Seagate

Decathlon Family

Decathlon 540, Decathlon 851

Decathlon 1080

ATA Interface Drives

Product Manual

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Introduction

This manual describes the functional, mechanical and interface specifications for the Decathlon 540, 851 and 1080 hard disc drives. The drives are referred to throughout this manual by their model numbers: ST5540A for the Decathlon 540, ST5851A for the Decathlon 851 and ST51080A for the Decathlon 1080.

The Seagate ST5540A, ST5851A and ST51080A represent the third generation of Decathlon drives. They combine features used in the early Decathlon drives, such as Fast ATA-2 capability, 5,376-RPM spindle speed, embedded servo and the mini 3.5-inch footprint with new technology and more cost-efficient design to provide high performance, high capacity, low noise, energy-efficiency and superior value.

The drives are designed to ensure fast data-throughput between the drive and the host. Fast ATA-2 capability means that the drives support PIO mode 4 and multiword DMA mode 2 and multiple block read/write. When the host chooses either transfer mode, the drives respond with burst data-transfer rates of up to 16.6 Mbytes per second. Multiple block read/write allows the drive to gather several blocks of data in cache and transfers them in a single burst.

Other features the drives have that promote fast data-throughput include embedded servo technology to ensure quick and accurate access to information on the drive without thermal recalibration interruptions, a 16-bit internal microprocessor 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 854-Mbyte capacity of the ST5851A and the 1.08-Gbyte capacity of the ST51080A (more than enough capacity to download a complete CD-ROM), you have a true multimedia-ready drive.

The drives support the power modes defined in the ATA-2 standard. Standby and Sleep modes reduce power consumption to a low 0.5 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. (A complete listing of the ATA commands the drives support is found in the table on page 27. The ATA commands that have Seagate-unique applications and the Seagate-unique commands the drives use are discussed in Section 3.0 on page 25.)

The drives are designed for the standard 3.5-inch footprint but have a slim 0.75-inch (19-mm) height profile and a shorter 5.0-inch depth profile. Even though the overall size of the drives is reduced, the top and bottom mounting holes are placed in strict compliance with the SFF committee standards for the 3.5-inch form-factor. This size reduction gives the

designer or integrator more room for air circulation, other peripherals or a smaller drive bay. In addition, the smaller size and a redesigned top cover have improved the acoustics for the 5,376-RPM drive. The idle acoustic sound level is 30 dBA.

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

Capacity

- 540, 854 and 1080 Mbytes formatted
- One-disc and two-disc formats
- LBA translation support
- ECHS translation support

Performance

- Fast ATA-2. (Supports multiword DMA modes 0, 1, 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
- 256-Kbyte segmented buffer
- 10.5-msec average seek time
- 16-bit microprocessor
- Data streaming

Energy efficiency

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

Acoustics

- 30-dBA idle acoustic sound level

Quick specification chart

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

Drive specification	**ST5540A**	**ST5851A**	**ST51080A**
Formatted capacity (Mbytes) ($\times 10^6$ bytes)	541.9	854.7	1,083.8
Total sectors	1,058,400	1,669,248	2,116,800
Bytes per sector	512	512	512
Logical cylinders	1,050	1,656	2,100
Sectors per track	63	63	63
Logical read/write heads	16	16	16
Physical read/write heads	2	4	4
Physical disc	1	2	2
Physical cylinders	4,834		
Recording density (Kbits per inch)	76.2		
Track density (tracks per inch)	4,800		
Spindle speed (RPM)	5,376		
Average latency (msec)	5.58		
Track-to-track seek time (msec typical)	2.0		
Average seek time (msec typical)	10.5		
Full-stroke seek time (msec typical)	20.0		
Internal data-transfer rate (Mbits per sec max)	34.5 to 67.7		
Ext. transfer rate[1] (Mbytes per sec) PIO mode 4	16.6		
Ext. transfer rate[1] (Mbytes per sec) DMA mode 2	16.6		
Cache buffer (Kbytes)	256		
Height, inches max (mm)	0.748 (19.0)		
Width, inches max (mm)	4.01 (102.8)		
Depth, inches max (mm)	5.00 (127.0)		
Typical weight, lb (g)	0.750 (320.2)		
Power-on to ready (sec typical)	8		
Spinup current (typical)	1.1A		
Seek power (typical)	6.37W		

