ST251N
ST277N
PRODUCT
MANUAL

§§ Seagate

ST251N/ST277N
Product Manual

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36034-001, Revision B

⑤ Seagate

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LIST OF ILLUSTRATIONS

INTRODUCTION

This manual supports the ST251N and ST277N disc drives.

These drives are complete hard disc subsystems for desktop comput-
ers and other systems requiring a rugged, half-height storage solution.

Seagate intelligent disc drives have an embedded controller which
supports the small computer system interface (SCSI command set),
as defined by ANSI X3T9.2/82-2, for self-configuring software.

Seagate reliability is a built-in feature. Our manufacturing facilities
are designed and located exclusively for the high-volume production
and testing of disc drives. Our commitment to vertical integration en-
compasses read/write head assembly, PC board, media and stepper
motor manufacturing. This assures you of the latest technology, con-
sistent quality and the lowest possible cost.

For pricing and delivery information call:
Inside California **1-800-468-DISK**
Outside California **1-800-468-DISC**

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1.0 INTELLIGENT DISC DRIVE SPECIFICATION SUMMARY

1.1 DRIVE CAPACITY

1.1.1 FORMATTED CAPACITY

	ST251N		ST277N	
Guaranteed Megabytes:	42.7	43.1	64.4	64.9
Bytes per Cylinder:	52,224	52,736	78,848	79,360
Bytes per Track:	13,312	13,312	13,312	13,312
Bytes per Sector:	1,024	512	1,024	512

1.1.2 DATA ORGANIZATION

Guaranteed Sectors:	41,718	84,254	63,804	126,790
Sectors per Cylinder:	51	103	77	155
Sectors per Track:	13	26	13	26

1.2 PERFORMANCE SPECIFICATIONS

1.3 ACCESS TIME DEFINITION AND TIMING

Access time is defined as the time from the leading edge of the first step pulse received to Seek Complete (including settling). All seek times are true statistical averages and are calculated with a step pulse period of 10 μsec. at nominal power and temperature.

Track-to-Track:	8 msec. max.
Average:	40 msec. max.
Full-Stroke:	95 msec. max.
Average Latency:	8.33 msec.

1.4 FUNCTIONAL SPECIFICATIONS

	ST251N	ST277N
Tracks:	3,272	4,908
Cylinders:	820 (0-819)	820 (0-819)
Read/Write Heads:	4	6
Discs:	2	3
Rotational Speed:	3,600 $\pm$0.5%	
Recording Method:	RLL(2,7)	
Recording Density (BPI):	14,902	
Track Density (FCI):	9,935	
Track Density:	777	
Interface:	SCSI	
I/O Data Transfer Rate:	Up to 1.2 Mbits/sec.	
Int. Data Transfer Rate:	Up to 7.5 Mbits/sec.	
Nonrecoverable Read Errors:	1 per 10^{12} bits read	

1.5 PHYSICAL SPECIFICATIONS

Height: 1.63 inches max. (41.4 mm)

Depth: 8.00 inches max. (203.2 mm)

Width: 5.77 inches max. (146.1 mm)

Weight: 2.75 lbs. (1.25 Kg.)

1.6 RELIABILITY SPECIFICATIONS

MTBF: 20,000 Power-on hours (Typical usage at 25°C ambient temp., sea level)

PM: Not Required

MTTR: 30 minutes

Component Design Life: 5 years

1.7 ENVIRONMENTAL SPECIFICATIONS

1.7.1 AMBIENT TEMPERATURE

Operating: 10° C to 45° C (50° F to 113° F)

Nonoperating: -40° C to 60° C (-40° F to 140° F)

1.7.2 TEMPERATURE GRADIENT

Operating: 10° C/hr max. (18° F/hr)

Nonoperating: Below condensation

1.7.3 RELATIVE HUMIDITY

Operating: 8 to 80% noncondensing

Maximum Wet Bulb: 78.8^{o} F (26° C) noncondensing

Nonoperating: Below condensation

1.7.4 ALTITUDE

Operating: -1,000 ft to 10,000 ft
Nonoperating: -1,000 ft to 30,000 ft

1.8 SHOCK AND VIBRATION SPECIFICATIONS

All shock and vibration measurements assume that the drive is mounted in an approved orientation with the input levels at the drive mounting screws.

