Seagate

ST5660A

AT Interface Drive

Product Manual

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Seagate

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Contents

Figures

1.0 Specifications

1.1 Formatted capacity

The drive was low-level formatted at the factory—you cannot low-level format it.

You can operate the drive using many different logical configurations, provided the number of sectors per track does not exceed 63. Three possible configurations are shown below. The first two configurations represent conventional CHS addressing as used on most DOS computers. The third configuration uses LBA addressing.

	CHS	**CHS***	**LBA****
Cylinders	1,024	1,057	N/A
Heads	16	16	N/A
Sectors	63	63	N/A
Total sectors	1,032,192	1,065,456	1,066,184
Formatted capacity (Mbytes***)	528.48	545.3	545.8

***** This is the default configuration. This configuration can only be used in computers that are capable of addressing more than 1,024 cylinders. Therefore, if your computer cannot address more than 1,024 cylinders, you must change the configuration using the setup utility.

****** This configuration can only be used in computers that support LBA addressing.

*******One megabyte equals one million bytes.

The drive was configured in translation mode at the factory. You can verify the number of cylinders, sectors per track and heads and the total number of LBA sectors by using the Identify Drive (EC_H) command. See Section 3.1.1 for details about the Identify Drive command.

1.2 Functional specifications

Interface	AT (IDE)
Zone Bit Recording method	RLL (1,7)
External data burst transfer rate (Mbytes per sec)	11.1* 13**
Internal data transfer rate (Mbits per sec)	27 to 48
Spindle speed (RPM)	4,500 ± 0.5%
Cache size (Kbytes)	256
Read/write heads	4
Discs	2
Bytes per sector	512
Recording density, max (BPI)	68,000
Track density (TPI)	3,309

***** This is the external transfer rate using PIO mode 3 timing.

****** This is the external transfer rate using multiword DMA mode 1 timing.

1.2.1 Seek time

Seek time is measured under nominal conditions of temperature and voltage with the drive mounted horizontally. Seek time is a true statistical average of at least 5,000 seeks.

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.

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

Track-to-track seek time	**Average/Typ seek time**	**Full-stroke seek time**	**Average latency**
3.5 msec typ 4.0 msec max	12.0 msec read 14.0 msec write	25.0 msec max	6.67 msec

1.2.2 Multisegmented cache buffer

The drive uses the 256-Kbyte, multisegmented cache buffer to improve performance by eliminating access times under certain conditions.

Read look-ahead. The drive uses the read segments to store additional logical sectors, after the last requested sector, into a buffer before the additional sectors are requested by the computer. The cache buffer stores data from the start of a read until the buffer segment is full, or until another command is received from the computer.

Write immediate. The drive uses the write segment to store write commands and data. After the drive receives all 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.

Write caching. The last data written by the drive is retained in the buffer for use by future reads.

1.3 Start/stop time

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

1.4 Typical power-up and power-down sequence

The typical power-up and power-down sequences assist you in evaluating the drive's performance; they are not performance specifications.

1.4.1 Power-up sequence

1. Power is applied to the drive.

2. When power is applied, the LED is on for about 1 second.

3. The spindle motor reaches operating speed in about 4 seconds.

4. The magnetic actuator lock releases the actuator.

5. The drive performs velocity adjustment seeks.

6. The heads are positioned over track 0 and the drive is ready.

1.4.2 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 heads automatically move to the shipping zone, which is inside the maximum data cylinder.

4. The magnetic actuator locks the arm with the heads over the landing zone. This completes the power-down sequence.

1.4.3 Auto-park

Upon power-down, the heads automatically move to the shipping zone. The heads park inside the maximum data cylinder. When power is applied, the heads recalibrate to track 0.

1.5 Reliability

Read error rates are measured with automatic retries and data correction with ECC enabled and all flaws re-allocated. The mean time between failures (MTBF) is measured at nominal power at sea level and at an ambient temperature of 40°C.

Nonrecoverable read errors	1 per 10^{13} bits transferred
Seek errors	1 per 10^{7} physical seeks
MTBF	300,000 power-on hours
Service life	5 years

1.6 Physical dimensions

The mounting dimensions are shown in Figure 5 on page 19.

Height, max	0.748 inches (19 mm)
Width, max	4.00 inches (101.6 mm)
Depth, max	5.00 inches (127 mm)
Weight	1.0 lb (0.45 Kg)

1.7 Environmental specifications

1.7.1 Ambient temperature

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

1.7.2 Temperature gradient

Operating	20°C per hour (36°F per hour)
Nonoperating	30°C per hour (54°F per hour)

1.7.3 Relative humidity

Operating	8% to 80% noncondensing Maximum wet bulb 26°C (79°F)
Maximum operating gradient	10% per hour
Nonoperating	5% to 95% noncondensing Maximum wet bulb 26°C (79°F)

1.7.4 Altitude

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

1.7.5 Acoustics

Sound pressure is measured from 1 meter above the drive top cover at idle.

