Seagate

ST34323A Family

ST31013A, ST32111A

ST33223A, ST34323A

Ultra ATA Interface Drives

Product Manual

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ST31013A, ST32111A

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Contents

Contents

Figures

Introduction

This manual describes the functional, mechanical and interface specifications for the ST31013A, ST32111A, ST33223A and the ST34323A. These drives provide the following key features:

- Low power consumption
- Quiet operation
- Support for (S.M.A.R.T.) self-monitoring, analysis and reporting technology for drives.
- High instantaneous (burst) data-transfer rates (up to 33.3 Mbytes per second) using Ultra DMA mode 2
- Full-track multiple-sector transfer capability without local processor intervention
- 128-Kbyte cache
- State-of-the-art cache and on-the-fly error-correction algorithms
- Support for Read Multiple and Write Multiple commands
- Support for autodetection of master/slave drives that use cable select (CSEL)
- These drives use MR recording heads and PRML technology, which provide the drives with increased areal density.

Specification summary table

The specifications listed in this table are for quick reference. For details on specification measurement or definition, see the appropriate section of this manual.

Drive Specification	ST31013A	ST32111A	ST33223A	ST34323A
Guaranteed Mbytes ($\times 10^6$ bytes)	1,082	2,111	3,249	4,311
Guaranteed sectors	2,114,784	4,124,736	6,346,368	8,421,840
Bytes per sector	512			
Default sectors per track	63			
Default read/write heads	16	16	16	15
Default cylinders	2,098	4,092	6,296	8,912
Physical read/write heads	1	2	3	4
Discs	1	1	2	2
Recording density (bits/inch max)	165,000			
Track density (tracks/inch)	8,897			
Areal density (Mbits/inch^2)	1,468			
Spindle speed (RPM)	4,500			
Internal data-transfer rate (Mbits/sec max)	126			
I/O data-transfer rate (Mbytes/sec max)	33.3			
ATA data-transfer modes supported	PIO modes 0, 1, 2, 3, 4; Multiword DMA modes 0, 1, 2; Ultra DMA modes 0, 1, 2			
Cache buffer (Kbytes)	128			
Height (mm max)	26.1			
Width (mm max)	102.1			
Length (mm max)	147.0			
Weight (grams typical)	540			

Drive Specification	ST31013A	ST32111A	ST33223A	ST34323A
Track-to-track seek time (msec typical)	1.5 (read), 3.0 (write)			
Average seek time (msec typical)	11.0 (read), 13.0 (write)			
Full-stroke seek time (msec typical)	18.0 (read), 21.0 (write)			
Average latency (msec)	6.7			
Power-on to ready (sec typical)	10 sec			
Standby to ready (sec typical)	5 sec			
Startup current: 12V (peak) 5V (RMS)	 1.5 amps 0.5 amps			
Seek power and current (mean)	6.0 watts			
Read/Write power and current (typical)	4.0 watts			
Idle mode power and current (typical)	3.3 watts			
Standby mode power and current (typical)	0.8 watts			
Sleep mode power and current (typical)	0.8 watts			
Voltage tolerance (including noise)	5V ± 5%, 12V ± 10%			
Ambient temperature	5° to 55°C (op.), –40° to 70°C (nonop.)			
Temperature gradient (°C per hour max)	20°C			
Relative humidity (op. and nonop.)	5% to 90% (op.) 5% to 90% (nonop.)			
Relative humidity gradient	30% per hour max			
Wet bulb temperature (°C max)	29.4 (op.), 40.0 (nonop.)			
Altitude, operating	–61 m to 3,048 m (–200 ft to 10,000+ ft)			

Drive Specification	ST31013A	ST32111A	ST33223A	ST34323A
Altitude, nonoperating	–61 m to 3,048 m (–200 ft to 40,000+ ft)			
Shock, operating (Gs max at 11 msec)	5			
Shock, nonoperating (Gs max at 1 msec) (Gs max at 2 msec)	200 200			
Vibration, operating	0.50 Gs (0 to peak, 5–350 Hz)			
Vibration, nonoperating	5.0 Gs (0 to peak, 5–350 Hz)			
Drive acoustics Idle mode (bels—sound power) (dBA—sound pressure)	3.7 (typical), 4.0(max) 26 (typical)			
Drive acoustics Seek mode (bels—sound power) (dBA—sound pressure)	4.2 (typical), 4.5 (max) 31 (typical)			
Nonrecoverable read errors	1 per 10^{14} bits read			
Mean time between failures (power-on hours)	300,000			
Contact start-stop cycles (25°C, 40% relative humidity)	40,000			
Service life (years)	5			

1.0 Drive specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases *the drive* and *this drive* are used throughout this manual to indicate the ST31013A, ST32111A, ST33223A and the ST34323A.

