Seagate

Medalist Family

Medalist 1640

Medalist 2140

ATA Interface Drives

Product Manual

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Publication Number: 36314-201, Rev. A, January 1996

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Introduction

This manual describes the functional, mechanical and interface specifications for the Medalist™ 1640 and 2140 hard disc drives. The drives are referred to throughout this manual by their model numbers, ST31640A for the Medalist 1640 and ST32140A for the Medalist 2140.

The Seagate® ST31640A and ST32140A are high-capacity, Fast ATA-2 performance drives. The drives' features include: 3 and 4 data-surfaces respectively, 5,376-RPM spindle speed, embedded servo technology, a 16-bit internal microprocessor and an intelligent controller. These features and others combine to give you high-performance, high-capacity and energy-efficient drives.

Fast ATA-2 offers you the twin-performance advantage of larger data-volume transferred at higher speeds. Fast ATA-2 assures you of PIO mode 4 and multiword DMA mode 2 for burst transfer rates of up to 16.6 Mbytes per second. (The drives support all PIO and all multiword DMA transfer modes. The transfer rate for any given operation depends on capability of the entire system.[1]) Fast ATA-2 also means that Multiple block read/write is supported. This feature allows multiple blocks of data to be stored in cache and transferred in a single burst. These features make the drives responsive to the demands of high-performance Pentium and PowerPC-class microprocessors and VL and PCI Local Bus architectures.

These 5,400-RPM class drives use embedded servo technology to ensure quick and accurate access to information on the drive without thermal recalibration interruptions. They use a 16-bit internal microprocessor that is more responsive to 32-bit operating systems and an intelligent controller that provides data streaming—direct data transfers between the host and the drive without microprocessor intervention. These features increase the sustained data-transfer rate, facilitating video playback and other multimedia operations. Coupled with the 1.62-Gbyte and 2.11-Gbyte capacities, the drives have more than enough capacity to download and play back a complete CD-ROM.

The ST31640A and ST32140A are energy-efficient drives. They feature the power modes defined in the ATA-2 standard. Standby and Sleep modes reduce power consumption to a low 0.755 watts (typical). The drives enter power-saving modes at the request of the computer and can be programmed to automatically enter Idle or Standby modes. (The ATA commands with specific applications for the drives and the Seagate-unique commands the drives use are discussed in Section 3.0 on page 25. A complete listing of the commands the drive supports is found in the table on page 27.)

1. In computers that support the highest levels of performance, the drive may exceed some of the listed specifications.

The ST31640A and ST32140A drives fit the standard 3.5-inch footprint. They have a 1.027-inch (26.08-mm) high profile and a 5.79-inch depth profile. The following is a summary of the drive's features:

Capacity

- 1,625 and 2,113 Mbytes formatted
- Three-disc and four-disc formats
- LBA translation support
- CHS translation support over 528 Mbytes

Performance

- Fast ATA-2. (Supports multiword DMA modes 0, 1 and 2 and PIO modes 0, 1, 2, 3 and 4 for up to 16.6-Mbyte-per-second transfer rates. Supports Multiple block read/write.)
- 5,376-RPM rotational speed
- 128-Kbyte segmented buffer
- 10.0-msec average seek time
- 16-bit microprocessor
- Intelligent controller
- Data streaming

Energy efficiency

- Supports ATA-2 power-management modes: Active, Idle, Standby and Sleep
- 0.755 watt typical power dissipation rating in Standby and Sleep modes

Acoustics

- 4.1-bels idle acoustic sound power level

Quick specification chart

The following table serves as a quick reference for the ST32140A performance specifications. These and other specifications are discussed in the Specification summary section following the table.

Drive specification	**ST31640A**	**ST32140A**
Guaranteed capacity (Mbytes) ($\times 10^6$ bytes)	1,625.7	2,113.4
Guaranteed sectors	3,175,200	4,127,760
Bytes per sector	512	512
Sectors per track	63	63
Logical Read/Write heads	16	16
Logical cylinders	3,150	4,095
Physical Read/Write heads	6	8
Physical disc	3	4
Recording density (Kbits/inch)	76.2	76.2
Track density (tracks/inch)	4,800	4,800
Spindle speed (RPM)	5,376	5,376
Track-to-track seek time (msec typical)	2.0	2.0
Average seek time (msec typical)	10.0	10.0
Full-stroke seek time (msec typical)	20.0	20.0
Average latency (msec)	5.58	5.58
Internal data-transfer rate (Mbits per sec max)	34.5 to 67.7	34.5 to 67.7
External transfer rate[2] (Mbytes per sec) PIO mode	up to 16.6	up to16.6
External transfer rate (Mbytes per sec) DMA mode	up to16.6	up to 16.6
Cache buffer (Kbytes)	128	128
Height (inches max)	1.03	1.03
Width (inches max)	4.02	4.02
Depth (inches max)	5.79	5.79
Typical weight (lb)	1.0	1.0

continued

2. External transfer rate is based on the ATA-2 standard. Actual performance may exceed the standard. See your Seagate representative for details.

continued from previous page

Drive specification	**ST31640A**	**ST32140A**
Power-on to ready (sec typical)	8	8
Spinup current (typical)	1.6A	1.6A
Seek power (typical)	8.41W	8.41W
Read/Write power (typical)	5.98W	5.98W
Idle total power (typical)	4.72W	4.72W
Standby/Sleep power (typical)	0.755W	0.755W
Voltage tolerance (including noise): +5V	±5%	±5%
Voltage tolerance (including noise): +12V	±5%	±5%
Operating temperature (°C)	5 to 55°C	5 to 55°C
Nonoperating temperature (°C)	–40 to 70°C	–40 to 70°C
Operating temperature gradient (°C per hr. max)	20°C	20°C
Relative humidity, operating gradient (max.)	10% per hr	10% per hr
Altitude operating	–1,000 to 10,000 ft.	–1,000 to 10,000 ft.
Altitude nonoperating	–1,000 to 40,000 ft.	–1,000 to 40,000 ft.
Shock, normal operating (Gs max at 2 or 11 msec)	2 Gs	2 Gs
Vibration (Gs max at 22-350 Hz without nonrecoverable errors), operating	0.75 Gs 0 to Peak	0.75 Gs 0 to Peak
Vibration (Gs max at 22-350 Hz with no physical damage incurred), Nonoperating	2.0 Gs 0 to Peak	2.0 Gs 0 to Peak
Drive acoustics, Idle mode (bels), typ	4.1 bels	4.1 bels
Drive acoustics, Seek mode (bels), typ	4.4 bels	4.4 bels
Nonrecoverable read errors (per bits transferred)	10^{13}	10^{13}
Mean time between failures (power-on hours)	500,000	500,000
Contact start-stop cycles	20,000	20,000
Service life (years)	5	5

1.0 Specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, at sea level and nominal power.

1.1 Formatted capacity

Medalist drives are low-level formatted at the factory. You cannot low-level format them.

