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Medalist 2132 (ST32132A)

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ATA Interface Drive

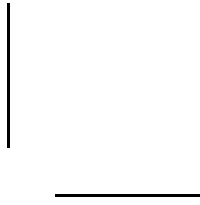
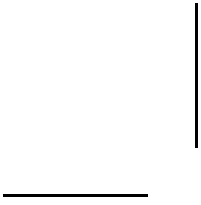
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Product Manual

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ATA Interface Drive

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Introduction

This manual describes the functional, mechanical and interface specifications for the Medalist[®] 2132 hard disc drive. The drive is referred to throughout this manual by its model number, ST32132A.

The ST32132A drive is designed to meet the needs of entry-level to midrange desktop computers. It is a standard 3.5-inch form-factor drive that features PRML recording technology, advanced transfer modes, multiple block read/write, segmented cache, power management and S.M.A.R.T. capabilities. The drive's 2.1-Gbyte capacity provides ample space to store large software programs and allows these programs to run efficiently.

Fast ATA-3 performance is available on this drive. The Medalist 2132 supports advanced PIO modes 3 and 4 and advanced multiword DMA modes 1 and 2 for burst transfer rates up to 16.6 Mbytes per second. The drive supports multiple block read/write, which allows it to store contiguous blocks of data in its 128-Kbyte segmented cache and to transfer the blocks in a single burst.

The drive supports power-management modes for energy-efficient operation. Power dissipation falls to 0.84W (typical) in Standby mode. The drive enters power-saving modes at the request of the host. It can also be programmed to automatically enter power-saving modes using the Idle timer or Standby timer commands. The power-management modes the drive supports are discussed in Section 1.7.1 on page 8. The power-management commands the drive supports are listed in the ATA-command table on page 25.

Specifications summary table

The following table serves as a quick reference for the ST32132A performance specifications. These and other specifications are discussed in the Drive Specifications section following the table.

Drive specification	ST32132A
Guaranteed capacity (Mbytes ¹) ($\times 10^6$ bytes)	2,113.413
Guaranteed sectors	4,127,760
Bytes per sector	512
Sectors per track	63
Logical Read/Write heads	16
Logical cylinders	4,095
Physical Read/Write heads	6
Physical discs	3
Recording density (kbits)	89
Track density (tracks per inch)	5,435
Spindle speed (RPM)	4,504
Track-to-track seek time (msec typical)	2.5
Average seek time (msec typical)	12.5
Full-stroke seek time (msec typical)	30
Average latency (msec)	6.66
Internal data-transfer rate (Mbits per sec max)	35 to 68.0
External transfer rate (Mbytes per sec max) PIO mode	16.6
External transfer rate (Mbytes per sec max) DMA mode	16.6
Cache buffer (Kbytes)	128
Height (inches max)	1.00
Width (inches max)	4.02
Depth (inches max)	5.77
Typical weight (lb)	1.3
Power-on to ready (sec typical)	7
Spinup current (typical)	1.31A

1. One Mbyte equals one million bytes.

Drive specification	ST32132A
Seek power (typical)	5.98W
Read/Write power (typical)	4.97W
Idle total power (typical)	3.24W
Standby power (typical)	0.84W
Voltage tolerance (including noise): +5V	± 5%
Voltage tolerance (including noise): +12V	± 5%
Operating temperature (°C)	5° to 55°C
Nonoperating temperature (°C)	-40° to 70°C
Operating temperature gradient (°C per hour max)	20°C
Relative humidity, operating gradient (max)	10% per hour
Altitude, operating	-1,000 to 10,000 ft.
Altitude, nonoperating	-1,000 to 40,000 ft.
Shock, normal operating (Gs max at 11 msec)	2.0 Gs
Shock, nonoperating (Gs max at 11 msec)	125 Gs
Vibration (Gs max at 22–300 Hz without nonrecoverable errors), operating	1.0 G Peak to Peak
Vibration (Gs max at 22–300 Hz with no physical damage incurred), nonoperating	8.0 Gs Peak to Peak
Drive acoustics, Idle mode (dBA), typ	30 dBA
Nonrecoverable read errors (per bits transferred)	10 ¹³
Mean time between failures (power-on hours)	300,000
Contact start-stop cycles	40,000
Service life (years)	5

1.0 Drive Specifications

1.1 Formatted Capacity

The drive is low-level formatted at the factory. You do not need to low-level format the drive.

This drive supports cylinder-head-sector (CHS) and logical-block addressing (LBA) translation modes. You can use the Identify drive (ECH) command to verify the address modes the drive supports, the number of cylinders, sectors per track, total number of sectors, heads and other parameters. The Identify drive parameters are listed in Section 3.3.1. on page 26.

	CHS	LBA
Cylinders	4,095	—
Heads	16	—
Sectors per track	63	—
Guaranteed capacity (bytes)	2,113,413,120	2,113,413,120
Guaranteed sectors	4,127,760	4,127,760

1.2 Physical organization

Heads	6
Discs	3

1.3 Functional specifications

Interface	ATA-3
Internal data-transfer rate (Mbits/sec)	35.0 to 68.0
External data-transfer rate (Mbytes/sec)	
PIO Mode 4	16.6 (max)
DMA Mode 2	16.6 (max)
Spindle speed $\pm 0.5\%$ (RPM)	4,504
Segmented cache (Kbytes)	128
Zone Bit Recording method	PRML (0,12,8)
Bytes per sector	512
Recording density, max (BPI)	89K
Flux density, max (FCI)	97K
Track density, max (TPI)	5,435

1.4 Physical dimensions

Height (max)	1.00 inch (25.4 mm)
Width (max)	4.02 inches (102.1 mm)
Depth (max)	5.77 inches (146.6 mm)
Weight (max)	1.3 lb (0.59 Kg)

1.5 Seek time

Seek value is the interval between the time the actuator begins to move and the time the head has settled over the target track. Seek time is a true statistical average of at least 10,000 measurements of seek time. All measurements are taken under nominal conditions of temperature and voltage with the drive mounted horizontally. The specifications in the table below are defined as follows:

- Track-to-track seek time is an average of all possible single-track seeks in both directions.
- Average seek time is a true statistical random average of at least 10,000 measurements of seeks between random tracks, less overhead.
- Full-stroke seek time is one-half the time needed to seek from the first data cylinder to the maximum data cylinder and back to the first data cylinder. The full-stroke average is determined by measuring 100 full-stroke seeks in both directions.