1.1 Formatted capacity

Drive Model	Guaranteed Mbytes (1 Mbyte = 10^6 bytes)	Guaranteed sectors	Bytes per sector
ST31013A	1,082	2,114,784	512
ST32111A	2,111	4,124,736	512
ST33223A	3,249	6,346,368	512
ST34323A	4,311	8,421,840	512

Note. DOS systems cannot access more than 528 Mbytes on a drive unless 1) the host system supports and is configured for LBA addressing or for extended CHS addressing, 2) the host system contains a specialized drive controller, or 3) the host system runs BIOS translation software. Contact your Seagate® representative for details.

1.1.1 Default logical geometry

CHS Mode	Cylinders	Read/Write heads	Sectors per track
ST31013A	2,098	16	63
ST32111A	4,092	16	63
ST33223A	6,296	16	63
ST34323A	8,912	15	63

LBA Mode
When addressing either drive in LBA mode, all blocks (sectors) are consecutively numbered from 0 to *n–1,* where *n* is the number of guaranteed sectors as defined above.

1.2 Physical organization

Drive Model	Read/Write heads (MR)	Number of discs
ST31013A	1	1
ST32111A	2	1
ST33223A	3	2
ST34323A	4	2

1.3 Recording and interface technology

Interface	ATA
Recording method	16/17 (0,14) ZBR
Recording density (bits/inch)	165,000
Track density (tracks/inch)	8,897
Areal density (Mbits/inch^2)	1,468
Spindle speed (RPM) (± 0.2%)	4,500
Internal data-transfer rate (Mbits per second max)	126
I/O data-transfer rate (Mbytes per second max)	16.6 (PIO mode 4 with IORDY) 16.6 (multiword DMA mode 2) 33.3 (Ultra DMA mode 2)
Interleave	1:1
Cache buffer (Kbytes)	128

1.4 Physical characteristics

Drive Specification		ST31013A, ST32111A, ST33223A, ST34323A
Maximum height	(mm) (inches)	26.1 1.028
Maximum width	(mm) (inches)	102.1 4.020

Maximum length	(mm) (inches)	147.0 5.78
Typical weight	(grams) (pounds)	540 1.2

1.5 Seek time

All seek times are measured using a 486 AT computer (or faster) with an 8.3 MHz I/O bus. The measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics. 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 5,000 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 typical value is determined by averaging 100 full-stroke seeks in both directions.

Seek times	**Read (msec, typ.)**	**Write (msec, typ.)**
Track-to-track	1.5	3.0
Average	11.0	13.0
Full-stroke	18.0	21.0
Average latency: 6.7 msec	—	—

Note. These drives are designed to consistently meet the seek times represented in this manual. Physical seeks, regardless of mode (such as track-to-track and average) are expected to meet or exceed the noted values. However, due to the manner in which these drives are formatted, benchmark tests that include command overhead or measure logical seeks may produce results that vary from these specifications.

1.6 Start/stop times

Power-on to Ready (sec)	10 (typical)
Standby to Ready (sec)	5 (typical)
Ready to spindle stop (sec)	12 (typical)

1.7 Power specifications

The drive receives DC power (+5V or +12V) through a four-pin standard drive power connector.

1.7.1 Power consumption

Power requirements for the drives are listed in the table on page 9. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V input voltage at 25°C ambient temperature.

- **Spinup power**

  Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.

- **Seek Mode**

  During seek mode, the read/write actuator arm moves toward a specific position on the disc surface and does not execute a read or write operation. Servo electronics are active. Seek mode power represents the worst-case power consumption, using only random seeks with read or write latency time. This mode is not typical and is provided for worst-case information.

- **Read/Write power and current**

  Read/write power is measured with the heads on track, based on a 16-sector write followed by a 32-msec delay, then a 16-sector read followed by a 32-msec delay.

- **Operating power and current**

  Operating power is measured using 40 percent random seeks, 40 percent read/write mode (1 write for each 10 reads) and 20 percent drive inactive.

- **Idle mode power**

  Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.

- **Standby mode**

  During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode.