continued

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

continued from previous page

Drive specification	**ST5540A**	**ST5851A**	**ST51080A**
Read/Write power and current (typical)	4.9W		
Idle total power (typical)	3.0W		
Standby/Sleep total power (typical)	0.5W		
Voltage tolerance (including noise): +5V	±5%		
Voltage tolerance (including noise): +12V	±5%		
Operating temperature (°C)	5° to 55°C		
Nonoperating temperature (°C)	–40° to 70°C		
Operating temperature gradient (°C per hour max)	20°C		
Relative humidity, operating gradient (max)	10% per hr		
Altitude operating	–1,000 to 10,000 ft.		
Altitude nonoperating	–1,000 to 40,000 ft.		
Shock, normal operating (Gs max for 11 msec)	2 Gs		
Shock, abnormal operating (Gs max for 11 msec)	10 Gs		
Vibration (Gs max at 22–350 Hz without nonrecoverable errors), operating	0.75 Gs 0 to Peak		
Vibration (Gs max at 22–350 Hz with no physical damage incurred), nonoperating	4 Gs 0 to Peak		
Drive acoustics, Idle mode (dBA)	30 dBA		
Drive acoustics, seeking (dBA)	34 dBA		
Nonrecoverable read errors (per bits transferred)	10^{13}		
Mean time between failures (power-on hours)	300,000		
Contact start-stop cycles	40,000		
Service life (years)	5		

1.0 Specifications

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

1.1 Formatted capacity

Decathlon 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 ECHS 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

ST5540A	**ECHS**	**LBA**
Cylinders	1,050	N/A
Heads	16	N/A
Sectors	63	N/A
Total sectors	1,058,400	1,058,400
Formatted capacity (bytes[2])	541,900,800	541,900,800

ST5851A	**ECHS**	**LBA**
Cylinders	1,656	N/A
Heads	16	N/A
Sectors	63	N/A
Total sectors	1,669,248	1,669,248
Formatted capacity (bytes[2])	854,654,976	854,654,976

2. One Mbyte equals one million bytes.

ST51080A	ECHS	LBA
Cylinders	2,100	N/A
Heads	16	N/A
Sectors	63	N/A
Total sectors	2,116,800	2,116,800
Formatted capacity (bytes[2])	1,083,801,600	1,083,801,600

1.2 Physical organization

	ST5540A	ST5851A	ST51080A
Read/write heads	2	4	4
Discs	1	2	2

1.3 Functional specifications

Interface	ATA-2
Zone Bit Recording method	RLL (1,7)
External data burst-transfer rate:	
DMA mode 2 (Mbytes per sec)[3]	16.6
PIO mode 4 (Mbytes per sec)[4]	16.6
Internal data-transfer rate (Mbits per sec)	
Inner track	34.5
Outer track	67.7
Spindle speed (RPM)	5,376 ± 0.5%
Cache size (Kbytes)	256
Physical cylinders	4,834
Bytes per sector	512
Recording density, max (KBPI)	76.2
Track density (TPI)	4,800

3. See Figure 10 on page 37 for timing specifications.

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

1.4 Physical dimensions

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

Height, max	0.748 inches (19.0 mm)
Width, max	4.02 inches (102.1 mm)
Depth, max	5.00 inches (127.0 mm)
Weight	0.750 lb (340.2 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	10.5 msec[5]	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.

5. When measured on a 66 MHz, 486DX AT computer with a 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. It is not a specification.