Shock measurements are based on an 11 msec. half-sine wave shock pulse. The nonoperating specifications assume that the read/write heads are positioned in the shipping zone.

1.8.1 OPERATING SHOCK

Maximum permitted shock without incurring physical damage or degradation in performance: 10 G's

1.8.2 OPERATING VIBRATION

Maximum permitted vibration at the following frequencies, without incurring physical damage or degradation in performance:

Frequency	Vibration
5-22 Hz	0.010 in. double amplitude
22-300 Hz	0.25 G peak amplitude
300-22 Hz	0.25 G peak amplitude
22-5 Hz	0.010 in. double amplitude

1.8.3 NONOPERATING SHOCK

Maximum permitted shock without incurring physical damage or degradation in performance: 40 G's

1.8.4 NONOPERATING VIBRATION

Maximum permitted vibration at the following frequencies, without incurring physical damage or degradation in performance:

Frequency	Vibration
5-22 Hz	0.020 in. double amplitude
22-300 Hz	0.50 G peak amplitude
300-22 Hz	0.50 G peak amplitude
22-5 Hz	0.020 in. double amplitude

1.9 DC POWER SPECIFICATIONS

Power may be applied or removed in any sequence without loss of data or damage to the drive.

Typical power specifications assume nominal voltages applied, 25°C ambient temperature, sea level and spindle rotating with drive not seeking.

+12 VDC

Voltage Tolerance (inc. ripple):	$\pm 5\%$
Max. Current at Power-Up:	2.0 Amps
Typical:	0.5 Amps

+5 VDC

Voltage Tolerance (inc. ripple):	$\pm 5\%$

Typical

With Termination:	1.4 Amps
Without Termination:	1.2 Amps

POWER

Nominal with Termination:	13 Watts

1.9.1 INPUT NOISE RIPPLE AND FREQUENCY

The maximum permitted noise ripple is 100 mV (peak-to-peak) on either +5 or +12 VDC measured on the host system power supply across the following equivalent resistive loads:

+ 12 VDC: 16 Ω
+ 5 VDC: 5 Ω

The maximum permitted noise frequency is 20 MHz on both the +12 VDC and +5 VDC lines.

FIGURE 1: Typical RMS Start-up Current Profile

These measurements are at nominal voltages, 25°C ambient temperature, with drive termination.
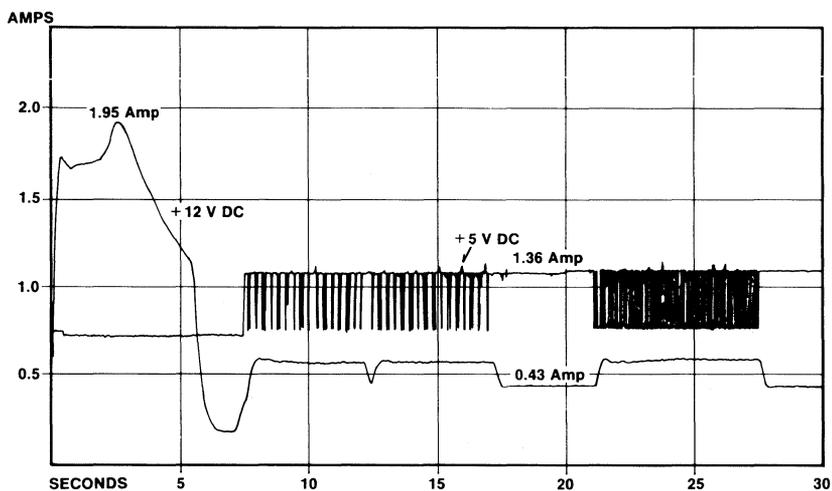
1.10 MOUNTING REQUIREMENTS

The ST251N/277N may be mounted horizontally with the spindle motor down, or on either side. The drive should not be tilted (front to back) in any position, by more than 5°.

For optimum performance the drive should be formatted in the same orientation as it will be mounted in the host system.

FIGURE 2: Mounting Dimensions

8.00 max
(203.2)

1.63 max
(41.4)

1.682 ± .010
(42.72 ± .25)

.510 Ref.

.250 Ref.
.250 Ref.

