Seagate

Medalist Family:

ST3780A, ST31220A

AT Interface Drives

Product Manual

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1.0 Specifications

1.1 Formatted capacity

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

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 sectors by using the Identify Drive (EC_H) command. See Section 3.1.1 for details about the Identify Drive command.

The amount of disc space that your computer can access depends on the type of computer you have and the type of operating system or third-party installation software that is used to high-level format ST31220 family drives.

Your computer may support one of two addressing schemes to access data on a hard disc—logical block addressing (LBA) or cylinder-head-sector addressing (CHS). LBA allows you to access the full capacity of your hard disc. CHS, which is used on older DOS systems, limits the capacity of your hard disc to 1,024 cylinders (approximately 512 Mbytes) unless:

- You are using third-party installation software that supports more than 1,024 cylinders.
- You have configured your system to support dual-drive emulation (see page 19).
- You have a host adapter (controller card) that supports more than 1,024 cylinders.

The relationship between sectors, heads and cylinders and the total number of sectors per drive is shown in the following equation:

(sectors) $\times$ (heads) $\times$ (cylinders) $\leq$ total sectors per drive

1.1.1 ST3780A configurations

	CHS	LBA
Cylinders	1,399	N/A
Heads	16	N/A
Sectors	63	N/A
Total sectors	1,410,192	1,410,864
Formatted capacity (Mbytes[1])	722.02	722.36

1. One Mbyte equals one million bytes.

1.1.2 ST31220A configurations

	CHS	LBA
Cylinders	2,099	N/A
Heads	16	N/A
Sectors	63	N/A
Total sectors	2,115,792	2,116,296
Formatted capacity (Mbytes[1])	1,083.2	1,083.5

1. One Mbyte equals one million bytes.

1.1.3 Physical organization

	ST3780A	ST31220A
Read/write heads	4	6
Discs	2	3

1.2 Functional specifications

Interface	ATA
Zone Bit Recording method	RLL (1,7)
External data burst transfer rate, DMA Mode 2 (Mbytes per sec)	16.6[1]
External data burst transfer rate, PIO Mode 4 (Mbytes per sec)	16.6[2]
Internal data transfer rate (Mbits per sec)	27.92 to 47.24
Spindle speed (RPM)	4,500 ± 0.5%
Cache size (Kbytes)	256
Cylinders	3,876
Bytes per sector	512
Recording density, max (BPI)	70,101
Track density (TPI)	4,250

1. The drives achieve this external transfer rate when using multiword DMA mode 2; see Figure 9 on page 33.
2. See Figure 8 on page 32.

1.3 Seek time

Seek time is the interval between the time the actuator begins to move and the time the head has settled over the target track. Seek time is a true statistical average of at least 5,000 measurements of seek time. All measurements are taken under nominal conditions of temperature and voltage with the drive mounted horizontally. The specifications in the table below are defined as follows:

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

Track-to-track seek time	Average/typical seek time	Full-stroke seek time	Average latency
3.5 msec typ 4.5 msec max	12.0 msec read 14.0 msec write	25.0 msec typ 27.0 msec max	6.67 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 0.5 msec.

1.3.1 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 computer requests the additional sectors. The cache buffer stores data from the start of a read until the buffer segment is full or until another command is received.

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

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

1.4 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.

1.5 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.

1.5.1 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 achieves final speed-control lock.

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

1.5.2 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 magnetic actuator-lock locks the arm. This completes the power-down sequence.

1.5.3 Auto-park

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

1.6 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 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/Stop	40,000 cycles
MTBF	300,000 power-on hours
Service life	5 years

1.7 Physical dimensions

The mounting dimensions are shown in Figure 5 on page 22.