Power Mode	Typical Watts RMS	Typical Amps RMS	
		5V	12V
Spinup		0.6	1.5 (Peak)
Seeking (Random, no read/write)	6.0	0.45	0.31
Read/Write	4.0	0.51	0.12
Operating	4.3	0.51	0.15
Idle	3.3	0.37	0.12
Standby	0.8	0.16	—
Sleep	0.8	0.16	—

1.7.1.1 Typical current profile

Figure 1 shows a typical current profile.

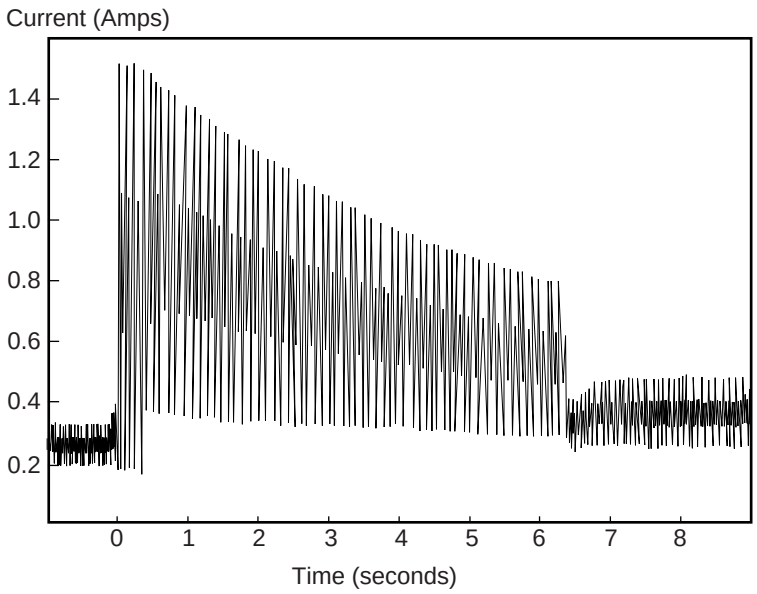


Figure 1. Typical startup and operation current profile

1.7.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 80-ohm resistive load on the +12 volt line or an equivalent 15-ohm resistive load on the +5 volt line.

- Using 12-volt power, the drive is expected to operate with a maximum of 120 mV peak-to-peak square-wave injected noise at up to 10 MHz.
- Using 5-volt power, the drive is expected to operate with a maximum of 100 mV peak-to-peak square-wave injected noise at up to 10 MHz.

Note. Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

1.7.3 Voltage tolerance

Voltage tolerance (including noise): 5V ± 5% and 12V ± 10%

1.7.4 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. In most systems, you can control power management through the system setup program. The drive features the following power-management modes:

Power Mode	Heads	Spindle	Buffer
Active	Tracking	Rotating	Enabled
Idle	Tracking	Rotating	Enabled
Standby	Parked	Stopped	Enabled
Sleep	Parked	Stopped	Disabled

- **Active mode**

  The drive is in Active mode during the read/write and seek operations.

- **Idle mode**

  The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Standby mode**

  The drive enters Standby mode when the host sends a Standby Immediate command. If the host has set the standby timer, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the

drive buffer is enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Sleep mode**

  The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the drive buffer is disabled, the heads are parked and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard Reset or Soft Reset from the host. After receiving a reset, the drive exits Sleep mode and enters Active mode with all current translation parameters intact.

- **Idle and Standby timers**

  Each time the drive performs an Active function (read, write or seek), the standby timer is reinitialized and begins counting down from its specified delay times to zero. If the standby timer reaches zero before any drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disc access is necessary.

1.8 Environmental tolerances

1.8.1 Ambient temperature

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

Note. Above 1,000 feet (305 meters), the maximum temperature is derated linearly to 112°F (44°C) at 10,000 feet (3,048 meters). Operating ambient temperature is defined as the temperature of the environment immediately surrounding the drive.

1.8.2 Temperature gradient

Operating	20°C/hr (68°F/hour) max, without condensation
Nonoperating	20°C/hr (68°F/hour) max, without condensation

1.8.3 Humidity

1.8.3.1 Relative Humidity

Operating	5% to 90% noncondensing (30% per hour max)
Nonoperating	5% to 90% noncondensing (30% per hour max)

1.8.3.2 Wet bulb temperature

Operating	29.4°C (84°F) max
Nonoperating	40.0°C (104°F) max

1.8.4 Altitude

Operating	–61 m to 3,048 m (–200 ft to 10,000+ ft)
Nonoperating	–61 m to 12,192 m (–200 ft to 40,000+ ft)

1.8.5 Shock

All shock specifications assume that the drive is mounted securely with the input shock applied at the drive mounting screws. Shock may be applied in the X, Y or Z axis.

