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***Medalist 2520***

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***Ultra ATA Interface Drive***

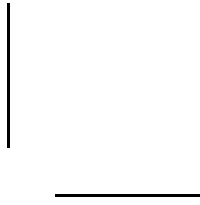
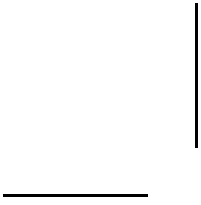
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***Product Manual***

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***Medalist 2520 (ST32520A)***  
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***Ultra ATA Interface Drive***  
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***Product Manual***  
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## Contents

<b>Introduction</b> . . . . .	<b>1</b>
<b>Specification summary table</b> . . . . .	<b>3</b>
<b>1.0 Specifications</b> . . . . .	<b>5</b>
1.1 Formatted capacity . . . . .	5
1.1.1 Standard configuration . . . . .	5
1.2 Physical organization . . . . .	6
1.3 Functional specifications . . . . .	6
1.4 Physical dimensions . . . . .	7
1.5 Seek time . . . . .	7
1.6 Multisegmented cache buffer . . . . .	7
1.7 Start and stop times . . . . .	8
1.8 Typical power-up and power-down sequence . . . . .	8
1.9 Power-up sequence . . . . .	9
1.9.1 Power-down sequence . . . . .	9
1.10 Auto-park . . . . .	9
1.11 Power specifications . . . . .	9
1.11.1 Power management . . . . .	9
1.11.2 Power consumption . . . . .	11
1.12 Input noise . . . . .	11
1.13 Environmental specifications . . . . .	12
1.13.1 Ambient temperature . . . . .	12
1.13.2 Temperature gradient . . . . .	12
1.13.3 Altitude . . . . .	12
1.13.4 Relative humidity . . . . .	12
1.14 Shock . . . . .	12
1.14.1 Operating shock . . . . .	12
1.14.2 Nonoperating shock . . . . .	13
1.14.3 Operating vibration . . . . .	13
1.14.4 Nonoperating vibration . . . . .	13

1.15 Acoustics . . . . .	14
1.16 Reliability . . . . .	14
1.17 Agency listings . . . . .	14
1.18 Electromagnetic compliance for the European Union . . . . .	14
1.19 FCC verification . . . . .	15
<b>2.0 Configuring and mounting the drive . . . . .</b>	<b>17</b>
2.1 Handling and static-discharge precautions . . . . .	17
2.2 I/O cable and connector. . . . .	18
2.3 Power connector . . . . .	18
2.4 Options jumper block . . . . .	19
2.4.1 Master/slave configuration . . . . .	20
2.4.2 Alternate capacity jumper . . . . .	21
2.4.3 Cable-select option . . . . .	21
2.4.4 Diagnostics jumper . . . . .	21
2.4.5 Life test jumper . . . . .	22
2.5 Mounting the drive . . . . .	23
<b>3.0 ATA interface . . . . .</b>	<b>25</b>
3.1 ATA Interface connector pin assignments . . . . .	25
3.2 Command set . . . . .	27
3.2.1 Identify Drive command (E <sub>CH</sub> ) . . . . .	29
3.2.2 Set Features command (E <sub>FH</sub> ) . . . . .	32
3.2.3 Standby timer timeout period . . . . .	34
3.2.4 Sleep command (99 <sub>H</sub> , E6 <sub>H</sub> ) . . . . .	34
3.2.5 Automatic reallocation . . . . .	34
3.2.6 S.M.A.R.T. commands (B0 <sub>H</sub> ) . . . . .	35
3.3 Synchronous DMA transfer . . . . .	36
3.3.1. Signal line definitions . . . . .	36
3.3.2 Protocol rules . . . . .	36
3.3.3 Error register . . . . .	37
<b>Appendix. Timing diagrams . . . . .</b>	<b>39</b>

## Figures

Figure 1. Typical startup current profile . . . . .	8
Figure 2. ATA interface connector . . . . .	18
Figure 3. Connectors . . . . .	19
Figure 4. Configuration settings . . . . .	20
Figure 5. Connecting cable-selected drives . . . . .	22
Figure 6. Mounting dimensions . . . . .	24
Figure 7. Ultra ATA interface connector pin assignments . . . . .	26
Figure 8. Programmed I/O timing (with or without IORDY) . . . . .	39
Figure 9. Multiword DMA timing . . . . .	40
Figure 10. Sustained synchronous DMA burst . . . . .	41





## Introduction

This manual describes the functional, mechanical and interface specifications for the Medalist® 2520 hard disc drive. This drive is referred to throughout this manual by its model number, ST32520A.

Seagate® desktop products take a step into the future with the ST32520A. The drive features advanced thin-film proximity heads and PRML recording technology, Ultra ATA performance, segmented cache, embedded servo technology, low noise, power management and S.M.A.R.T. capabilities.

Ultra ATA performance means that the drive supports PIO mode 4, multiword DMA mode 2 transfer modes and synchronous DMA mode. When the host chooses Ultra DMA mode 2, the drive provides burst-transfer rates of up to 33.3 Mbytes per second. The drive supports multiple block read/write, which allows it to store contiguous blocks of data in its 256-Kbyte segmented cache and transfer the blocks in a single burst.

The ST32520A has other features that ensure fast data throughput. Embedded servo technology allow the drive to position the heads for data retrieval efficiently and accurately while eliminating the periodic thermal recalibration that can interrupt during data transfers. An intelligent controller provides data streaming: direct data transfers between the drive and the host without microprocessor intervention. These features allow for a sustained data-transfer rate that facilitates video playback and other multimedia operations.

The drive supports Active, Idle and Standby power-management modes. Power-saving modes can be controlled by the host computer. Standby mode reduces power consumption to 1.618 watts (typical) while retaining drive accessibility.

Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.) is available on the drive. This feature is discussed on page 35. To use the feature, you must have a BIOS, a software driver or application software that supports S.M.A.R.T.

The ATA commands with specific applications for the drive and the Seagate-unique commands the drive uses are discussed in Section 3.0 on page 25. A complete list of the commands the drive supports is found in the table on page 27.

The following is a summary of the drive's features:

**Capacity**

- 2.5 Gbytes formatted
- LBA translation support
- Available software driver that surpasses the 528-Mbyte barrier and 4,092-cylinder barrier limited by some system BIOS
- Available software driver that provides expanded 32-bit disk access support for Windows 3.x

**Performance**

- Ultra ATA (burst transfer rates up to 33.3 Mbytes per second)
- Supports multiword DMA mode 2, PIO mode 4, Ultra DMA mode 2 and multiple block read/write
- 256-Kbyte segmented buffer
- 13-msec average read seek time
- 14.5-msec average write seek time
- Data streaming
- 5,411-RPM spindle speed

**Energy efficiency**

- Active, Idle and Standby power-management modes
- 1.618 watt typical power dissipation rating in Standby mode

## Specification summary table

The following table serves as a quick reference for the ST32520A performance specifications. These and other specifications are discussed in "Specifications" on page 5.