You can operate the drive using many different address configurations, provided the number of sectors per track does not exceed 63. The following tables show CHS and LBA translation geometries for the standard configurations. You can verify the parameters using the Identify Drive (EC_H) command.

1.1.1 Standard configuration

ST31640A	**CHS**
Cylinders	3,150
Heads	16
Sectors	63
Guaranteed sectors	3,175,200
Guaranteed capacity (bytes[3])	1,625,702,400

ST32140A	**CHS**
Cylinders	4,095
Heads	16
Sectors	63
Guaranteed sectors	4,127,760
Guaranteed capacity (bytes[3])	2,113,413,120

3. One Mbyte equals one million bytes.

1.2 Physical organization

	ST31640A	**ST32140**A
Read/write heads	6	8
Discs	3	4

1.3 Functional specifications

	ST31640A	**ST32140A**
Interface	ATA-2	ATA-2
Zone Bit Recording method	RLL (1,7)	RLL (1,7)
External data burst-transfer rate:		
DMA mode 2 (Mbytes per sec)[4]	16.6	16.6
PIO mode 4 (Mbytes per sec)[5]	16.6	16.6
Internal data-transfer rate (Mbits per sec)		
Inner track	34.5	34.5
Outer track	67.7	67.7
Spindle speed (RPM)	5,376 ± 0.5%	5,376 ± 0.5%
Cache size (Kbytes)	128	128
Physical cylinders	4,726	4,726
Bytes per sector	512	512
Recording density, max (KBPI)	76.2	76.2
Track density (TPI)	4,800	4,800

4. See Figure 9 on page 36 for timing specifications.

5. See Figure 8 on page 35 for timing specifications.

1.4 Physical dimensions

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

Height, max	1.027 inches (26.1 mm)
Width, max	4.023 inches (102.2 mm)
Depth, max	5.787 inches (147.0 mm)
Weight	1.0 lb (453.6 g)

1.5 Seek time

Seek time is the interval between the time the actuator begins to move and the time the head is over the target track. Seek time is a true statistical average of at least 10,000 measurements of seek time. All measurements for maximum values 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	Average/typical seek time	Full-stroke seek time	Average latency
2.0 msec typ	10.0 msec[6]	20.0 msec typ	5.58 msec

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 1.0 msec.

1.6 Start and stop times

The drive is ready within 8 seconds after the power is applied. The drive spindle stops rotating within 7 seconds typical after the power is removed.

6. When measured on a 66 MHz, 486DX AT computer with an 8.33 MHz I/O Bus while executing PC Labs or Core test with Smartdrive.

1.7 Typical power-up and power-down sequence

A typical power-up and power-down sequence is described below to assist you in evaluating the drive's performance. It is not a performance specification.

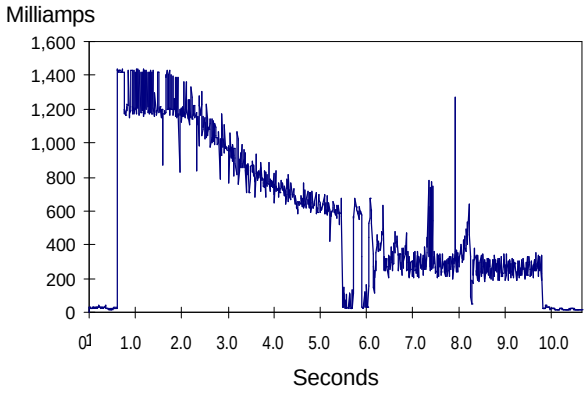

Figure 1. Typical startup current profile

1.7.1 Power-up sequence

1. Power is applied to the drive.
2. After a delay, the startup current is applied and the spindle begins to turn.
3. The accelerating current is applied, causing the spindle speed to increase.
4. The spindle speed is close to the final correct value. The drive begins to lock in speed-control circuits.
5. The arm-lock mechanism releases the arm.
6. The final speed-control lock is achieved.
7. The heads are positioned over track 0, and the drive has completed its power-up sequence.

1.7.2 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. Within 3 seconds, the motor begins to spin down.

3. The read/write heads automatically move to the shipping zone, which is inside the maximum data cylinder.

4. The actuator-lock mechanism locks the arm. This completes the power-down sequence.

1.7.3 Auto-park

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

1.8 Power specifications

1.8.1 Power consumption

The drives supports Active, Idle, Standby and Sleep power-management modes. The power-management commands the drive supports are listed in the table on page 27. The table on page 10 shows the average typical power consumption rates for each power-management mode. Each mode is defined in the section following the table.

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

	Spinup	Seeking	Read/ write	Idle	Standby
Current at +12V					
Amps peak	1.60	—	—	—	—
RMS amps typ	0.885	0.530	0.315	0.295	0.015
Watts typ	10.62	6.36	3.78	3.54	0.18
Current at +5V	—	—	—	—	—
RMS amps typ	0.260	0.41	0.44	0.235	0.115
Watts typ	1.3	2.05	2.2	1.18	0.575
Power					
Total watts typ	11.92W	8.41W	5.98W	4.72W	0.755W

1.8.1.1 Active mode

During the Active mode, the drive is involved in spinup, seeking or read/write activities.