Sound pressure, typ (dBA)	26
Sound pressure, max (dBA)	29

1.8 Shock and vibration

All shock and vibration specifications assume that the inputs are measured at the drive mounting screws. Shock measurements are based on an 11-msec, half sine wave shock pulse, not to be repeated more than twice per second.

During normal operating shock and vibration, there is no physical damage to the drive or performance degradation.

During abnormal operating shock and vibration, there is no physical damage to the drive, although performance may be degraded during the shock or vibration episode. When normal operating shock levels resume, the drive meets its performance specifications.

During nonoperating shock and vibration, the read/write heads are positioned in the shipping zone.

	Normal operating	**Abnormal operating**	**Nonoperating**
Shock	2 Gs	10 Gs	75 Gs
5–22 Hz vibration	0.020-inch displacement	0.030-inch displacement	0.160-inch displacement
22–400 Hz vibration	0.50 Gs	0.75 Gs	4.00 Gs

1.9 DC power

Except during the write procedure, you can turn off and turn on power to the drive in any sequence without losing data or damaging the drive. If you turn off the power during a write procedure, you may lose the data currently being written.

1.9.1 Input noise

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

1.9.2 Power management

This drive provides and uses power-management modes which reduce power consumption. The level of drive activity for each power-management mode is described below.

You can customize the power-management modes using the AT interface commands that control the power modes. These commands are described in the *Seagate ATA Interface Reference Manual*, publication number 36111-*xxx*.

Note. If you install the ST5660A as a slave with a master drive that does not support power management (for example, a Seagate ST1239A drive), do not send power-management commands to the ST5660A.

1.9.2.1 Power-management modes

The drive supports the following power-management modes:

- **Spinup.** The drive brings the spindle and discs up to operating speed. Power in this mode is defined as the average power during the first 10 seconds of spinup. The drive enters this mode during startup and from the Standby mode.
- **Seeking.** The drive moves the read/write heads to a specific location on the disc surface in preparation for reading from or writing to the disc. Read/write electronics are powered down and servo electronics are active. The power measured during this mode is the average power while executing random seeks with a 2-revolution (26.6 msec) dwell between Seek commands.
- **Read/write.** The drive reads from or writes to the disc. Read/write electronics are active and the servo is on track. The drive enters this mode from the Idle mode.
- **Idle.** The heads are parked in the shipping zone. The spindle is spinning and the cache buffer remains enabled, and the drive accepts all commands and returns to the Seeking or Read/write modes when it receives a command that requires disc access.
- **Standby.** 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 sets a status flag indicating to the computer that it is ready to access the disc. When the drive receives a command that does not require disc access, the drive remains in the Standby mode. When the drive receives a command that requires disc access, it spins up and performs the command.

1.9.2.2 Idle and Standby modes

The drive can enter the Idle or Standby modes by either of two methods:

- The computer sends either the Idle command, the Idle Immediate command, the Standby command or the Standby Immediate command.
- The idle timer or the standby timer counts down to zero.

At power-on, the standby timer is disabled. Also at power-on, the drive sets the idle timer so that the drive enters the Idle mode after 25 seconds of inactivity. You can set the timer delays using the system setup utility. During each read, write or seek, the drive reinitializes the idle timer and begins counting down from the specified delay to zero.

If the idle timer reaches zero before the drive is commanded to read, write or seek, the drive switches to the Idle mode. Then, if the standby timer is enabled, the standby timer begins counting down. After the standby timer has finished counting down, the drive switches to Standby mode. To set the idle and standby timers, refer to the Idle command in the *Seagate ATA Interface Reference Manual*, publication number 36111-*xxx*.

While in either Idle mode or Standby mode, the drive accepts all commands and returns to the Seeking or Read/write modes whenever disc access is necessary.

1.9.3 Power consumption

In the table below, the values apply at the drive power connector. Current was measured with an RMS DC ammeter after a 10-minute warm-up period.

	Spinup	Seeking	Read/ Write	Idle	Standby
Current at +12V					
Amps peak	1.2	—	—	—	—
RMS amps typ	—	0.354	0.208	0.116	0.012
Watts typ	—	4.25	2.5	1.394	0.144
Current at +5V					
RMS amps typ	—	0.35	0.4	0.221	0.221
Watts typ	—	1.75	2	1.106	1.106
Power					
Total watts typ	—	6.00	4.5	2.50	1.25

The startup current profile of each drive is unique. A typical startup current profile is shown in Figure 1.