1.8.5.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 5.0 Gs (based on half-sine shock pulses of 11 msec. Shocks should not be repeated more than two times per second.

1.8.5.2 Nonoperating shock

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 75 Gs (based on nonrepetitive half-sine shock pulses of 11 msec duration) or 200 Gs (based on nonrepetitive half-sine shock pulses of 2 msec duration).

1.8.6 Vibration

All vibration specifications assume that the drive is mounted securely with the input vibration applied at the drive mounting screws. Vibration may be applied in the X, Y or Z axis.

1.8.6.1 Operating vibration

The following table lists the maximum vibration levels that the drive may experience while meeting the performance standards specified in this document.

5–22 Hz 0.020-inch displacement (peak to peak)

22–350 Hz 0.5 Gs acceleration (zero to peak)

1.8.6.2 Nonoperating vibration

The following table lists the maximum nonoperating vibration that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation.

5–22 Hz 0.20-inch displacement (peak to peak)

22–350 Hz 5.0 Gs acceleration (zero to peak)

1.9 Drive acoustics

Drive acoustics are measured as overall A-weighted acoustic sound power levels (no pure tones). All measurements are generally consistent with ISO document 7779. Sound power measurements are taken under essentially free-field conditions over a reflecting plane. For all tests, the drive is oriented with the cover facing upward.

Note. For seek mode tests, the drive is placed in seek mode only. The number of seeks per second is defined by the following equation: (Number of seeks per second = 0.4 / (average latency + average access time).

Acoustic Mode	Idle	Seek
Sound power (bels)	3.7 (typ) 4.0 (max)	4.2 (typ) 4.5 (max)
Sound pressure (dBA)	26 (typ)	31 (typ)

1.10 Electromagnetic susceptibility

The drive operates without errors when subjected to the following:

Radiated noise	≤ 3 volt/meter, 30 Hz to 500 MHz
Electrostatic discharge*	≤ 10 KVolts
Magnetic field strength	≤ 5 Gauss

* Electrostatic discharge susceptibility is measured with the drive mounted in a representative computer system (mounted to a ground plane with an earth ground). Discharges are applied to the bezel or other external surfaces on the ground plane.

1.11 Reliability

Nonrecoverable read errors	1 per 10^{14} bits read, max
Mean time between failures	300,000 power-on hours (nominal power, 25°C ambient temperature)
Contact start-stop cycles	40,000 cycles (at nominal voltage and temperature, with 60 cycles per hour and a 50% duty cycle)
Preventive maintenance	None required

1.12 Agency certification

1.12.1 Safety certification

The drives are recognized in accordance with UL 1950 and CSA C22.2 (950) and meet all applicable sections of IEC950 and EN 60950 as tested by TUV North America.

1.12.2 Electromagnetic compatibility

Hard drives that display the CE marking comply with European Union requirements specified in Electromagnetic Compatibility Directives. Testing is performed to standards EN50082-1 and EN55022-B.

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. 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. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Australian C-Tick

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZS3548 1995 and meet the Electromagnetic Compatibility (EMC) Framework requirements of Australia's Spectrum Management Agency (SMA).

1.12.3 FCC verification

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

Seagate Technology, Inc. has tested this device in enclosures 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, 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 computer 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, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.0 Configuring and mounting the drive

This section contains the specifications and instructions for configuring and mounting the drive.

2.1 Handling and static-discharge precautions

After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

Caution:

- Keep the drive in its static-shielded bag until you are ready to complete the installation. Do not attach any cables to the drive while it is in its static-shielded bag.
- Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap 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 place 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. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.

2.2 Jumper settings

2.2.1 Master/slave configuration

The options jumper block (J8) shown in Figure 2 is used to configure the drive for operation. It is the 6-pin dual header between the I/O connector and the power connector. Use the following settings to configure the drive as a master or a slave.

Master or single drive. The drive is configured at the factory for a master or single-drive operation with a jumper set on pins 5 and 6.

Drive as slave. Remove all the jumpers if you are installing the drive as a slave.

Drive as master with a non-ATA-compatible slave. Set a jumper on pins 3 and 4 and pins 5 and 6. Use this jumper setting *only* if the drive does not work with a single jumper on pins 5 and 6.