- **Spinup.** Spinup mode is entered from the Standby mode. The drive brings the spindle and discs up to operating speed. Power in this mode is measured from power-on to the time the drive is ready for normal operation.
- **Seeking.** Seek mode is entered from 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. 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 power and current are measured with the heads on track. The test cycle consists of writing 16 sectors followed by a 22.2 msec delay and reading 16 sectors followed by a 22.2 msec delay.

1.8.1.2 Idle mode

The motor is up to speed, the servo electronics are inactive and the heads are in the landing zone. A time delay is encountered when executing a command that requires disc access.

The drive enters Idle mode when the host issues an Idle, Idle Immediate or Idle and Set Idle Timer command. The Idle timer is a Seagate-unique command and is disabled by the factory. It is discussed in Section 3.2.3 on page 33.

1.8.1.3 Standby mode

Standby mode is entered from the Idle mode. The drive is fully operational through the interface and accepts commands, but a latency will occur if any command received requires disc access or actuator movement. In 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.

1.8.1.4 Sleep mode

The spindle is stopped, the heads are parked in the landing zone, the actuator is latched and the interface and some of the drive electronics are powered down. The drive exits Sleep mode when the computer issues a hard or soft reset. The drive returns to Standby mode when the computer issues a soft reset.

1.8.2 Voltage tolerance

	+5V	**+12V**
Voltage tolerance (including noise)	± 5%	± 5%

1.8.3 Input noise

	+5V	**+12V**
Input noise frequency (max)	25 MHz	25 MHz
Input noise (max, peak-to-peak)	100 mV	240 mV

1.9 Environmental specifications

1.9.1 Ambient temperature

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

1.9.2 Temperature gradient

Operating	20°C per hour (36°F per hour)
Nonoperating	25°C per hour (45°F per hour)

1.9.3 Altitude

Operating	–1,000 to 10,000 ft (–305 to 3,048 m)
Nonoperating	–1,000 to 40,000 ft (–305 to 12,192 m)

1.9.4 Relative humidity

Operating	8% to 80% noncondensing Maximum wet bulb 29.4°C (84.9°F)
Maximum operating gradient	10% per hour
Nonoperating	5% to 95% noncondensing Maximum wet bulb 35.0°C (95.0°F)

1.9.5 Shock and vibration

Mount the drive for normal operation as recommended in Section 2.4 on page 23. Shock and vibration may be applied in the X, Y or Z axis. Episodes are not repeated more than twice per second.

The shock and vibration limits specified in this document are measured directly on the chassis. If the drive is installed in an enclosure to which the shock or vibration is applied, the resonances within the enclosure may not subject the drive to movement that exceeds the specification limits. The enclosure must be modified to ensure that the drive movement complies with the specification.

The specified shock pulse is a half sine wave with a duration of 11 msec. Shock measurements are taken directly on the drive chassis.

Operating—normal

The drive shall perform to specification while being subjected to continuous vibration or intermittent shock not exceeding the shock and vibration specification.

Operating—abnormal

The drive shall incur no physical damage while subjected to periodic vibration or intermittent shock. Performance degradation may occur during the abnormal period, but performance shall return to normal when normal operating levels resume. Cumulative application of abnormal shock or vibration to write and read verify operations can cause excessive recoverable data errors. No adjacent track corruption shall occur during this operation.

Nonoperating

The nonoperating shock and vibration limits apply to all conditions of handling and transportation. This includes both isolated devices and integrated equipment.

The drive shall not incur physical damage or performance degradation from continuous vibration or nonrepetitive shock.

	Operating	**Abnormal**	**Nonoperating**
Shock	2 Gs	5 Gs	75 Gs
5–22 Hz vibration	0.020-inch peak-to-peak	0.030-inch peak-to-peak	0.081-inch peak-to-peak
22–350 Hz vibration	0.50 Gs 0-to-peak	0.75 Gs 0-to-peak	2.00 Gs 0-to-peak

1.10 Acoustics

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

Overall A-weighted Value	**Idle**	**Seek**
Sound power, typ (bels)	4.1	4.4
Sound power, max (bels)	4.6	4.9

1.11 Reliability

The Medalist 1640A and 2140A drives provide error correction code, ECC, for both the data field and the header ID field. Data field ECC uses a three-way interleaved Reed-Solomon code with a redundancy of 6 ECC bytes per interleave and 18 bytes of ECC redundancy total. The maximum correction length is 65 bits for a single-error burst, or 17 bits each for three-error burst.

The read error rates shown in the table below are measured with automatic retries and data correction with ECC enabled. Mean time between failures (MTBF) is measured with 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 and stops (CSS)[7]	20,000
MTBF	500,000 power-on hours
Service life	5 years

1.12 Agency listings

This 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-M1989
- Certified to VDE 0806/05.90 and EN 60950/1.88 as tested by TUV
- Complies with the requirements of the Electromagnetic Compatibility Directive 89/336/EEC as amended by Directive 92/31/EEC of 28 April 1992 by conforming to EN55022 Class B (emissions) and EN50082-1:1982 (immunity RFI, ESD, EFT).

1.13 FCC verification

The Medalist family 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.

7. CSS is measured under ambient conditions.

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

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

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

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

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

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.

Sicherheitsanleitung

1. Das Gerrät ist ein Einbaugerät, das für eine maximale Umgebungstemperatur von 55°C vorgesehen ist.

2. Zur Befestigung des Laufwerks werden 4 Schrauben 6-32 UNC-2A benötigt. Bei seitlicher Befestigung darf die maximale Länge der Schrauben im Chassis nicht mehr als 5,08 mm und bei Befestigung an der Unterseite nicht mehr als 5,08 mm betragen.

3. Als Versorgungsspannugen werden benötigt:
+5V ± 5% 0,6A
+12V ± 5% 0,8A (1,9A fur ca. 30 Sek. fur ± 10%)

4. Die Versorgungsspannung muss SELV entsprechen.

5. Alle Arbeiten auf dem Festplatte dürfen nur von Ausgebildetem Servicepersonal durchgeführt werden. Bitte schaffen Sie Festplatteetiketten nicht weg.