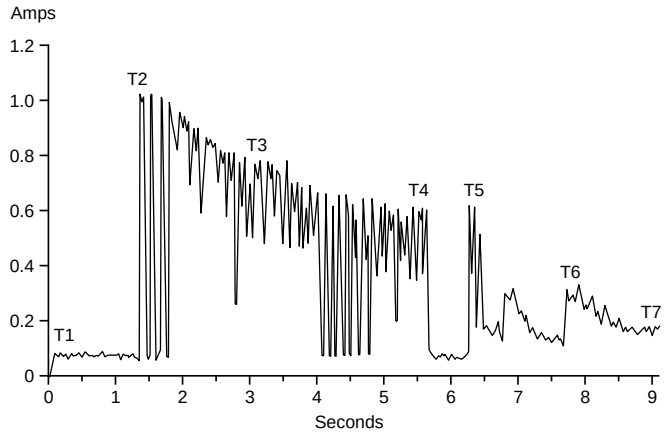

Figure 1. Typical startup current profile

T1 Power is applied to the drive.

T2 After a delay, the startup current is applied and the spindle begins to turn.

T3 The accelerating current is applied, causing the spindle speed to increase.

T4 The spindle speed is close to the final correct value. The drive begins to lock in speed-control circuits.

T5 The magnetic arm lock releases the arm.

T6 The final speed-control lock is achieved.

T7 The heads are positioned over track 0 and the drive is ready.

1.10 Agency listings

This drive is listed by agencies as follows:

- Recognized in accordance with UL 478 and UL 1950
- 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

1.11 FCC verification

The ST5660A 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 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 Umegebungstemperatur 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% 0,65A
+12V ± 5% 0,45A (1,9A fur ca. 10 Sek. fur ± 10%)

4. Die Versorgungsspannung muβ SELV entsprechen.

5. Alle Arbeiten dürfen nur von ausgebildetem Servicepersonal durchgeführt werden.

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 computer or other 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.
- Avoid wool or synthetic clothing, carpeting, plastics, and Styrofoam; these items cause static discharge.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. If you do, you void 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 cable and connector

The I/O connector is a 40-pin connector. The even pins are next to the edge of the printed circuit board; the odd pins are away from the printed circuit board. Pin 1 is near the 4-pin power connector. The I/O connector is shown in Figure 2.

There is no pin 20 because that location is used as a key. Make sure the corresponding pin hole on the cable connector is plugged to prevent the connector from being installed upside down. The I/O cable cannot be longer than 18 inches (0.46 meters).

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

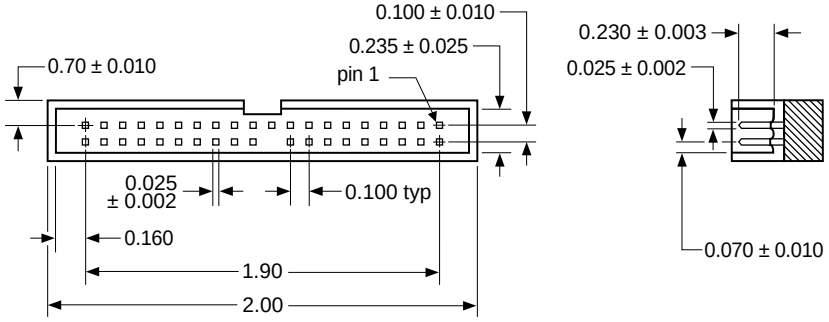

Figure 2. AT interface connector

2.3 Remote LED connection

To add an optional remote LED, attach a two-pin, 2-mm connector to pins 9 and 10 of the options jumper block.

2.4 Jumpers

You can connect two drives to a daisy-chain cable if both drives meet the same interface specifications. In a dual-drive configuration, one drive is designated as the master (drive 0) and the other as the slave (drive 1). See Figure 3 on page 16 for jumper settings.

If you intend to use the cable select option in a dual-drive system, you should determine whether both drives and your computer support cable select. See your computer documentation for details. The cable select option is described in more detail in Section 2.5.

2.4.1 Jumper sizes

The options jumper block accepts 2-mm connectors and jumpers. Use Seagate part number 13211-001 or an equivalent.

Caution. If you try to install a jumper that is not the correct size, you may damage the jumper and the jumper block pins.