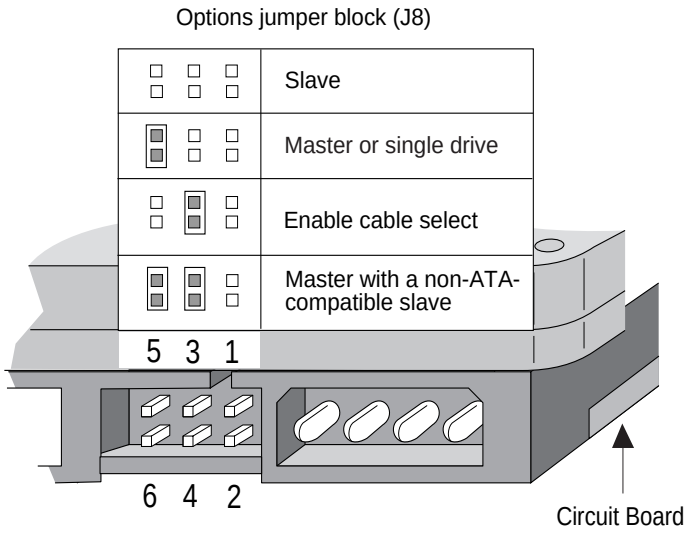


Figure 2. Master/slave jumper settings

2.2.2 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. To enable cable select, set a jumper on pins 3 and 4 as shown in Figure 2 above. Consult your computer manual to determine whether your computer supports this option.

2.2.3 Alternate capacity jumper

Some older computers may “hang” if their BIOS detects a hard drive that has more than 4,092 cylinders at startup. The ST33223A and the ST34323A include a capacity-limiting jumper, which sets the drive’s default translation geometry to 4,092 cylinders. This limits the drive’s capacity to 2.1 Gbytes, unless third-party software is used.

The drive is shipped for full capacity without a jumper set, as shown in Figure 3. To enable the alternate capacity option, set a jumper on pins 1 and 2.

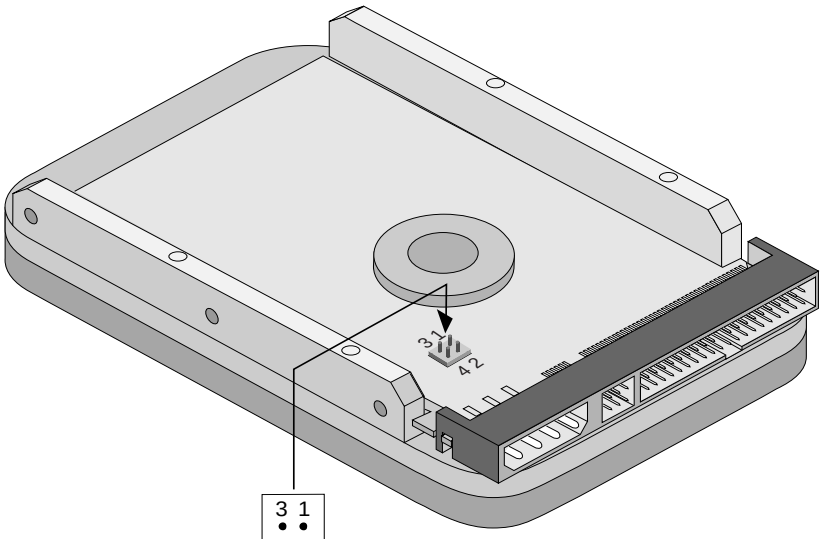


Figure 3. Alternate capacity jumper

2.3 Drive mounting

You can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See Figure 4 for drive mounting dimensions.

Important mounting precautions:

- Allow a minimum clearance of 0.030 inches (0.76 mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.22 inch into the bottom mounting holes and no more than 0.14 inch into the side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 3 inch-lb).
- Do not use a drive interface cable that is more than 18 inches long.

Note: Dimensions are shown in inches (mm).

