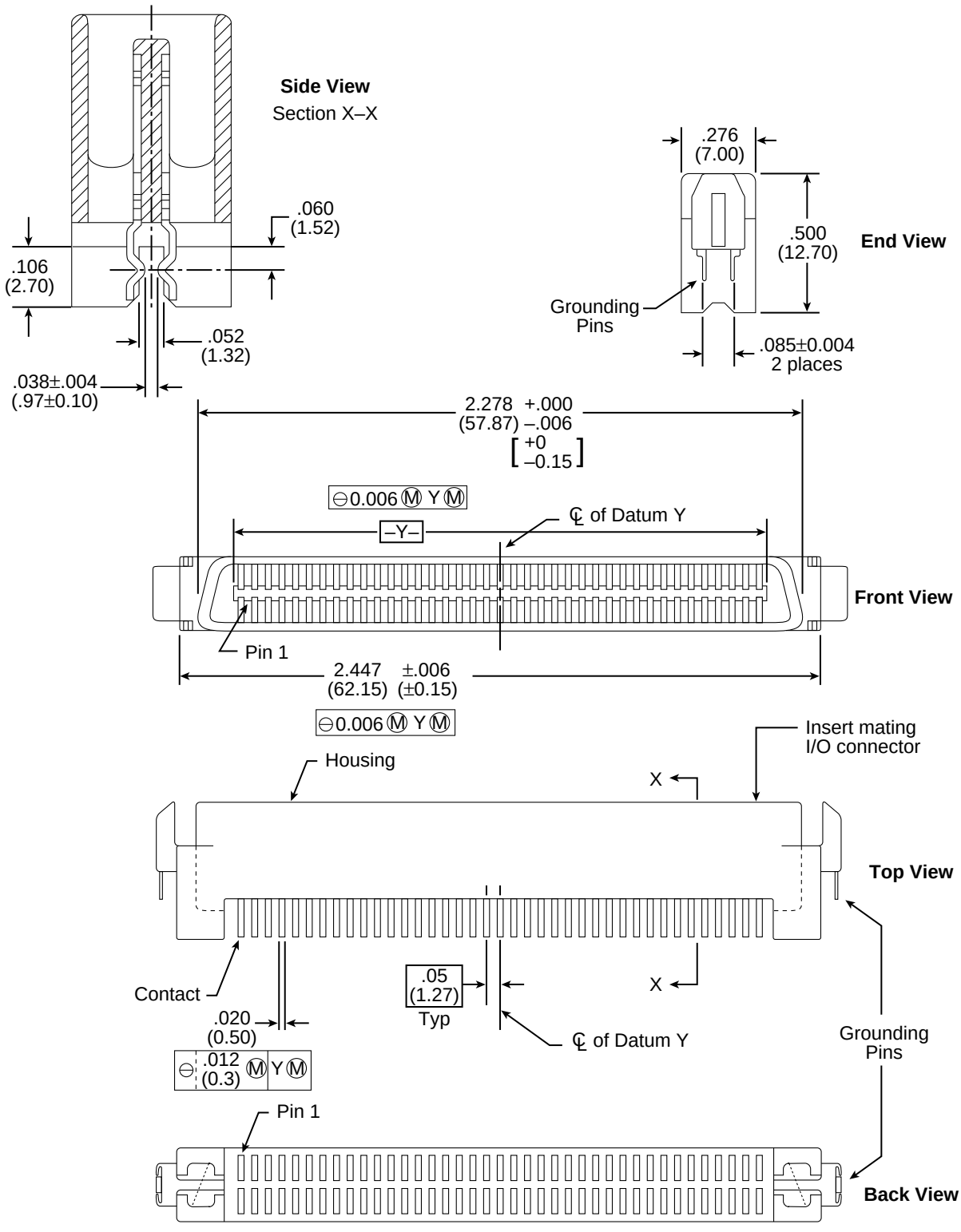


Figure 19. Non-shielded 80-pin SCSI connector, used on “WC” model

Table 13: Single-ended signal/contact assignments for ST19171N drives

Signal name [1]	Connector contact number [11]	Cable conductor number [12]		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 or the drive 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 17.