2.4.2 Master/slave configuration

Your drive is shipped with spare jumpers installed on pins 15 and 16, pins 21 and 22, and pins 23 and 24 of the options jumper block [J8]. You can install up to two drives in a standard AT system.

If you are installing only one drive, you do not need to move the jumpers.

If you are installing two drives, configure one as the master and the other as the slave according to following guidelines:

- To configure a drive as a master with a slave present, install a jumper on pins 3 and 4 only of the options jumper block of the master drive.
- To configure a drive as a slave, install a jumper on pins 1 and 2 only of the options jumper block on the slave drive.

When the cable select option is used, a drive becomes the master or the slave depending on which connector it is plugged into on the cable. This requires a cable designed for cable select usage. In addition, a drive using cable select also requires jumpers on pins 1 and 2, 3 and 4, and 5 and 6 of the options jumper block [J8]. Cable select is described in more detail in Section 2.5.

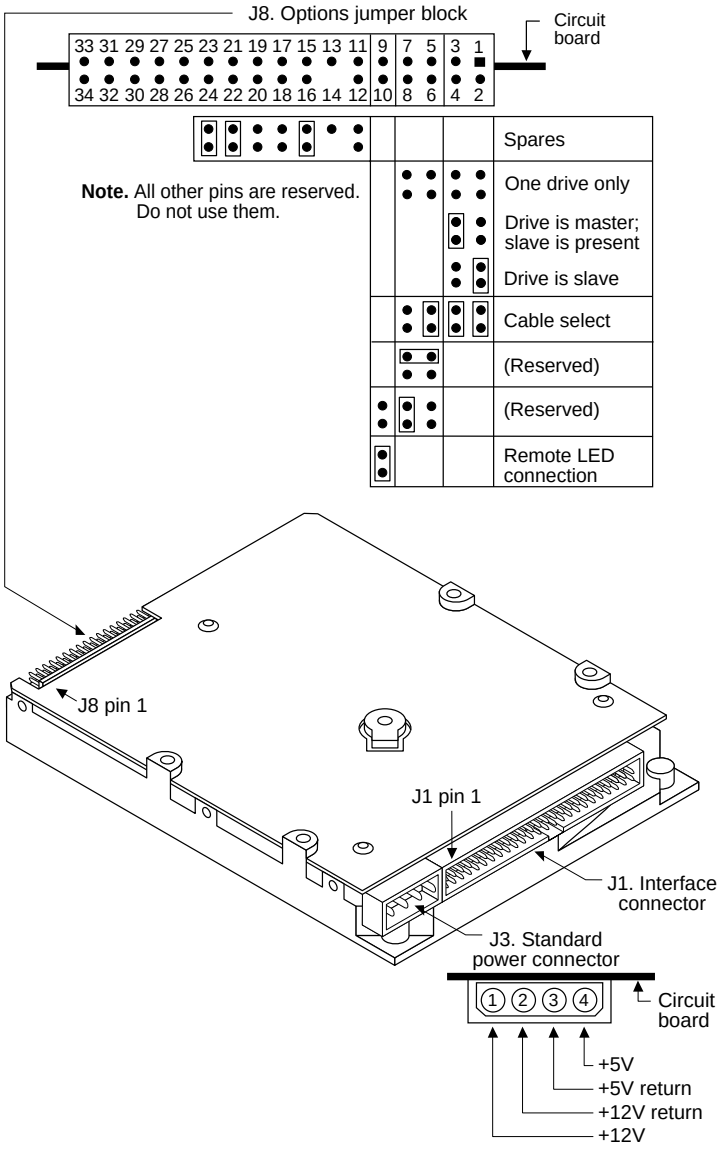

Figure 3. Configuration jumpers

2.5 Cable select option

If your computer and both of your drives support cable select, you can use the cable select option to determine the master and slave, according to the following guidelines, which are illustrated in Figure 4.

- 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 your drives using cable select, you need to:

- Install jumpers on pins 1 and 2, pins 3 and 4, and pins 5 and 6 of the options jumper block shown in Figure 3.
- Use a cable built for cable select to designate master and slave. The cable and its connectors transmit the CSEL signal (pin 28) to the master drive, but not to the slave drive, as shown in Figure 4.

