ST125N
ST138N
ST157N
PRODUCT MANUAL

Seagate

ST125N/ST138N/ST157N
Product Manual

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1 Specification Summary

1.1 Drive Capacity

1.1.1 Formatted Capacity

		ST125N	
Guaranteed Megabytes:	21.3	21.5	18.2
Bytes per Cylinder:	52,224	52,736	44,800
Bytes per Track:	13,312	13,312	11,264
Bytes per Sector:	1,024	512	256

		ST138N	
Guaranteed Megabytes:	31.8	32.2	27.4
Bytes per Cylinder:	52,224	52,736	44,800
Bytes per Track:	13,312	13,312	11,264
Bytes per Sector:	1,024	512	256

		ST157N	
Guaranteed Megabytes:	48.2	48.6	41.3
Bytes per Cylinder:	78,848	79,360	67,328
Bytes per Track:	13,312	13,312	11,264
Bytes per Sector:	1,024	512	256

1.2 Data Organization

		ST125N	
Guaranteed Sectors:	20,757	41,921	71,225
Sectors per Cylinder:	51	103	175
Sectors per Track:	13	26	44
Diagnostic R/W Cylinders:	1	1	1
Bytes per Sector:	1,024	512	256

	ST138N		
Guaranteed Sectors:	31,059	62,933	107,100
Sectors per Cylinder:	51	103	175
Sectors per Track:	13	26	44
Diagnostic R/W Cylinders:	1	1	1
Bytes per Sector:	1,024	512	256

	ST157N		
Guaranteed Sectors:	47,047	94,860	161,219
Sectors per Cylinder:	77	155	263
Sectors per Track:	13	26	44
Diagnostic R/W Cylinders:	1	1	1
Bytes per Sector:	1,024	512	256

1.3 Access Time Definition and Timing

Access time is a true statistical average of at least 5000 measurements of the time it takes to execute the seek specified below less overhead. Overhead is measured by issuing a no motion seek from the highest Logical Block Address (LBA). Seek times are measured by monitoring the Busy line on the SCSI bus. All measurements assume a block size of 512 bytes and an ambient temperature of 25° C.

Track-to-track access time is an average of all possible single track seeks in both directions.

Average access time is measured by executing seek commands from one random LBA to another.

Maximum (full-stroke) access time is half the time needed to seek from LBA 0 to the maximum LBA and back to LBA 0.

	MLC-0	MLC-1
Track-to-Track:	8 msec. typ. 10 msec. max.	8 msec. typ. 10 msec. max.
Average:	38 msec. typ. 40 msec. max.	28 msec. typ. 30 msec. max.
Maximum (Full-Stroke):	90 msec. typ. 95 msec. max.	70 msec. typ. 75 msec. max.
Average Latency:	8.33 msec.	8.33 msec.

Note: Several factors contribute to overhead time, including host and controller overhead. Host overhead varies from one host to another and can not be specified. Controller overhead is a function of controller hardware and firmware and is typically less than 3 msec.

1.4 Functional Specifications

	ST125N	ST138N	ST157N
Tracks:	1,628	2,452	3,678
Cylinders:	407 (0-406)	615 (0-614)	615 (0-614)
Read/Write Heads:	4	4	6
Discs:	2	2	3
Rotational Speed:	3,600 ±0.5%		
Recording Method:	RLL (2,7)		
Recording Density (BPI):	22,430		
Flux Density (FCI):	14,953		
Track Density (TPI):	824		
Interface:	SCSI		
I/O Data Transfer Rate:	Up to 1.5 Mbytes/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)
Width:	4.02 inches max. (102.6 mm)
Depth:	5.77 inches max. (146.6 mm)
Weight:	1.6 lbs. (0.73 Kg.)

1.6 Reliability Specifications

MTBF:	30,000 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:	26° C (78.8° F) 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 at the inside diameter of the disc.

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	0.020 in. double amplitude
22-300 Hz	0.5 G peak amplitude
300-22 Hz	0.5 G peak amplitude
22-5 Hz	0.020 in. double amplitude

1.8.3 Nonoperating Shock

Maximum permitted shock without incurring physical damage or degradation in performance: 60 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	0.040 in. double amplitude
22-300 Hz	1.00 G peak amplitude
300-22 Hz	1.00 G peak amplitude
22-5 Hz	0.040 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 seeking/nonseeking current and power specifications assume nominal voltage applied, 25° C ambient temperature, sea level and spindle rotating.

Maximum (3 Σ max.) seeking and nonseeking current specifications assume 10° C ambient temperature, 5.25 VDC and 12.6 VDC applied, sea level and spindle rotating.