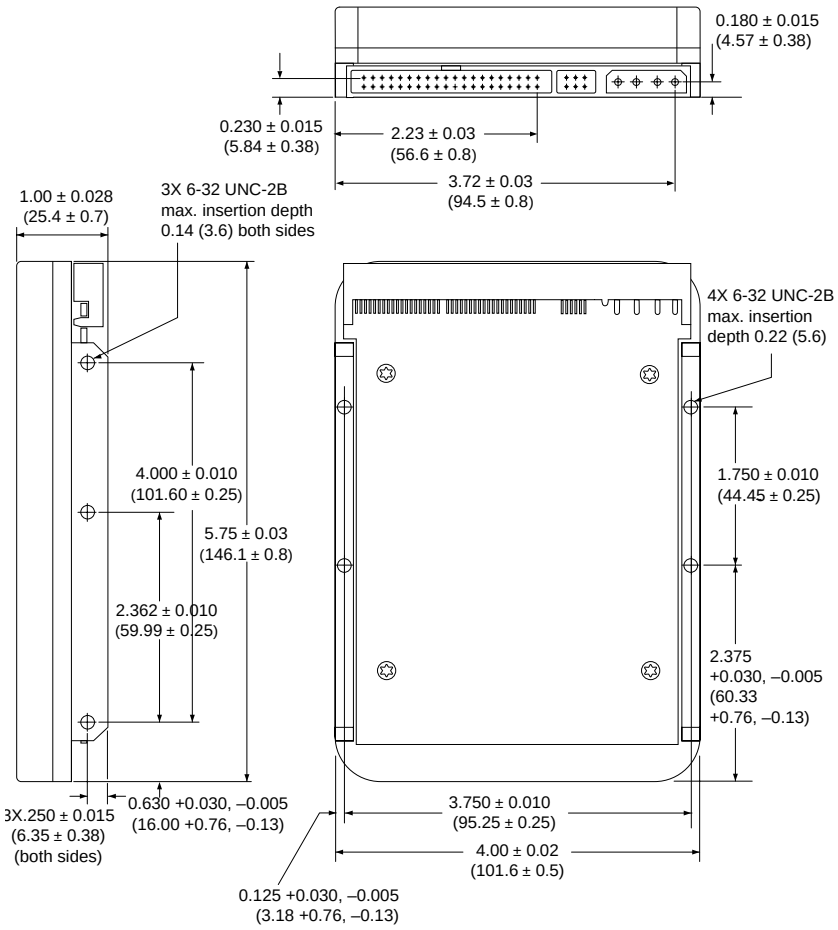


Figure 4. Mounting dimensions—top, side and end view

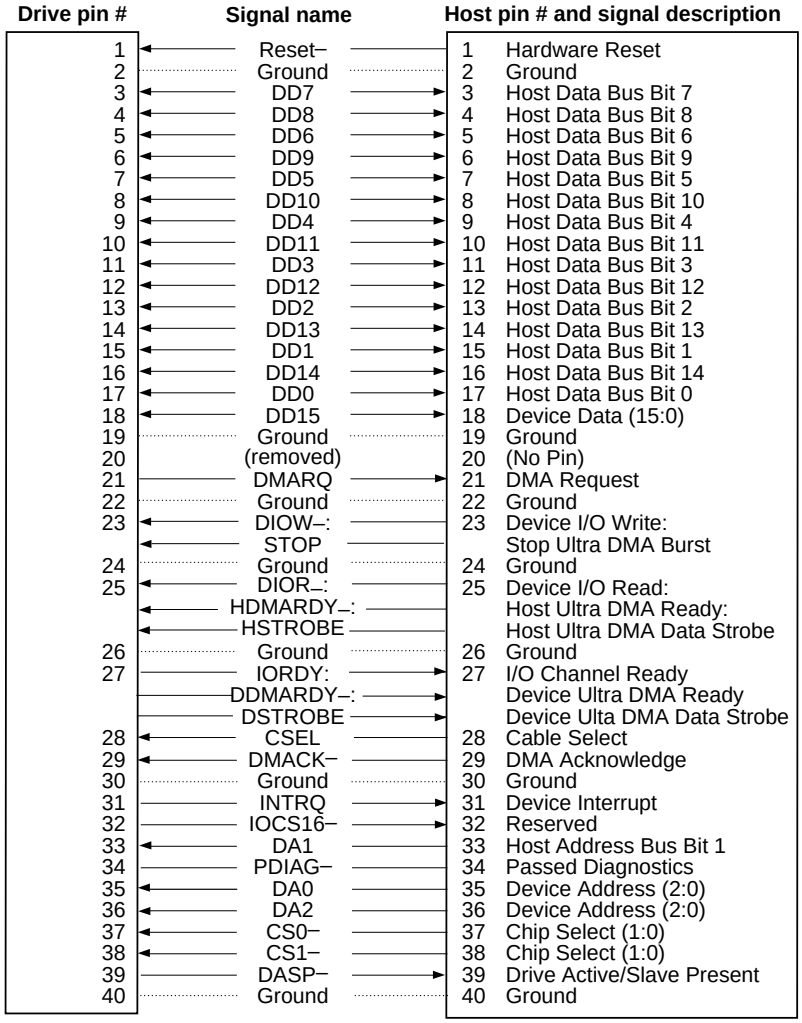
3.0 ATA interface

These drives use the industry-standard ATA task file interface that supports 16-bit data transfers. It supports ATA programmed input/output (PIO) modes 0, 1, 2, 3 and 4; multiword DMA modes 0, 1 and 2, and Ultra DMA modes 0, 1 and 2. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

You can use a daisy-chain cable to connect two drives to a single AT host bus. For detailed information about the ATA interface, refer to the draft of *AT Attachment with Packet Interface Extension (ATA/ATAPI-4), NCITS T13 1153D,* subsequently referred to as the *Draft ATA-4 Standard*.