Height, max	1.00 inch (25.4 mm)
Width, max	4.02 inches (102.1 mm)
Depth, max	5.77 inches (146.6 mm)
Weight	1.5 lb (0.68 Kg)

1.8 Environmental specifications

1.8.1 Ambient temperature

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

1.8.2 Temperature gradient

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

1.8.3 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)

1.8.4 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)

1.9 Acoustics

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

Value	Idle	Seek
Sound pressure, typ (dBA)	30	36
Sound pressure, max (dBA)	33	39

1.10 Shock and vibration

All shock and vibration specifications assume that the drive is mounted as recommended in Section 2.6, with the input levels 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 nonoperating shock and vibration, the read/write heads are positioned in the shipping zone.

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.

	Operating	**Abnormal**	**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

1.11 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 the write procedure, you may lose the data currently being written.

1.11.1 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

1.11.2 Power management

This drive provides and uses power-management modes to reduce its overall 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*.

1.11.3 Idle and Standby modes

The drive may enter Idle mode or Standby mode through either of the following actions:

- The computer can send one of the Idle commands or the Standby commands. All of the commands that put the drive into the Idle or Standby mode are listed in the *Seagate ATA Interface Reference Manual.*
- The idle timer or the standby timer counts down to zero.

At power-on, the drive sets the idle timer to enter the Idle mode after 25 seconds of inactivity and the standby timer is disabled. On some computers, the system setup utility provides a means of setting the timer delay values. 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*.

In both the Idle and Standby modes, the drive accepts all commands and returns to the Seeking or Read/write modes any time disc access is necessary.

1.11.4 Power-management modes

The following power-management modes are supported by the drive:

- **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 after starting 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 or writing the disc. Read/write electronics are powered down and servo electronics are active. The power measure 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, 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 reports 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.

1.11.5 Power consumption

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

	Spinup	Seeking	Read/ write	Idle	Standby
Current at +12V					
Amps peak	1.9	—	—	—	—
RMS amps typ	—	0.398	0.185	0.118	0.012
Watts typ	—	4.77	2.22	1.41	0.144
Current at +5V					
RMS amps typ	—	0.360	0.404	0.225	0.164
Watts typ	—	1.80	2.02	1.12	0.82
Power					
Total watts typ	7.00	6.60	4.50	2.75	1.0

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

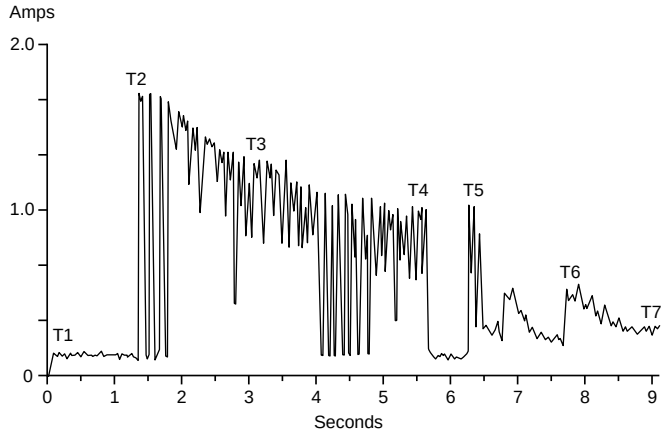

Figure 1. Typical startup current profile

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.

1.12 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
- Certified to VDE 0805/05.90 and EN 60950/1.88 as tested by VDE

1.13 FCC verification

ST31220 family AT 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 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% 0,6A
+12V ± 5% 0,8A (1,9A fur ca. 30 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 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, carpet, plastic, and styrofoam; these items cause static discharge.
- 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 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

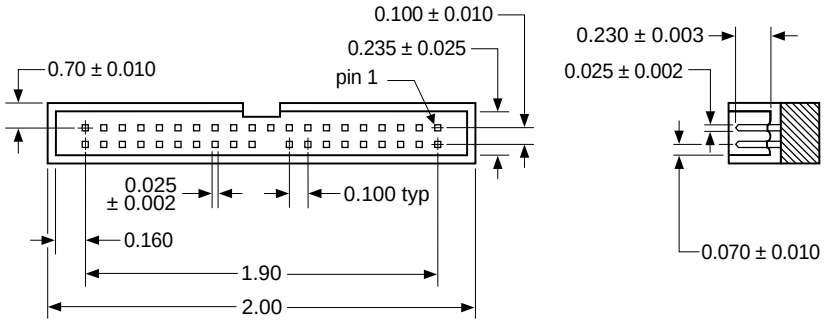

Figure 2. AT interface connector

2.3 Remote LED connection

To add an optional remote LED, attach a two-pin, 0.1-inch connector to pins 13 (–) and 14 (+) of the options jumper block J8.