Drive specification	ST32520A
Guaranteed capacity (Mbytes) ( $\times 10^6$ bytes)	2,521
Guaranteed sectors	4,927,104
Bytes per sector	512
Sectors per track	63
Logical read/write heads	16
Logical cylinders	4,888
Physical cylinders	6,420
Physical read/write heads	4
Physical discs	2
Areal density (Mbits per square inch)	848
Data zones	15
Recording density (bits per inch)	125–126K
Track density (tracks per inch)	6,660
Spindle speed (RPM)	5,411
Track-to-track seek time (msec typical)	2.5
Average read seek time (msec typical)	13.0
Average write seek time (msec typical)	14.5
Full-stroke seek time (msec typical)	25
Average latency (msec)	5.54
Internal data-transfer rate (Mbits per sec max)	57 to 123

*continued*

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<b>Drive specification</b>	<b>ST32520A</b>
External transfer rate (Mbytes per sec max)	
DMA mode 2	16.6
PIO mode	16.6
Synchronous DMA mode	33.3
Cache buffer (Kbytes)	256
ECC on-the-fly (bits max)	128
Height (inches max)	1.028
Width (inches max)	4.023
Depth (inches max)	5.787
Typical weight (lb)	1.31
Spinup current (max)	1.3A
Seek power (typical)	4.99W
Read/Write power and current (typical)	5.12W
Idle total power (typical)	4.45W
Standby total power (typical)	1.618W
Voltage tolerance (including noise): +5V	± 5%
Voltage tolerance (including noise): +12V	± 5%
Operating temperature (°C)	5° to 55°C

## 1.0 Specifications

### 1.1 Formatted capacity

The ST32520A 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 3.2.1 on page 29.

#### Notes:

1. DOS and FAT 16 cannot access more than 2.147 Gbytes per partition. You must create multiple partitions to access the drive's full capacity.
2. One Mbyte equals one million bytes.
3. If the system BIOS does not support more than 4,092 cylinders, it may cause the computer to hang during startup, or it may truncate or wrap the cylinders. To resolve this issue, the system BIOS needs to be modified: the cylinder register or variable must be increased from 12 bits to 16 bits to accommodate more than 4,092 cylinders. See Section 2.4.2 on page 21.

#### 1.1.1 Standard configuration

CHS Mode	ST32520A
Cylinders	4,888
Heads	16
Sectors	63
Guaranteed sectors	4,927,104
Guaranteed capacity (Mbytes)	2,521

#### LBA Mode

When addressing the drive in LBA mode, all blocks (sectors) are consecutively numbered from 0 to  $n-1$ .

## 1.2 Physical organization

Read/write heads	4
Discs	2

## 1.3 Functional specifications

Interface	Ultra ATA-4
Recording method	PRML (16/17)
External data burst transfer rate:	
DMA mode 2 (Mbytes/sec)	16.6
PIO mode 4 (Mbytes/sec)	16.6
Ultra DMA mode 2	33.3
Internal data-transfer rate (Mbits/sec)	57 to 123
Spindle speed (RPM)	5,411 ± 0.3%
Cache size (Kbytes)	256
Bytes per sector	512
Areal density (Mbits/sq. in)	848
Data zones	15
Recording density, max (BPI)	125–126K
Track density (TPI)	6,600

**Note.** See Figure 8 on page 39 for PIO timing specifications. See Figure 9 on page 40 and Figure 10 on page 41 for DMA timing specifications.

## 1.4 Physical dimensions

The mounting dimensions are shown in Figure 6 on page 24.

Height, max	1.028 inch (26.1 mm)
Width, max	4.02 inches (102.1 mm)
Depth, max	5.787 inches (147mm)
Weight	1.31 lb (594 grams)

## 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 the average of all possible single-track seeks in both directions.
- Average seek time is measured by executing seeks in both directions between random cylinders.
- Full-stroke seek time is half the time needed to seek from track 0 to the maximum track and back to track 0.

Track-to-track seek time (typ)	Average/typical seek time	Full-stroke seek time (typ)	Average latency
2.5 msec seek	11.5 msec seek	25.0 msec seek	5.54
3.1 msec read	13.0 msec read	27.0 msec read	
3.5 msec write	14.5 msec write	30.0 msec write	

**Note.** Host overhead varies between systems and cannot be specified. Drive internal overhead is measured by issuing a no-motion seek. Overhead is typically less than 0.5 msec.

## 1.6 Multisegmented cache buffer

The ST32520A drive is available with a 256-Kbyte, multisegmented cache buffer that improves performance by reducing access times.

**Read look-ahead.** The drive uses the read segments to store additional logical sectors, after the last requested sector, into a buffer before the computer requests the additional sectors. The cache buffer stores data

from the start of a read until the buffer segment is full or until another command is received.

**Write immediate.** The drive uses the write segment to store write commands and data. After the drive receives all of the data for the command, it issues a write complete. Then, the drive writes the data to the disc.

**Write merging.** The drive accepts contiguous write commands and executes them as one command.

## 1.7 Start and stop times

Within 20 seconds after power is applied, the drive is ready. Within 15 seconds after power is removed, the drive spindle stops rotating.

## 1.8 Typical power-up and power-down sequence

This section describes typical power-up and power-down sequences to assist you in evaluating the drive's performance. They are not performance specifications. A typical startup current profile is shown in Figure 1.

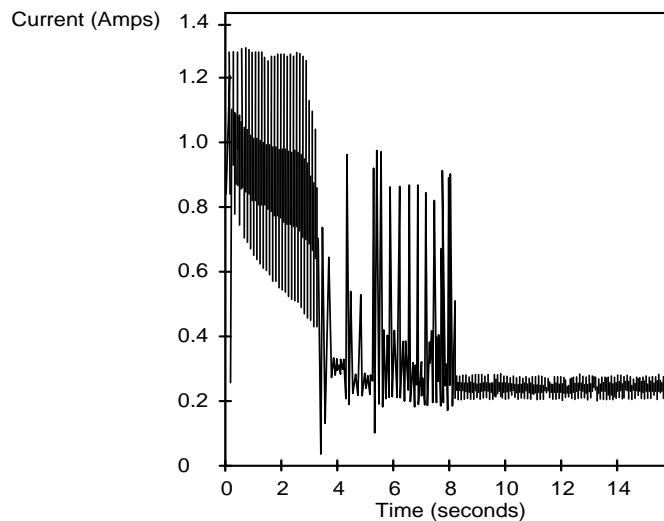


Figure 1. Typical startup current profile



## 1.9 Power-up sequence

1. Power is applied to the drive.
2. The spindle motor typically reaches operating speed in about 5 seconds.
3. The magnetic actuator-lock releases the actuator.
4. The drive synchronizes to servo pattern.
5. Calibration routines are performed.
6. The heads move back to track 0 and the drive is ready.

