Seagate

# *Medalist 2520*

## *Ultra ATA Interface Drive*

*Product Manual*

# *Medalist 2520 (ST32520A)*

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*Product Manual*

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# 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 EPR4 (16/17) 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 1.6 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
- 1.6 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) | 858 |
| Data zones | 15 |
| Recording density (bits per inch) | 130K |
| 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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| **Drive specification** | **ST32520A** |
|---|---|
| External transfer rate (Mbytes per sec max)<br>DMA mode 2<br>PIO mode<br>Synchronous DMA mode | <br>16.6<br>16.6<br>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) | 5.0W |
| Read/Write power and current (typical) | 5.1W |
| Idle total power (typical) | 4.5W |
| Standby total power (typical) | 1.6W |
| 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 |
| Recording method | EPR4 (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) | 858 |
| Data zones | 15 |
| Recording density, max (BPI) | 130,000 |
| 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 (147 mm) |
| 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<br>3.1 msec read<br>3.5 msec write | 10.0 msec seek<br>13.0 msec read<br>14.5 msec write | 25.0 msec seek<br>27.0 msec read<br>30.0 msec write | 5.54 |

**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.

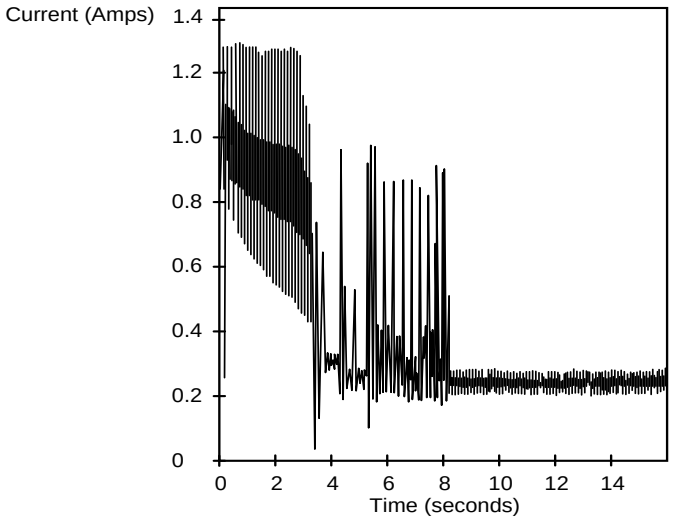



**Figure 1. Typical startup current profile**

## 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 15 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 on page 10.

All power 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.The Idle and Standby timers were disabled at the factory.

#### 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 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 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 |
|---|---|---|---|---|---|---|
| **Current at +12V** | | | | | | |
| 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 |
| **Current at +5V** | | | | | | |
| RMS amps typ | 0.6A | 0.35 | 0.40 | 0.29 | 0.29 | 0.16 |
| Watts typ | — | 1.75 | 2.0 | 1.45 | 1.45 | 0.8 |
| **Power** | | | | | | |
| Total watts typ | — | 5.0W | 5.1W | 4.5W | 1.6W | 0.956W |

## 1.12 Input noise

| | +5V | +12V |
|---|---|---|
| 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. (–61 m to 3,048 m) |
| Nonoperating | –200 ft. to 40,000 ft. (–61 m to 12,200 m) |

### 1.13.4 Relative humidity

| | |
|---|---|
| Operating | 8% to 90% noncondensing<br>Maximum wet bulb 29.4°C (85°F) |
| Maximum operating gradient | 30% per hour |
| Nonoperating | 5% to 95% noncondensing<br>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 levels 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 drive. 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.

| **Overall A-weighted Value** | **Idle** | **Seek** |
|---|---|---|
| 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 $10^{13}$ bits transferred |
| Seek errors | 1 per $10^{7}$ 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 with the directives, we cannot guarantee that all systems will comply. The com-

puter 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.

**Australian C-Tick**

If this model has the C-Tick marking, it complies with the Australia/New Zealand Standard AS/NZS3548 1995 and meets the Electromagnetic Compatibility (EMC) Framework requirements of Australia's Spectrum Management Agency (SMA).

## 1.19 FCC verification

The Medalist 2520 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 this drive 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.