+12 VDC	
Voltage Tolerance (inc. ripple):	±5%
Max. Current at Power-Up:	2.0 Amps
Max. RMS Current at Power-Up (t≤10 sec.):	1.5 Amps
Seeking Current:	
Peak Max.	1.4 Amps
RMS Max.	0.9 Amps
RMS Typ.	0.6 Amps
Nonseeking Current:	
RMS Max.	0.5 Amps
RMS Typ.	0.35 Amps

+5 VDC	Without Term.	With Term.
Voltage Tolerance (inc. ripple):	±5%	±5%
Seeking Current:		
Peak Max.	1.4 Amps	1.6 Amps
RMS Max.	1.2 Amps	1.4 Amps
RMS Typ.	1.0 Amps	1.2 Amps
Nonseeking Current:		
RMS Max.	1.1 Amps	1.3 Amps
RMS Typ.	0.9 Amps	1.1 Amps

POWER		
Power Typ.	9 Watts	10 Watts

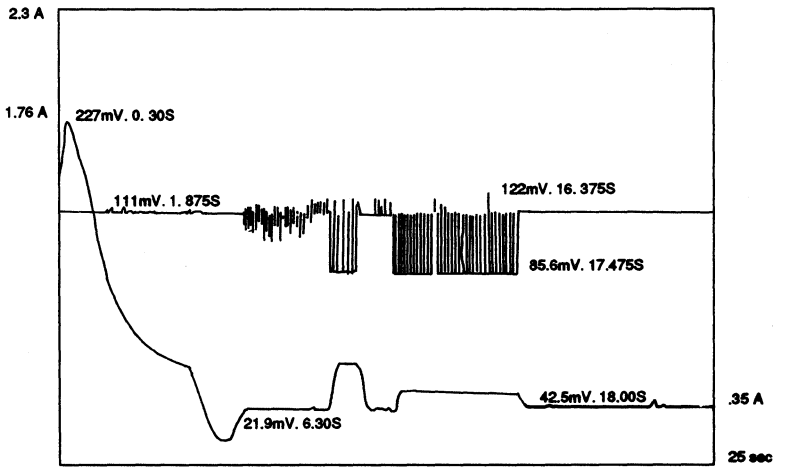
1.9.1 Input Noise Ripple and Frequency

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 drive may be mounted horizontally with the spindle motor down, or on either side (edge). Mounting vertically on either end is a prohibited orientation. The drive should not be tilted (front to back) in any position, by more than 5°.

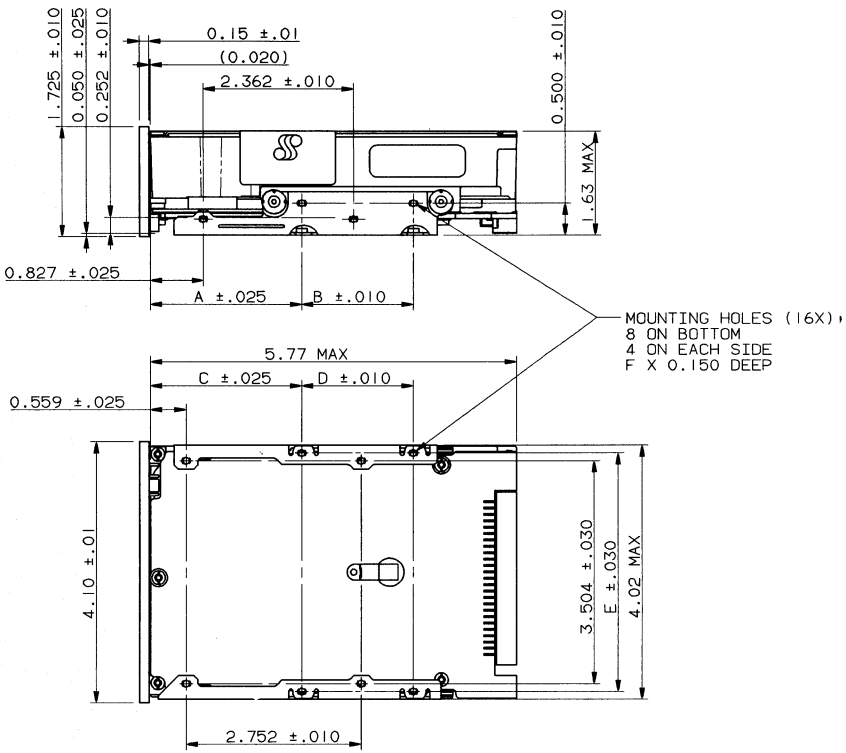
For optimum performance the drive should be formatted in the same orientation as it will be mounted in the host system.

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.

Figure 2: Mounting Dimensions



TABULATION						
THREAD TYPE	A	B	C	D	E	F
ENGLISH	2.375	1.750	2.375	1.750	3.750	6-32 UNC-2B
METRIC	2.433	1.752	2.433	1.752	3.752	M4 X 0.7-6H

NOTES:

1. ALL DIMENSIONS, INCLUDING TABULATION, ARE IN INCHES.

1.10.2 Handling and Static Discharge Precautions

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

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 10 cm (3.9 in) maximum stub length.