### 1.9.1 Power-down sequence

**Caution.** Do not move the drive until the motor has come to a complete stop.

1. The power is turned off.
2. The read/write heads automatically move to the landing zone, which is inside the maximum data cylinder.
3. The magnetic actuator-lock mechanism locks the arm. This completes the power-down sequence.
4. Within 5 seconds, the drive spindle stops rotating.

## 1.10 Auto-park

During power-down, the read/write heads automatically move to the landing zone. The heads park inside the maximum data cylinder and the magnetic actuator-lock engages. When power is applied, the heads recalibrate to track 0.

## 1.11 Power specifications

### 1.11.1 Power management

The drive supports Active, Idle and Standby power-management modes. The power-management commands that the drive supports are listed in the table on page 29. The table on page 11 shows the average typical power consumption rates for each power-management mode. The test criteria for each mode is defined below. The Idle and Standby timers are disabled by default at the factory.

All measurements were taken at the drive power connector. A true RMS meter was used to measure all modes except Standby. A DMM is used for Standby measurements.

#### 1.11.1.1 Active mode

During the Active mode, the drive is involved in spinup, seeking or read/write activities. The table on page 11 shows the typical power-consumption rates for these activities.

- **Spinup.** The drive enters the Spinup mode from the Standby mode and brings the spindle and discs up to operating speed. Power in this mode is defined as the peak power after starting spinup.
- **Seek.** The drive enters the Seek mode from the Idle mode. The read/write heads are moved to a specific location on the disc surface in preparation for reading from or writing to the disc. Read/write electronics are powered down but servo electronics are active. Typical power is defined as the power average of executing random seeks with a 2-revolution (22.2 msec) dwell between Seek commands.
- **Read/write.** Read/write mode is entered from Idle mode. Read/write electronics are activated and the servo is on track. The drive reads from or writes to the disc.

#### 1.11.1.2 Standby mode

The spindle is stopped, the heads are parked in the landing zone, the actuator is latched and some of the drive electronics are powered down. The drive does not enter this mode automatically.

**Note.** When recovering from Standby or Sleep mode, you must allow the drive to post ready before reporting a timeout. The drive can take up to 10 seconds to post ready. In a master and slave configuration, the master can wait up to 31 seconds for the slave to complete diagnostics before posting ready.

#### 1.11.1.3 Sleep mode

The drive enters Sleep mode after receiving a Sleep command from the host. 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 soft reset, the drive exits Sleep mode and enters Standby mode. After a hard reset, the drive exits Sleep mode and enters Active mode.

### 1.11.2 Power consumption

In the table below, the values apply at the drive power connector. Current was measured with an RMS DC ammeter.

	Spinup	Seek	Read/ write	Idle	Standby	Sleep
<b>Current at +12V</b>						
Amps max	1.3A	—	—	—	—	—
RMS amps typ	—	0.27	0.26	0.25	0.014	0.013
Watts typ	—	3.24	3.12	3.0	0.168	0.156
<b>Current at +5V</b>						
RMS amps typ	0.60A	0.35	0.40	0.29	0.29	0.16
Watts typ	—	1.75	2.0	1.45	1.45	0.8
<b>Power</b>						
Total watts typ	—	4.99W	5.12W	4.45W	1.618W	0.956W

### 1.12 Input noise

	<b>+5V</b>	<b>+12V</b>
Voltage tolerance (including noise)	± 5%	± 5%
Input noise frequency (max)	10 Hz to 100 KHz	100 KHz to 10 MHz
Input noise (max, peak-to-peak)	150 mV	100 mV

## 1.13 Environmental specifications

### 1.13.1 Ambient temperature

Operating 5° to 55°C (41° to 131°F)

Nonoperating -40° to 70°C (-40° to 158°F)

**Note.** The system must provide sufficient airflow to maintain a surface temperature of the aluminum base below 60°C.

### 1.13.2 Temperature gradient

Operating 30°C per hour

Nonoperating 40°C per hour

### 1.13.3 Altitude

Operating -200 ft. to 10,000 ft. (-61m to 3,048 m)

Nonoperating -200 ft. to 40,000 ft. (-61m to 12,200 m)

### 1.13.4 Relative humidity

Operating 8% to 90% noncondensing  
Maximum wet bulb 29.4°C (85°F)

Maximum operating gradient 30% per hour

Nonoperating 5% to 95% noncondensing  
Maximum wet bulb 40°C (104°F)

## 1.14 Shock

All shock and vibration 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.

### 1.14.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 10.0 Gs (based

on half-sine shock pulses of 11 msec, as specified in MIL-STD-202F). Shocks are not to be repeated more than two times per second.

### **1.14.2 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 200 Gs (based on repetitive half-sine shock pulses of 2 msec duration, as defined in MIL-STD-202F).

### **1.14.3 Operating vibration**

The maximum vibration levels that the drive can experience while meeting the performance standards specified in this document are:

5–22 Hz	0.012-inch displacement (peak to peak)
22–350 Hz	0.5 Gs acceleration (zero to peak)

### **1.14.4 Nonoperating vibration**

The maximum nonoperating vibration that the drive can experience without incurring physical damage or degradation in performance when put into operation are:

22–350 Hz	5.0 Gs acceleration (zero to peak)
350–500 Hz	3.0 Gs acceleration (zero to peak)

### 1.15 Acoustics

This table shows the overall A-weighted acoustic sound power and sound pressure levels for the drives. All measurements are generally consistent with ISO document 7779. Acoustic measurements are taken under essentially free-field conditions over a reflecting plane. The drive is oriented with the top cover up for all tests.

<b>Overall A-weighted Value</b>	<b>Idle</b>	<b>Seek</b>
Sound power, (bels)	3.9 (typ), 4.2 (max)	4.4 (typ), 4.7 (max)
Sound pressure, (dBA)	29 (typ), 32 (max)	34 (typ), 37 (max)

### 1.16 Reliability

Read error rates are measured with automatic retries and data correction with ECC enabled and all flaws reallocated. The mean time between failures (MTBF) is measured at nominal power at sea level and an ambient temperature of 25°C.

Nonrecoverable read errors	1 per 10 <sup>13</sup> bits transferred
Seek errors	1 per 10 <sup>7</sup> physical seeks
Contact start/stops	40,000 times, based on a 30 second on/off duty cycle
MTBF	300,000 power-on hours
Service life	5 years

### 1.17 Agency listings

The drive is listed by agencies as follows:

- Recognized in accordance with UL478 and UL1950
- Certified to CSA C22.2 No. 220-M1986 and CSA C22.2 No. 950
- Certified to VDE 0805/05.90 and EN 60950/1.88 as tested by VDE

### 1.18 Electromagnetic compliance for the European Union

If this model has the CE Marking, it complies with the European Union requirements of the Electromagnetic Compatibility Directive 89/336/EEC

of 03 May 1989 as amended by Directive 92/31/EEC of 28 April 1992 and Directive 93/68/EEC of 22 July 1993.