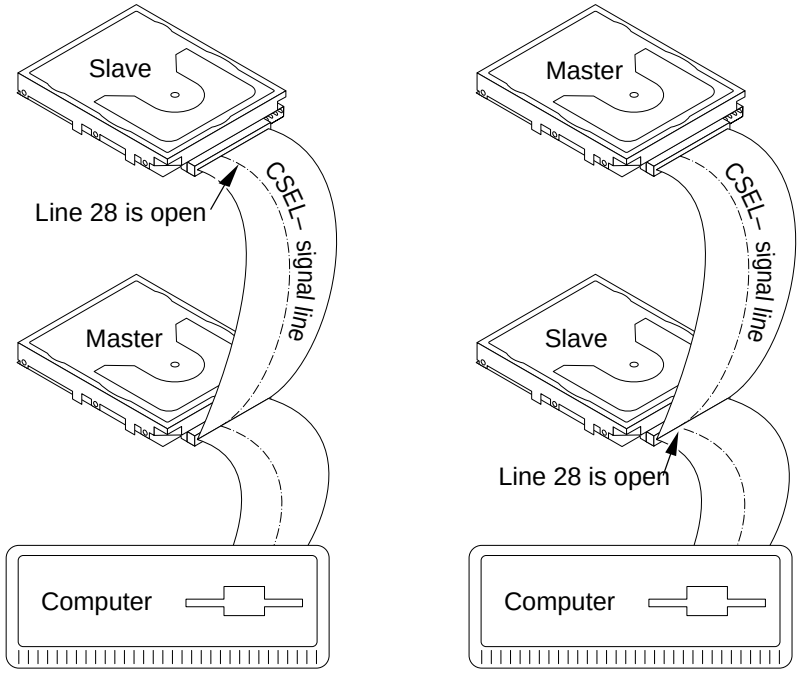

Figure 4. Connecting cable-selected drives

2.6 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 5 on page 19 shows the drive mounting dimensions and the side and 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 four of the six available side mounting holes. Use two 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 (mm).

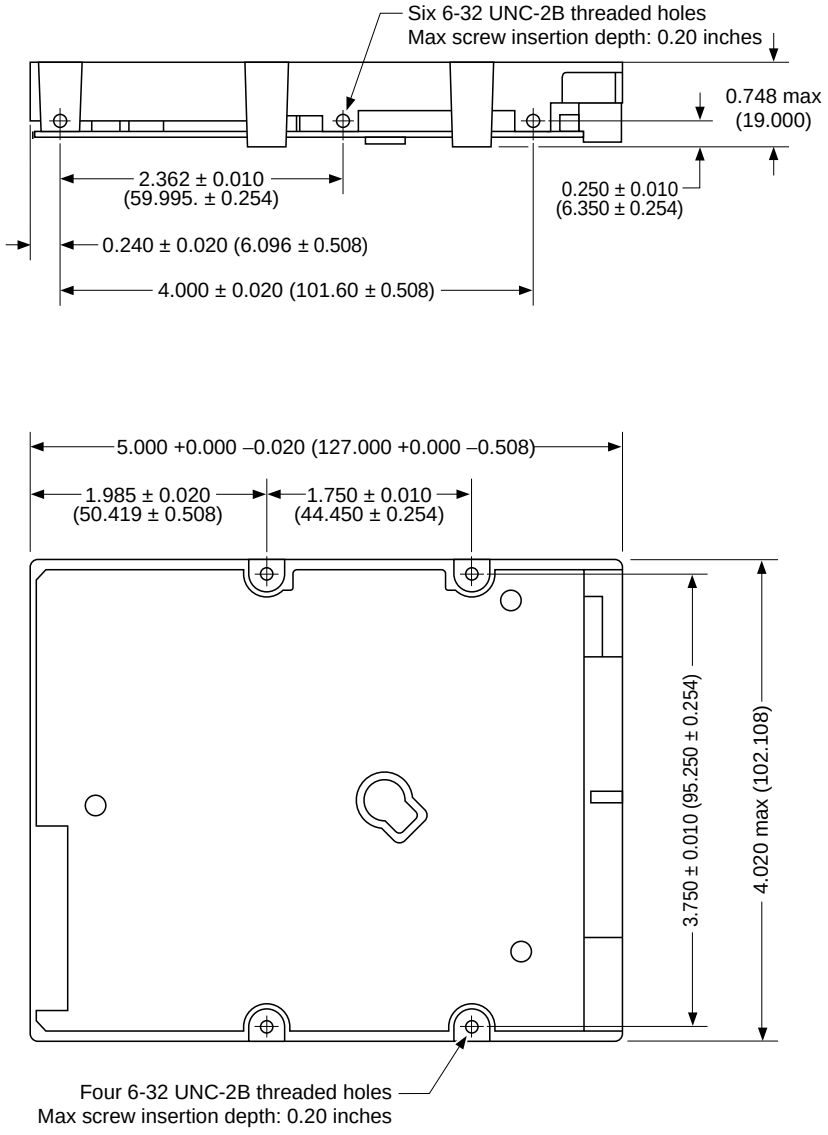

Figure 5. Mounting dimensions

3.0 AT interface

The drive complies with all ATA interface specifications. The interface consists of single-ended, TTL-compatible receivers and drivers communicating through a 40-conductor flat-ribbon, nonshielded cable with a maximum length of 18 inches (0.46 meters) using an asynchronous interface protocol. The drivers can sink up to 24 mA and drive a load up to 300 pF.