Track-to-track typ (msec)	Average typ (msec)	Full-stroke typ (msec)	Latency (msec)
2.5	12.5	30	6.66

1.6 Start and stop time

The drive is ready within 10 seconds. Typical and maximum start and stop times are shown in the following table. Figure 1 on page 8 shows a typical startup current profile.

	Typical	Maximum
Start time	7 sec	11 sec
Stop time	6 sec	9 sec

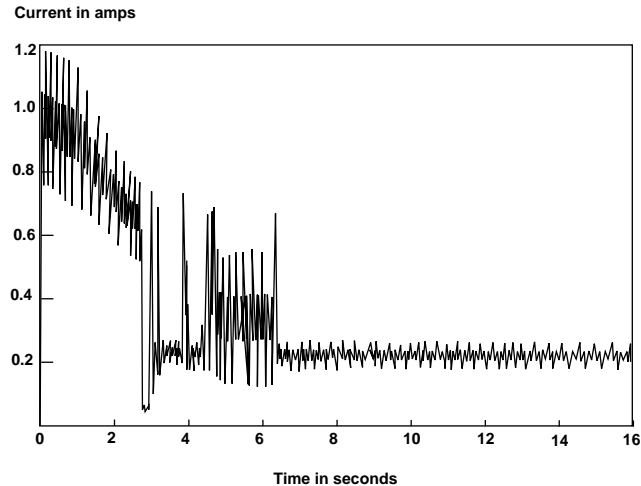


Figure 1. Typical startup current profile

1.7 Power specifications

Except during a write operation, you can apply power to the drive or remove power from the drive in any sequence without losing data or damaging the drive.

1.7.1 Power-management modes

The drive supports the following power-management modes:

- **Active mode.** The drive is seeking, reading or writing.
- **Idle mode.** The drive enters Idle mode when it receives an Idle Immediate command or the idle timer counts down to zero. In Idle mode the spindle remains up to speed, the segmented cache remains enabled, and the drive accepts all commands and returns to the Active mode whenever a seek, read or write operation is needed.
- **Standby mode.** The drive enters Standby mode when it receives a Standby Immediate command or the standby timer counts down to zero. In the Standby mode the segmented cache remains enabled, the heads are parked in the shipping zone and the spindle is stopped. The drive accepts all commands and returns to the Active mode whenever a seek, read or write operation is needed.
- **Sleep mode.** The drive enters Sleep mode when it receives a Sleep Immediate command. The heads are parked in the shipping zone and the spindle is at rest. A hard reset or a soft reset returns the drive to Active mode. A soft reset preserves the current emulation and translation parameters.

1.7.1.1 Idle and Standby timers

The drive can enter the Idle mode or the Standby mode by two different methods:

- The computer sends an Idle Immediate command or a Standby Immediate command.
- The idle timer or the standby timer counts down to zero.

The Idle and Standby timers are disabled at the factory. Use the computer's setup utility to enable and to set the timer delays. When the Idle timer is enabled, it is initialized each time the drive completes a read, write or seek.

If the Idle timer reaches zero before any drive activity is required, the drive goes into the Idle mode, and the Standby timer, if it is enabled, is initialized. If the Standby timer reaches zero before any drive activity is required, the drive goes into the Standby mode. See the *Seagate ATA Interface Reference Manual*, publication number 36111-xxx, for details.

In both the Idle and Standby modes, the drive accepts all commands and returns to the Active mode any time disc access is necessary. There may be a slight delay between the time the drive receives the command and the time drive activity begins.

1.7.1.2 Power consumption

The following guidelines are used to measure power consumption:

- All measurements are taken at sea level with an ambient temperature of 25°C.
- All typical measurements are taken using nominal voltages; the peak startup power is measured using the nominal voltages.
- Seek current measurements are taken using an RMS meter while the drive is randomly seeking with two spindle rotations between each seek.

Mode	Current (amps)		Power (watts)
	+12V	+5V	
Spinup (peak)	1.31	0.35	10.2 ³
Active			
Seeking (typ)	0.39	0.26	5.98
Read/write (typ)	0.26	0.37	4.97
Idle ² (typ)	0.22	0.12	3.24
Standby ² (typ)	0.02	0.12	0.84
Sleep ² (typ)	0.02	0.07	0.59

1.7.2 Voltage tolerances

	+5V	+12V
Voltage tolerance including noise	± 5%	± 5% ± 10% during spinup

1.7.3 Conducted noise

The drive is expected to operate with a maximum of:

- 150 mV peak-to-peak triangular-wave injected noise at the power connector. The frequency is 10 Hz to 100 KHz with equivalent resistive loads.⁴
- 100 mV peak-to-peak triangular-wave injected noise at the power connector. The frequency is 100 KHz to 10 MHz with equivalent resistive loads.⁴

2. These values apply only when power management is enabled. To enable power management, use the computer's setup utility.

3. Spinup power is averaged over 7 seconds.

4. Equivalent resistance is calculated by dividing the respective voltage by the typical RMS read/write current.

1.7.4 Environment

The acceptable environmental conditions for the drive are specified below. The specifications in this section are defined as follows:

- Operating specifications assume that the drive is powered up.
- Nonoperating specifications assume that the drive is packaged as it was shipped from the factory.