Table 14: Single-ended wide cable assignments for ST19171W drives

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 17.

Table 15: Wide differential P cable assignments (non-shielded connector) for ST19171WD drives

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
GND	6	11	12	40	GND
+DB0	7	13	14	41	–DB0
+DB1	8	15	16	42	–DB1
+DB2	9	17	18	43	–DB2
+DB3	10	19	20	44	–DB3
+DB4	11	21	22	45	–DB4
+DB5	12	23	24	46	–DB5
+DB6	13	25	26	47	–DB6
+DB7	14	27	28	48	–DB7
+DBP	15	29	30	49	–DBP
DIFFSENS	16	31	32	50	GND
TermPwr	17	33	34	51	TermPwr
TermPwr	18	35	36	52	TermPwr
Reserved	19	37	38	53	Reserved
+ATN	20	39	40	54	–ATN
GND	21	41	42	55	GND
+BSY	22	43	44	56	–BSY
+ACK	23	45	46	57	–ACK
+RST	24	47	48	58	–RST
+MSG	25	49	50	59	–MSG
+SEL	26	51	52	60	–SEL
+C/D	27	53	54	61	–C/D
+REQ	28	55	56	62	–REQ
+I/O	29	57	58	63	–I/O
GND	30	59	60	64	GND
+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 17.

Table 16: Wide, single connector, single-ended signal/contact assignments for ST19171WC drives

Signal name [1]	Connector contact number [12]	Connector contact number [12]	Signal name [1]
+12 V	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
–DBP1	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	36	76	5 V GND
Do not use	37	77	LEDC [4] [9]
RMT_START [5] [9]	38	78	DLYDST [6] [9]
SCSIAO [7] [9]	39	79	SCSIA1 [7] [9]
SCSIA2 [7] [9]	40	80	SCSIA3 [7] [9]

Notes [ ]: See page following Table 17.

Table 17: Wide, single connector, differential signal/contact assignments for ST19171DC drives

Signal name	Connector contact number		Signal name
12 V	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
RESERVED/NC [10]	5	45	RESERVED/NC [10]
RESERVED/NC [10]	6	46	DIFFSENS [8]
–DB11 [13]	7	47	+DB11 [13]
–DB10 [13]	8	48	+DB10 [13]
–DB9 [13]	9	49	+DB9 [13]
–DB8 [13]	10	50	+DB8 [13]
–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
–DBP0	20	60	+DBP0
–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
–DBP1 [13]	29	69	+DBP1 [13]
–DB15 [13]	30	70	+DB15 [13]
–DB14 [13]	31	71	+DB14 [13]
–DB13 [13]	32	72	+DB13 [13]
–DB12 [13]	33	73	+DB12 [13]
5 V	34	74	MATED 2
5 V	35	75	5 V GND
5 V	36	76	5 V GND
Do not use	37	77	ACTIVE LED OUT [4] [9]
RMT_START [5] [9]	38	78	DLYD_START [6] [9]
SCSI ID0 [7] [9]	39	79	SCSI ID1 [7] [9]
SCSI ID2 [7] [9]	40	80	SCSI ID3 [7] [9]

Notes [ ]: See page following this Table.

Notes [ ] for Tables 13 through 17:

[1] See Section 9.7.1 for detailed electrical characteristics of these signals.
[2] The conductor number refers to the conductor position when using 0.025-inch (0.635 mm) centerline flat ribbon cable. Other cable types may be used to implement equivalent contact assignments.
[3] Connector contacts are on 0.050 inch (1.27 mm) centers.
[4] Front panel LED signal; indicates drive activity for host front panel hard drive activity indicator.
[5] Asserted by host to enable Motor Start option (enables starting motor via SCSI bus command).
[6] Asserted by host to enable Delayed Motor Start option (motor starts at power on or after a delay of 12 seconds multiplied by the 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 also Section 8.1.1 notes.
[10] “NC” means no connection.
[11] The conductor number refers to the conductor position (right to left in Figure 16) when using 0.050 inch (1.27 mm) centerline flat ribbon cable. Other cable types may be used to implement equivalent contact assignments.
[12] Connector contacts are on 0.100 inch (2.54 mm) centers.
[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.
All other signals shall be connected as defined.