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 18 for jumper settings.

If you intend to use the cable select option in a dual-drive system, before continuing you should determine whether your system supports it. See your computer documentation for details. These options are described in more detail in Section 2.5.

2.4.1 Jumper sizes

The jumper blocks use 0.1-inch configuration jumpers. Use Seagate part number 10562-001 or an equivalent. You may use the spare jumpers shipped with the drive on any jumper block. The positions of these jumpers are shown in Figure 3 on page 18.

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

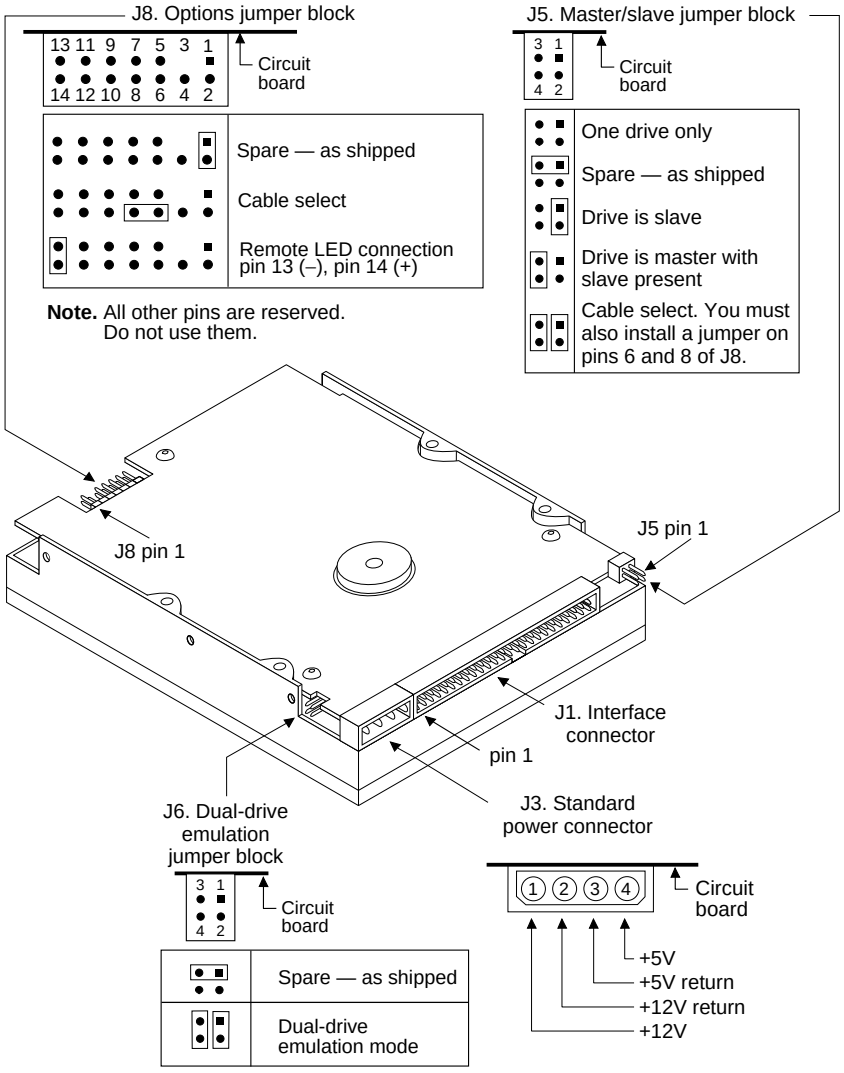

Figure 3. Configuration jumpers

2.4.2 Dual-drive emulation jumper block J6

With jumpers installed on pins 1 and 2, and pins 3 and 4 of jumper block J6, you can install this drive as both C and D drives simultaneously. Under dual-drive emulation, capacities are as follows: for the ST31220A, each *subdrive* has a capacity of 528 Mbytes for a total of 1,056 Mbytes; for the ST3780A, each drive has a capacity of 360 Mbytes for a total of 720 Mbytes.

Installation in this manner causes the drive to appear to your computer as two drives, master and slave, so an additional slave drive cannot be added.

Note. When the drive is configured to support dual-drive emulation, both emulated drives respond as one to any power-management command.

2.4.3 Master/slave configuration

Your drive is shipped with a jumper installed in a spare location on pins 1 and 3 of the master/slave jumper block. If you are installing only one drive, you can leave the jumper installed on pins 1 and 3, or you can remove all jumpers from the jumper block.

You can install up to two drives in a standard AT system. If you are installing two drives in your system, configure one drive as the master and the other as the slave according to the following guidelines:

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

  Note. If both the master and the slave are ST31220 family drives, you do not need to install a jumper on pins 3 and 4. This is because the master can detect the presence of the slave using the DASP– signal on the AT interface cable. If the drives in your application do not implement the DASP– signal, install the jumper on pins 3 and 4 of the master/slave jumper block on the master drive only.

- To configure the drive as a slave, install a jumper on pins 1 and 2 only of the master/slave jumper block on the slave drive.

With the aid of a special interface ribbon cable, the cable select option allows you to determine the master and slave according to where the drives are plugged into the cable. Cable select is described in more detail in Section 2.5.

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. To configure your drives using cable select, you need to install jumpers and use a special cable-select cable as follows:

- Install jumpers on pins 1 and 2 and pins 3 and 4 of the master/slave jumper block J5 and on pins 6 and 8 of the options jumper block J8. These jumper blocks are shown in Figure 3 on page 18.
- You must use an interface ribbon cable built to support master and slave selection. The cable and its connectors must connect the CSEL signal line to pin 28 of the master drive, but not to the slave drive (see Figure 4). That is, the drive that is plugged into the I/O connector connecting the CSEL signal line to pin 28 is the master. The drive plugged into the I/O connector, whose pin 28 is open, is the slave. Pin 28 of its cable connector is not connected to the CSEL line.

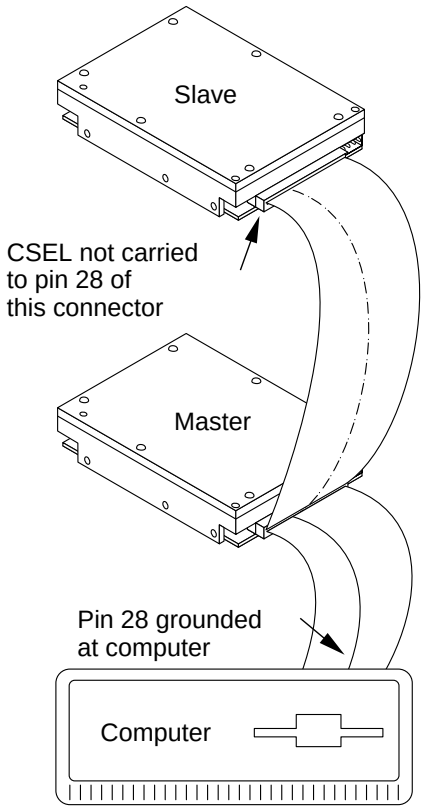

Figure 4. Connecting cable-selected drives

2.6 Mounting the drive

You can mount the drive in any orientation.

Note. If you format the drive before mounting it in the computer, it is best to format it in the same physical orientation it will have when it is mounted.