6. Der Einbaudes Drives muss den Anforderungen gemäss DIN IEC 950V DC 0805/05.90 entsprechen.

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 or static discharge. Wool and synthetic clothing, carpet, plastic and styrofoam are contributors to static charge buildup. This charge is released when you touch another conductor and can damage sensitive components in the drive. 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. Others are used to seal out dirt and contamination.

2.2 I/O connector

The drive uses a 40-pin, male I/O connector with two rows of twenty pins each. The even-numbered pins are closest to the printed circuit board's edge. Pin 1 is near the 4-pin power connector. Pin 20 is removed for keying purposes. A drawing of the I/O connector is shown in Figure 2.

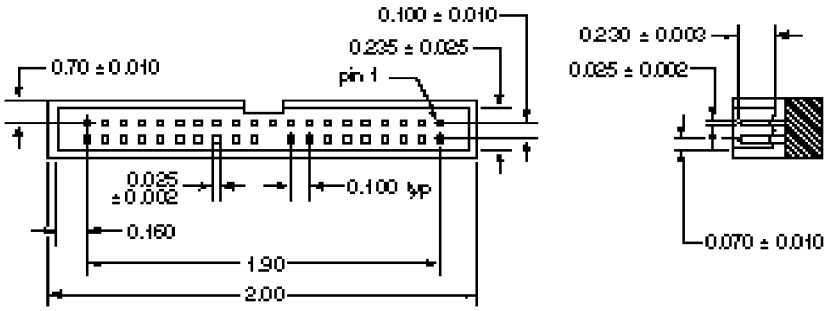

Figure 2. ATA interface connector

We recommend the following part numbers or their equivalents for the mating connector.

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 (0.46 meters).

2.3 Options jumper block

The options jumper block, shown in Figure 3, is used to configure the drive for operation. It is a 12-pin dual header and uses 0.1-inch shunts. The options jumper block allows you to:

- Configure the drive for single-drive operation.
- Configure the drive as master or slave.
- Extend the time period the Seagate drive as master waits for the slave to respond for status acknowledgment during the boot cycle.

- Configure the drive for cable select.
- Install a remote LED.

The jumper settings for these options are shown in Figure 4 on page 20. A spare shunt is attached to pins 2 and 4. This pin combination does not affect any drive function. If you need additional shunts, use Seagate part number 10562-001 or an equivalent.

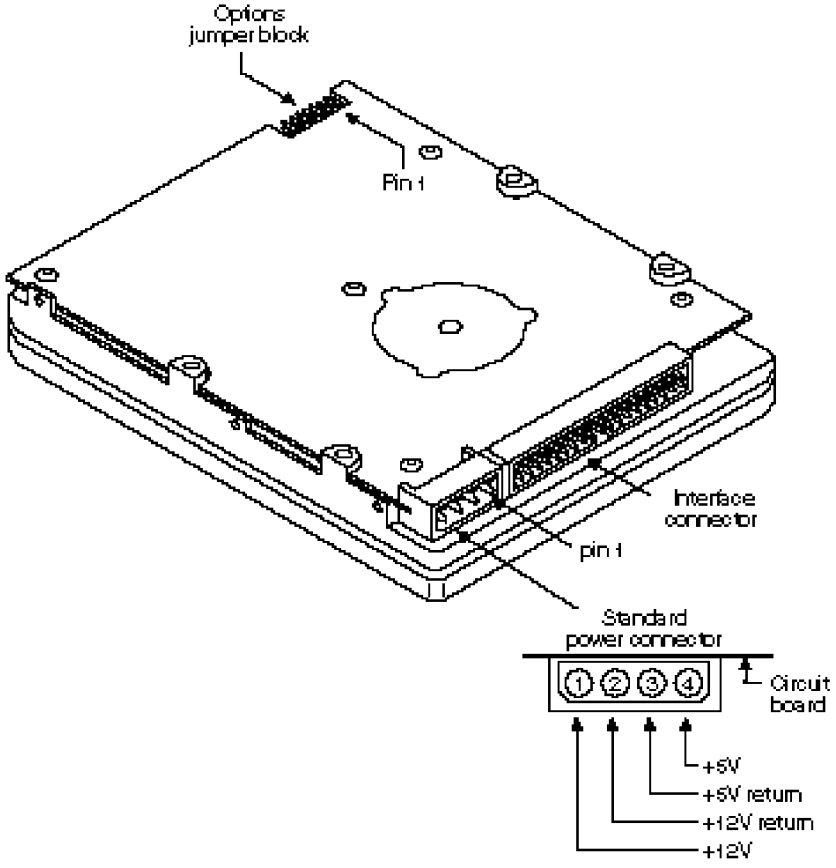

Figure 3. Connectors and jumper block

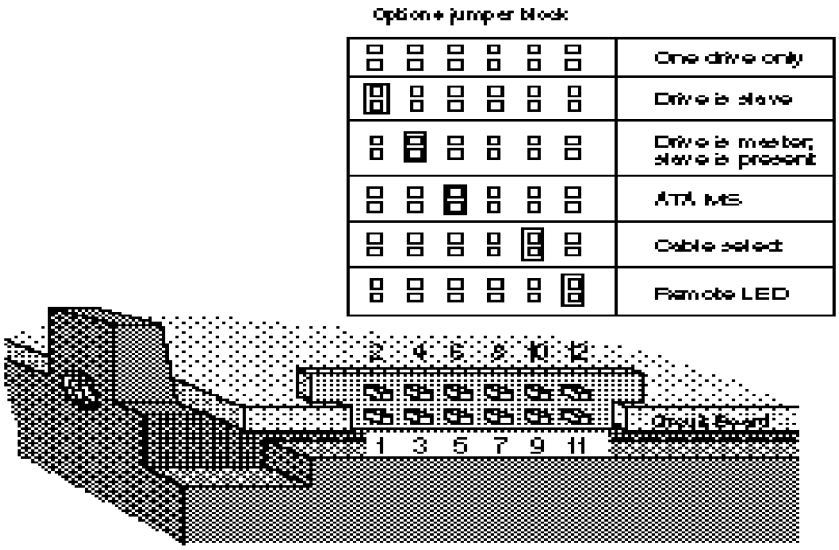

Figure 4. Configuration settings

2.3.1 Master/slave configuration

Pins 1 and 2 and pins 3 and 4 on the options jumper block are used to configure the drive as the slave or as the master with a slave present.