3.1 ST5660A commands

The following table lists all commands implemented on the ST5660A. For a complete description of all AT interface commands, refer to the *Seagate ATA Interface Reference Manual*, part number 36111-*xxx*. 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

continued

continued from previous page

Command name	Command code (in hex)	Parameters used				
		FR	SC	SN	CY	DH
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
Idle Immediate	95, F8, E1	n	n	n	n	D
Initialize Drive Parameters	91	n	y	n	n	y
Read DMA	C8, C9	—	y	y	y	y
Read Long	22, 23	n	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
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
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 Long	32, 33	n	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

3.1.1 Identify Drive command (EC_H)

The parameters for the drive 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 0020_H Spindle motor control option implemented 0010_H Head switch time > 15 µsec 0008_H Not MFM encoded 0002_H Hard sectored
1	Default cylinders	1,057
2	Reserved	0
3	Default heads	16
4	Bytes per track	36,540
5	Bytes per sector	580
6	Default sectors per track	63
7–9	Vendor-unique	0
10–19	Serial number	Drive-unique
20	Buffer type	3
21	Buffer size/512	512
22	ECC bytes (R/W Long)	4
23–26	Firmware revision	Drive-dependent
27–46	Model number	ST5660A
47	Sectors per R/W Multiple command	8020_H R/W Multiple supported; 32 sectors per block
48	Double word I/O	0000_H
49	Capabilities	$0B01_H$ IORDY, DMA, LBA supported
50	Reserved	0000_H

Word	Description	Value
51	PIO timing mode	0200_H
52	DMA timing mode	0201_H
53	Current valid	0003_H, 54–58, 64–70 valid
54	Current cylinders	Drive-unique
55	Current heads	16
56	Current sectors per track	63
57–58	Current sectors	1,065,456
59	Current multiple mode	0000_H
60–61	LBA total sectors	1,066,184
62	Single-word DMA	0000_H No modes are active; no modes are supported.
63	Multiword DMA	0103_H Mode 0 is active; modes 0 and 1 are supported.
64	Advanced PIO	0103_H Mode 3 is supported.
65	Minimum multiword DMA transfer per word	150 nsec
66	Recommended multiword DMA transfer per word	150 nsec
67	Minimum PIO transfer without IORDY	200 nsec
68	Minimum PIO transfer with IORDY	180 nsec
69–127	Reserved	0
128–159	Vendor-unique	*x*

Two ST5660A commands that are described in the *ATA Interface Reference Manual* require further elaboration. These commands are described below.

3.1.2 Set Features command (EF_H)

The Set Features command is used to enable or disable the Read Look-ahead, write immediate and write merging features. These features are enabled during startup. The values used in the features register of the ST5660A drive are:

02_H Enable write immediate and write merging

03_H Set transfer mode

55_H Disable read look-ahead

82_H Disable write immediate and write merging

AA_H Enable read look-ahead

3.1.3 Sleep command (99_H, $E6_H$)

This command performs the same function as the Standby Immediate command.

3.2 Interface connector pin assignments

The signal name and signal direction for each I/O connector pin is described in Figure 6 on page 26. See the *Seagate ATA Interface Reference Manual*, publication number 36111-*xxx*, for a complete description of each pin.