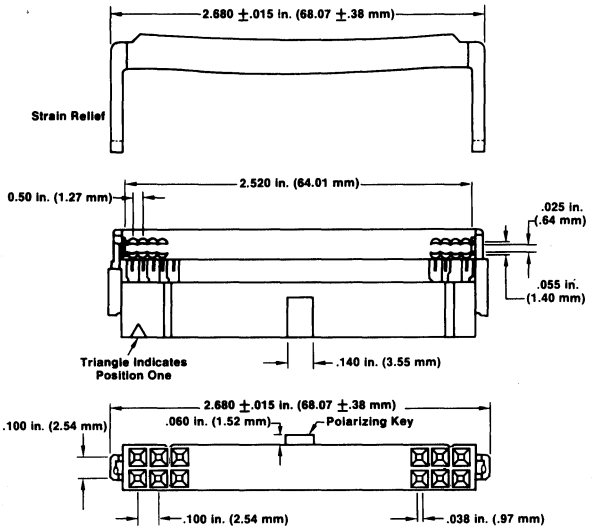
The characteristic impedance for unshielded flat or twisted pair ribbon cable should be 100 Ω ±10%. A characteristic impedance greater than 90 Ω is preferred for shielded cables. To minimize discontinuities and signal reflections it is desirable to minimize the use of cables of different impedances in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

Figure 3: 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.

Figure 4: Nonshielded Cable Connector



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.

1.12 SCSI Bus Drivers/Receivers

The drive 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 drive have the following output characteristics, when measured at the drive connector:

Signal true:	0.0 VDC to 0.4 VDC
Signal false:	2.5 VDC to 5.25 VDC

Signals received by the drive 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 General Product Definition

The ST125N/138N/157N 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.

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 1.5 megabytes/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*, 36021-001, for a detailed discussion of the SCSI interface.

2.2 Intelligent Disc Drive Configuration

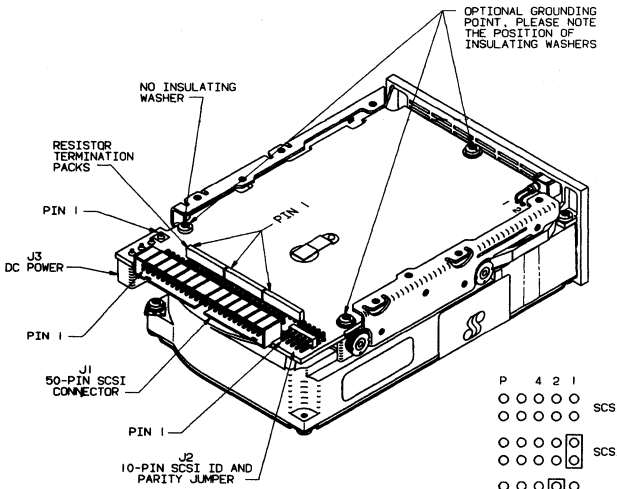
The ST125N/138N/157N support four commands which determine and control the drive's operating environment.

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

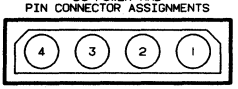
The host system can control the following key parameters:

- Total number of blocks available
- Block length

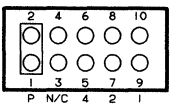
Figure 5: Host/Drive Interface Connectors

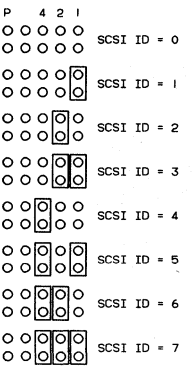


J3
DC POWER AND
PIN CONNECTOR ASSIGNMENTS



PIN	POWER
1	+12 VDC
2	+12 VOLTS RETURN
3	+5 VOLTS RETURN
4	+5 VDC





J2 SCSI ID JUMPERS
SELECT THE DESIRED SCSI ID WITH JUMPERS.
INSTALLING A JUMPER ON PINS 1 AND 2 ENABLES PARITY.
N/C = NO CONNECTION

- Sector 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

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 ST125N/138N/157N SCSI Commands

The commands shown in the Command Summary figure that follows are supported by the ST125N/138N/157N. Refer to the *Seagate SCSI Interface Manual* for a detailed discussion of the SCSI interface.

Figure 6: Command Summary

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 256, 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 ST125N/138N/157N 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 Sector Interleave

The ST125N/138N/157N support user-specified sector interleaves of from 1 to 1 (sectors formatted sequentially on the disc) through the number of sectors 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 ST125N/138N/157N 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 20_H invalid. The drive is ready to read/write if no error codes are received within 25 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 81_H.

Microprocessor ROM Checksum Test: Failure is indicated by two flashes and an additional sense code of 82_H.

Controller Chip Test: Failure to initialize correctly is indicated by three flashes and an additional sense code of 83_H.

Controller Program RAM Test: Failure is indicated by four flashes an an additional sense code of 85_H.

Data Buffer RAM Test: Failure is indicated by five flashes and an additional sense code of 86_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 87_H.

Read Sector ID Mark: If the controller is unable to find and read an ID mark for any sector, seven flashes are returned with an additional sense code of 88_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 88_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 88_H.

2.7 Incoming Inspection

The ST125N/138N/157N 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.

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