1.7.5 Ambient temperature

Operating	5° to 55°C (41° to 131°F)
Nonoperating	−40° to 70°C (−104° to 158°F)

1.7.6 Temperature gradient

Operating (max)	20°C per hour (36°F per hour)
Nonoperating (max)	30°C per hour (54°F per hour)

1.7.7 Relative humidity

Operating	8% to 80% noncondensing Maximum wet bulb 29.4°C (85.0°F)
Nonoperating	5% to 95% noncondensing Maximum wet bulb 40.0°C (104.0°F)

1.7.8 Altitude

Operating	−1,000 ft to 10,000 ft (−305 m to 3,050 m)
Nonoperating	−1,000 ft to 40,000 ft (−305 m to 12,200 m)

1.7.9 Shock and vibration

All shock and vibration specifications apply when the drive is mounted as recommended in Section 2.5. on page 20, with the input levels measured at the drive mounting screws. Shock measurements are based on an 11 msec, half sine wave shock pulse, not to be repeated more than twice per second.

During normal operating shock and vibration, there is no physical damage to the drive or performance degradation. During nonoperating shock and vibration, the read/write heads are positioned in the landing zone.

During abnormal operating shock and vibration, there is no physical damage to the drives, although performance may be degraded during the shock or vibration episode. When normal operating shock levels resume, the drive meets its performance specifications.

	Normal operating	Abnormal operating	Nonoperating
Shock	2.0 Gs	10.0 Gs	125 Gs
5–22 Hz vibration	0.020-inch displacement peak-to-peak	0.030-inch displacement peak-to-peak	0.160-inch displacement peak-to-peak
22–300 Hz vibration	1.0 G peak-to-peak	1.5 Gs peak-to-peak	8.0 Gs peak-to-peak

1.8 Acoustics

Sound pressure is measured at idle from 1 meter above the drive's top cover.

Idle sound pressure, max (dBA)	30
Idle sound pressure, max (dBA)	33

1.9 Reliability

The MTBF and contact start-stop specifications assume nominal power at sea level with an ambient temperature of 25°C.

Nonrecoverable errors	1 per 10 ¹³ bits read
MTBF	300,000 power-on hours
Contact start-stop (CSS)	40,000 cycles
MTTR	30 minutes
Service life	5 years

1.10 Auto-park

Upon power-down, the read/write heads automatically move to the shipping zone. The heads park inside the maximum data cylinder. When power is applied, the heads recalibrate to track 0.

1.11 Agency listings

This drive is listed with agencies as follows:

- UL 1950
- CSA C22.2 No. 0-M91 and CSA C22.2 No. 950-M89
- EN 60950/10.92 as tested by TUV-Rheinland, North America

1.12 EC compliance

Hard drives that display the CE marking comply with European Union requirements specified in Electromagnetic Compatibility Directive 89/336/EEC as amended by Directive 92/31/EEC of 28 April 1992 and Directive 93/68/EEC of 22 July 1993.

Seagate® uses an independent laboratory to confirm compliance with the EC directives specified in the previous paragraph. Drives are tested in representative end-user systems using 80486, Pentium and PowerPC microprocessors. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. The computer manufacturer or system integrator should confirm EMC compliance and provide CE marking for their product.

1.13 FCC verification

The ST32123A drive is intended to be contained solely within a personal computer or similar enclosure (not attached to an external device). As such, a drive is considered to be a subassembly even when individually marketed to the customer. As a subassembly, no Federal Communications Commission authorization, verification or certification of the device is required.

Seagate Technology, Inc. has tested the drive in an enclosure as described above to ensure that the total assembly (enclosure, disc drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of the FCC rules. Operation with noncertified assemblies is likely to result in interference to radio and television reception.

Radio and television interference. This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Move the device to one side or the other of the radio or TV.
- Move the device farther away from the radio or TV.
- Plug the equipment into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.0 Configuring and mounting the drive

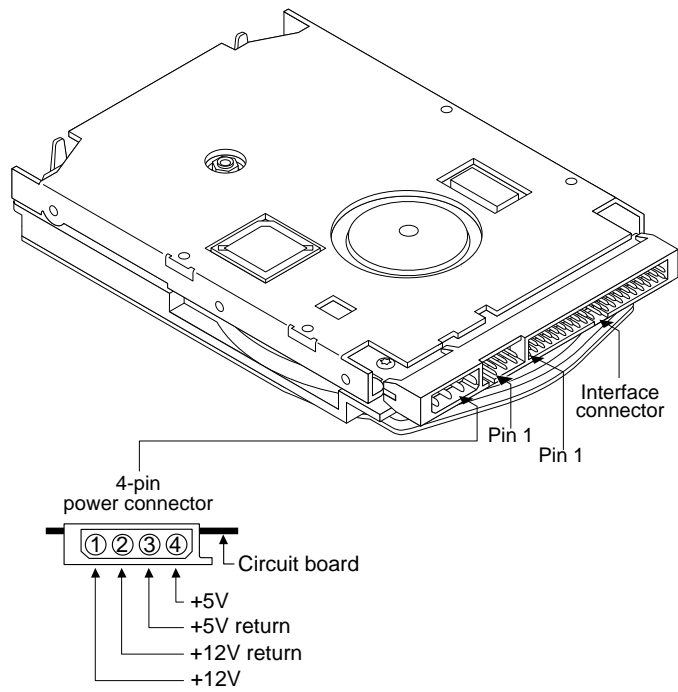
This section contains specifications for configuring and mounting the drive. Figure 2 on page 16 shows the location of the connectors on the drive. A brief discussion about the connectors, the master/slave jumper block settings and how to mount the drive follows.

2.1 Handling and static-discharge precautions

After you unpack the drive, and before you install it in a computer, be careful not to damage it through mishandling. Wool and synthetic clothing, carpet, plastics and Styrofoam are contributors to the static build-up that can damage sensitive components that is discharged through touch. Observe these standard handling and static-discharge precautions:

Caution:

- Keep the drive in its static-shielded bag until you are ready to install it. Do not attach any cables to the drive while it is in the static-shielded bag.
- Wear a wrist strap that is properly connected to earth ground, or ground yourself frequently by touching the metal chassis of a power supply that is plugged into a grounded outlet when handling the drive and throughout the entire installation procedure.
- Handle the drive by its edges or frame only.
- The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until you mount it in the computer.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. If you do, you void the warranty. Some factory-installed labels contain information needed to service the drive. Others are used to seal out dirt and contamination.