Seagate uses an independent laboratory to confirm compliance to the above directives. The drive was tested in a representative system for typical applications. The selected system represents the most popular characteristics for test platforms. The system configurations include:

- 486, Pentium, and PowerPC microprocessors
- 3.5-inch floppy disc drives
- Keyboard
- Monitor/display

Although the test system with this Seagate model complies to the directives, we cannot guarantee that all systems will comply. The computer manufacturer or system integrator should confirm EMC compliance and provide CE Marking for their product. The drive is not meant for external use (without properly designed enclosure, shielded I/O cable, etc.). A terminator should be used on all unused I/O ports.

### 1.19 FCC verification

The Medalist Ultra ATA interface drives are 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 these drives in an enclosure as described above to ensure that the total assembly (enclosure, disc drives, 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.

**Note.** This digital apparatus does not exceed the Class B limits for radio noise emissions from computer equipment as set out in the radio interference regulations of the Canadian Department of communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.



## 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

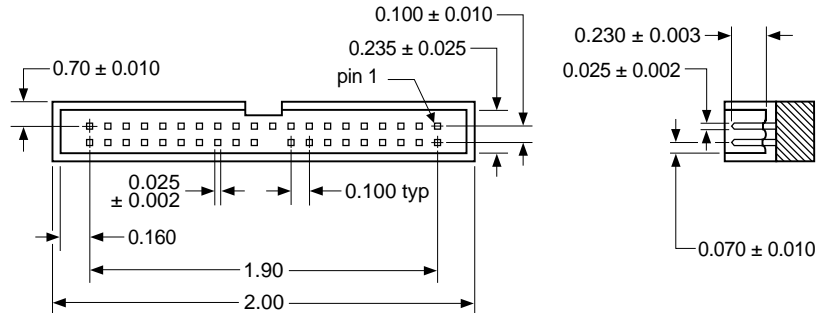
After you unpack the drive, and before you install it in a system, be careful not to damage it through mishandling. Observe the following standard handling and static-discharge precautions:

**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 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. 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 I/O cable and connector

The drive uses a 40-pin, male I/O connector with two rows of twenty pins each and a notch for keying. Pin 20 is removed for keying purposes. A drawing of the I/O connector is shown in Figure 2. Pin 1 is located near the 4-pin power connector when the I/O connector is mounted.



**Figure 2. ATA interface connector**

The table below lists recommended parts for the mating connector. You can use equivalent parts.

Part	Description	3M part number
Connector	40-pin	3M-3417-7000
Connector	40-pin	3M-3448-2040
Flat cable	AWG28 (stranded)	3M-3365-40

To ensure the integrity of your data, use a 40-connector, nonshielded I/O cable with a maximum length of 18 inches (46 centimeters).

## 2.3 Power connector

The drive uses a standard 4-pin, male power connector. We recommend the following part number or its equivalent for the mating connector.

Part	Description	Part number
Connector	Housing	AMP 1-480424-0
Connector	Pin (loose piece)	AMP 60619-4
Connector	Pin (reel)	AMP 6117-4
Cable	18 AWG	—

## 2.4 Options jumper block

The options jumper block (J5), shown in Figure 4, is used to configure the drive for operation. It is the 8-pin dual header between the I/O connector and the power connector. Pin 1 is located next to the power connector and is farthest from the printed circuit board. It accepts 0.1-inch jumpers. The options jumper block is used to:

- Configure the drive for single-drive operation.
- Configure the drive as master with an ATA-compatible or non-ATA slave.
- Configure the drive as the slave.
- Configure the drive for alternate capacity.
- Configure the drive for cable select.

The jumper settings for these options are shown in Figure 4 on page 22. The drive is shipped with a spare jumper attached to pins 6 and 8. Use this jumper to configure the drive.

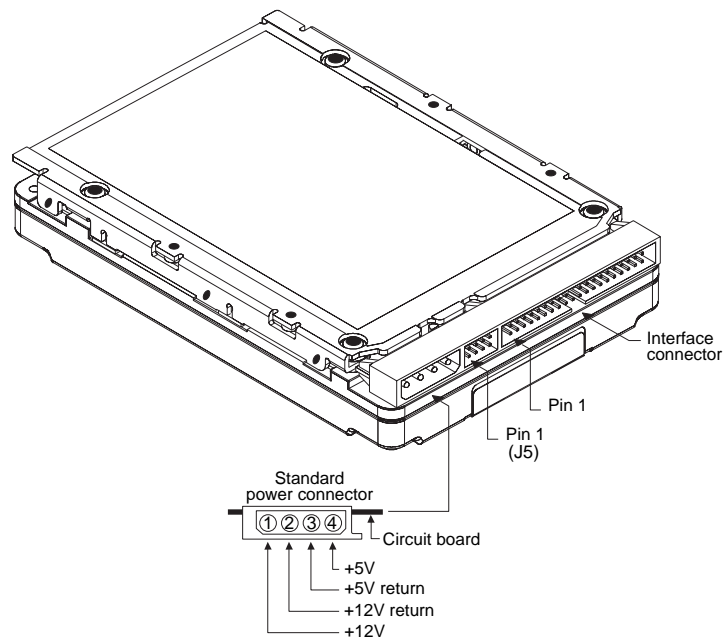
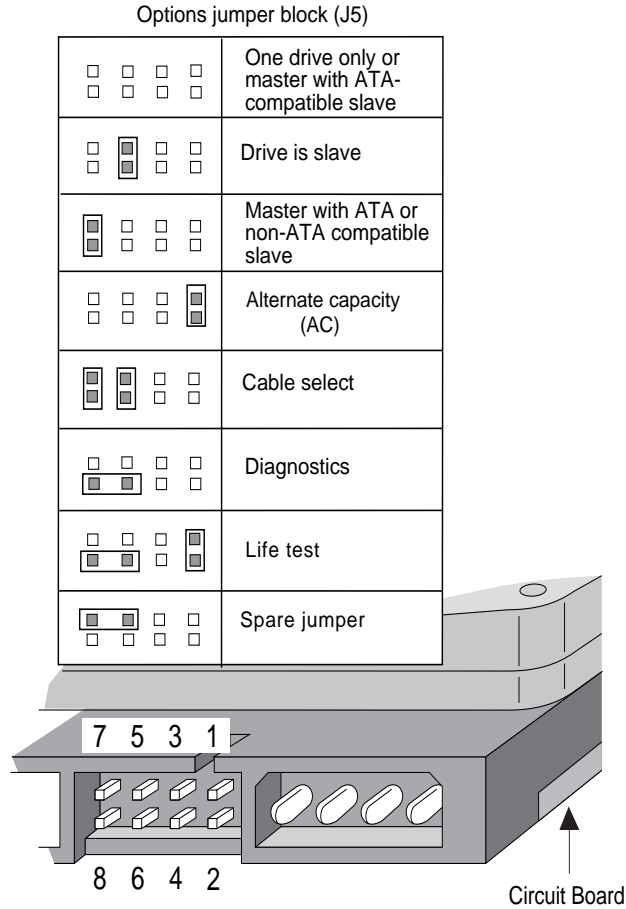


Figure 3. Connectors



**Figure 4. Configuration settings**

### 2.4.1 Master/slave configuration

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

**One drive only or master with an ATA-compatible slave.** The drive is configured at the factory for a single-drive operation or a master with an ATA-compatible slave. No jumpers are required for a single-drive operation. If you are installing a master with an ATA-compatible slave, remove all the jumpers from the master drive. The jumper on pins 5 and 7 is a spare and does not affect drive operation.