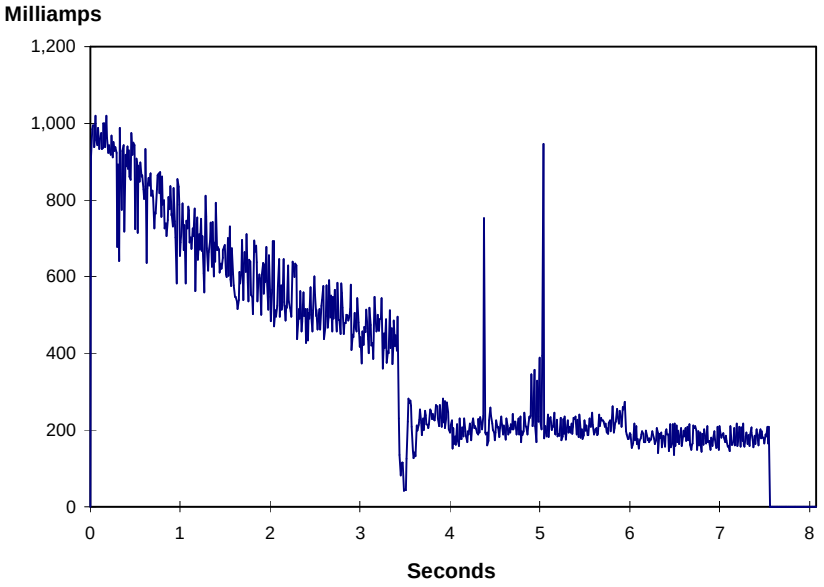

Figure 1. Typical +12V startup current profile

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 landing zone, a designated area beyond 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 beyond the maximum data cylinder and the actuator-lock mechanism locks the arm. 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	1.100	—	—	—	—
RMS amps typ	0.635	0.385	0.242	0.220	0.015
Watts typ	7.62	4.62	2.90	2.64	0.18
Current at +5V					
RMS amps typ	0.140	0.350	0.400	0.072	0.064
Watts typ	0.700	1.75	2.00	0.36	0.32
Power					
Total watts typ	8.32	6.37	4.9	3.0	0.50

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 command, Idle Immediate command or Idle and Set Idle Timer command. The Idle timer is a Seagate-unique feature 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 occurs 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	30°C per hour (54°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

The drive is mounted 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 performs to specification while being subjected to continuous vibration or intermittent shock not exceeding the specification.

Operating—abnormal

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

Nonoperating

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

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

	Operating (Normal)	**Operating (Abnormal)**	**Nonoperating**
Shock	2 Gs	10 Gs	75 Gs
5–22 Hz vibration	0.020-inch peak-to-peak	0.030-inch peak-to-peak	0.160-inch peak-to-peak
22–350 Hz vibration	0.50 Gs 0-to-peak	0.75 Gs 0-to-peak	4.00 Gs 0-to-peak

1.10 Acoustics

This table shows the acoustic sound pressure level (no pure tones) when the drive is measured with a microphone from a distance of one meter. The drive is oriented with the cover up.

Value	**Idle**	**Seek**
Sound pressure, typ (dBA)	30 dBA	34 dBA
Sound pressure, max (dBA)	34 dBA	38 dBA

1.11 Reliability

The Decathlon 540A, 851A and 1080A 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 data field correction length is 65 bits for a single-error burst, or 17 bits each for three-error burst. The maximum ID field correction is 16 bits.

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 at nominal power at sea level and an ambient temperature of 40°C.

Nonrecoverable read errors	1 per 10^{13} bits transferred
Seek errors	1 per 10^{7} physical seeks
Contact start-stops (CSS)[6]	40,000 cycles
MTBF	300,000 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 VDE

6. CSS is measured between 20°C, 50% relative humidity (RH) to 40°C, 20% RH.

1.13 FCC verification

The Decathlon 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.

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 radioélectri-

ques 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℃ 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 muβ 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 muβ den Anforderungen gemäβ 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. 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 on the drive as shown in Figure 3.

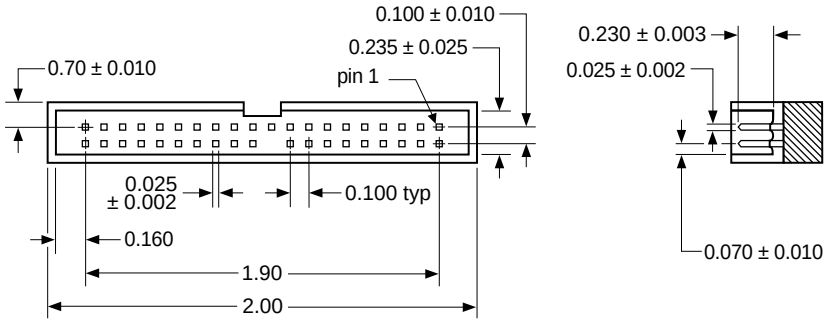

Figure 2. ATA interface connector

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 2-mm connectors and jumpers. The options jumper block allows you to:

- Configure the drive for single-drive operation.
- Configure the drive as the 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.