.39 ± .02
(9.91 ± .51)

.86 ± .02
(21.8 ± .51)

0.031 ± .025
(0.78 ± .63)

1.87 ± .03
(47.50 ± .76)

3.12 ± .03
(79.25 ± .76)

Mounting Holes
4 on bottom, 4 on each side:
6-32 UNC-2B (12X)

.195 ± .010
(4.95 ± .25)

1.0 Ref.

5.875 ± .010
(149.22 ± .25)

.230 Ref.

5.77 max.
(146.6)

5.50 ± .03
(139.7 ± .76)

1.75 Ref.
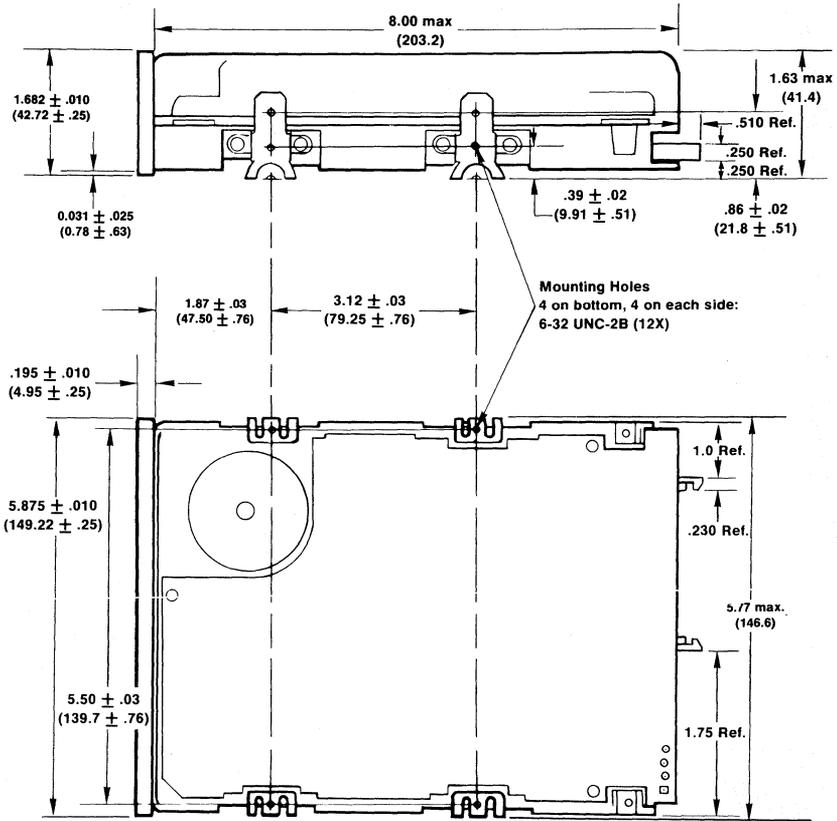
Dimensions are in inches (mm)

Note:
The mounting screws must not extend inside the mounting feet more than 0.125 inch, measured from the outside surface of the foot.

Outside Surface

Mounting Foot

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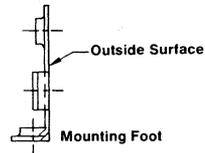
1.10.1 SHOCK MOUNTING RECOMMENDATIONS

It is recommended that any external shock mounts between the drive and the host frame be designed so that the composite system has a vertical resonant frequency of 25 Hz or lower.

A minimum clearance of 0.050 inch should be allowed around the entire perimeter of the drive to allow for cooling airflow and mechanical movement during shock or vibration.

1.10.2 HANDLING AND STATIC DISCHARGE PRECAUTIONS

After unpacking and prior to system integration, the drive is exposed to potential handling and ESD hazard. It is mandatory that you observe standard static-discharge precautions and handle the drive by the frame only.