**Figure 2. Connectors**

2.2 The ATA interface connector

The drive uses a standard 40-pin interface connector with 2 rows of 20 male pins. Pin 20 is removed. The connector is shown in Figure 3.

For the mating connector, use a 40-pin, nonshielded connector with 2 rows of 20 female contacts. We recommend the following part numbers:

AMP	499496
Berg Electronics	66900-040

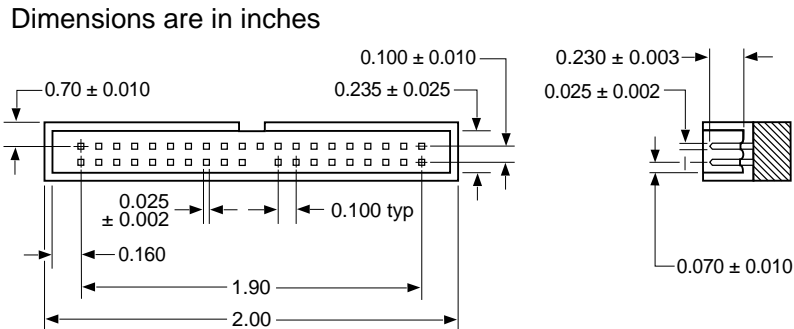


Figure 3. The drive interface connector

2.3 Power connector

The drive comes with a standard 4-pin power connector.

2.4 Master/slave jumper block

The master/slave jumper block allows you to configure the drive for operation. Figure 4 on page 18 shows the master/slave jumper block configuration options. A brief description of each option follows the drawing.

A spare jumper is attached in a neutral position on pins 1 and 3 by the factory. This jumper does not affect drive operation. The jumper block accepts 2-mm (0.100-inch) jumpers. If you need additional jumpers, use Seagate part number 63005-001 or an equivalent.

Caution. If you use a jumper that is not the correct size, you may damage the jumper block and the jumper.

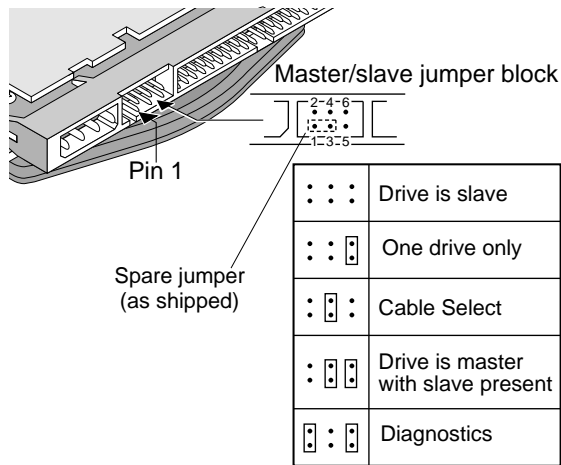


Figure 4. Master/slave jumper block settings

2.4.1 Master/slave configuration

Use the following settings to configure the drive as master or slave.

One drive only. The drive is configured at the factory for single-drive operation. A jumper placed on pins 5 and 6 configures the drive for single-drive installation. The horizontal jumper on pins 1 and 3 is a spare and does not affect drive operation.

Drive as master with an ATA-compatible slave. Place jumpers on pins 3 and 4 and 5 and 6 of the master/slave jumper block.

Drive as slave. Remove all the jumper settings.

2.4.2 Cable-select option

Computers that use cable-select determine the master and slave drives by selecting or deselecting pin 28, CSEL, on the interface bus. Master and slave drives are determined by their physical position on the cable.

- The drive plugged into the I/O connector that carries the CSEL signal is the master.
- The drive plugged into the I/O connector that does not carry the CSEL signal is the slave.

To configure drives for computers that use cable-select:

- Install jumpers on pins 3 and 4 as shown in Figure 4 above.
- Connect the drives to the cable as shown in Figure 5 on page 19.

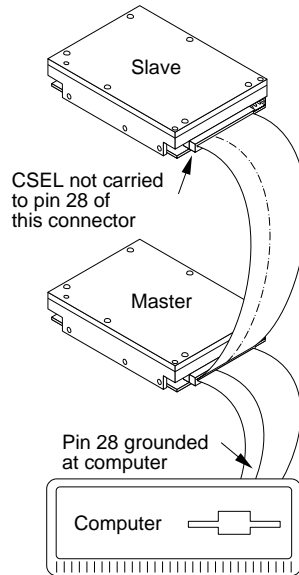


Figure 5. Connecting cable-selected drives

2.4.3 Diagnostics Jumper

The diagnostics jumper activates a drive feature called EZConfig. EZConfig allows the advanced user to enable, disable or change the size of the read and write cache and to configure PIO mode 4 capability. To use EZConfig, follow the procedure below.

1. Place jumpers on pins 1 and 2 and on pins 5 and 6 of the options jumper block.
2. If you have more than one hard drive, remove the drive you do not want to test. Connect the test drive to the primary channel on the host adapter.
3. Restart your computer and enter the system BIOS setup program. Select auto-detect or an available drive type if no hard drive is defined.
4. Reboot your computer. The EZConfig program starts automatically.
5. When you are done running EZConfig, turn off your computer, remove the drive and place the master/slave jumpers back on the appropriate pins. Reinstall the drive and reconfigure the system BIOS setup.

2.5 Mounting the drive

You can mount the drive in any orientation using either the bottom or the side mounting holes as described below. Figure 6 shows the drive dimensions and mounting holes.

Bottom mounting holes. Insert four mounting screws not more than 0.20 inches (6 full turns) into the drive frame.

Side mounting holes. Insert four mounting screws not more than 0.13 inches (4 full turns) into the drive frame.

Caution. To prevent damage to the drive:

- Use only mounting screws of the correct size and length.
- Lightly tighten the mounting screws—do not apply more than 6 inch-pounds of torque.

Figure 6 on page 21 shows the dimensions in inches and millimeters.