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

The jumper settings for these options are shown in Figure 4 on page 20. A spare jumper that can be used to configure the drive is attached to pins 2 and 4. This pin combination does not affect any drive function. If you need additional jumpers, use Seagate part number 13211-001 or an equivalent.

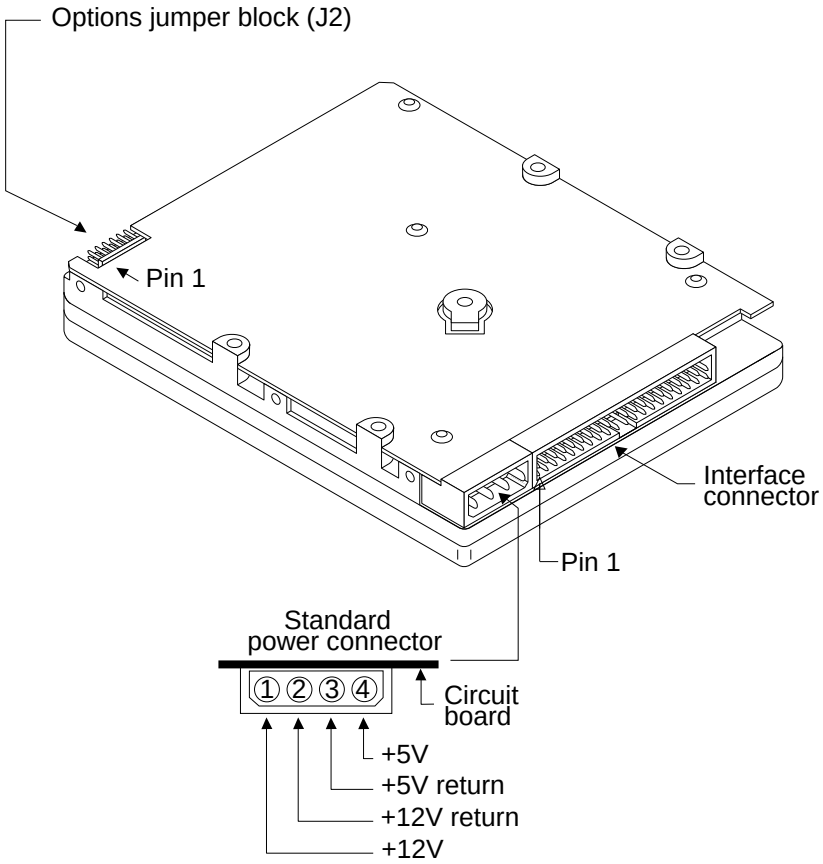

Figure 3. Drive connectors

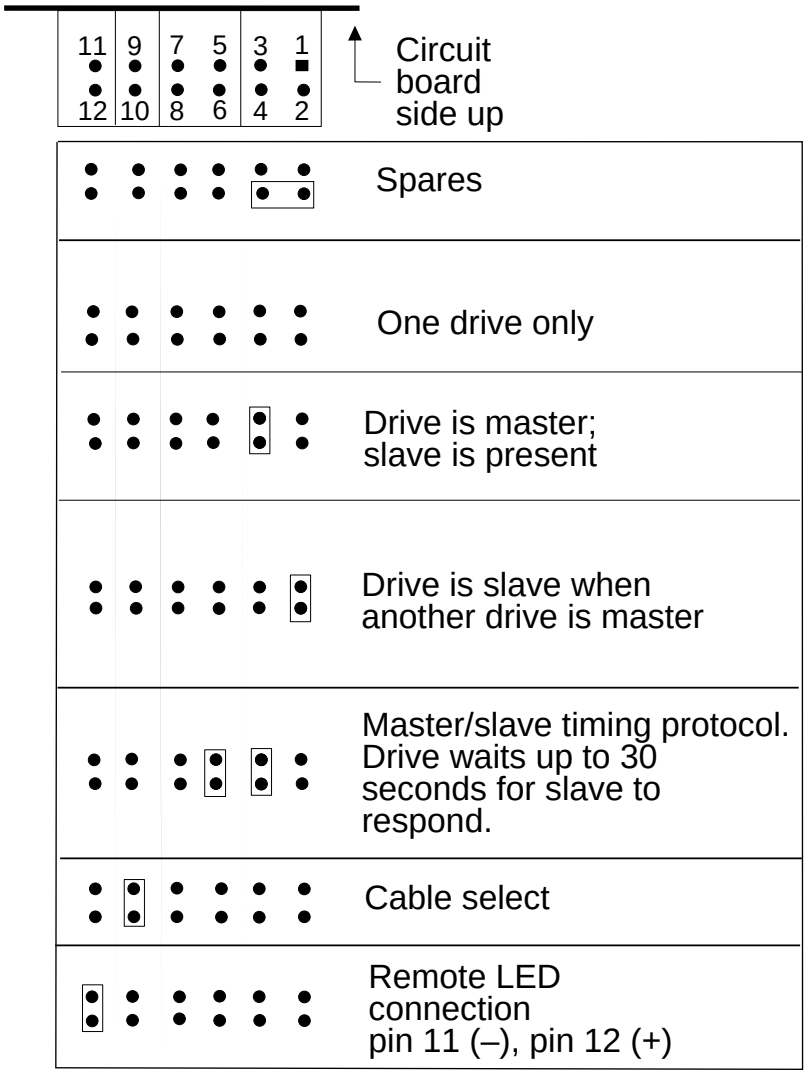

Figure 4. Options jumper block settings

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 master or the slave.

Spare jumper. The factory places a spare jumper on pins 2 and 4 to be used for configuring the drive. This setting is electrically neutral and does not affect drive operation.