Use the set of mounting guidelines below that are appropriate to the type of mounting holes used: either bottom mounting holes or side mounting holes. Refer to Figure 5 on page 22 for mounting dimensions.

Mounting with the optional 1-inch faceplate adds 0.180 inches ± 0.010 inches (4.572 mm ± 0.254 mm) to the overall drive length.

Bottom mounting holes. Insert four 6-32 UNC screws in the four bottom mounting holes as shown in Figure 5.

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

Side mounting holes. Use four 6-32 UNC screws in four of the six available side mounting holes as shown in Figure 5. Use two mounting holes on each side of the drive.

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

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

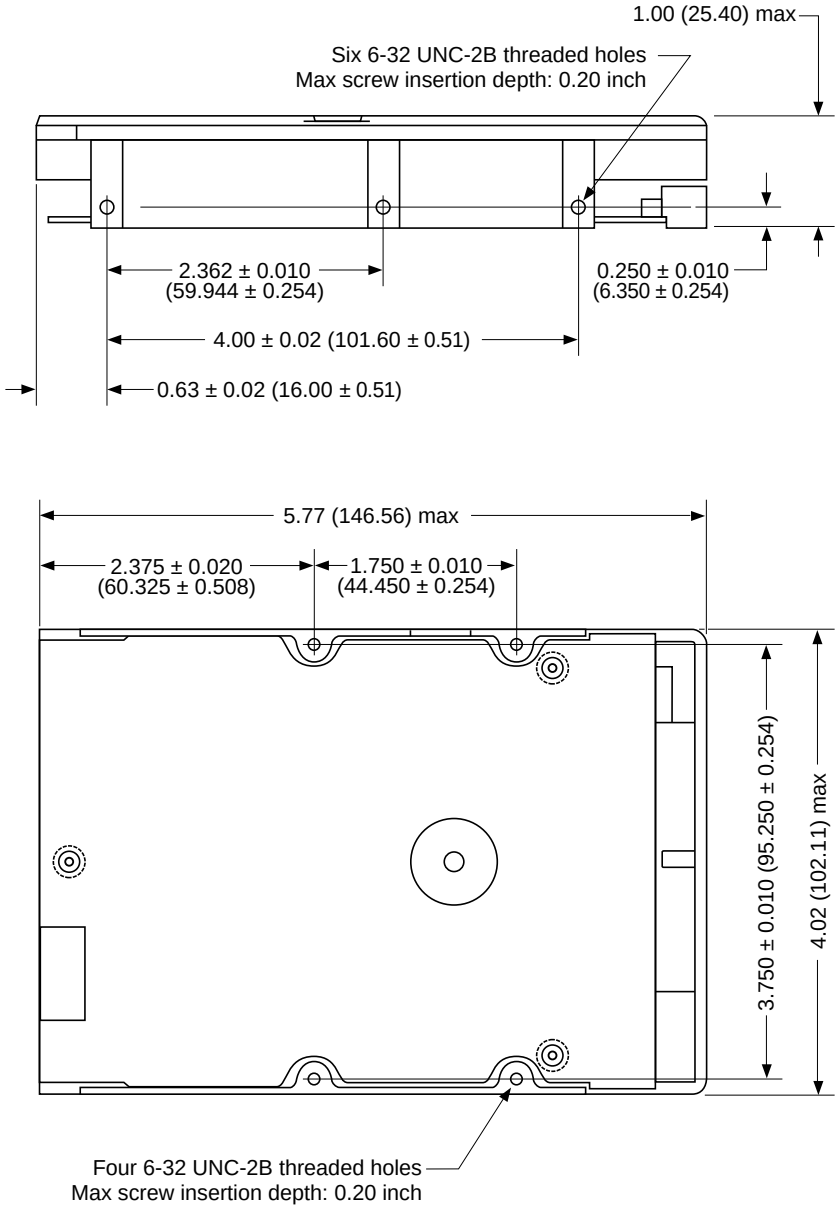

Figure 5. Mounting dimensions

3.0 AT interface

The AT interface implemented on these drives is compatible with the requirements of the IBM AT bus. The AT 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 Command set