**Drive as slave.** Place a jumper on pins 5 and 6.

**Drive as master with an ATA or non-ATA compatible slave.** Place a jumper on pins 7 and 8.

### 2.4.2 Alternate capacity jumper

This jumper lowers the drive capacity by setting the default translation to 4,092 cylinders and causes the drive to appear to your BIOS as having a capacity of 2.1 Gbytes. Some BIOS that only auto-detect may require this jumper. Place a jumper on pins 1 and 2 of the J5 options jumper block to enable this option. When installing this jumper, you may need third-party partitioning software to achieve full capacity of the drive.

### 2.4.3 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 the drives for computers that use cable select:

- Install jumpers on pins 5 and 6 and pins 7 and 8 as shown in Figure 4 on page 20.
- Connect the drives to the cable as shown in Figure 5 on page 22.

### 2.4.4 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 a jumper on pins 6 and 8 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.

### 2.4.5 Life test jumper

This option enables the test function used in the manufacturing process and is not recommended for field use. When a jumper is placed on pins 1 and 2 and pins 6 and 8 of the options jumper block, the drive's actuator performs continuous seeks between track 0 and the maximum data cylinder and ignores any control signals that the interface sends.

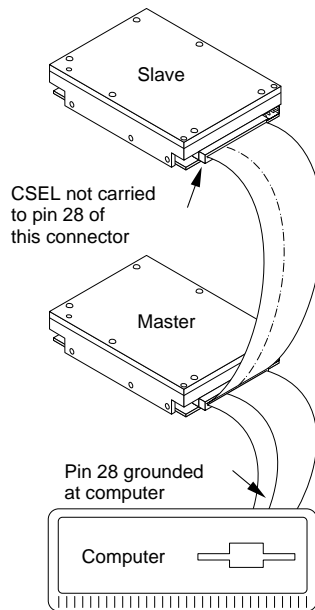


Figure 5. Connecting cable-selected drives

## 2.5 Mounting the drive

You can mount the drive in any orientation.

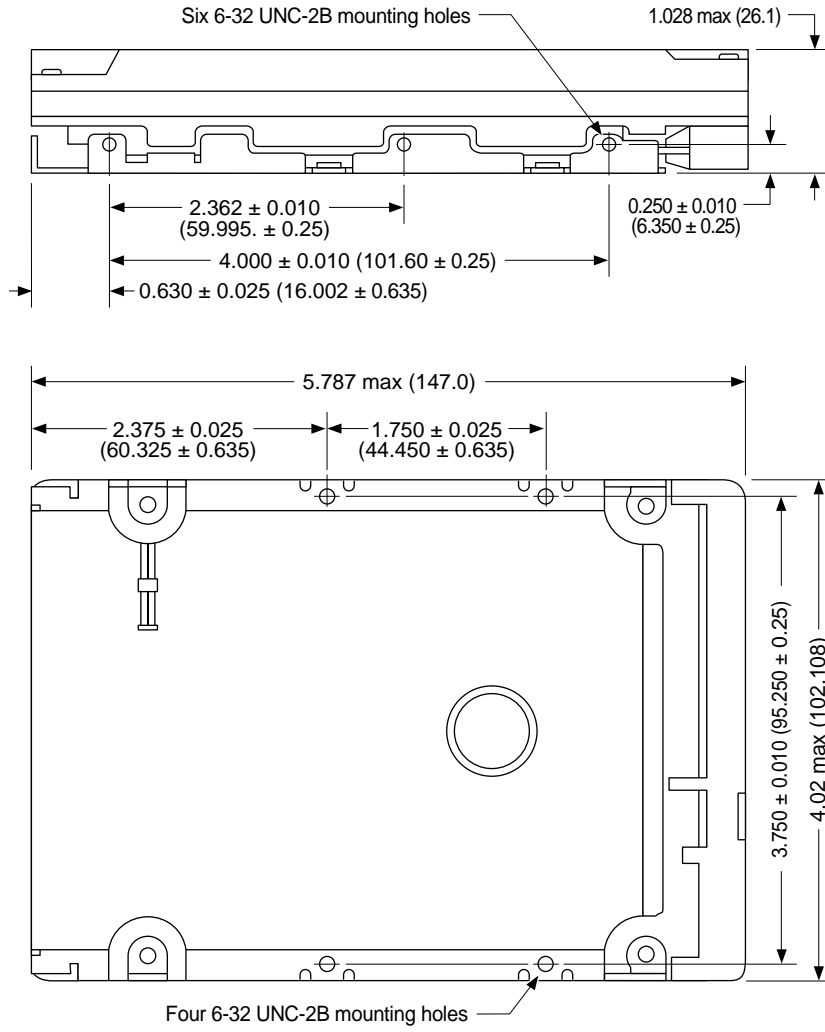
Use the set of mounting guidelines below that are appropriate to the type of mounting holes used: either bottom mounting holes or side mounting holes. Refer to Figure 6 on page 24 for mounting dimensions.

**Bottom mounting holes.** Insert four 6-32 UNC screws in the four bottom mounting holes as shown in Figure 6.

**Caution.** Do not insert the bottom mounting screws more than 0.20 inches (6 turns) into the drive frame.

**Side mounting holes.** Use four 6-32 UNC screws in four of the six available side mounting holes as shown in Figure 6. Use two mounting holes on each side of the drive.

**Caution.** Do not insert the side mounting screws more than 0.20 inches (6 turns) into the drive frame. If you use a screw that is too long, you may damage the drive's circuit board.



**Figure 6. Mounting dimensions**



### 3.0 ATA interface

The drive uses an ATA-4 interface. The interface complies with ANSI (AT Attachment) Interface Document *X3T13.1153 D Rev. 9* specification. *The ATA commands that the drive supports is listed on pages 29 and 30. Commands and features with specific applications for the drive is also discussed in this section.*

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 (46 centimeters).

#### 3.1 ATA interface connector pin assignments

The signal name and signal direction for each I/O connector pin is shown in Figure 7 on page 26. See the *Seagate ATA Interface Reference Manual*, publication number 36111-xxx, for a complete description of each pin.