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

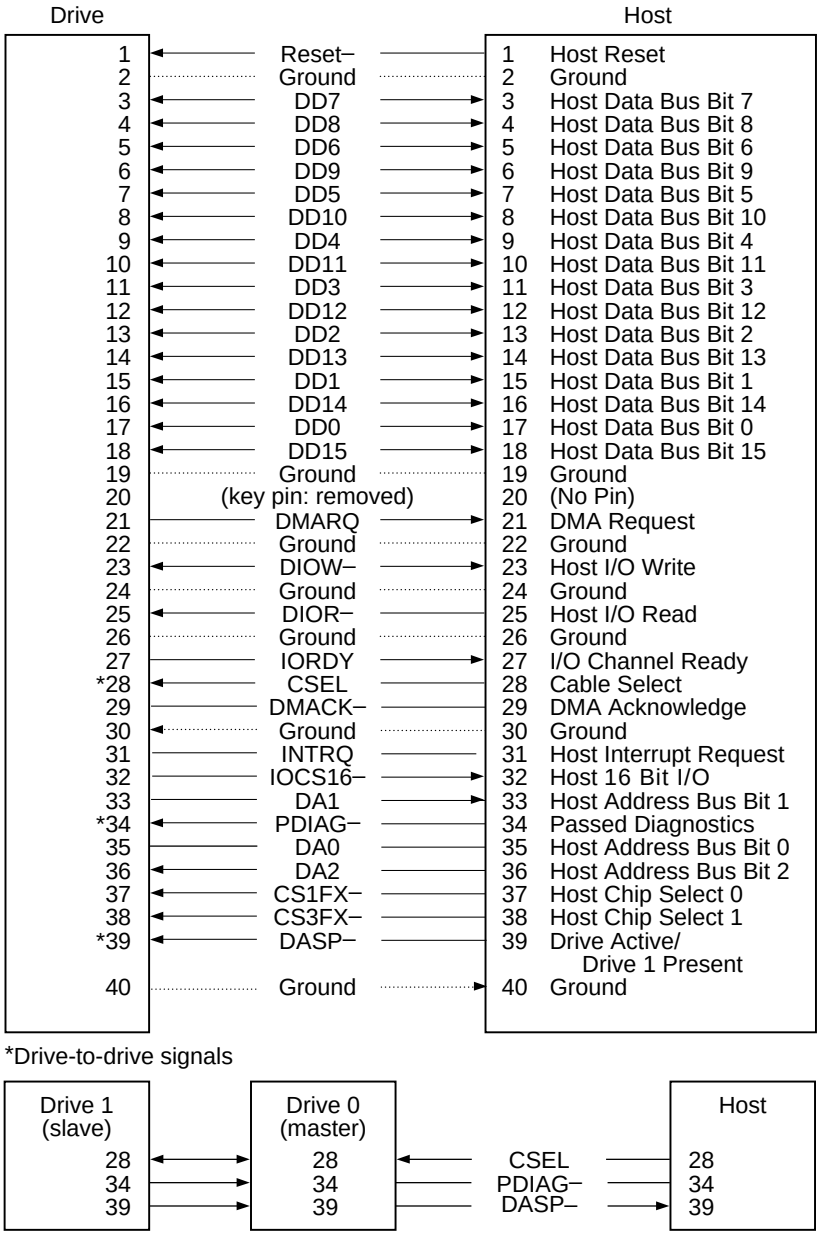

Figure 6. AT interface connector pin assignments

Appendix. Timing diagrams

Without IORDY, the drive operates at programmed I/O mode 3 timing specifications, as shown below.

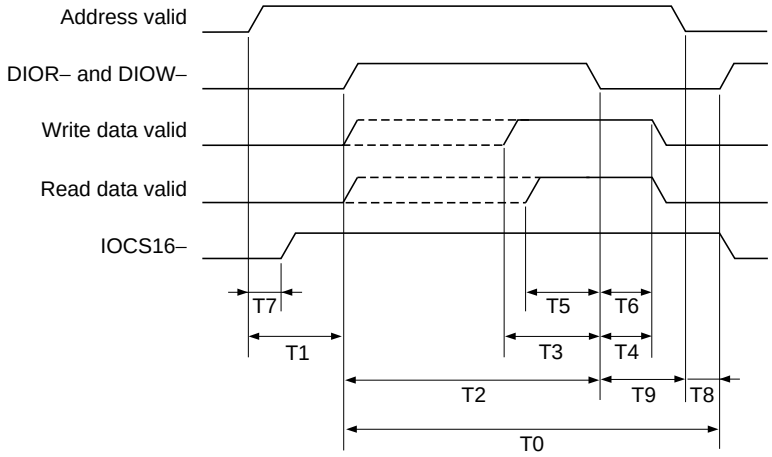

Figure 7. Programmed I/O timing without IORDY

Time	Description	Min	Max
T0	Cycle time	200 nsec	—
T1	Drive address (CS1FX–, CS3FX–, DA0, DA1 and DA2) valid and DIOR–/DIOW– setup	30 nsec	—
T2	DIOW– or DIOR– pulse width	80 nsec	—
T3	DIOW– data setup	30 nsec	—
T4	DIOW– data hold	15 nsec	—
T5	DIOR– data setup	20 nsec	—
T6	DIOR– data hold	5 nsec	—
T7	DIOW– or DIOR– to address valid hold	—	40 nsec
T8	DIOW– false to write data hold	—	30 nsec
T9	DIOR– false to read data hold	10 nsec	—

When using IORDY, the drive operates at programmed I/O mode 3 timing specifications, as shown below.