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

Drive as master. Place a jumper across pins 3 and 4.

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

2.3.2 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 jumpers are placed across pins 3 and 4 and 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 cable:

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

To configure the drives for computers using cable select:

- Install jumpers 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.

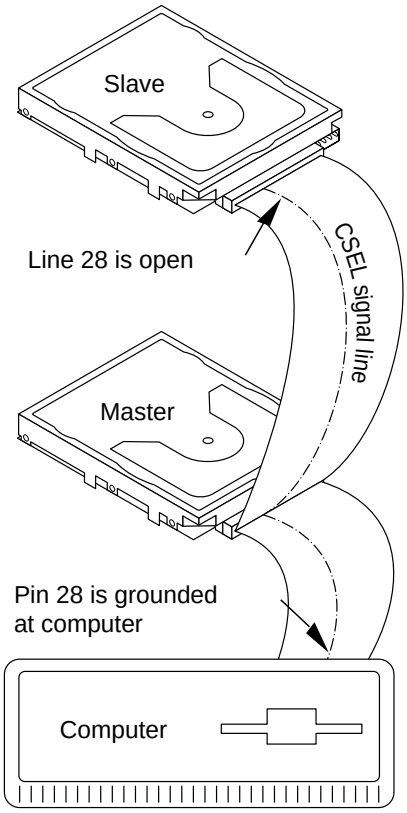

Figure 5. Connecting cable-selected drives

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).