3.1 ATA interface signals and connector pins

Figure 5 on page 24 summarizes the signals on the ATA interface connector that the drive supports. For a detailed description of these signals, refer to the *Draft ATA-4 Standard.*



Pins 28, 34 and 39 are used for master-slave communication (details shown below).

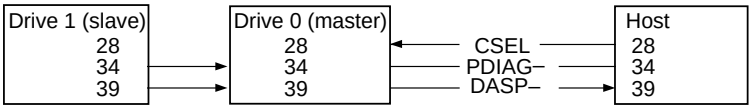


Figure 5. I/O pins and supported ATA signals

3.2 ATA Interface commands

3.2.1 Supported ATA commands

The following table lists ATA-standard commands that the drive supports. For a detailed description of the ATA commands, refer to the *Draft ATA-4 Standard.* See Section 3.2.4 on page 31 for details and subcommands used in the S.M.A.R.T. implementation.

Command name	Command code (in hex)
ATA-standard commands	
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Format Track	50_H
Identify Device	EC_H
Initialize Device Parameters	91_H
Read Buffer	$E4_H$
Read DMA	$C8_{H,}$ $C9_H$
Read Multiple	$C4_H$
Read Sectors	$20_{H,}$ 21_H
Read Verify Sectors	$40_{H,}$ 41_H
Recalibrate	10_H
Seek	70_H
Set Features	EF_H
Set Multiple Mode	$C6_H$
S.M.A.R.T.	$B0_H$
Write Buffer	$E8_H$
Write DMA	$CA_{H,}$ CB_H
Write Multiple	$C5_H$

Command name	Command code (in hex)
Write Sectors	$30_{H,}$ 31_{H}
ATA-standard power-management commands	
Check Power Mode	98_{H} or $E5_{H}$
Idle	97_{H} or $E3_{H}$
Idle Immediate	95_{H} or $E1_{H}$
Sleep	99_{H} or $E6_{H}$
Standby	96_{H} or $E2_{H}$
Standby Immediate	94_{H} or $E0_{H}$

3.2.2 Identify Drive command

The Identify Drive command (command code EC_{H}) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data whose contents are shown in the table below. All reserved bits or words should be set to zero. Parameters listed with an "x" are drive-specific or vary with the state of the drive. See Section 1 of this manual for default parameter settings.

Note. If the alternate capacity jumper is installed on the drive, the drive capacity is reduced in word 1 to 4,092 cylinders.

The following commands contain drive-specific features that may *not* be described in the *Draft ATA-4 Standard*.

Word	Description	Value
0	Configuration information: • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	$0C5A_{H}$
1	Number of logical cylinders: ST31013A = 2,098 ST32111A = 4,092 ST33223A = 6,296 ST34323A = 8,912	0832_{H} (ST31013A) $0FFC_{H}$ (ST32111A) 1898_{H} (ST33223A) $22D0_{H}$ (ST34323A)

Word	Description	Value
2	ATA-reserved	0000_H
3	Number of logical heads: ST31013A = 16 ST32111A = 16 ST33223A = 16 ST34323A = 15	0010_H (ST31013A) (ST32111A) (ST33223A) $000F_H$ (ST34323A)
4	Retired	0000_H
5	Retired	0000_H
6	Number of logical sectors per logical track: 63	$003F_H$
7–9	Retired	0000_H
10–19	Serial number: (20 ASCII characters, 0000_H = none)	ASCII
20	Retired	0000_H
21	Retired	0100_H
22	Obsolete	0000_H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	*x.xx*
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	ST31013A ST32111A ST33223A ST34323A
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (64)	8020_H
48	Reserved	0000_H
49	Standard Standby timer, IORDY supported and may be disabled	$2F00_H$
50	ATA-reserved	0000_H
51	PIO data-transfer cycle timing mode	0200_H