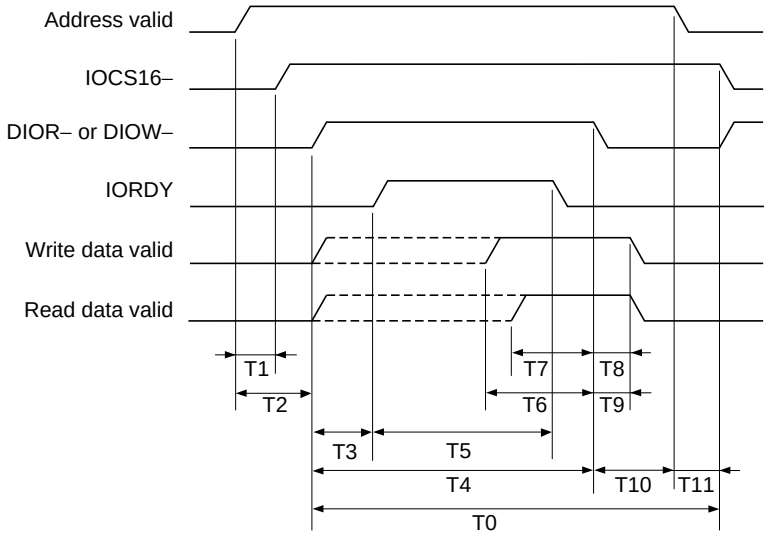

Figure 8. Programmed I/O timing with IORDY

Time	Description	Min	Max
T0	Cycle time	180 nsec	—
T1	Address valid until IOCS16– is asserted	—	40 nsec
T2	Drive address (CS1FX–, CS3FX–, DA0, DA1 and DA2) valid before DIOR– or DIOW– setup	30 nsec	—
T3	IORDY setup time	—	—
T4	DIOW– or DIOR– pulse width (8-bit)	80 nsec	—
	DIOW– or DIOR– pulse width (16-bit)	80 nsec	—
T5	IORDY pulse width	—	1,250 nsec
T6	DIOW– data setup	30 nsec	—
T7	DIOR– data setup	20 nsec	—
T8	DIOR– data hold	5 nsec	—
T9	DIOW– data hold	15 nsec	—
T10	DIOW– or DIOR– to address valid hold	10 nsec	—
T11	Address valid until IOCS16– is negated	—	30 nsec

The drive operates at multiword DMA mode 1 timing specifications, as shown below.

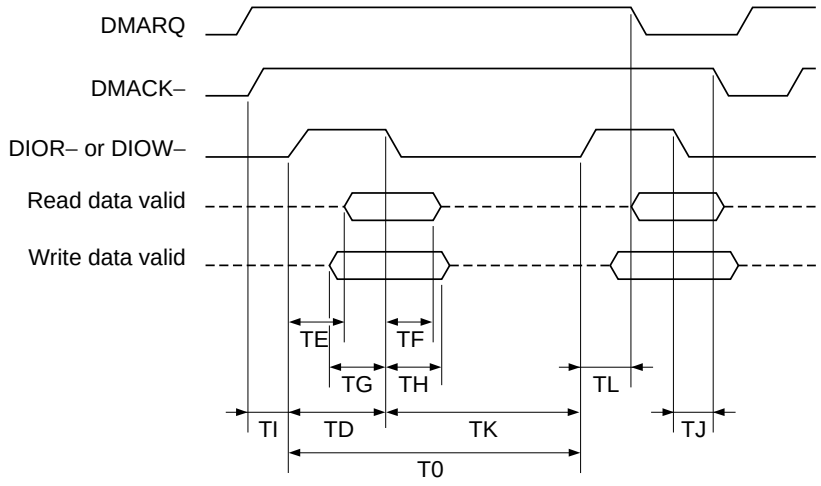

Figure 9. Multiword DMA timing

Time	Description	Min	Max
T0	Cycle time	150 nsec	—
TD	DIOW– or DIOR– pulse width (16-bit)	80 nsec	—
TE	DIOR– data access	—	60 nsec
TF	DIOW– data hold	5 nsec	—
TG	DIOR– data setup	30 nsec	—
TH	DIOW– data hold	15 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	60 nsec	—
TK_W	DIOW– negated pulse width	60 nsec	—
TL_R	DIOR– to DMARQ delay	—	120 nsec
TL_W	DIOW– to DMARQ delay	—	40 nsec

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