9.7 Electrical description

ST19171N and ST19171W 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. All of these models can be configured to provide the SCSI termination.

ST19171WD models use differential interface signals and each of these must be terminated at each end of the total cable with 330 ohms to +5V and 330 ohms to ground with 150 ohms between each differential pair. All I/O circuits are open collector, three state drivers. Differential I/O drives are shipped without terminators. These drives have no provisions for adding terminator sockets on the PCB. This means some method of external termination must be provided by the user when termination is required.

ST19171WC and ST19171DC 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.

9.7.1 Single-ended drivers/receivers

Typical single-ended driver and receiver circuits are shown in Figure 20. Use terminator circuits only where the disc drive is first or last in the daisy chain. See Note 1 following Figure 20.

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.

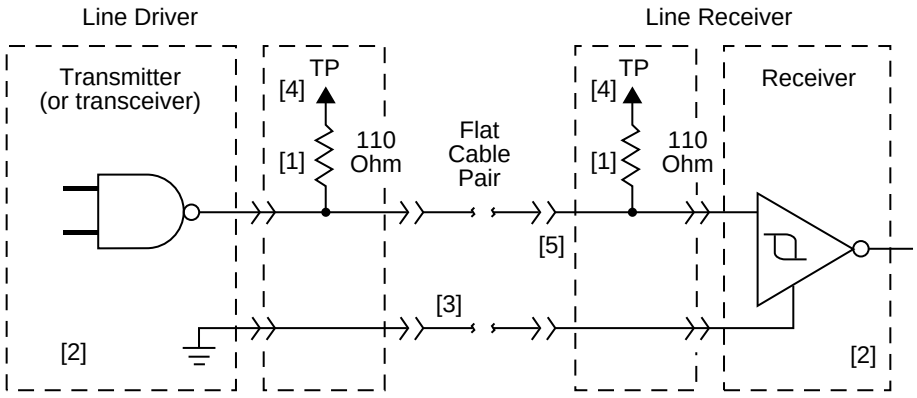


Figure 20. Single-ended transmitters and receivers

Notes.

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

[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 Figures 9 and 10. Applies to “N” and “W” models only.

[5] Interface signal levels and logical sense at the drive I/O connector for “N,” “W,” and “WC” models are defined as follows:

Vil (low-level input voltage) = 1.0 V maximum (signal true); minimum = Vss – 0.5 V.

Vih (high-level input voltage) = 1.9 V minimum (signal false); maximum = Vdd +0.5V.

Vihys (Input Hysteresis) = 425 mV minimum

9.7.2 Differential drivers/receivers

Typical differential driver and receiver circuits used by ST19171WD drives are shown in Figure 21. The drive has no provisions for terminator circuits on differential I/O drives.

Differential signals

All differential interface signals consist of two lines denoted +SIGNAL and –SIGNAL. A signal is true when +SIGNAL is more positive than –SIGNAL, and a signal is false when –SIGNAL is more positive than +SIGNAL. All assigned signals must be terminated at each end of the cable. You must provide external termination for the differential drives.

Output characteristics

Each signal driven by differential interface drives should have the following output characteristics when measured at the disc drive's SCSI connector:

Low-level output voltage*
= 2.0 V maximum at low-level output current
= 55 milliamps

High-level output voltage*
= 3.0 V minimum at high-level output current
= –55 milliamps

Differential voltage
= 1.0 V minimum with common-mode voltage ranges from –7 V DC to +12 V DC

*Measure these voltages between the output terminal and the SCSI device's logic ground reference.