One drive only. The drive is configured at the factory for single-drive operation. No shunts are placed on pins 1 and 2 or pins 3 and 4. The spare shunt on pins 2 and 4 does not affect drive operation.

Drive as slave. Place a shunt on pins 1 and 2.

Drive as master with a slave present. Place a shunt on pins 3 and 4.

2.3.2 ATA master/slave timing compatibility

You can extend the length of time the Seagate drive as master waits for the slave to respond before it reports the status of both drives to the host during the boot cycle. When a shunt is placed on pins 5 and 6, the Seagate drive waits 30 seconds for the slave to signal that it is ready to give status. The default setting allows the slave five seconds to respond.

2.3.3 Remote LED connection

Pins 11 (–) and 12 (+) on the options jumper block are used to connect the drive to a remote LED. The LED is polarized and can be damaged if connected incorrectly.

It may be necessary to replace the current connector on the LED cable to fit the options jumper block. Use Seagate part number 13211-001 or an equivalent for the replacement connector.

2.3.4 Cable-select option

Computers that use the cable-select method for determining the master and slave drive do so by selecting or deselecting pin 28, CSEL, on the interface bus. Figure 5 shows a typical cable-select configuration. The master and slave drives are determined by their physical position on the bus:

- 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 shunts on pins 9 and 10 as shown in Figure 4 on page 20.

Connect the drives to the bus as shown in the example in Figure 5.

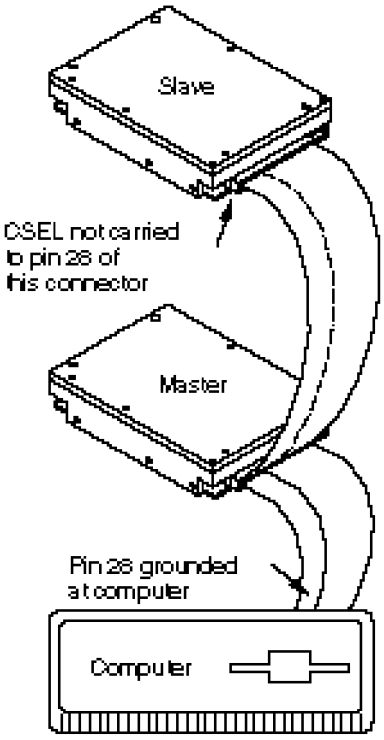

Figure 5. Connecting cable-selected drives

2.4 Mounting the drive

Mount the drive securely in the computer using either the bottom or side mounting holes as described below. Position the drive so that you do not strain or crimp the cables. Figure 6 on page 24 shows the drive's dimensions and includes the side and the bottom mounting holes.

Bottom mounting holes. Insert 6-32 UNC-2A mounting screws in the four available bottom mounting holes. Do not insert the screws more than 0.20 inches (6 turns) into the drive frame.

Side mounting holes. Insert 6-32 UNC-2A mounting screws in any two of the side mounting holes on each side of the drive. Do not insert the screws more than 0.20 inches (6 turns) into the drive frame.

Caution. To avoid damaging the drive:

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

In the following figure, all dimensions are in inches and millimeters (mm).