This section lists all ATA commands implemented in the ST31220 family drives and describes certain commands in detail. Some commands, as mentioned in the text, supplement the standard ATA commands. For a complete description of all AT interface commands, refer to the *Seagate ATA Interface Reference Manual*, part 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 Set Features command and the Sleep command, described in the *Seagate ATA Interface Reference Manual*, require further elaboration. These commands are described in Section 3.1.2 and 3.1.3.

The table on page 24 lists all commands implemented in the ST31220 family 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
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 these 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 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	See Sections 1.1.1 and 1.1.2 for value appropriate to model.
2	Reserved	0
3	Default heads	16
4	Bytes per track	$8EBC_H$ (36540 decimal) (unformatted)
5	Bytes per sector	244_H (580 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)	0004_H
23–26	Firmware revision	Drive-dependent: 8 ASCII characters
27–46	Model number	Drive-dependent: 40 ASCII characters

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	$0B01_H$ IORDY, DMA, LBA supported
50	Reserved	0000_H
51	PIO timing mode	0200_H
52	DMA timing mode	0207_H Multiword DMA mode 2 supported
53	Current valid	0003_H, 54–58, 64–70 valid
54	Current cylinders	Drive-unique
55	Current heads	Drive-unique
56	Current sectors per track	Drive-unique
57–58	Current sectors	Drive-unique
59	Current multiple mode	0000_H
60–61	LBA total sectors	See Sections 1.1.1 and 1.1.2 for value appropriate to model.
62	Single-word DMA	0000_H No modes are active; no modes are supported.
63	Multiword DMA	0107_H Mode 0 is active; modes 0 and 1 are supported.
64	Advanced PIO	0003_H Mode 4 is supported.
65	Minimum multiword DMA transfer per word	120 nsec
66	Recommended multiword DMA transfer per word	120 nsec
67	Minimum PIO transfer without IORDY	200 nsec

Word	Description	Value
68	Minimum PIO transfer with IORDY	120 nsec
69–127	Reserved	*xxxx*$_H$
128–159	Seagate-reserved	*xxxx*$_H$
160– 255	Reserved	*xxxx*$_H$

3.1.2 Set Features command (EF_H)

The host uses the Set Features command (command code EF_H) to establish parameters that affect the execution of certain drive features. The command is used to enable or disable the Read Look-ahead, write immediate and write merging features and to set the transfer mode. These features are enabled during startup.

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.

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

The following table shows alterable features supported by the ST31220 family drives. Where a factory-default value exists, that value is listed.

Feature Value	Feature
02_H	Enable write immediate and write merging
55_H	Disable cache
82_H	Disable write immediate and write merging
AA_H	Enable cache
03_H	Set transfer mode

3.1.2.1 PIO and DMA Data Transfer Modes

You can use the Set Features command to set the type of data-transfer mechanism and transfer mode that the drive uses. To do this:

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 low order 3 bits encode the mode value. 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*

If the drive does not support a commanded mode, the drive returns an Aborted Command error.

If the drive receives a Set Features command with a mechanism and mode value of 0000 0001 and the drive supports disabling of IORDY, then the drive sets its default PIO transfer mode and disables IORDY.

3.1.3 Sleep command (99_H, $E6_H$)

This command performs the same function as the Standby Immediate command (94_H, $E0_H$).

3.2 AT Interface connector pin assignments

The signal name and signal direction for each I/O connector pin is described in Figure 6 on page 30. See the *Seagate ATA Interface Reference Manual*, publication number 36111-*xxx*, for a complete description of each pin.