The output characteristics must additionally conform to EIA RS-485-1983.

Input characteristics

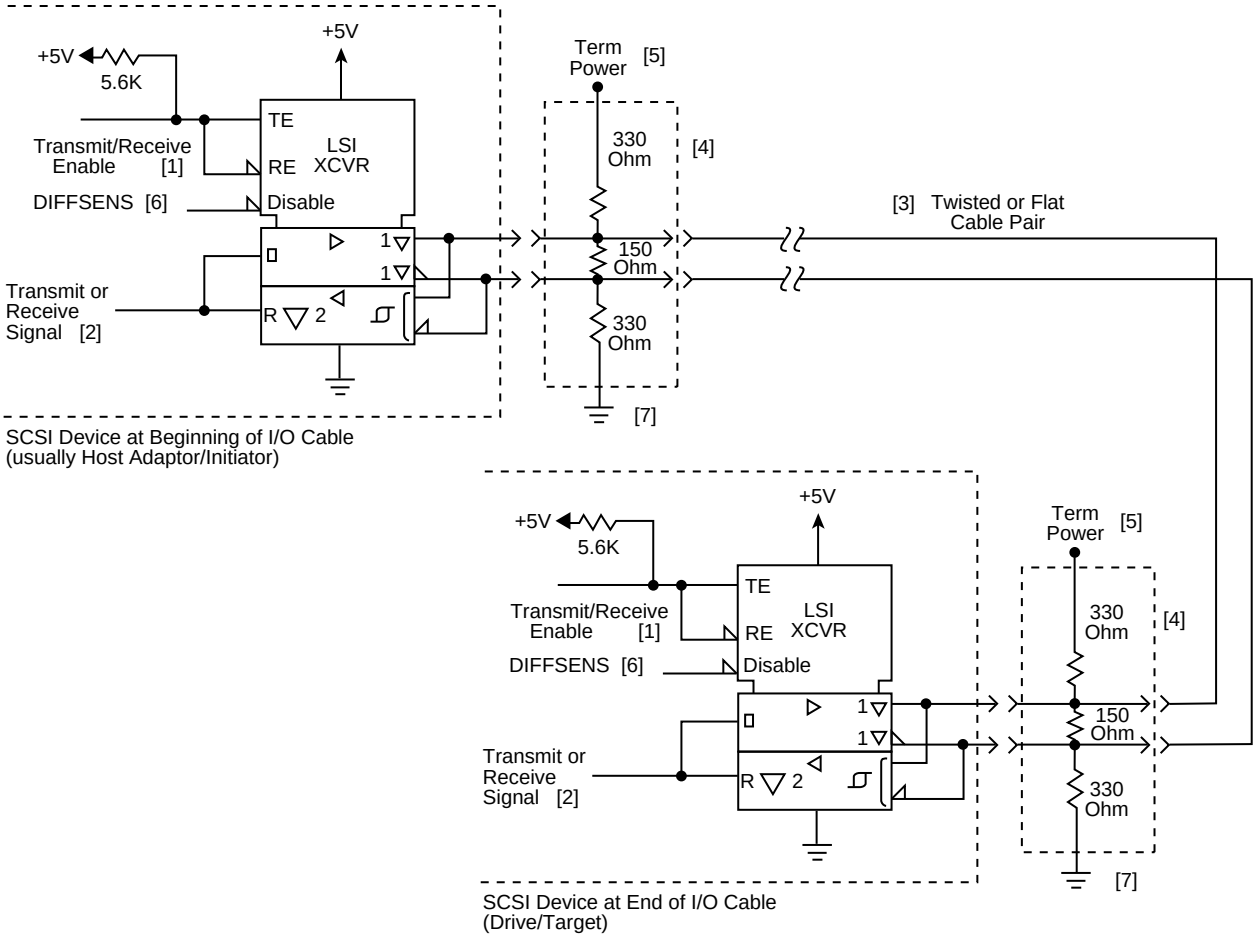
Each signal received by differential interface drives should have the following input characteristics when measured at the disc drive's SCSI connector:

Input current on either input

= +2.0 milliamps maximum (includes both receivers and passive drivers)

This requirement is met with the input voltage varying between –7 V DC and +12 V DC, with power on or off, and with the hysteresis equaling 35 mV minimum.