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

Drive pin #	Signal name	Host pin # and signal description
1	Reset-	1 Hardware 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 Device Data (15:0)
19	Ground	19 Ground
20	(removed)	20 (No Pin)
21	DMARQ	21 DMA Request
22	Ground	22 Ground
23	DIOW-: STOP	23 Host I/O Write: Stop Ultra DMA Burst
24	Ground	24 Ground
25	DIOR-: HDMARDY-: HSTROBE	25 Host I/O Read: Host Ultra DMA Ready/ Host Ultra DMA Data Strobe
26	Ground	26 Ground
27	IORDY-: DDMARDY-: DSTROBE	27 I/O Channel Ready: Device Ultra DMA Ready/ Device Ultra DMA Data Strobe
28	CSEL	28 Cable Select
29	DMACK-	29 DMA Acknowledge
30	Ground	30 Ground
31	INTRQ	31 Device Interrupt
32	IOCS16-	32 Host 16 Bit I/O
33	DA1	33 Host Address Bus Bit 1
34	PDIAG-	34 Passed Diagnostics
35	DA0	35 Device Address (2:0)
36	DA2	36 Device Address (2:0)
37	CS0-	37 Chip Select (1:0)
38	CS1-	38 Chip Select (1:0)
39	DASP-	39 Drive Active / Slave Present
40	Ground	40 Ground

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

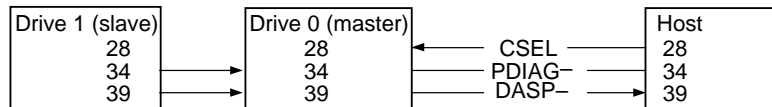


Figure 7. Ultra ATA interface connector pin assignments

### 3.2 Command set

This section lists all of the ATA commands the drive uses. Only the commands with unique implementation for the drive is discussed in this manual. For information about the ATA interface, refer to X3T13.1153D Rev. 9, Information Technology—AT Attachment-4 Interface specification.

The table below lists all commands implemented in the drive. It 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.

**Note.** Read DMA, Read Sector, Read Verify Sector, Write DMA, and Write Sector support with retry and without retry commands.

Command name	Command code (in hex)	Parameters used				
		FR	SC	SN	CY	DH
Check Power Mode	98, E5	n	y	n	n	D
Execute Drives Diagnostic	90	n	n	n	n	D
Identify Drives	EC	n	n	n	n	D
Initialize Drive Parameters	91	n	y	n	n	y
Read DMA	C8, C9	—	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

*continued*

*continued from previous page*

Command name	Command code (in hex)	Parameters used				
		FR	SC	SN	CY	DH
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
Sleep	99, E6	n	n	n	n	D
S.M.A.R.T.	B0	y	y	n	y	y
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 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

### 3.2.1 Identify Drive command (ECH)

The Identify drive parameters for the drive is listed in the table below.

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

Word	Description	Value
0	Configuration	045AH
1	Number of logical cylinders	4,888
2	Reserved	0000
3	Number of logical heads	16
4	Vendor-specific	34,540
5	Vendor-specific	580
6	Number of logical sectors per track	63
7–9	Vendor-specific	0000
10–19	Serial number (20 ASCII characters)	drive-unique
20	Vendor-specific	3
21	Vendor-specific	896
22	Vendor-specific	
23–26	Firmware revision (8 ASCII characters)	drive-unique
27–46	Model number (40 ASCII characters)	ST32520A
47	Maximum sectors per track in read/write multiple	8010H
48	Reserved	0000
49	Capabilities	2F80H
50	Capabilities	8001H
51	PIO data-transfer cycle timing mode	0200H
52	Obsolete	0200H

*continued*

*continued from previous page*

<b>Word</b>	<b>Description</b>	<b>Value</b>
53	Current valid	07 <sub>H</sub>
54	Number of current logical cylinders	4,888
55	Number of current logical heads	16
56	Number of current sectors	63
57–58	Current capacity in sectors (CHS)	4,927,104
59	xx <sub>H</sub> = Current setting for number of sector that can be transferred per interrupt on Read/Write Multiple command	0000s
60–61	Total number of user-addressable LBA sectors	4,927,104
62	Obsolete	0000
63	Multiword DMA transfer mode active	0107 <sub>H</sub> Mode 0 is active Modes 0, 1, and 2 supported
64	Advanced PIO transfer mode supported	0003 <sub>H</sub> Modes 3 and 4 supported
65	Minimum multiword DMA transfer cycle time per word	120 nsec
66	Manufacturer recommended multiword DMA transfer cycle time	120 nsec
67	Minimum PIO transfer cycle time without flow control	120 nsec
68	Minimum PIO transfer with IORDY flow control	120 nsec
69–79	Reserved	0000
80	Major version number	004 <sub>H</sub>
81	Minor version number	00D <sub>H</sub>
82	Command set support	706B <sub>H</sub>
83	Command set support	4000 <sub>H</sub>

<b>Word</b>	<b>Description</b>	<b>Value</b>
84	Command set/feature supported extension	4000 <sub>H</sub>
85–86	Command set/feature enabled	0
87	Command set/feature default	0
88	Ultra DMA mode	0007 <sub>H</sub>
89	Time required for security erase unit completion	
90	Time required for enhanced security erase completion	
128	Security status	0000
129–159	Vendor-specific	
160–255	Reserved	

### 3.2.2 Set Features command (EF<sub>H</sub>)

The Set Features command (command code EF<sub>H</sub>) allows you to enable and disable the multisegmented cache and automatic reallocation features and to identify the transfer modes the drive uses. The multisegmented buffer consists of read look-ahead and write-immediate and write-merging features. The table below lists the features the drive supports. The features that are set to default by the factory are indicated in the Feature column.

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 drives post an Aborted Command error.

At power-on or after a hard reset, the feature selections are restored to the factory-default values.

The table below shows alterable features that the drive supports. Values that are preset at the factory are indicated as default in the feature description.

Feature Value	Feature
02 <sub>H</sub>	Enable write cache (default)
03 <sub>H</sub>	Set transfer mode
04 <sub>H</sub>	Enable read automatic reallocation (default)
55 <sub>H</sub>	Disable read look-ahead cache
82 <sub>H</sub>	Disable write cache
84 <sub>H</sub>	Disable read automatic reallocation
AA <sub>H</sub>	Enable read look-ahead cache (default)



### 3.2.2.1 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
Multiword DMA Mode	0	00100	000
	1	00100	001
	2	00100	010
Synchronous DMA Mode	0	01000	000
	1	01000	001
	2	01000	010

**Note.** If the drive does not support a commanded mode, it returns a 04 aborted command error.

### 3.2.3 Standby timer timeout period

The Idle command and Standby command Sector Count registers are used to activate the Standby timer. The host can enable the Standby timer by placing a value in the sector-count register of the Idle command or Standby command. The value corresponds to a predetermined period of drive inactivity. The table below lists the values the Seagate drive uses and their corresponding timeout period.