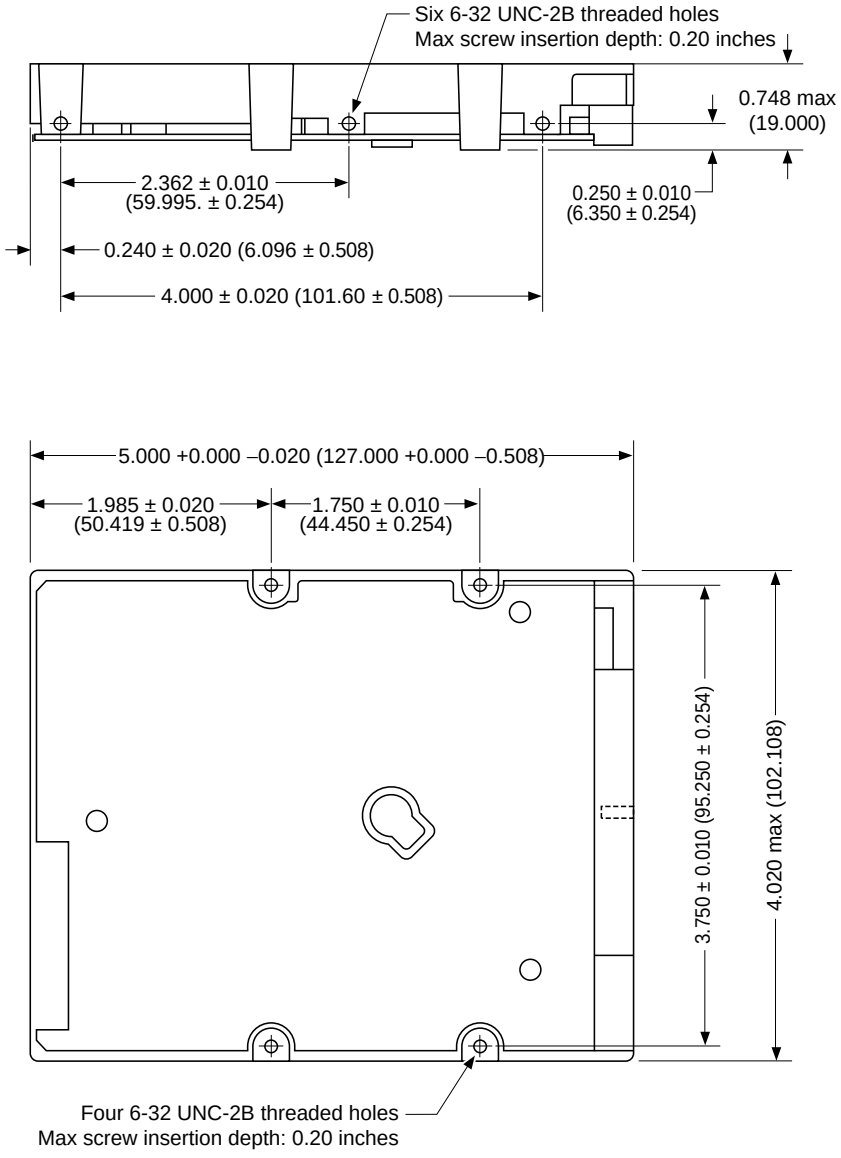

Figure 6. Mounting dimensions

3.0 ATA interface

The drives uses 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 supported by the drive on pages 27 and 28. Commands and features with specific applications for the drive 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 that use an asynchronous interface protocol. The drivers can sink up to 24 mA and drive a load up to 300 pF. The integrity of the ATA interface is affected by the interface cable. It is designed to support a 40-conductor, nonshielded interface cable with a maximum length of 18 inches (0.46 meters).

3.1 ATA interface connector pin assignments

The signal name and 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.