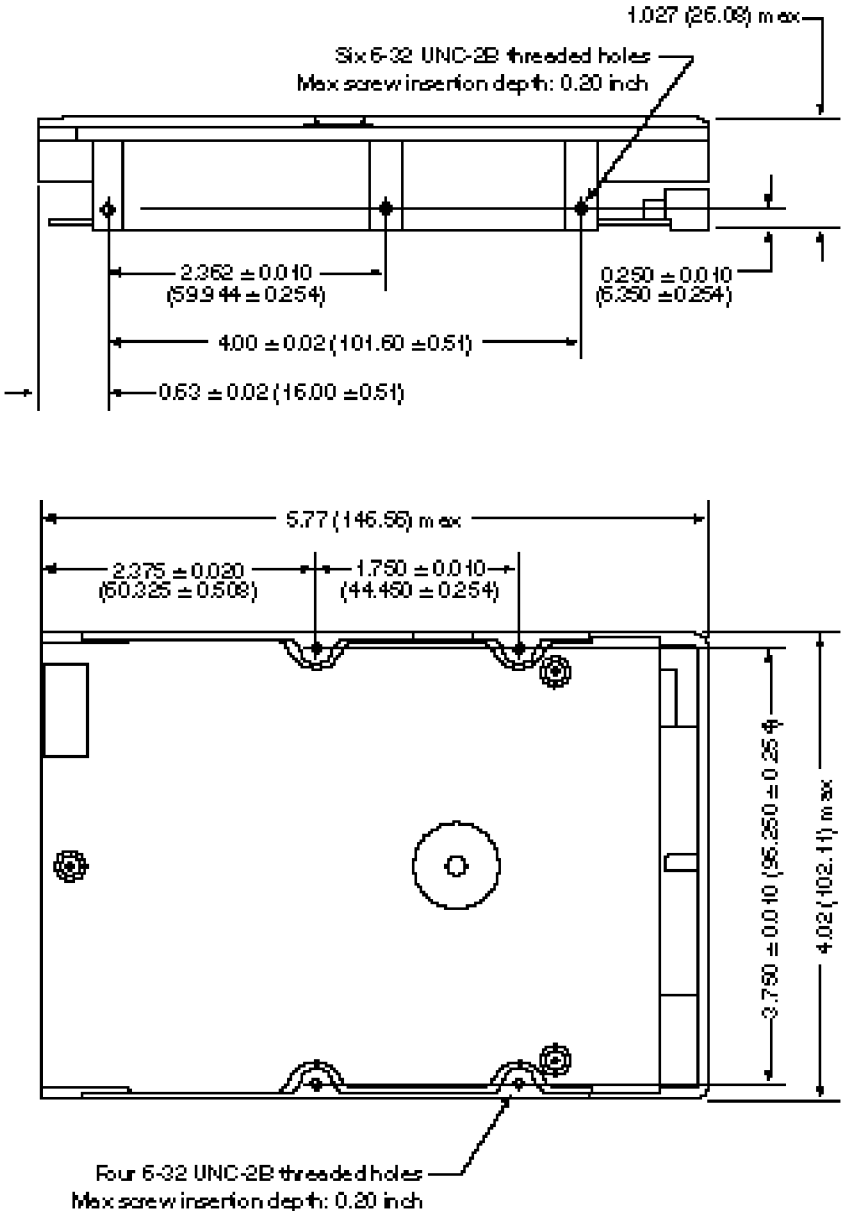

Figure 6. Mounting dimensions

3.0 ATA interface

The drives use an ATA-2 interface. The interface is in compliance with ANSI *ATA (AT Attachment) Interface X3T9.2/143 Rev. 4.0*; *SFF 8011: ATA Timing Extension for Local Bus Attachments, Rev. 2.0* and SFF 8019: *Identify Drive Data for Drives Under 8 GB*. This section lists the ATA commands the drives support on pages 27 and 28. Commands and features with specific applications for the drives are also discussed in this section. For more information on Seagate's implementation of the ATA interface and commands, see the *Seagate ATA Interface Manual,* publication number 36111-*xxx*.

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

3.1 ATA interface connector pin assignments

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

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.

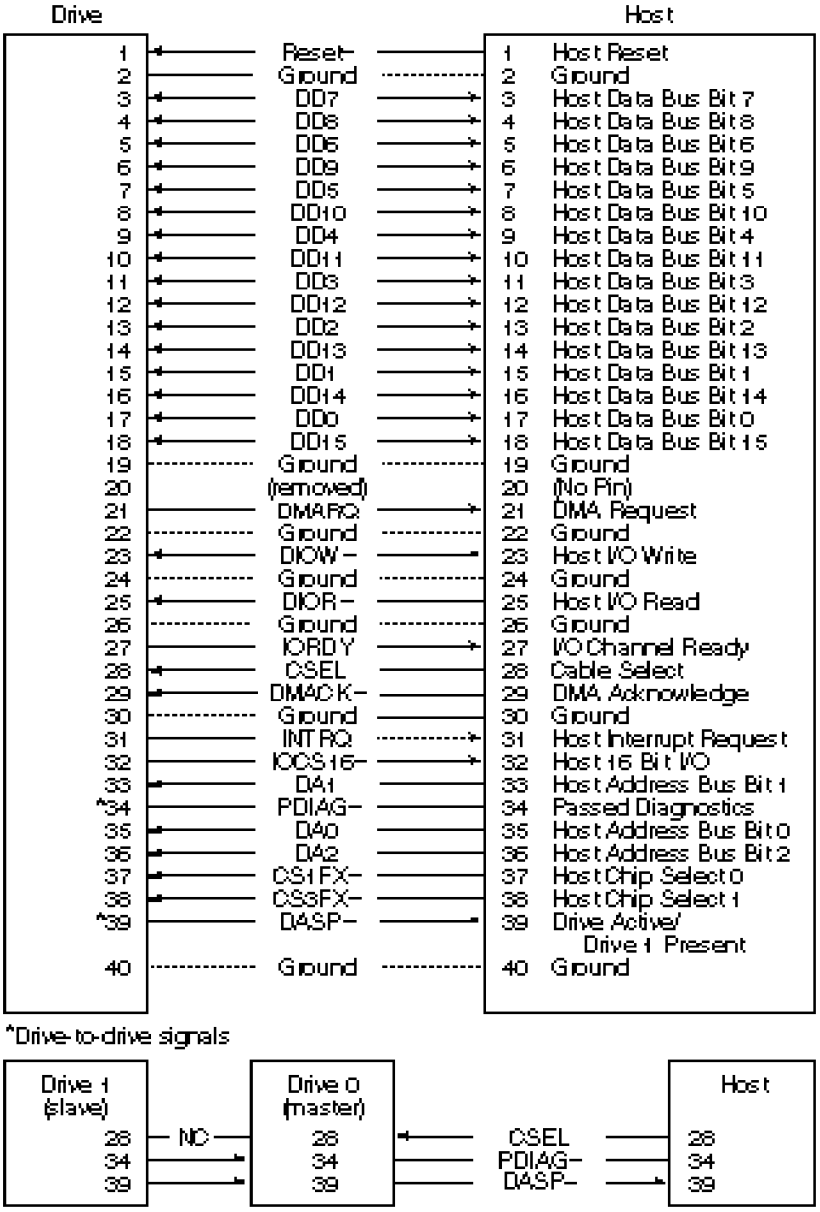

Figure 7. ATA interface connector pin assignments

3.2 Command set

This section lists all of the ATA commands the drives use. Commands whose implementation is specific for the drive are discussed in this manual. For information on Seagate's implementation on the other supported commands, refer to the *Seagate ATA Interface Reference Manual*, publication number 36111-*xxx*. Additional information on Fast ATA-related features is provided by the Small Form Factor specification, SFF-8011 Rev 1.1, September 18, 1993.

The following table lists all commands implemented in the drives. The table uses the following abbreviations:

FR Features register

SC Sector Count register

SN Sector Number register

CY Cylinder register

DH Drive/Head register

n This register does not contain a valid parameter for this command.

y This register contains a valid parameter for this command. In the Drive/Head register, both the drive and head parameters are valid for this command.

D The Drive/Head register contains a valid drive parameter for this command. The head parameter is not valid for this command.