<b>Sector Count Register contents</b>	<b>Corresponding timeout period</b>
0 (0H)	Timeout disabled
1–12 (1H–CH)	value = 60 seconds
13–240 (DH–F0H)	(value * 5) seconds
241–251 (F1H–FBH)	(value – 240 * 30) minutes
252 (FCH)	21 minutes
253 (FDH)	8 hours
254 (FEH)	Reserved
255 (FFH)	21 minutes 15 seconds

The drives are shipped with the Standby timer disabled.

### 3.2.4 Sleep command (99H, E6H)

The drive enters sleep mode after receiving a Sleep immediate command from the host. 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 the reset, the drive exits Sleep mode and enters Idle mode with all current emulation and translation parameters intact.

### 3.2.5 Automatic reallocation

This feature allows the drive to identify grown media defects and to reallocate the sector without host intervention using both read and write automatic reallocation.

You can disable read reallocation by using the Set Features command Disable Read Automatic Reallocation, feature value 84H. This feature is not used for the Read Long command.

You can disable the write reallocation, in addition to write cache by using the Set Feature command Disable Write Cache, feature value 82<sub>H</sub>. This feature is not implemented for the Write Long command.

### 3.2.6 S.M.A.R.T. commands (B0<sub>H</sub>)

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 only attributes that the drive can monitor.

The S.M.A.R.T. feature is disabled at the factory. You must have a BIOS, software driver or application software that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the Seagate drives use.

**Note.** To implement a S.M.A.R.T. command, the host must write 0x4F to Cylinder\_lo register, 0xC2 to the Cylinder\_hi register, S.M.A.R.T. opcode to the Features register, and B0<sub>H</sub> to the Command 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
D0 <sub>H</sub>	Return drive attributes
DA <sub>H</sub>	Return S.M.A.R.T. status
D1 <sub>H</sub>	Read Warranty Failure Threshold
D2 <sub>H</sub>	Enable/Disable Attribute Autosave
D3 <sub>H</sub>	Write current attribute values to disk
D4 <sub>H</sub>	Collect off line data
D7 <sub>H</sub>	Write Warranty Failure Threshold
D8 <sub>H</sub>	Enable Failure Prediction Operation
D9 <sub>H</sub>	Disable operation
DB <sub>H</sub>	Enable/Disable Automatic off-line data collection

### 3.3 Synchronous DMA transfer

#### 3.3.1 Signal line definitions

Some existing ATA signal lines are redefined during the Synchronous DMA protocol to provide new functions. If the Synchronous DMA transfer mode was previously chosen by the Set Features, the ATA lines change from the old to new definitions as soon as the host allows for a DMA burst. The drive detects this change when the  $\text{-DMACK}$  line is asserted. These lines revert back to their original definitions upon the deassertions of  $\text{-DMACK}$  at the termination of the DMA burst.

Signal Line Definitions		
Pin	New Definitions	Old Definitions
21	DMARQ	DMARQ
29	$\text{-DMACK}$	$\text{-DMACK}$
27 25	$\text{-DMACK}$	IORDY on write commands $\text{-DIOR}$ on read commands
25 27	STROBE	$\text{-DIOR}$ on write commands IORDY on read commands
23	STOP	$\text{-DIOW}$

**Note.** DMARQ and  $\text{-DMACK}$  signal lines remain unchanged. This ensures backward-compatibility with PIO modes.

#### 3.3.2 Protocol rules

The general rules of the Synchronous DMA Transfer Protocol are as follows:

- A DMA burst is defined as the period from an assertion of  $\text{-DMACK}$  to subsequent deassertion of  $\text{-DMACK}$ .
- A receiver must be prepared to receive at least two words of data whenever it enters or resumes a burst mode.
- During the entire burst,  $\text{-CS0}$ ,  $\text{-CS1}$  and  $\text{-IOCS16}$  are in the high negated state. DA2, DA1 and DA0 are driven low.
- The drive begins driving and stops tristating IORDY when  $\text{-DMACK}$  is first asserted and SyncDMA is enabled. The drive must continue to

drive IORDY until  $\text{DMACK}$  is deasserted and then tristates IORDY within (T<sub>ordyz</sub>) nanoseconds.

- A device that supports a particular mode timing must support all slower modes.

### 3.3.3 Error register

Field/Bit Description								
Bit	7	6	5	4	3	2	1	0
	<b>ICRCE</b>	<b>UNC</b>	<b>MC</b>	<b>IDNF</b>	<b>MCR</b>	<b>ABRT</b>	<b>TKONF</b>	<b>AMNF</b>

- ICRCE (Interface CRC Error) indicates that a CRC error occurred on the data bus during a Synchronous DMA transfer. The correct response for this error is to retry the complete command. ABRT (bit 2) is also set to ensure compatibility with drivers designed for previous versions of the Synchronous DMA Transfer Protocol Specification.
- ABRT (Aborted Command) indicates that the requested command was aborted because the command code or a command parameter was invalid, or some other error occurred. The device may complete some portion of the command before setting ABRT and terminating the command. If the command was a data-transfer command, the data transfer is determinate. This bit is also set when an Interface CRC Error (bit 7) occurs. This ensures compatibility with drivers designed for previous versions of the Synchronous DMA Protocol Specification.



## Appendix. Timing diagrams

In PIO mode, the drive operates at programmed I/O timing specifications, as shown below.

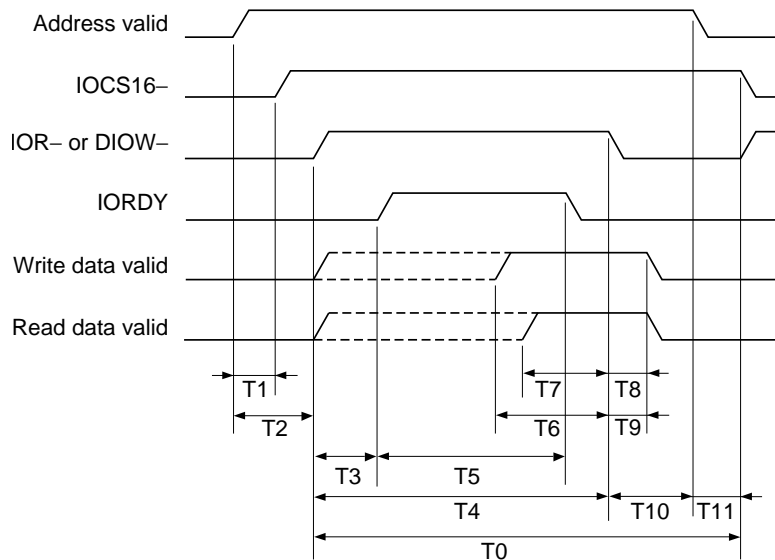


Figure 8. Programmed I/O timing (with or without IORDY)

Time	Description	Min	Max
T0	Cycle time	120 nsec	—
T1	Address valid until IOCS16- is asserted	—	30 nsec
T2	Drive address (CS1FX-, CS3FX-, DA0, DA1 and DA2) valid before DIOR- or DIOW- setup	25 nsec	—
T3	IORDY setup time	—	—
T4	DIOW- or DIOR- pulse width (8-bit)	70 nsec	—
	DIOW- or DIOR- pulse width (16-bit)	70 nsec	—
T5	IORDY pulse width	—	1,250 nsec
T6	DIOW- data setup	20 nsec	—
T7	DIOR- data setup	20 nsec	—
T8	DIOR- data hold	5 nsec	—
T9	DIOW- data hold	10 nsec	—
T10	DIOW- or DIOR- to address valid hold	5 nsec	—
T11	Address valid until IOCS16- is negated	—	25 nsec

The drive operates at multiword DMA mode 2 timing specifications, as shown below.