FIGURE 3: Host/Drive Interface Connectors

Resistor Termination Packs

Ejector/Latch
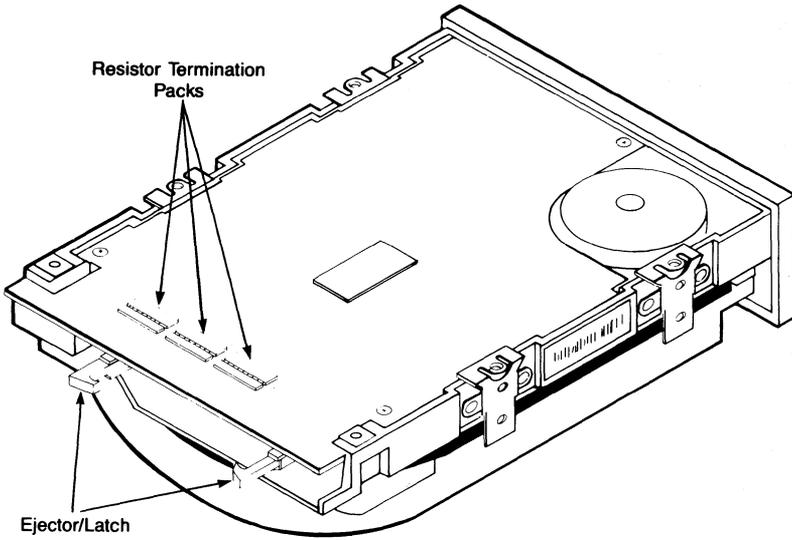
DC POWER CONNECTOR, J3
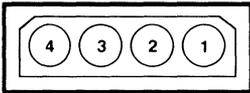
Pin	Power
1	+ 12 Volts
2	+ 12 Volts Return
3	+ 5 Volts Return
4	+ 5 Volts

```
                SCSI ID JUMPERS

SELECT THE DESIRED SCSI ID WITH JUMPERS.
  INSTALL THE P-JUMPER TO ENABLE PARITY.

        P 4 2 1
        o o o o
        o o o o   SCSI ID = O                                    8-PIN
                                                              SCSI ID AND
        o o o o                                               PARITY JUMPER
        o o o o   SCSI ID = I     J3 DC POWER    50-PIN SCSI CONNECTOR

        o o o o   SCSI ID = 2
        o o o o

        o o o o   SCSI ID = 3
        o o o o

        o o o o   SCSI ID = 4
        o o o o               PIN-I

        o o o o   SCSI ID = 5
        o o o o

        o o o o   SCSI ID = 6
        o o o o

        o o o o   SCSI ID = 7
        o o o o
```
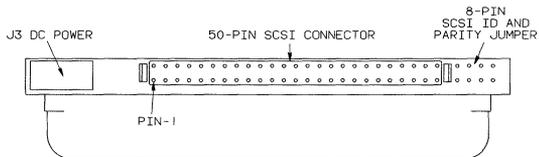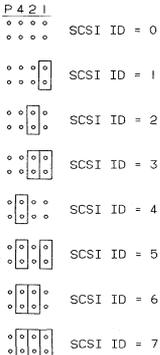
1.11 I/O CABLE REQUIREMENTS

1.11.1 CABLE

A 50-conductor flat cable or 25-conductor twisted pair cable is required. The maximum cable length is 6 meters (19.7 ft). Each SCSI bus connection may have a 0.1 meter (0.33 ft) maximum stub length.

The characteristic impedance for unshielded flat or twisted pair ribbon cable should be 100 Ω $\pm$10%. A characteristic impedance greater than 90 Ω is preferred for shielded cables. To minimize discontinuities and signal reflections it is desirable to minimize the use of cables of different impedances in the same bus.

1.11.2 CONNECTOR REQUIREMENTS

The drive connector is a 50-conductor connector with two rows of 25 male pins on 100 mil centers.

The cable connector is a 50-conductor nonshielded connector consisting of two rows of 25 female contacts on 100 mil centers. Recommended strain-relief connectors are AMP part number 1-499506-2 or DUPONT part number 66900-X50.

FIGURE 4: Nonshielded Cable Connector
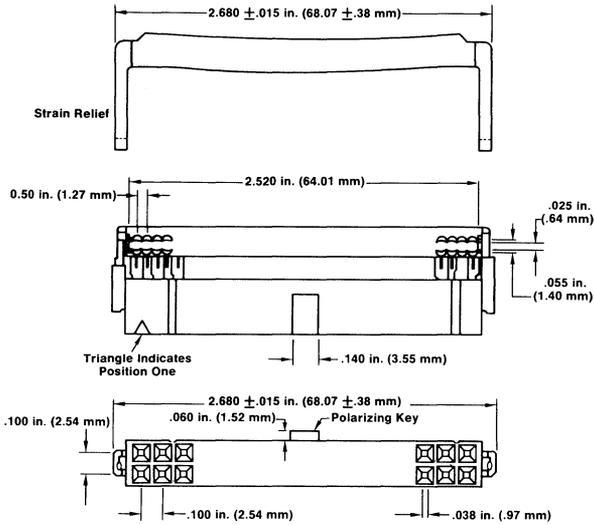
FIGURE 5: 50-Pin SCSI Connector Pin Assignments