The input characteristics must additionally conform to EIA RS-485-1983.



Notes.

[1] Positive logic enables transmitter (+5 V = asserted).
Negative logic enables receivers (0 V = asserted).

[2] Negative logic signal (0 V = asserted).

[3] Total interface cable length should not exceed value given in Section 9.6.3.2 from first SCSI device at beginning to end of daisy chain. See Section 9.7.2 for signal characteristics.

[4] I/O line terminators. If SCSI device is a Seagate disc drive, terminators and a place to plug them in must be provided external to the drive by user, systems integrator, or host equipment manufacturer where needed. The drive has no terminators and there are no provisions on the drive for terminator installation.

[5] Arrangements for connecting terminator power to the terminators must be made by the systems designer. As a help, drive +5 V power is made available on SCSI bus (“N,” “W,” “ND,” and “WD” models) for powering external terminators if the drive option select header jumper **TP** (Figures 9 and 10) is installed in rightmost position **“TP.”** See pin assignment Tables 15 and 17 for pins assigned to terminator power.

[6] SCSI I/O line (pin 21) disables I/O circuits if single-ended cable plugged in or cable plugged in upside down.

[7] SCSI I/O cable ground. See Tables 15 and 17.

Figure 21. Typical differential I/O line transmitter/receiver and terminators

9.8 Terminator requirements

ST19171N and ST19171W drives

Internal disc drive I/O termination consists of active circuits contained in an LSI module that is permanently mounted on the PCB. All single initiator/single target (non-daisy-chain) applications require you to terminate the initiator and drive.

Terminate both ends of the SCSI bus with ANSI SCSI-2 standard alternative 2 (active) termination. Do not mix active and passive terminators on the same SCSI bus.

Daisy-chain configurations require you to terminate only the units at each end of the daisy chain. Do not terminate any other peripherals on the chain.

Note. Remove the Enable SCSI Terminator jumper from J2 pins 15 and 16 when terminators are not required.

ST19171WC and ST19171DC drives

SCA connector drives do not have internal terminators available. You must provide external active terminators when termination is required.

ST19171WD drives

Differential I/O Barracuda drives do not have internal terminators available. You must provide external active termination when termination is required.

9.9 Terminator power

ST19171N and ST19171W 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:
   ST19171N Pin 26
   ST19171W 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

ST19171WD 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.