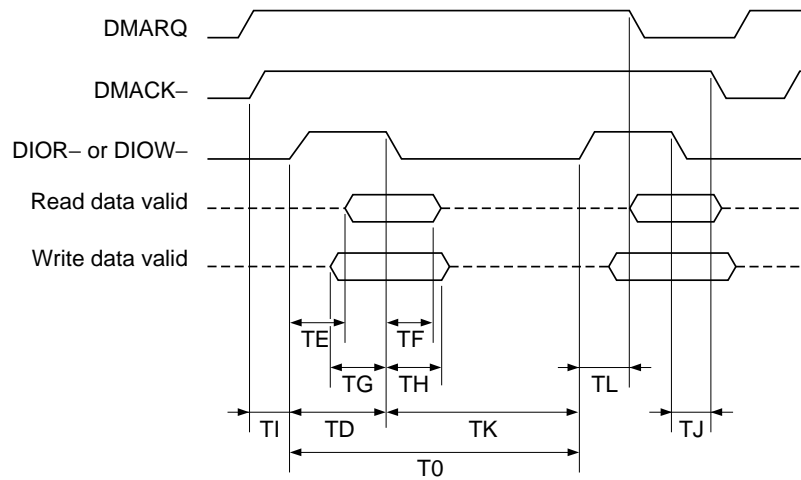


Figure 9. Multiword DMA timing

Time	Description	Min	Max
T0	Cycle time	120 nsec	—
TD	DIOW- or DIOR- pulse width (16-bit)	70 nsec	—
TE	DIOR- data access	—	—
TF	DIOR- data hold	5 nsec	—
TG	DIOW- data setup	20 nsec	—
TH	DIOW- data hold	10 nsec	—
TI	DMACK- to DIOR- or DIOW- setup	0 nsec	—
TJ	DIOR- or DIOW- to DMACK- hold	5 nsec	—
TK <sub>R</sub>	DIOR- negated pulse width	25 nsec	—
TK <sub>W</sub>	DIOW- negated pulse width	25 nsec	—
TL <sub>R</sub>	DIOR- to DMARQ delay	—	35 nsec
TL <sub>W</sub>	DIOW- to DMARQ delay	—	25 nsec



The drive operates at sustained synchronous DMA burst timing specifications, as shown below.

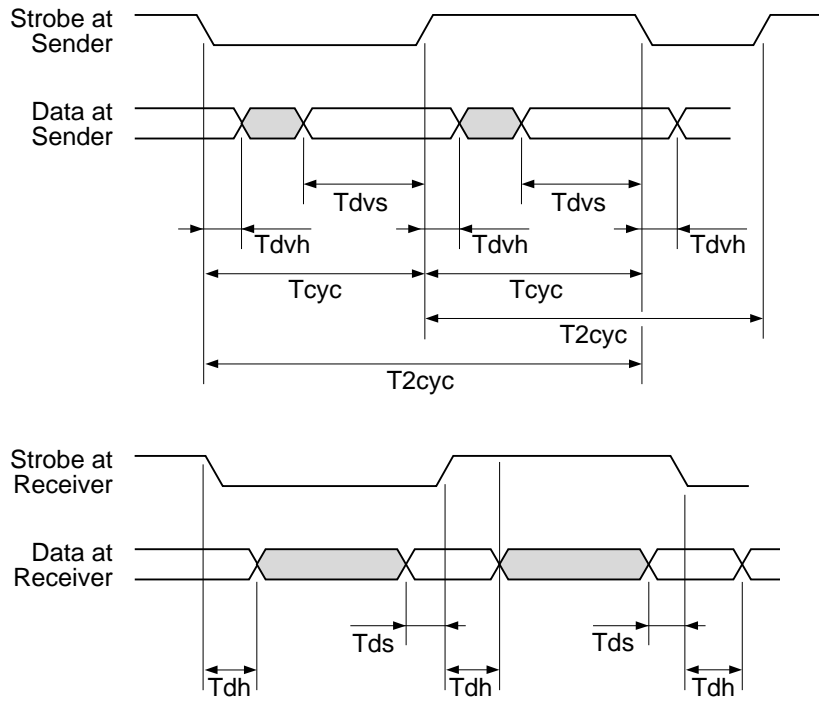
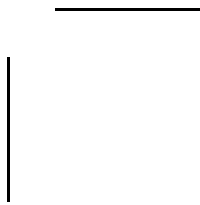
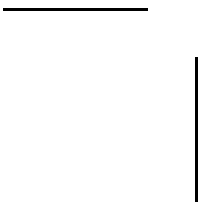
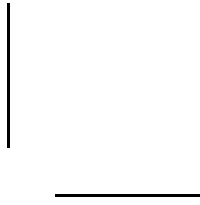
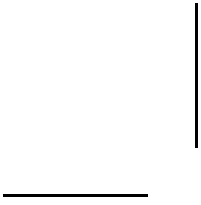
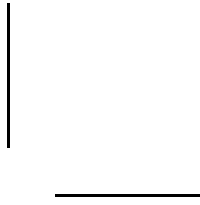
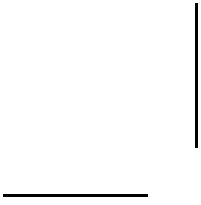


Figure 10. Sustained synchronous DMA burst

Time	Description	Mode 0	Mode 1	Mode 2
Tcyc	Cycle time	125 nsec	94 nsec	62.5 nsec
T2cyc	Two cycle times	250 nsec	188 nsec	125 nsec
Tds	Data setup time (at receiver)	15 nsec	10 nsec	7 nsec
Tdh	Data hold time (at receiver)	5 nsec	5 nsec	5 nsec
Tdvs	Data valid setup time (at sender)	70 nsec	48 nsec	34 nsec
Tdvh	Data valid hold time (at sender)	6 nsec	6 nsec	6 nsec

**Note.** Mode values show minimum time only.







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