Command name	Command code (in hex)	Parameters used				
		FR	SC	SN	CY	DH
Active and Set Idle Timer	FB	n	y	n	n	D
Active Immediate	F9	n	n	n	n	D
Check Idle Mode	FD	n	y	n	n	D
Check Power Mode	98, E5	n	y	n	n	D
Execute Drive Diagnostics	90	n	n	n	n	D
Format Track	50	n	y	n	y	y
Identify Drive	EC	n	n	n	n	D
Idle	97, E3	n	y	n	n	D

continued

continued from previous page

Command name	Command code (in hex)	Parameters used				
		FR	SC	SN	CY	DH
Idle and Set Idle Timer	FA	n	y	n	n	D
Idle Immediate	95, F8, E1	n	n	n	n	D
Initialize Drive Parameters	91	n	y	n	n	y
Read DMA[8]	C8, C9	—	y	y	y	y
Read Long[8]	22, 23	n	y	y	y	y
Read Multiple	C4	n	y	y	y	y
Read Sector[8]	20, 21	n	y	y	y	y
Read Sector Buffer	E4	n	n	n	n	D
Read Verify Sector[8]	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
Standby	96, E2	n	n	n	n	D
Standby Immediate	94, E0	n	n	n	n	D
Write DMA[8]	CA, CB	—	y	y	y	y
Write Long[8]	32, 33	n	y	y	y	y
Write Multiple	C5	n	y	y	y	y
Write Sector[8]	30, 31	n	y	y	y	y
Write Sector Buffer	E8	n	n	n	n	D

8. With retry and without retry commands supported

3.2.1 Identify Drive command (EC_H)

The parameters for the drives are listed in the table below. The Seagate *ATA Interface Reference Manual*, publication number 36111-*xxx*, describes the Identify Drive command in detail.

Word	Description	Value
0	Configuration	$045A_H$ 0400_H Disc transfer rate > 10 Mbytes per second 0040_H Fixed drive 0010_H Head switch time > 15 µsec 0008_H Not MFM encoded 0002_H Hard sectored
1	Default cylinders	ST31640A = 3,150 ST32140A = 4,095
2	Reserved	0
3	Default heads	16
4	Bytes per track	FFFFH (65535 decimal) (unformatted)
5	Bytes per sector	3B7H (951 decimal) (unformatted)
6	Default sectors per track	63
7–9	Vendor-unique	0000_H
10–19	Serial number	Drive-unique: 20 ASCII characters
20	Buffer type	0003_H Multisector with caching
21	Buffer size (number of 512-byte sectors)	0200_H
22	ECC bytes (R/W Long)	0016_H
23–26	Firmware revision	Drive-dependent: 8 ASCII characters
27–46	Model number	ST31640A ST32140A

continued

continued from previous page

Word	Description	Value
47	Maximum Sectors per interrupt per R/W Multiple command	8020_H R/W Multiple supported; 32 sectors per block
48	Double word I/O	0000_H Not supported
49	Capabilities	$0B00_H$ IORDY, DMA, LBA supported
50	Reserved	0000_H
51	PIO timing mode	0200_H
52	DMA timing mode	000_H Multiword DMA mode 2 supported
53	Current valid	0003_H, 54–58, 64–70 valid
54	Current cylinders	ST31640A = 3,150 ST32140A = 4,095
55	Current heads	16
56	Current sectors per track	63
57–58	Current sectors	ST31640A = 3,175,200 (CHS) ST32140A = 4,127,760 (CHS)
59	Current multiple mode	0000_H
60–61	LBA total sectors	ST31640A = 3,175,200 ST32140A = 4,127,760
62	Single-word DMA	0007_H No modes are active; no modes are supported
63	Multiword DMA	0107_H Mode 0 is active; modes 0, 1 and 2 are supported.
64	Advanced PIO	0003_H Modes 3 and 4 are supported.
65	Minimum multiword DMA transfer per word	120 nsec
66	Recommended multiword DMA transfer per word	120 nsec

Word	Description	Value
67	Minimum PIO transfer without IORDY	180 nsec
68	Minimum PIO transfer with IORDY	120 nsec
69–127	Reserved	*xxxx*$_H$
128–159	Seagate-reserved	*xxxx*$_H$
160– 255	Reserved	*xxxx*$_H$

3.2.2 Set Features command (EF_H)

The Set Features command (command code EF_H) allows the user to enable and disable the multisegmented cache 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 drives support. The features that are set to default by the factory are indicated in the Feature column.

Feature Value	Feature
02_H	Enable write cache (default)
03_H	Set transfer mode
04_H	Enable Read Auto Relocation (default)
44_H	Uses 22 bytes of ECC on read long and write long commands
55_H	Disable read look ahead cache
82_H	Disable write cache
84_H	Disable Read Auto Relocation
AA_H	Enable read look-ahead (default)
BB_H	Uses 4 bytes of ECC on read long and write long commands (default)

To use the command:

1. Write the feature value to the Features register.

2. Write the Set Features command to the command register.

Note. If the value in the Features register is not supported or is invalid, the drive posts an Aborted Command error (04).

The factory-default values are restored at power-on or after a hard reset.

3.2.2.1 Write cache (02_H)

Write cache facilitates the transfer of data from the host to the drive. It allows the host to send contiguous write commands to the drive while the data is being written to the media. As soon as all the current write command data has been transferred into the drive's buffer, it will issue a command complete status.

Caution. Although the drive issues a write complete when it has received all of the data from the host, it continues to write data to the media until the buffer is empty. If the host issues a hard reset or if the power is cycled down before the buffer is cleared, the data remaining in the buffer or not written to the media is lost.

3.2.2.2 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 table on the next page 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: Set PIO Mode = 2)	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
Multiword DMA Mode	1	00100	001
Multiword DMA Mode	2	00100	010
Reserved	—	01000	*nnn*

3.2.3 Idle and Set Idle Timer (FA_H)

This is a Seagate-unique power command. It moves the drive immediately to Idle mode. When the drive receives this command, it asserts Busy in the Host Status register, initiates entry into Idle mode, negates Busy and generates an interrupt. If the drive is in Standby mode, it spins up to enter Idle mode but does not wait for the spinup to complete before issuing the interrupt.

The command also allows the host to set a timer, the Idle timer, that causes the drive to move to Idle mode if no drive activity occurs within the allotted time. The timer is set using the Sector Count register. The register values correspond to 100-msec increments with a maximum programmable time of 25.5 seconds. A zero value in the Sector Count register disables the timer. If this value is set, the Idle timer is enabled

whenever the drive is in Active mode. The drive is shipped with the timer disabled.

3.2.4 Active and Set Idle Timer command (FB_H)

This is a Seagate-unique power command. It moves the drive immediately to Active mode. When the drive receives this command, it asserts Busy in the Host Status register, initiates entry into Active mode, negates Busy and generates an interrupt. If the drive is in Standby mode, it does not wait for the spinup to complete before issuing the interrupt.