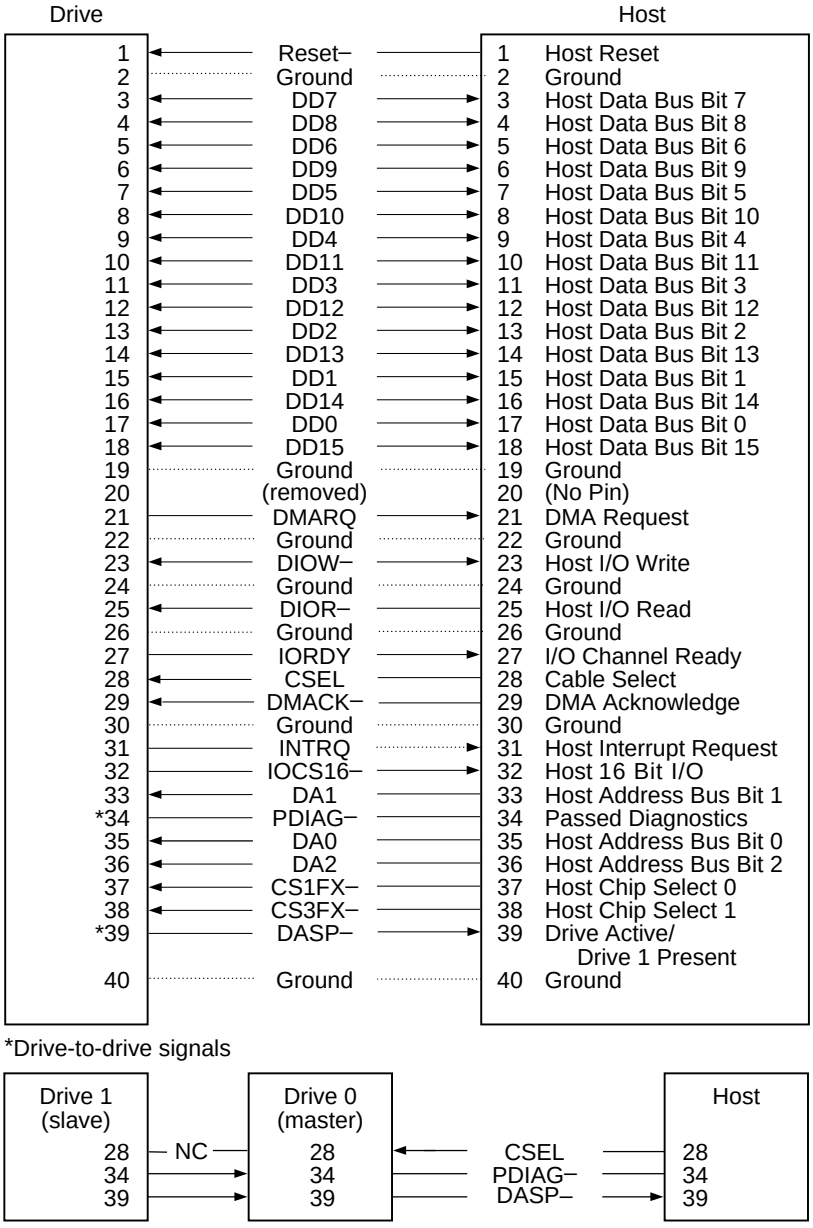

Figure 7. ATA interface connector pin assignments

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
Idle and Set Idle Timer	FA	n	y	n	n	D

continued

continued from previous page

Command name	Command code (in hex)	Parameters used				
		FR	SC	SN	CY	DH
Idle Immediate	95, F8, E1	n	n	n	n	D
Initialize Drive Parameters	91	n	y	n	n	y
Read DMA[7]	C8, C9	—	y	y	y	y
Read Long[7]	22, 23	n	y	y	y	y
Read Multiple	C4	n	y	y	y	y
Read Sector[7]	20, 21	n	y	y	y	y
Read Sector Buffer	E4	n	n	n	n	D
Read Verify Sector[7]	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[7]	CA, CB	—	y	y	y	y
Write Long[7]	32, 33	n	y	y	y	y
Write Multiple	C5	n	y	y	y	y
Write Sector[7]	30, 31	n	y	y	y	y
Write Sector Buffer	E8	n	n	n	n	D

7. 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	$047A_H$ 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	ST5540A = 1,050 ST5851A = 1,656 ST51080A = 2,100
2	Reserved	0
3	Default heads	16
4	Bytes per track	$FFFF_H$ (65535 decimal) (unformatted)
5	Bytes per sector	$3DB_H$ (987 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)	16_H
23–26	Firmware revision	Drive-dependent: 8 ASCII characters
27–46	Model number	ST5540A ST5851A ST51080A

continued

continued from previous page

Word	Description	Value
47	Maximum sectors per interrupt per R/W Multiple command	0010_H R/W Multiple supported; 16 sectors per block
48	Double word I/O	0000_H Not supported
49	Capabilities	$0B01_H$ IORDY, DMA, LBA supported
50	Reserved	0000_H
51	PIO timing mode	0200_H
52	DMA timing mode	0000_H Multiword DMA mode 0 supported
53	Current valid	0003_H, 54–58, 64–70 valid
54	Current cylinders	ST5540A = 1,050 ST5851A = 1,656 ST51080A = 2,100
55	Current heads	16
56	Current sectors per track	63
57–58	Current sectors	ST5540A = 1,058,400 (CHS) ST5851A = 1,669,248 (CHS) ST51080A = 2,116,800 (CHS)
59	Current multiple mode	0100_H Word 59 is valid. 0 sectors/block
60–61	LBA total sectors	ST5540A = 1,058,400 ST5851A = 1,669,248 ST51080A = 2,116,800
62	Single-word DMA	0007_H Single-word modes active; Single-word modes 0, 1 and 2 supported.
63	Multiword DMA	0107_H Mode 1 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

Word	Description	Value
66	Recommended multiword DMA transfer per word	120 nsec
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 supported by the drives. 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
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
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 medium. As soon as all the data of the current write command 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 medium 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 medium 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 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: 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, which 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.