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

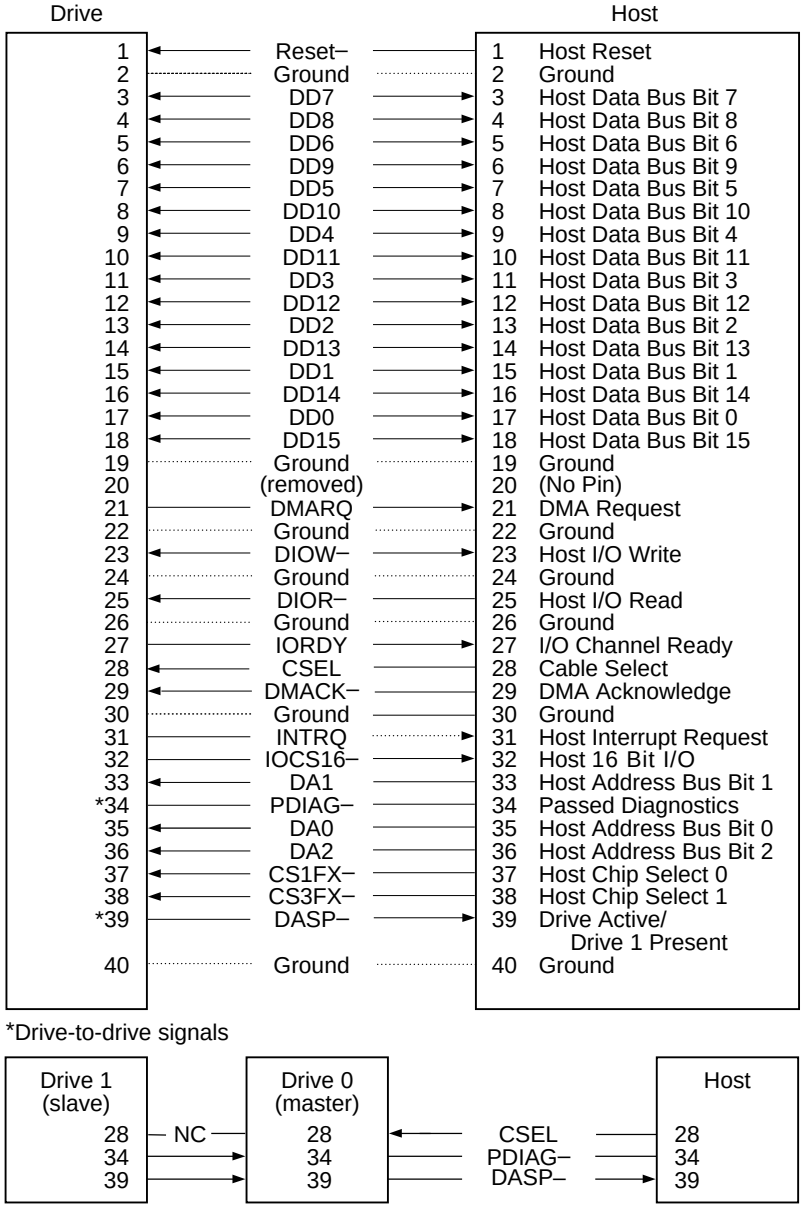

Figure 6. AT interface connector pin assignments

Appendix. Timing diagrams

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

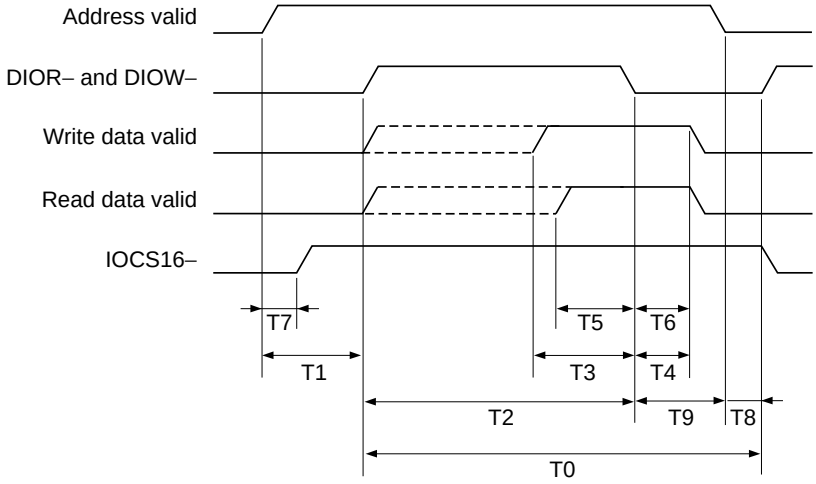

Figure 7. Programmed I/O timing without IORDY

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 timing specifications, as shown below.

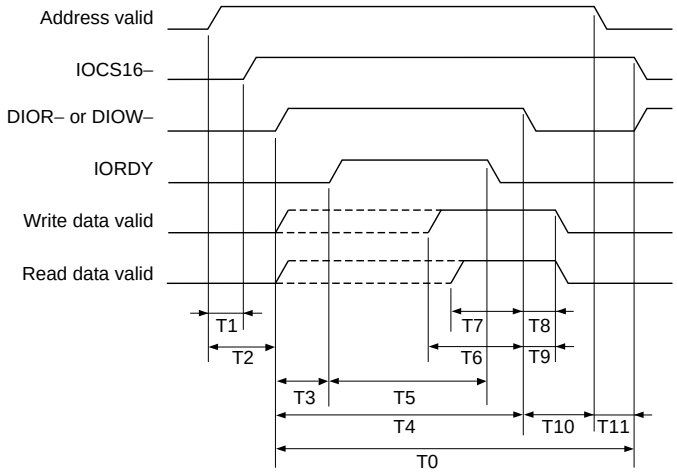

Figure 8. Programmed I/O timing with IORDY

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

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