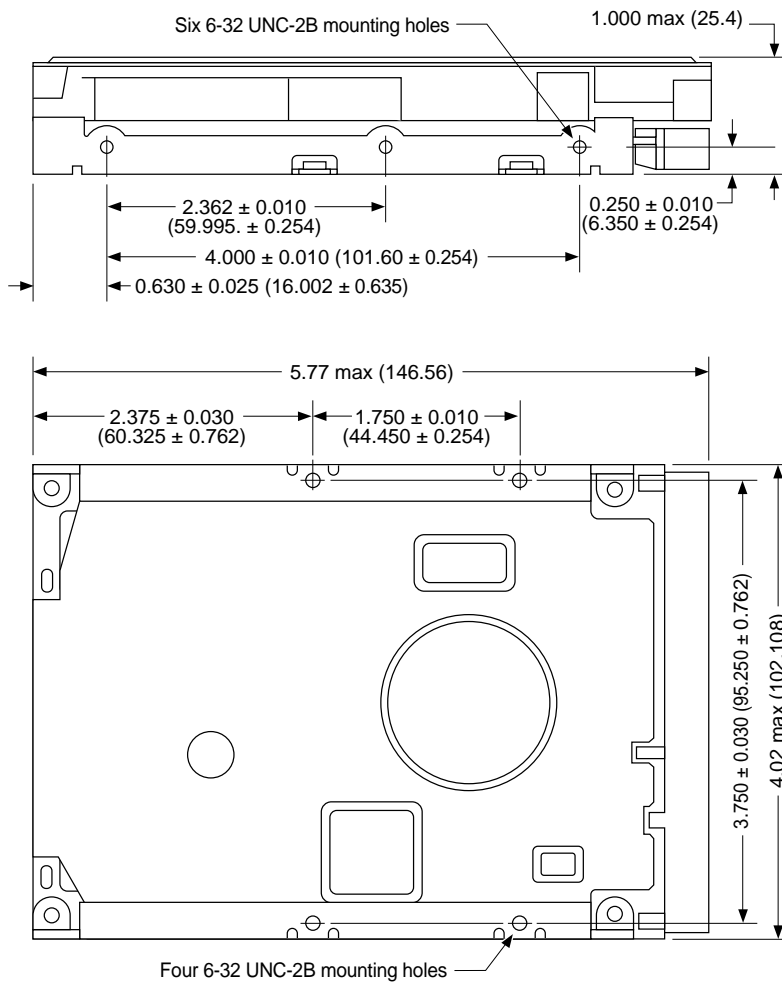


Figure 6. Standard mounting dimensions

3.0 ATA interface

The drive uses an ATA interface. The interface is in compliance with ANSI *ATA (AT Attachment) Interface X3.221, Rev. 4; SFF 8011: ATA Timing Extension for Local Bus Attachments, Rev. 2.0; SFF 8019: Identify Drive Data for Drives Under 8 GB and Draft Proposal American National Standards AT Attachment Interface X3.310-948D, Rev. 2E*. The ATA commands the drive supports is listed in the table on page 24. Commands and features with specific applications for the drive are discussed in this section. For a general discussion of the Seagate ATA interface, refer to the *Seagate ATA Interface Reference Manual*, publication number 36111-xxx.

The ATA interface consists of single-ended, TTL-compatible receivers and drivers that use an asynchronous interface protocol. The drivers can sink up to 24 mA and drive a load up to 300 pF. The integrity of the ATA interface is affected by the interface cable. It is designed to support a 40-conductor, nonshielded interface cable with a maximum length of 18 inches (0.46 meters).

3.1 ATA interface connector pin assignments

The signal name and direction for each I/O connector pin is shown in Figure 7. For a description of each pin, see the *Seagate ATA Interface Reference Manual*, publication number 36111-xxx.

Signal names are shown in upper-case letters. A signal name followed by a minus sign (-) indicates the signal is active low. Otherwise, the signal is active high.

3.2 Bus signal levels

Signals that the drive sends have the following output characteristics measured at the drive connector.

Logic low	0 to 0.4V
Logic high	2.5 to 5.25V

Signals that the drive receives must have the following input characteristics measured at the drive connector.

Logic low	0 to 0.8V
Logic high	2.0 to 5.25V

Drive pin #	Signal name	Host pin # and signal description
1	Reset-	1 Host Reset
2	Ground	2 Ground
3	DD7	3 Host Data Bus Bit 7
4	DD8	4 Host Data Bus Bit 8
5	DD6	5 Host Data Bus Bit 6
6	DD9	6 Host Data Bus Bit 9
7	DD5	7 Host Data Bus Bit 5
8	DD10	8 Host Data Bus Bit 10
9	DD4	9 Host Data Bus Bit 4
10	DD11	10 Host Data Bus Bit 11
11	DD3	11 Host Data Bus Bit 3
12	DD12	12 Host Data Bus Bit 12
13	DD2	13 Host Data Bus Bit 2
14	DD13	14 Host Data Bus Bit 13
15	DD1	15 Host Data Bus Bit 1
16	DD14	16 Host Data Bus Bit 14
17	DD0	17 Host Data Bus Bit 0
18	DD15	18 Host Data Bus Bit 15
19	Ground	19 Ground
20	(removed)	20 (No Pin)
21	DMARQ	21 DMA Request
22	Ground	22 Ground
23	DIOW-	23 Host I/O Write
24	Ground	24 Ground
25	DIOR-	25 Host I/O Read
26	Ground	26 Ground
27	IORDY	27 I/O Channel Ready
*28	CSEL	28 Cable Select
29	DMACK-	29 DMA Acknowledge
30	Ground	30 Ground
31	INTRQ	31 Host Interrupt Request
32	IOCS16-	32 Host 16 Bit I/O
33	DA1	33 Host Address Bus Bit 1
*34	PDIAG-	34 Passed Diagnostics
35	DA0	35 Host Address Bus Bit 0
36	DA2	36 Host Address Bus Bit 2
37	CS1FX-	37 Host Chip Select 0
38	CS3FX-	38 Host Chip Select 1
*39	DASP-	39 Drive Active or Slave Present
40	Ground	40 Ground

*Indicates master-slave signals (details shown below).