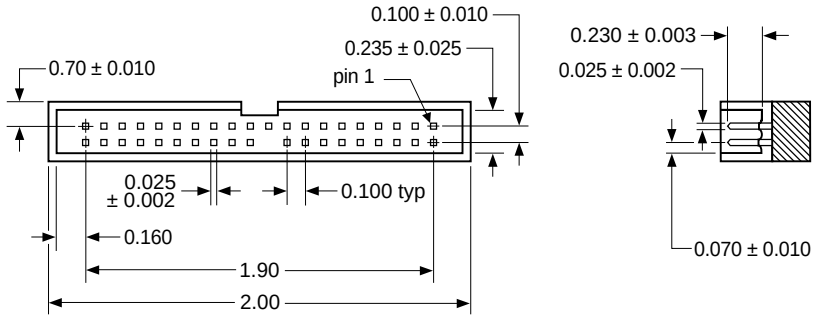



**Figure 2. ATA interface connector**

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 20. The drive is shipped with a spare jumper attached to pins 5 and 7. Use this jumper to configure the drive.

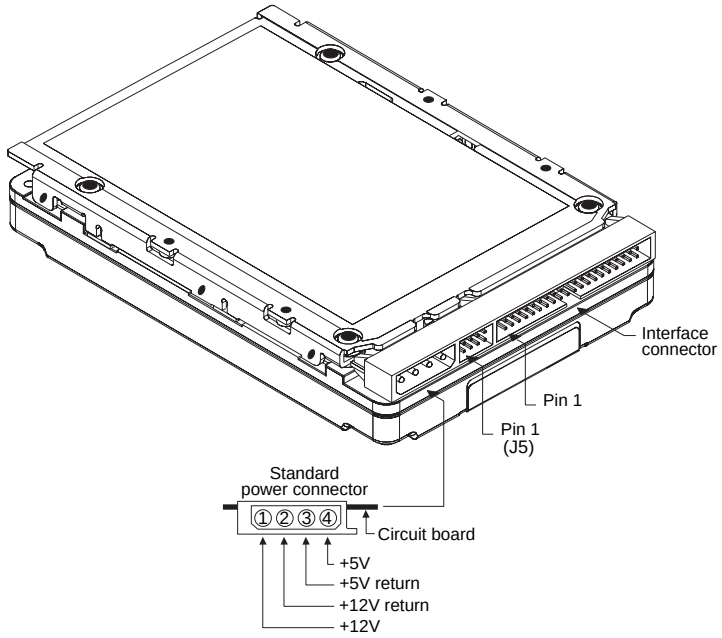



**Figure 3. Connectors**

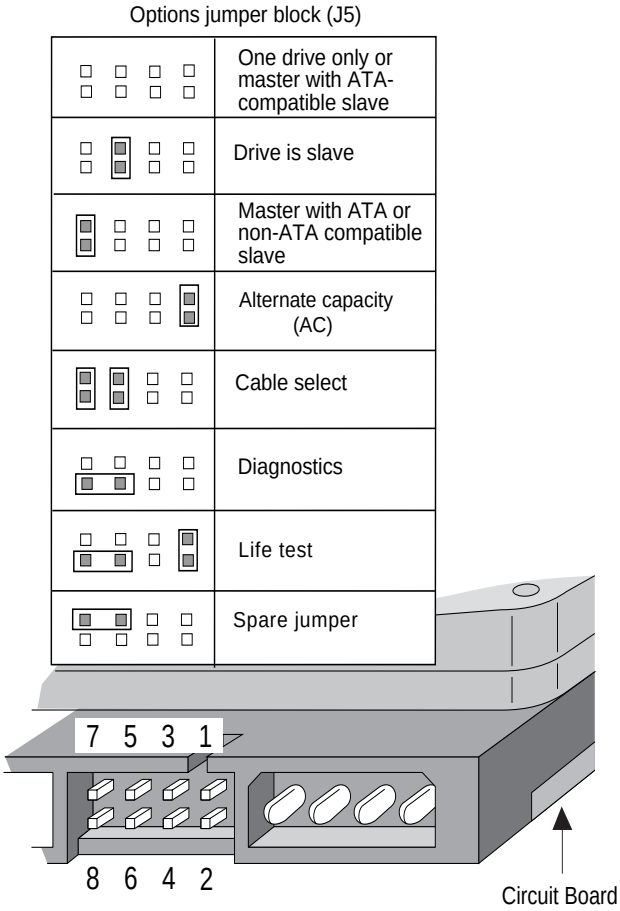



**Figure 4. Configuration settings**

## 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 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.

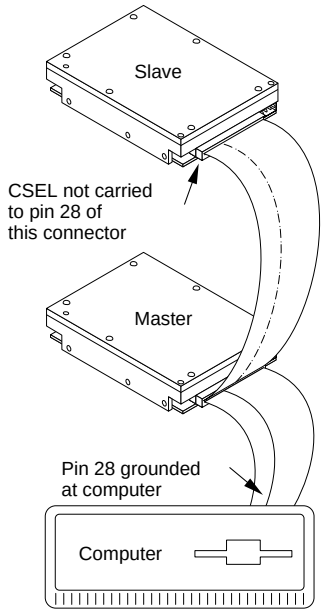



**Figure 5. Connecting cable-selected drives**

### 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.

### 2.4.6 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.

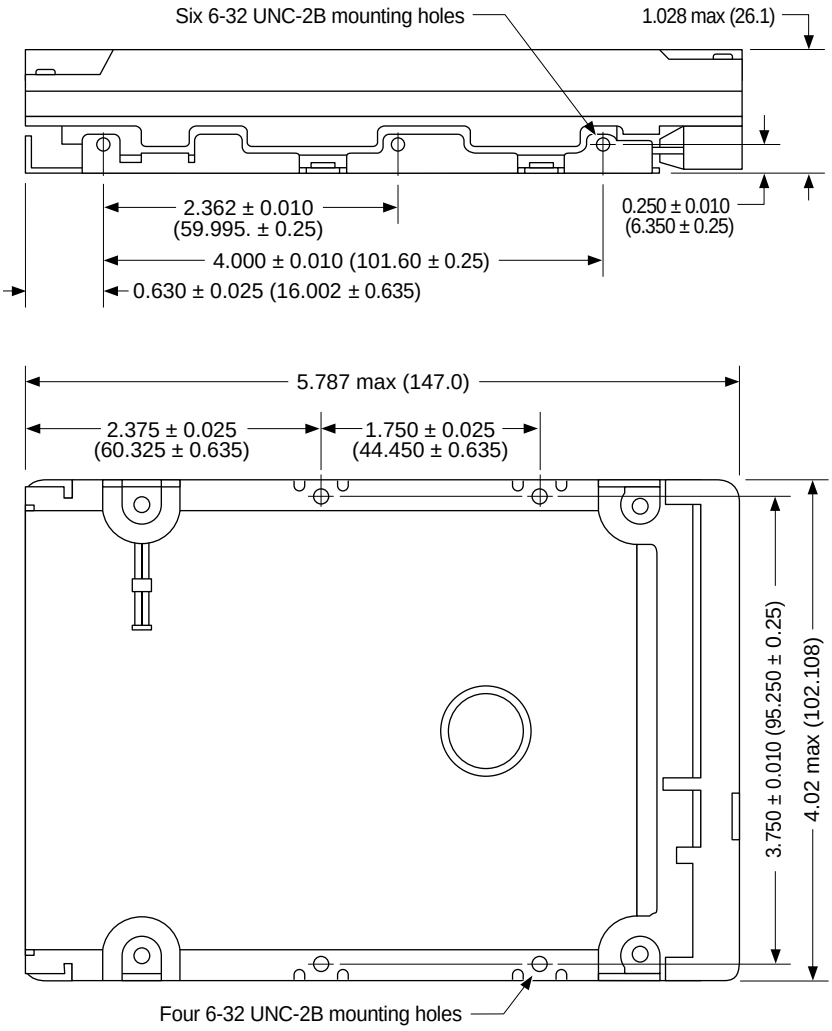



**Figure 6. Mounting dimensions**

# 3.0 ATA interface

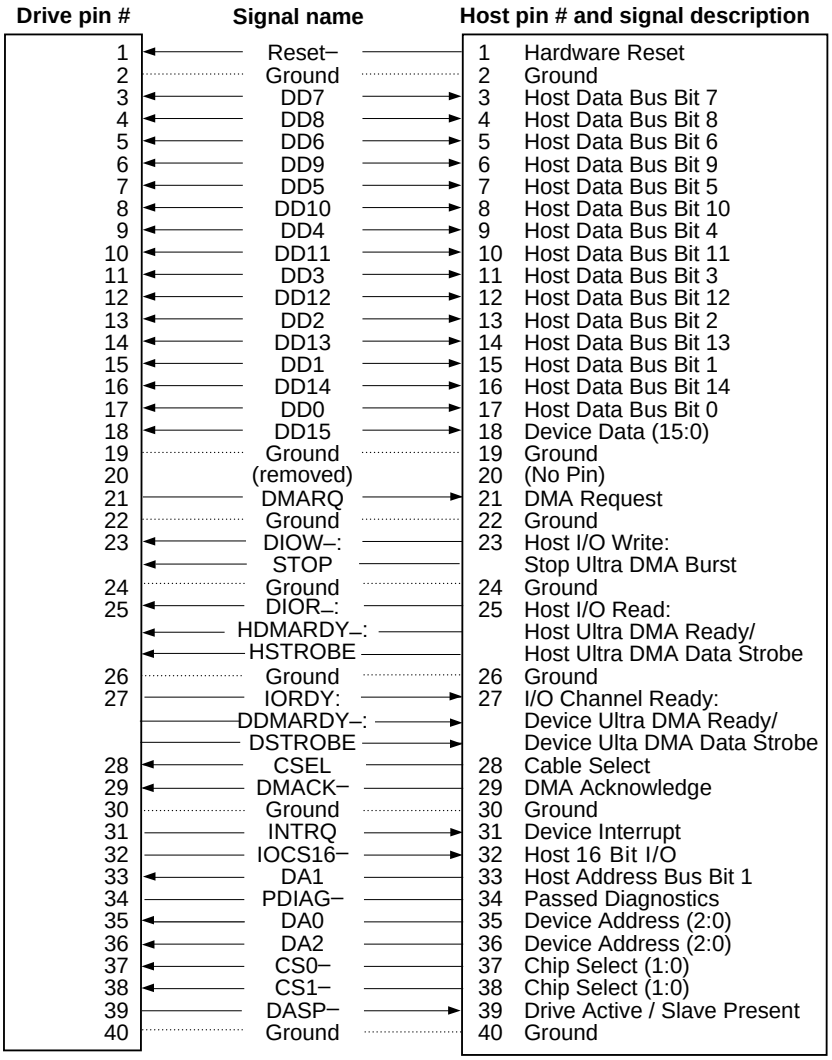