Signal	Pin Num.	Signal	Pin Num.
-DB(0)	2	Ground	28
-DB(1)	4	Ground	30
-DB(2)	6	-ATN	32
-DB(3)	8	Ground	34
-DB(4)	10	-BSY	36
-DB(5)	12	-ACK	38
-DB(6)	14	-RST	40
-DB(7)	16	-MSG	42
-DB(P)	18	-SEL	44
Ground	20	-C/D	46
Ground	22	-REQ	48
Ground	24	-I/O	50
Terminator Power	26		

Note: *All odd pins, except pin-25 are connected to ground.*
Pin-25 is not connected.

1.12 SCSI BUS DRIVERS/RECEIVERS

The ST251N/277N use open collector drivers. All signals are terminated with 220 Ω to +5 VDC (nominal) and 330 Ω to ground. The terminating resistors are removable for multi-drive configuration.

For these measurements, SCSI bus termination is assumed to be external to the drive. A typical drive is supplied with the resistor termination packs installed.

Signals driven by the ST251N/277N have the following output characteristics, when measured at the drive connector:

Signal assertion = 0.0 VDC to 0.4 VDC
Minimum driver output capability = 48 mAmps (sinking) @ 0.5 VDC
Signal negation = 2.5 VDC to 5.25 VDC

Signals received by the ST251N/277N must have the following input characteristics, when measured at the drive connector:

Signal true: 0.0 VDC to 0.8 VDC
Maximum total input load: -0.4 mAmps @ 0.4 VDC
Signal false: 2.0 VDC to 5.25 VDC
Minimum Input Hysteresis: 0.2 VDC

2.0 GENERAL PRODUCT DEFINITION

The ST251N/277N feature an integral SCSI-compatible controller. This embedded controller performs all of the functions that were previously implemented by an add-on, controller. And, with the controller onboard, the diagnostic capabilities of the drive are enhanced because the controller is able to optimize drive performance and error recovery.

Our low-cost ST01 Host Adaptor provides the SCSI interface between your IBM PC/XT/AT (or compatible) and up to seven SCSI devices.

Refer to the *Seagate ST01 Host Adaptor Product Manual* for detailed product definition and specifications.

2.1 SCSI INTERFACE

The embedded controller supports the SCSI interface as defined in the ANSI X3T9.2/82-2 document. The interface hardware is capable of transferring up to 12 megabits/second using asynchronous data transfer. Devices on the SCSI interface are daisy-chained together using a common cable. Both ends of the cable are terminated. All signals on the interface are common between all devices.

Refer to the *Seagate SCSI Interface Manual* for a detailed discussion of the SCSI interface.

2.2 INTELLIGENT DISC DRIVE CONFIGURATION

The ST251N/277N support four commands which determine and control the drive's operating environment.

Read Capacity: Defines the formatted capacity

Inquiry: Defines the drive type and identifies physical device parameters

Mode Sense: Defines the drive's current operating environment

Mode Select: Provides a method to change the operating characteristics of the drive

The host system can control the following key parameters:

- Total number of blocks available
- Block length
- Record interleave
- Enable/disable error recovery
- Enabling/disabling reporting of recovered error status
- Enabling/disabling of reporting usage and error counter overflow

2.2.1 SCSI BUS ADDRESS

Three jumpers are provided on the drive for selecting the SCSI bus address. The microprocessor accesses this information at power-on. The address jumpers are accessed only during the power-on sequence. If the SCSI address is changed, the drive must be powered off and on.

2.3 ST251N/277N SCSI COMMANDS

The commands shown in *Figure 6 on page 2-3* are supported by the ST251N/277N. Refer to the *Seagate SCSI Interface Manual* for a detailed discussion of the SCSI interface.