The command also allows the host to set a timer, the Idle timer, that causes the drive to move to Idle mode if no drive activity occurs within the allotted time. The timer is set using the Sector Count register. The register values correspond to 100-msec increments with a maximum programmable time of 25.5 seconds. A zero value in the Sector Count register disables the timer. If this value is set, the Idle timer is enabled whenever the drive is in Active mode. The drive is shipped with the timer disabled.

3.2.5 Read Autorelocation

This feature allows the drive to identify grown media defects and to reallocate the sector without host intervention.

This feature is disabled if the retries are disabled in the Read command or Write command. Also, the feature is not implemented for the Read Long or Write Long commands.

Appendix. Timing diagrams

The ST31640A and ST32140A are designed to comply with and can exceed the ATA-2 timing standards. Performance in excess of the ATA-2 standard depends on the capability of the host-system environment. See your Seagate representative for additional details.

Without IORDY, the drive operates at programmed I/O timing specifications, as shown below.

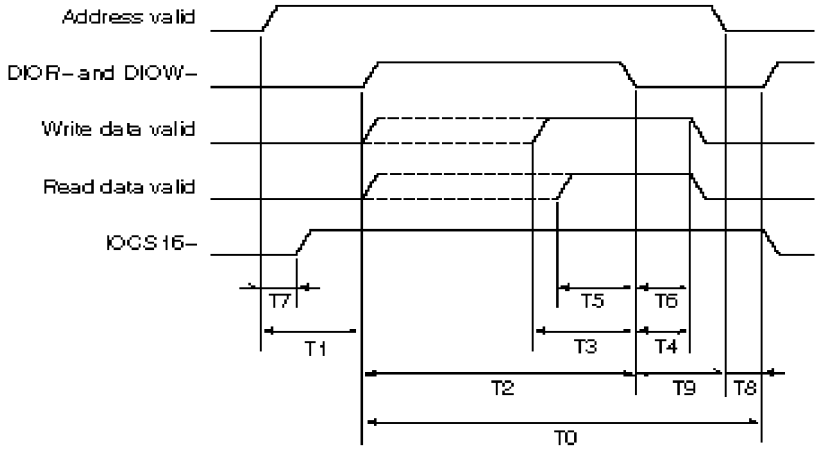

Figure 8. Programmed I/O timing without IORDY

Time	Description	Min	Max
T0	Cycle time	120 nsec	—
T1	Drive address (CS1FX–, CS3FX–, DA0, DA1 and DA2) valid and DIOR–/DIOW– setup	25 nsec	—
T2	DIOW– or DIOR– pulse width	70 nsec	—
T3	DIOW– data setup	20 nsec	—
T4	DIOW– data hold	10 nsec	—
T5	DIOR– data setup	20 nsec	—
T6	DIOR– data hold	5 nsec	—
T7	Address valid until I/OCS16– is asserted	—	—
T8	Address invalid to I/OCS16– tristate	—	—
T9	DIOR– false to address valid hold	10 nsec	—

When using IORDY, the drive operates at programmed timing specifications, as shown below.

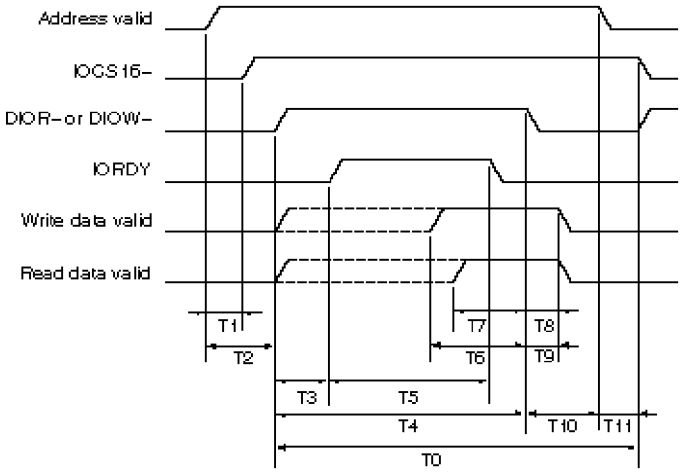

Figure 9. Programmed I/O timing with IORDY

Time	Description	Min	Max
T0	Cycle time	120 nsec	—
T1	Address valid until IOCS16– is asserted	—	20 nsec
T2	Drive address (CS1FX–, CS3FX–, DA0, DA1 and DA2) valid before DIOR– or DIOW– setup	25 nsec	—
T3	IORDY setup time	—	25 nsec
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 invalid until IOCS16– is negated	—	5 nsec

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

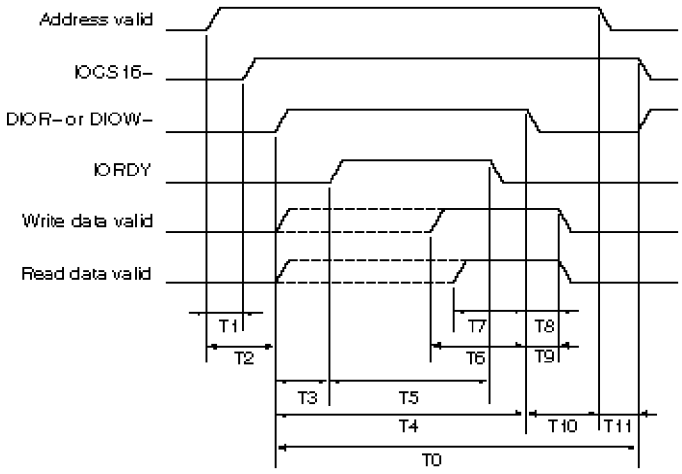

Figure 10. Programmed I/O timing with IORDY

Time	Description	Min	Max
T0	Cycle time	120 nsec	—
TD	DIOW-- or DIOR-- pulse width (16-bit)	70 nsec	—
TE	DIOR-- data access	—	30 nsec
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	—	30 nsec
TL_W	DIOW-- to DMARQ delay	—	30 nsec

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Publication Number: 36314-201, January 1996, Printed in USA