Word	Description	Value
52	Retired	0200_H
53	Words 54–58, 64–70 and 88 are valid	0007_H
54	Number of current logical cylinders	$xxxx_H$
55	Number of current logical heads	$xxxx_H$
56	Number of current logical sectors per logical track	$xxxx_H$
57–58	Current capacity in sectors	$xxxx_H$
59	Number of sectors transferred during a Read Multiple or Write Multiple command	$xxxx_H$
60–61	Total number of user-addressable LBA sectors available: ST31013A = 2,114,784 ST32111A = 4,124,736 ST33223A = 6,346,368 ST34323A = 8,421,840	$44E0_H$ 0020_H (ST31013A) $F040_H$ $003E_H$ (ST32111A) $D680_H$ 0060_H (ST33223A) $81D0_H$ 0080_H (ST34323A)
62	Retired	0000_H
63	Multiword DMA active and modes supported (see note following this table)	$xx07_H$
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003_H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078_H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078_H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	$00F0_H$
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078_H

Word	Description	Value
69–74	ATA-reserved	0000_H
75	Queue depth	0000_H
76–79	ATA-reserved	0000_H
80	Major version number	$001E_H$
81	Minor version number	0000_H
82	Command sets supported	3069_H
83	Command sets supported	4001_H
84	Command sets support extension	4000_H
85	Command sets enabled	$30xx_H$
86	Command sets enabled	0001_H
87	Command sets enable extension	4000_H
88	Ultra DMA support and current mode	$0x07_H$
89	Security erase time	0000_H
90	Enhanced security erase time	0000_H
91–127	ATA-reserved	0000_H
128	Security status	0000_H
129–159	Seagate-reserved	$xxxx_H$
160–255	ATA-reserved	0000_H

Note. The following Multiword DMA and Ultra DMA mode settings are used in word 63 and 88, respectively, of the Identify Drive data:

Description (if bit is set to 1)

Bit	Word 63
0	Multiword DMA mode 0 is supported.
1	Multiword DMA mode 1 is supported.
2	Multiword DMA mode 2 is supported.

8 Multiword DMA mode 0 is currently active.

9 Multiword DMA mode 1 is currently active.

10 Multiword DMA mode 2 is currently active.

Bit Word 88

0 Ultra DMA mode 0 is supported.

1 Ultra DMA mode 1 is supported.

2 Ultra DMA mode 2 is supported.

8 Ultra DMA mode 0 is currently active.

9 Ultra DMA mode 1 is currently active.

10 Ultra DMA mode 2 is currently active.

3.2.3 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows:

02_H Enable write cache *(default).*

03_H Set transfer mode (based on value in Sector Count register). Sector Count register values:

- 00_H Set PIO mode to default (PIO mode 2).
- 01_H Set PIO mode to default and disable IORDY (PIO mode 2).
- 08_H PIO mode 0
- 09_H PIO mode 1
- $0A_H$ PIO mode 2 *(default)*
- $0B_H$ PIO mode 3
- $0C_H$ PIO mode 4
- 20_H Multiword DMA mode 0

21_H Multiword DMA mode 1

22_H Multiword DMA mode 2

40_H Ultra DMA mode 0

41_H Ultra DMA mode 1

42_H Ultra DMA mode 2

55_H Disable read look-ahead (read cache) feature.

82_H Disable write cache.

AA_H Enable read look-ahead (read cache) feature *(default).*

$F1_H$ Report full capacity available.

At power-on, or after a hardware reset, the default values of the features are as indicated above. A software reset also changes the features to default values.

3.2.4 S.M.A.R.T. commands

S.M.A.R.T. provides near-term failure prediction for disc drives. When S.M.A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a failure is likely, S.M.A.R.T. makes a status report available to the host. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A.R.T. commands and implementation, see the *Draft ATA-4 Standard.*

This drive is shipped with S.M.A.R.T. features disabled. You must have a recent BIOS or software package that supports S.M.A.R.T. to enable the feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

Code in Features Register	**S.M.A.R.T. Command**
$D0_H$	S.M.A.R.T. Read Data
$D1_H$	Vendor-specific
$D2_H$	S.M.A.R.T. Enable/Disable Attribute Autosave
$D3_H$	S.M.A.R.T. Save Attribute Values
$D4_H$	S.M.A.R.T. Execute Off-line Immediate
$D7_H$	Vendor-specific

Code in Features Register	S.M.A.R.T. Command
$D8_H$	S.M.A.R.T. Enable Operations
$D9_H$	S.M.A.R.T. Disable Operations
DA_H	S.M.A.R.T. Return Status

Note. If an appropriate code is not written to the Features Register, the command is aborted and 0x04 (abort) is written to the Error register.

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