The drive uses an ATA-4 interface. The interface complies with ANSI (AT Attachment) Interface Document *X3T13.1153 D Rev. 9* specification. *The ATA commands that the drive supports are listed on pages 29 and 30. Commands and features with specific applications for the drive are also discussed in this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




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

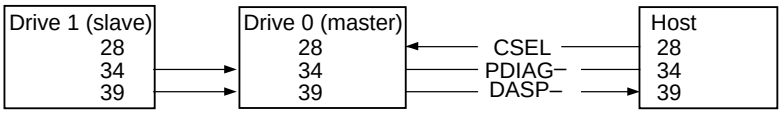



**Figure 7. Ultra ATA interface connector pin assignments**

## 3.2 Command set

This section lists all of the ATA commands the drive uses. Only the commands with unique implementation for the drive are 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 ($EC_H$)

The Identify Drive parameters for the drive are 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 | $045A_H$ |
| 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 | $8010_H$ |
| 48 | Reserved | 0000 |
| 49 | Capabilities | $2F80_H$ |
| 50 | Capabilities | $8001_H$ |
| 51 | PIO data-transfer cycle timing mode | $0200_H$ |
| 52 | Obsolete | $0200_H$ |

*continued*

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| Word | Description | Value |
|---|---|---|
| 53 | Current valid | $07_H$ |
| 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 | $xx_H$ = Current setting for number of sectors 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 | $0107_H$<br>Mode 0 is active<br>Modes 0, 1, and 2 supported |
| 64 | Advanced PIO transfer mode supported | $0003_H$<br>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 | $004_H$ |
| 81 | Minor version number | $00D_H$ |
| 82 | Command set support | $706B_H$ |
| 83 | Command set support | $4000_H$ |

| Word | Description | Value |
|---|---|---|
| 84 | Command set/feature supported extension | $4000_H$ |
| 85–86 | Command set/feature enabled | 0 |
| 87 | Command set/feature default | 0 |
| 88 | Ultra DMA mode | $0007_H$ |
| 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 ($EF_H$)