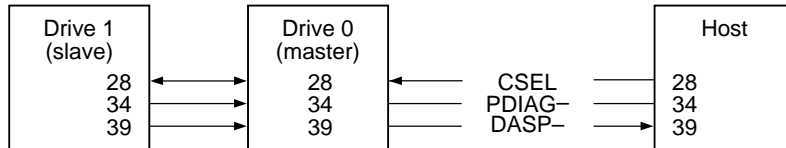


Figure 7. ATA connector pin assignments

3.3 Supported ATA commands

The table on page 25 lists all ATA commands the drive uses. Commands that have a unique application or that may be of special interest are discussed in this manual. For a complete description of all ATA interface commands the drives use, refer to the *Seagate ATA Interface Reference Manual*, part number 36111-xxx. Additional information is provided by the *Small Form Factor specification, SFF-8011 Rev 1.1, September 18, 1993*.

The table on the following page lists all of the ATA commands implemented in the drive. The table uses the following abbreviations:

- FR Features register
- SC Sector count register
- SN Sector number register
- CY Cylinder register
- DH Drive/head register
- n This register does not contain a valid parameter for this command.
- y This register contains a valid parameter for this command. In the drive/head register, both the drive and head parameters are valid for this command.
- D The drive/head register contains a valid drive parameter for this command. The head parameter is not valid for this command.

Command name	Command code (in hex)	Parameters used				
		FR	SC	SN	CY	DH
Check Power Mode	98, E5	n	y	n	n	D
Execute Drive Diagnostics	90	n	n	n	n	D
Format Track	50	n	y	n	y	y
Identify Drive	EC	n	n	n	n	D
Idle	97, E3	n	y	n	n	D
Idle Immediate	95, F8, E1	n	n	n	n	D
Initialize Drive Parameters	91	n	y	n	n	y
Read DMA	C8, C9	—	y	y	y	y
Read Long	22, 23	n	y	y	y	y
Read Multiple	C4	n	y	y	y	y
Read Sector	20, 21	n	y	y	y	y
Read Sector Buffer	E4	n	n	n	n	D
Read Verify Sector	40, 41	n	y	y	y	y
Recalibrate	1X	n	n	n	n	D
Seek	7X	n	n	y	y	y
Set Features	EF	y	n	n	n	D
Set Multiple Mode	C6	n	y	n	n	D
Set Sleep Mode	99, E6	n	n	n	n	D
Standby	96, E2	n	n	n	n	D
Standby Immediate	94, E0	n	n	n	n	D
Write DMA	CA, CB	—	y	y	y	y
Write Long	32, 33	n	y	y	y	y
Write Multiple	C5	n	y	y	y	y
Write Sector	30, 31	n	y	y	y	y
Write Sector Buffer	E8	n	n	n	n	D

3.3.1 Identify Drive command (ECH)

The Identify Drive command transfers information about the drive to the host after power up. The data is organized as a single 512-byte block. The block's contents are shown in the table below. All reserved bits or words must be set to zero. Parameters listed with an "x" are drive-specific or vary with the state of the drive.

The drive parameters are listed in the table below. For a complete description of the Identify Drive command, see the *Seagate ATA Interface Reference Manual*, publication number 36111-xxx.

Word	Description	Value
0	Configuration	045AH Bit 10: 1 = disc transfer rate > 10 Mbits/sec Bit 6: 1 = fixed drive Bit 4: 1 = head switch time > 15 μ sec Bit 3: 1 = not MFM encoded Bit 1: 1 = hard-sectored disc
1	Default cylinders	4,095
2	Reserved	0000H
3	Default heads (default)	16
4	Bytes per track	8D90H
5	Bytes per sector	0248H
6	Default sectors per track	63
7-9	Vendor-unique	0000H
10-19	Serial number	Drive-unique: 20 ASCII characters
20	Buffer type	0003H Multisector with caching
21	Buffer size (number of 512-byte sectors)	00F0H (240D)
22	ECC bytes (R/W Long)	0010H (16D)
23-26	Firmware revision	Drive-dependent: 8 ASCII characters
27-46	Model number	ST32132A

continued

continued from previous page

Word	Description	Value
47	Maximum sectors per interrupt on read/write multiple	0010 _H
48	Double word I/O	0000 _H Not supported
49	Capabilities	0B00 _H DMA, IORDY and LBA supported
50	Reserved	0000 _H
51	PIO timing mode	0200 _H
52	DMA timing mode	0200 _H Single-word DMA supported
53	Current valid	0003 _H Bit 0 = 1 indicates the fields reported in words 54–58 are valid; Bit 1 = 1 indicates the fields reported in words 64–68 are valid
54	Current cylinders	4,095
55	Current heads	16
56	Current sectors per track	63
57–58	Current sectors	4,127,760
59	Current multiple sector setting	01xx _H
60–61	LBA total sectors	4,127,760
62	Single-word DMA	07 _H Modes 0, 1 and 2 are supported
63	Multiword DMA	0107 _H Mode 0 is active; Modes 0,1, and 2 are supported
64	Advanced PIO	0003 _H Modes 3 and 4 are supported
65	Minimum multiword DMA transfer per word	120 nsec
66	Recommended multiword DMA transfer per word	120 nsec (DMA mode 2)

Word	Description	Value
67	Minimum PIO without IORDY	240 nsec
68	Minimum PIO with IORDY ⁵	120 nsec (PIO mode 4)
69–79	Reserved	0000H
80	Supports ATA-1, ATA-2, ATA-3	000EH
81	ATA minor version number	0006H
82	S.M.A.R.T., security status, and power modes supported	000BH
83	Command sets supported	4000H
84–127	Reserved	0000H
128	Security status	
129–159	Reserved	xxxxH
160–255	Reserved	0000H

3.3.2 Format track command (50H)

The drive accepts a Format track command (50H) and the 512 bytes of the format data transferred by the host. However, the command does not mark bad sectors, reassign sectors or unreassign sectors. The first sector data the host transfers is ignored. A 00 data pattern is written to the track specified in the command.