Op. Code	Description
00_H	Test Unit Ready
01_H	Rezero Unit
03_H	Request Sense
04_H	Format Unit
07_H	Reassign Blocks
08_H	Read
$0A_H$	Write
$0B_H$	Seek
11_H	Read Usage Counter
12_H	Inquiry
15_H	Mode Select
16_H	Reserve
17_H	Release
$1A_H$	Mode Sense
$1B_H$	Start/Stop
$1D_H$	Send Diagnostic
25_H	Read Capacity
28_H	Read
$2A_H$	Write
$2B_H$	Seek
$2F_H$	Verify
37_H	Read Defect Data
$3B_H$	Write Buffer
$3C_H$	Read Buffer
$E5_H$	Read Long
$E6_H$	Write Long

2.4 ERROR RECOVERY

The controller provides error recovery routines which are necessary to assure data integrity. These techniques include ECC, seek-retry, read-retry, head-offset and defect management. To assure a high degree of data reliability, the controller utilizes a 32-bit error checking and correction polynomial.

2.5 DISC FORMAT

The disc format is flexible and supports either 512 or 1,024 bytes per sector.

2.5.1 FORMATTING AND DEFECT MANAGEMENT

Media defects are identified and recorded on the disc during the manufacturing process. This defect map is used during formatting and enables the drive to bypass these defects. During the formatting operation, the controller uses the sector-slip technique to reassign defective sectors.

Sector-slip allows any sector with a defect to be mapped and bypassed. The next contiguous sector is given that sector address. The ST251N/277N support the following three variations of the format command:

● Format using a combined list of previously defined defects (manufacturer's list plus user-defined list)

● Format with previously defined list plus additional user-defined defects

● Format with manufacturer's list only (removes all user-defined defects)

2.5.2 RECORD INTERLEAVE

The ST251N/277N support user-specified record interleaves of from 1 to 1 (records formatted sequentially on the disc) through the number of records per track minus one. This gives the user the ability to configure the drive for maximum performance within the operating environment.

2.6 DIAGNOSTICS

At power-on the ST251N/277N will execute a series of diagnostic tests. Any failure will be indicated by a series of LED flashes. The first failure will be preserved. Any power-up failure will result in sense code 29_H,

an internal controller error and an additional power-on diagnostic code in sense byte one. The drive is ready to read/write if no error codes are received within 20 seconds. The failure codes and the test sequence follow:

Microprocessor/Internal Memory Test: Failure is indicated by one flash and an additional sense code (byte one) of 31_H.

Microprocessor ROM Checksum Test: Failure is indicated by two flashes and an additional sense code of 32_H.

Controller Chip Test: Failure to initialize correctly is indicated by three flashes and an additional sense code of 33_H.

Controller Program RAM Test: Failure is indicated by four flashes an an additional sense code of 34_H.

Data Buffer RAM Test: Failure is indicated by five flashes and an additional sense code of 35_H.

Spindle Speed Test: If the drive is unable to reach and maintain correct spindle speed, six flashes will be returned with an additional sense code of 36_H.

Read Record ID Mark: If the controller is unable to find and read an ID mark for any record, seven flashes are returned with an additional sense code of 37_H.

Read Operating System Microcode From Drive: If the controller is unable to read the operating system from the drive, eight flashes are returned with an additional sense code of 38_H. If the controller reads the operating system records, but determines that they are invalid, nine flashes are returned with an additional sense code of 39_H.

2.7 INCOMING INSPECTION

The ST251N/277N support a self-test routine that Seagate recommends for incoming inspection. This test may be run after the unit has sucessfully passed the power-on diagnostics.

2.7.1 ENABLING THE OFFLINE SELFTEST ROUTINES

To enable the test, short the following pins to ground at the SCSI connector: 2, 12, 16 and 32.

The selftest is in three parts. They will cycle in order until power or a grounding jumper is removed, or until 10 complete passes.

The LED will remain **on** during the test and will turn **off** if an error is detected or a jumper is removed. The LED will flash continuously if 10 passes are completed without error.

Part One: All sectors in the user data area are read starting with logical block zero.

Part Two: This is a butterfly seek/read test. Starting at the center of the user data tracks, the unit will seek outward and inward by increments until the limits of the user data tracks are reached. A one-track read is performed to verify position.

Part Three: This part performs a write/read compare on all sectors of the diagnostic cylinders using data pattern $6DB_H$. The diagnostic cylinders are located at an inner region on each media surface. Any unrecoverable errors will terminate the test and turn off the LED.