The Set Features command (command code $EF_H$) 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 |
|---|---|
| $02_H$ | Enable write cache (default) |
| $03_H$ | Set transfer mode |
| $04_H$ | Enable read automatic reallocation (default) |
| $55_H$ | Disable read look-ahead cache |
| $82_H$ | Disable write cache |
| $84_H$ | Disable read automatic reallocation |
| $AA_H$ | 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 $03_H$ (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 drive uses and its corresponding timeout period.

| Sector Count Register contents | Corresponding timeout period |
|---|---|
| 0 ($0_H$) | Timeout disabled |
| 1–12 ($1_H$–$C_H$) | value = 60 seconds |
| 13–240 ($D_H$–$F0_H$) | (value * 5) seconds |
| 241–251 ($F1_H$–$FB_H$) | (value – 240 * 30) minutes |
| 252 ($FC_H$) | 21 minutes |
| 253 ($FD_H$) | 8 hours |
| 254 ($FE_H$) | Reserved |
| 255 ($FF_H$) | 21 minutes 15 seconds |

The drive is shipped with the Standby timer disabled.

### 3.2.4 Sleep command ($99_H$, $E6_H$)

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 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.

### 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 $84_H$. 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 $82_H$. This feature is not implemented for the Write Long command.

### 3.2.6 S.M.A.R.T. commands ($B0_H$)

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 only to the 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 drive uses.

**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 $B0_H$ 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 |
|---|---|
| $D0_H$ | Return drive attributes |
| $DA_H$ | Return S.M.A.R.T. status |
| $D1_H$ | Read Warranty Failure Threshold |
| $D2_H$ | Enable/Disable Attribute Autosave |
| $D3_H$ | Write current attribute values to disc |
| $D4_H$ | Collect offline data |
| $D7_H$ | Write Warranty Failure Threshold |
| $D8_H$ | Enable Failure Prediction Operation |
| $D9_H$ | Disable operation |
| $DB_H$ | Enable/Disable Automatic offline 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 –DMACK line is asserted. These lines revert back to their original definitions upon the deassertions of –DMACK at the termination of the DMA burst.

| Signal Line Definitions | | |
|---|---|---|
| **Pin** | **New Definitions** | **Old Definitions** |
| 21 | DMARQ | DMARQ |
| 29 | –DMACK | –DMACK |
| 27<br>25 | –DMACK | IORDY on write commands<br>–DIOR on read commands |
| 25<br>27 | STROBE | –DIOR on write commands<br>IORDY on read commands |
| 23 | STOP | –DIOW |

**Note.** DMARQ and –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 –DMACK to subsequent deassertion of –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, –CS0, –CS1 and –IOCS16 are in the high negated state. DA2, DA1 and DA0 are driven low.
- The drive begins driving and stops tristating IORDY when –DMACK is first asserted and SyncDMA is enabled. The drive must continue to

drive IORDY until –DMACK is deasserted and then tristates IORDY within (Tiordyz) 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 |
| | **ICRCE** | **UNC** | **MC** | **IDNF** | **MCR** | **ABRT** | **TKONF** | **AMNF** |

- 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 timing specifications, as shown below.

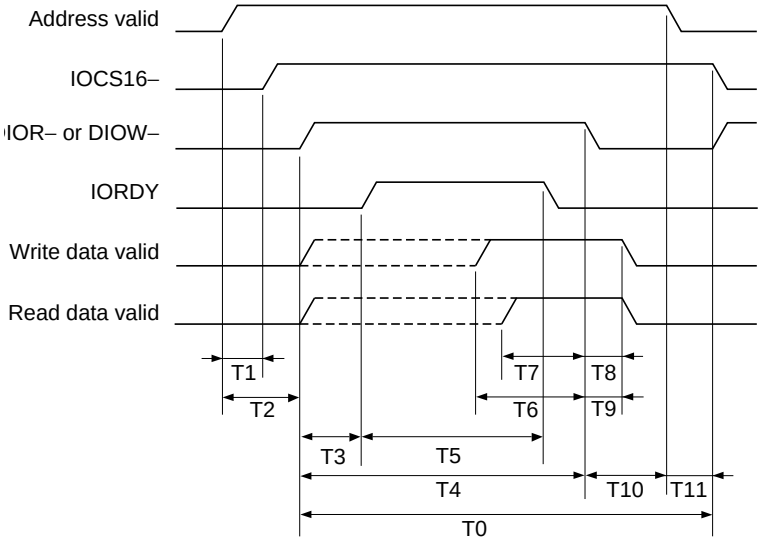


**Figure 8. Programmed I/O timing (with or without IORDY)**

| 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.