5. Cycle times less than 400 nsec require IORDY.

3.3.3 Set Features command (EF_H)

The host uses the Set Features command (EF_H) to establish parameters that affect the execution of certain drive features. To use the command:

1. Write the Feature value to the Features register.
2. Write the Set Features command to the command register.

Note. If the value in the Features register is not supported or is invalid, the drive posts an Aborted Command error.

Some Set Feature values are enabled at the factory and have default statuses. The drives revert to these values at power-on or after a hard reset. Value 66_H allows you to retain parameter modifications made to the Set Features command after you power on following a software reset.

The following table shows the alterable features the drive supports. The factory default features are indicated in the feature description.

Value	Feature description
02 _H	Enable write cache ⁶ (factory default).
03 _H	Set value for Set Transfer mode based on value in Sector Count register.
04 _H	Enable all automatic defect assignment.
44 _H	Use maximum length of ECC (16 bytes) on read long/write long commands (factory default).
55 _H	Disable read look-ahead feature.
66 _H	Use the current settings as default (until hard reset or power off).
82 _H	Disable write cache.
84 _H	Disable all automatic defect assignment.
AA _H	Enable read look-ahead feature (factory default).
BB _H	4 bytes of ECC apply on read long and write long commands.
CC _H	Enable reverting to power-on defaults (factory default).

6. Cache parameters can be modified using the EZConfig feature described on page 19.

3.3.3.1 PIO and DMA Data-Transfer Modes

You can set the multiword DMA mode and identify the PIO data-transfer mechanism and transfer mode with the Set Features command. To set the multiword DMA mode:

1. Write Set Features command value 03H (Set Data Transfer mode) to the Features register.
2. Write a transfer types value to the Sector Count register. The upper 5 bits of this value define the type of data transfer, and the lower 3 bits encode the mode value.

This changes word 63 of the Identify Drive command to the mode you enter in the Sector Count register.

The following table identifies allowable transfer types values:

Data-Transfer Mechanism		Transfer Types value	
Mechanism name	Mode value	Data Upper 5 bits	Lower 3 bits
PIO Transfer Mode (default)	2	00000	000
PIO Transfer Mode: Set PIO Mode = 2	2	00000	001
PIO Flow Control Transfer Mode: Set PIO Mode = 0	0	00001	000
PIO Flow Control Transfer Mode: Set PIO Mode = 1	1	00001	001
PIO Flow Control Transfer Mode: Set PIO Mode = 2	2	00001	010
PIO Flow Control Transfer Mode: Set PIO Mode = 3	3	00001	011
PIO Flow Control Transfer Mode: Set PIO Mode = 4)	4	00001	100
Single DMA Mode 0	0	00010	000
Single DMA Mode 1	1	00010	001
Single DMA Mode 2	2	00010	010
Multiword DMA Mode	0	00100	000
Multiword DMA Mode	1	00100	001
Multiword DMA Mode	2	00100	010
Reserved	—	01000	<i>nnn</i>

If the drive does not support a commanded mode, the drive returns an Aborted Command error.

If the drive receives a Set Features command with a Mechanism and mode value of 00000 001 and the drive supports disabling of IORDY, then the drive sets its default PIO transfer mode and disables IORDY.

3.3.4 Set Multiple Mode command (C6H)

The Set Multiple Mode command (C6H) establishes the number of sectors that make a transferable block and enables the drive to perform Read and Write Multiple operations. You do not have to issue this command before every Read Multiple or Write Multiple command.

The Sector Count register is loaded with the number of sectors per block. Drives normally support block sizes of 2, 4, 8 and 16 sectors. However, other block-size values may also be supported, depending on the size of the drive's buffer. After receiving the Set Multiple Mode command, the drive sets BSY=1 and checks the Sector Count register.

If the Sector Count register contains a valid value and the block count is supported, the Read Multiple or Write Multiple command is enabled, and the Sector Count register value is used for all subsequent Read Multiple and Write Multiple commands. If a block count is not supported, an Aborted Command error is posted and the Read Multiple or Write Multiple command is disabled.

If the Sector Count register contains 0 when the command is issued, the Read Multiple or the Write Multiple command is disabled.

The drive reverts to Read Multiple disabled and Write Multiple disabled following a power-on or a hardware reset. If Disable Default (66H) is set in the Set Features command, the current mode is retained following a software reset.

3.3.5 Read Multiple command (C4H)

The Read Multiple command (C4H) is similar to the Read Sectors command. However, instead of generating interrupts to transfer each sector, interrupts are generated to transfer blocks of sectors as defined by the Set Multiple Mode command.

The Set Multiple Mode command is used to determine the number of sectors that constitute a transferable block. It must be executed before the Read Multiple command. Interrupts are generated when DRQ is set to 1 at the beginning of each block or partial block.

When the Read Multiple command is issued, the Sector Count register contains the number of sectors (not the number of blocks or the block count) requested. If the number of requested sectors is not evenly divisible by the block count, as many full blocks as possible are transferred followed by the final, partial block. The partial block transfer is for n sectors, where

$$n = \text{remainder (sector count / block count)}$$

If the Read Multiple command is attempted before the Set Multiple Mode is set or when the Read Multiple commands are disabled, the Read Multiple operation is rejected with an Aborted Command error.

Disc errors encountered during Read Multiple commands are posted at the beginning of the block or partial block transfer. DRQ is set and the data transfer occurs. If there is any corrupted data, it is included in the transfer.

The contents of the Command Block registers, following the transfer of a data block that had a sector in error, are undefined. The host should retry the transfer as individual requests to obtain valid error information.

Subsequent blocks or partial blocks are transferred only if the error was a correctable data error. All other errors cause the command to stop after the block containing the error is transferred.

3.3.6 Write Multiple command (C5H)

The Write Multiple command (C5H) is similar to the Write Sectors command. However, instead of generating interrupts to transfer each sector, interrupts are generated to transfer blocks of sectors as defined by the Set Multiple Mode command.