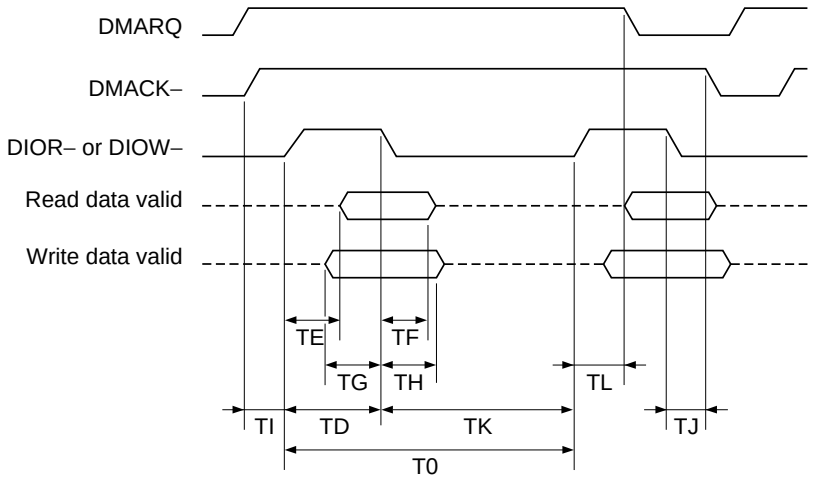

Figure 9. Multiword DMA timing

Time	Description	Min	Max
T0	Cycle time	120 nsec	—
TD	DIOW– or DIOR– pulse width (16-bit)	70 nsec	—
TE	DIOR– data access	—	—
TF	DIOR– data hold	5 nsec	—
TG	DIOW– data setup	20 nsec	—
TH	DIOW– data hold	10 nsec	—
TI	DMACK– to DIOR– or DIOW– setup	0 nsec	—
TJ	DIOR– or DIOW– to DMACK– hold	5 nsec	—
TK_R	DIOR– negated pulse width	25 nsec	—
TK_W	DIOW– negated pulse width	25 nsec	—
TL_R	DIOR– to DMARQ delay	—	35 nsec
TL_W	DIOW– to DMARQ delay	—	25 nsec

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