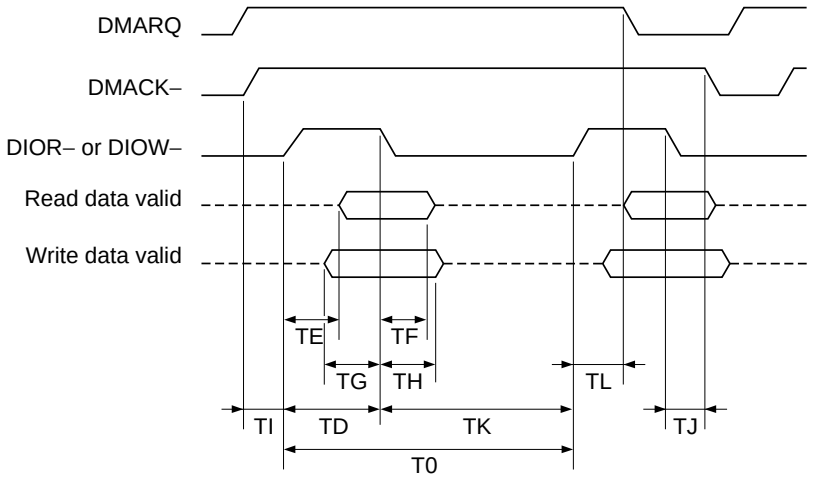


**Figure 9. Multiword DMA timing**

| 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 | — |
| $TK_R$ | DIOR– negated pulse width | 25 nsec | — |
| $TK_W$ | DIOW– negated pulse width | 25 nsec | — |
| $TL_R$ | DIOR– to DMARQ delay | — | 35 nsec |
| $TL_W$ | DIOW– to DMARQ delay | — | 25 nsec |

The drives operate at sustained synchronous DMA burst timing specifications, as shown below.

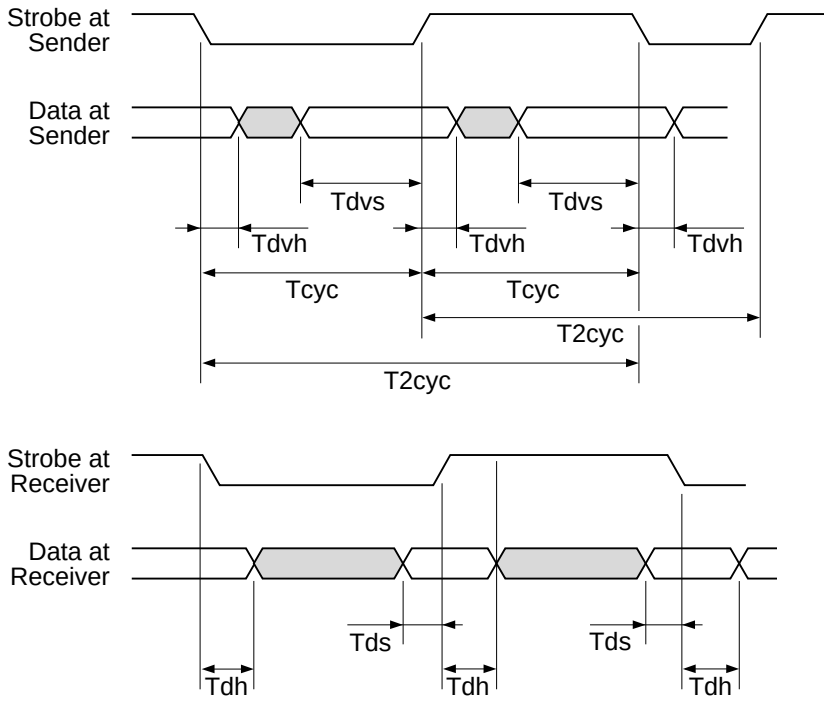


**Figure 10. Sustained synchronous DMA burst**

| 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 |
| Tdv | Data valid setup time (at sender) | 70 nsec | 48 nsec | 34 nsec |
| Tdvs | Data valid hold time (at sender) | 6 nsec | 6 nsec | 6 nsec |

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

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