The Set Multiple Mode command is used to determine the number of sectors that constitute a transferable block. It must be executed before the Write Multiple command.

When the Write Multiple command is issued, the Sector Count register contains the number of sectors (not the number of blocks or the block count) requested. If the number of requested sectors is not evenly divisible by the block count, as many full blocks as possible are transferred followed by the final, partial block. The partial-block transfer is for n sectors, where

$$n = \text{remainder (sector count / block count)}$$

If the Write Multiple command is attempted before the Set Multiple Mode command is set or when Write Multiple commands are disabled, the Write Multiple operation is rejected with an aborted command error.

Disc errors encountered during Write Multiple commands are posted after the attempted disc write of the block or partial block. The Write command ends with the sector in error, even if it was in the middle of a block. Subsequent blocks are not transferred in the event of an error. Interrupts are generated when DRQ is set at the beginning of each block or partial block.

The contents of the Command Block registers are undefined when they follow the transfer of a data block that had a sector in error. The host should retry the transfer as individual requests to obtain valid error information.

3.4 S.M.A.R.T. command (B0H)

Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.) is an emerging technology that provides near-term failure prediction for disc drives. When S.M.A.R.T. is enabled, the Seagate drive monitors predetermined attributes within itself that are susceptible to degradation over time. S.M.A.R.T. makes a status report available so that the host can prompt the user to back up the drive if self-monitoring determines that a failure is likely. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor.

The S.M.A.R.T. feature is enabled at the factory. You must have a BIOS, software driver or application software that supports S.M.A.R.T. The table below shows the S.M.A.R.T. command codes the Seagate drive uses.

Note. To implement a S.M.A.R.T. command, the host must write the value 0x4F to Cylinder_lo register and the value 0xC2 to the Cylinder_hi register at the same time it writes the S.M.A.R.T. command code to the Features register. If these values are not included with the command code, the command is aborted and 0x04 (abort) is written to the Error register.

Command Code	Feature description
D0H	Return drive attributes
D2H	Enable/disable attribute autosave
D4H	Collect offline data
D8H	Enable operation
D9H	Disable operation
DAH	Return S.M.A.R.T. status

3.5 Drive Security Commands

The drive security commands provide a password-based security system to prevent unauthorized access to a disc drive. During manufacturing, the master password, SEAGATE, is set for the drive, and the lock function is disabled. The system manufacturer or dealer may set a new user password using the Security Set Password command (F1H) without enabling the lock function. Before a user password is entered, the drive rejects all security commands except Security Set Password.

When you set a password, the drive automatically enters lock mode (lock mode is enabled) the next time it is powered on. When lock mode is enabled, the drive rejects all media-access commands until you enter the correct password, completing a Security Unlock command.

The drive supports two levels of security: high security and maximum security. In high-security mode, if you forget your password, you can still access the data by entering the master password. In maximum security mode, if you forget your password, you cannot access the data. In maximum security, you can erase all data on the drive and reinitialize the drive using the Erase Unit command (F4H). You must enter the master password to complete an erase Unit command.

The Freeze Lock command (F5H) prevents you from changing security features. If, during normal drive operation, the Freeze Lock command is executed, all normal commands are implemented, but the security commands Disable Password, Erase Unit, Set Password, and Unlock cannot be completed.

For additional details on the Drive Security Commands, see the ATA-3 specification (document X3T10/2008D).

3.6 Onboard drive diagnostics

During startup, the drive executes a series of diagnostic tests. If the diagnostic tests detect an error, the drive uses the LED to indicate the nature of the error by emitting a flash code. A subset of the error flash code is contained in the following table:

Number of flashes	Error code description
Irregular flashes	Microprocessor error
2	ROM checksum error
3	External RAM error
4	I/O chip error
5	Buffer RAM error

3.7 ECC performance tests

The drive does not report ECC errors when it performs on-the-fly error correction. This allows the drive to correct the data without sacrificing performance.

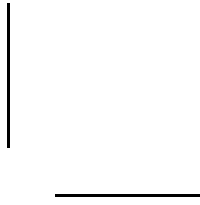
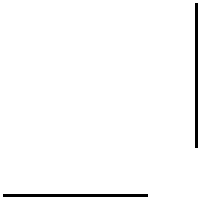
Some older drive diagnostic utilities test the drive's ability to apply ECC by creating small data errors and then checking to see if these errors are reported. If you run one of these tests on a drive that is functioning properly, the test may report that the drive is failing to detect ECC errors. However, this does not mean that the drive is malfunctioning.

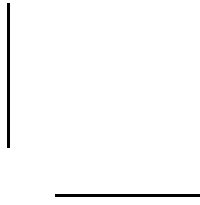
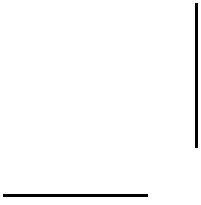
3.8 Supported BIOS

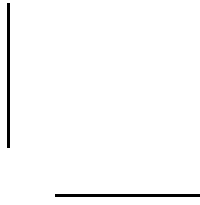
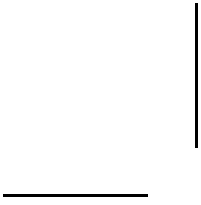
The drive uses 16 bytes of ECC with Read Long and Write Long commands. If the computer BIOS expects less than 16 bytes, some drive diagnostics may return false failures (typically time-out errors). If so, you must reconfigure the computer to receive 4 bytes of ECC.

The BIOS revisions listed in the following table are fully compatible with the ATA interface the drive uses. Earlier BIOS revisions than those listed may not fully support the ATA interface as implemented on the drive.

BIOS manufacturer	Version supported
American Megatrends	Dated 4/9/90 or later
Award	3.04 or higher
Quadtel	Single drive, any version Dual drive, 3.04 or higher
Phoenix	ROM BIOS Plus 286, 3.10 or higher ROM BIOS Plus 386, 1.10 or higher
Phoenix BIOS	1.00 or higher









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920 Disc Drive, Scotts Valley, California 95066, USA

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