Appendix. Timing diagrams

The ST5540A, ST5851A and ST51080A 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.

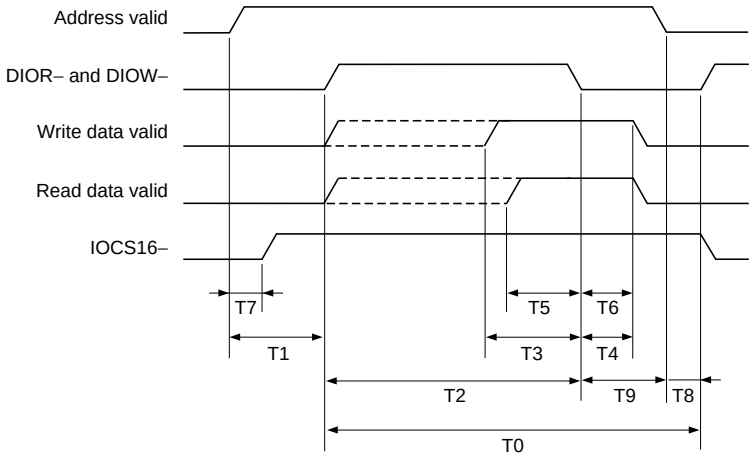

Figure 8. Programmed I/O timing without IORDY

Time	Description	Min	Max
T0	Cycle time	120 nsec	—
T1	Drive address (CS1FX–, CS3FX–, DA0, DA1 and DA2) valid and DIOR– and 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.

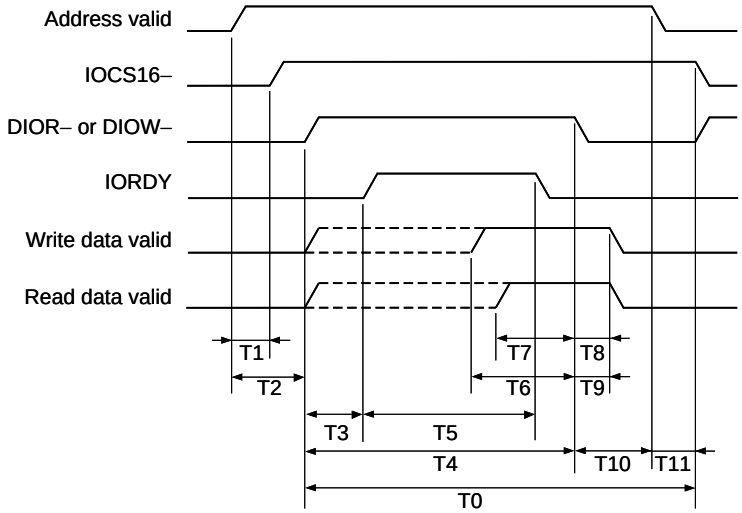

Figure 9. Programmed I/O timing with IORDY

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.

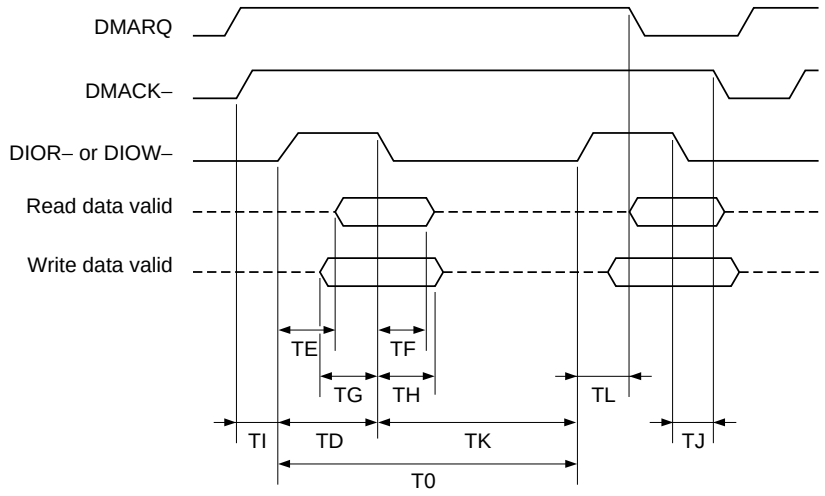

Figure 10. Multiword DMA timing

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