ST19171WC and ST19171DC drives

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

9.10 Disc drive SCSI timing

Table 18: Disc drive SCSI timing

Description	Waveform symbol [1]	Waveform table [1]	Typical timing
Target select time (no arbitration)	T00	N/A	<1 µs
Target select time (with arbitration)	T01	4.5-1,2	2.31 µs
Target select to command	T02	4.5-1	3.33 µs
Target select to MSG out	T03	4.5-2	1.51 µs
Identify MSG to command	T04	4.5-3	3.34 µs
Command to status	T05	4.5-5	Command dependent
Command to data (para. in)	T06	4.5-9	Command dependent
Command to data (para. out)	T07	4.5-10	Command dependent
Command to data (write to data buffer)	T08	4.5-10	Command dependent
Command to disconnect MSG	T09	4.5-6	Command dependent
Disconnect MSG to bus free	T10	4.5-6,14	0.64 µs
Disconnect to arbitration (for reselect) This measures disconnected CMD overhead.	T11	4.5-6–b	Command dependent
Target win arbitration (for reselect)	T12	4.5-7	2.8 µs max.
Arbitration to reselect	T13	4.5-7	1.8 µs max.
Reselect to identify MSG in	T14	4.5-7	1.34 µs max.
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	1.0 µs max.
Command complete MSG to bus free	T19	4.5-5,8,15	0.75 µs max.
Data to save data pointer MSG	T20	4.5-14	4.5 µs max.
Save data pointer MSG to disconnect MSG	T21	4.5-14	0.75 µs max.
Command byte transfer	T22	4.5-4	0.04 µs max.
Next command byte access		4.5-4	
Next CDB byte access (byte 2 of 6)	T23.6.2	4.5-4	0.55 µs
Next CDB byte access (byte 3 of 6)	T23.6.3	4.5-4	0.10 µs
Next CDB byte access (byte 4 of 6)	T23.6.4	4.5-4	0.09 µs
Next CDB byte access (byte 5 of 6)	T23.6.5	4.5-4	0.13 µs
Next CDB byte access (byte 6 of 6)	T23.6.6	4.5-4	0.13 µs
Next CDB byte access (byte 2 of 10)	T23.10.2	4.5-4	0.59 µs
Next CDB byte access (byte 3 of 10)	T23.10.3	4.5-4	0.14 µs
Next CDB byte access (byte 4 of 10)	T23.10.4	4.5-4	0.13 µs
Next CDB byte access (byte 5 of 10)	T23.10.5	4.5-4	0.12 µs
Next CDB byte access (byte 6 of 10)	T23.10.6	4.5-4	0.11 µs
Next CDB byte access (byte 7 of 10)	T23.10.7	4.5-4	0.10 µs
Next CDB byte access (byte 8 of 10)	T23.10.8	4.5-4	0.09 µs
Next CDB byte access (byte 9 of 10)	T23.10.9	4.5-4	0.13 µs
Next CDB byte access (byte 10 of 10)	T23.10.10	4.5-4	0.12 µs

Description	Waveform symbol [1]	Waveform table [1]	Typical timing
Data in byte transfer (parameter)	T24	4.5-12	0.04 µs max.
Data out byte transfer (parameter)	T25	4.5-13	0.04 µs max.
Next data in byte access (parameter)	T26	4.5-12	0.10 µs
Next data byte out access (parameter)	T27	4.5-13	0.10 µs
Data in byte transfer (media) [2]	T28	4.5-12	0.03 µ
Data out byte transfer (media) [2]	T29	4.5-13	0.03 µ
Next data in byte access (media [2]	T30	4.5-12	0.10 µs
Next data in byte access (media [2]	T31	4.5-13	0.10 µs
MSG IN byte transfer	T32	4.5-5,7 4.5-8,14,15	0.09 µs
MSG OUT byte transfer	T33	4.5-2	0.04 µs max.
STATUS byte transfer	T34	4.5-5,8,15	0.04 µs max.
Synchronous data transfer characteristics:			
Request signal transfer period [3]	–	–	various

Notes.

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

General timing diagrams for SCSI interface operation are shown in the *SCSI Interface Product Manual,* part number 77738479, Section 4.5. The specific timing values that apply to this drive are listed in Table 12.

10.0 Seagate technical support services

If you need assistance 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 assistance with your Seagate® drive or other Seagate products, use one of the Seagate technical support services listed below.

SeaFONE® 1-800-SEAGATE
Seagate's 800 number (1-800-732-4283) allows toll-free access to automated self-help services, providing answers to commonly asked questions, troubleshooting tips, and specifications for disc drives and tape drives. This service is available 24 hours daily and requires a touch-tone phone. International callers can reach this automated self-help service by dialing 408-456-4496.

Online services

Using a modem, you can obtain troubleshooting tips, free utility programs, drive specifications and jumper settings for Seagate's entire product line. You can also download software for installing and analyzing your drive.

SeaNET™
You can obtain technical information about Seagate products over the Internet from Seagate's World Wide Web home page **(http://www.seagate.com)** or Seagate's ftp server **(ftp://ftp.seagate.com)**. You can also send E-mail with your questions to **DiscSupport @ Seagate.com** or **TapeSupport @ Seagate.com**.

Seagate CompuServe forum
Online technical support for Seagate products is available on CompuServe. To access our technical support forum, type ***go seagate***. This forum provides information similar to that found on SeaBOARD. In addition, you can type questions or browse through previous questions and answers on the forum messages.

SeaBOARD®
SeaBOARD is a computer bulletin board system that contains information about Seagate disc and tape drive products and is available 24 hours daily. Set your communications software to eight data bits, no parity, and one stop bit (8-N-1).

Location	Phone number
Australia	61-2-9756-2359
England	44-1628-478011
France	33 1-48 25 35 95
Germany	49-89-140-9331
Singapore	TBA
Taiwan	886-2-719-6075
Thailand	662-531-8111
USA	Disc: 408-434-1080; Tape: 408-456-4415

FAX services

SeaFAX®
You can use a touch-tone telephone to access Seagate's automated FAX system to receive technical support information by return FAX. This service is available 24 hours daily.

Location	Phone number
Australia	61-2-9756-5170
England	44-1628-894084
USA	1-800-SEAGATE or 408-456-4496

Seagate technical support FAX
You can FAX questions or comments to technical support specialists 24 hours daily. Responses are sent during business hours.

Location	Phone number
Australia	61-2-9725-4052
England	44-1628-890660
France	33 1-46 04 42 50

Location	Phone number
Germany	49-89-1430-5100
Hong Kong	852-2368 7173
Japan	81-3-5462-2979
Korea	82-2-556-7294/4251
Singapore	65-488-7528
Taiwan	886-2-715-2923
USA	408-944-9120

Direct-support services

Seagate technical support

For one-on-one help, you can talk to a technical support specialist during local business hours. Before calling, note your system configuration and drive model number (ST*xxxx*).

Location	Phone number
Australia	61-2-9725-3366 (9:00 A.M. to 5:00 P.M., M–F)
England	44-1628-894083 (10:00 A.M. to 1:00 P.M., 2:00 P.M. to 5:00 P.M., M–F)
France	33 1-41 86 10 86 (9:30 A.M. to 12:30 P.M., 2:00 P.M. to 5:00 P.M., M–F)
Germany	Disc: 49-89-140-9332; Tape: 49-89-140-9333 (9:30 A.M. to 12:30 P.M., 2:00 P.M. to 4:00 P.M., M–F)
Hong Kong	852-2368 9918
Korea	82-2-556-8241
Singapore	65-488-7584 (9:00 A.M. to 12:00 P.M., 2:00 P.M. to 5:00 P.M., M–F)
Taiwan	886-2-514-2237
USA	Please dial 1-800-SEAGATE or 408-456-4496 for the specific product telephone number. (6:00 A.M. to 11:15 A.M., 12:30 P.M. to 5:00 P.M., Pacific time, M–F)

SeaTDD™ 408-944-9121

Using a telecommunications device for the deaf (TDD), you can send questions or comments 24 hours daily and exchange messages with a technical support specialist between 6:00 A.M. to 11:15 A.M. and 12:30 P.M. to 5:00 P.M. (Pacific time) Monday through Friday.

Customer service centers

Seagate direct OEM, Distribution, and System Integrator customers should contact their Seagate service representative for warranty information. Other customers should contact their place of purchase. Seagate offers comprehensive customer support for all Seagate drives. These services are available worldwide.

Location	Phone number	FAX number
Asia Pacific and Australia	65-485-3595	65-485-4980
Europe, Middle East, and Africa	31-2031-67300	31-2065-34320
Japan	81-3-5462-2904	81-3-5462-2979
USA	1-800-468-3472	405-949-6740
Other Americas (Brazil, Canada, Mexico)	405-949-6706	405-949-6738
Manufacturer's representatives		
Brazil		
MA Informatica	55-11-810-7794	55-21-253-6467
Canada		
Memofix	905-660-4936	905-660-8738
Adtech	905-812-8099 1-800-624-9857	905-812-7807
Mexico		
Abicom Seamax SA DE CV	525-546-6965	525-546-4888

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