Seagate

ST9655 Family

ST9655AG, ST9550AG

ST9385AG

ATA Interface Drives

Product Manual

ST9655 Family

ST9655AG, ST9550AG

ST9385AG

ATA Interface Drives

Product Manual

Seagate

Publication Number: 36270-001, Rev. A
September 1994

Contents

Figures

1.0 Drive specifications

1.1 Formatted capacity

	ST9655AG	ST9550AG	ST9385AG
Guaranteed Mbytes (1 Mbyte = 10^6 bytes)	524	455	341
Guaranteed sectors	1,024,128	889,248	666,876
Bytes per sector	512	512	512

1.2 Physical organization

	ST9655AG	ST9550AG	ST9385AG
Read/Write heads	8	8	6
Discs	4	4	3

1.3 Logical organization

The ST9655 family drives support all head, cylinder and sector geometries, subject to the maximums specified below, and to the following condition:

(*sectors*) × (*heads*) × *(cylinder*s) ≤ *total sectors per drive*

	ST9655AG	ST9550AG	ST9385AG
Sectors per track (max)	64	64	64
Read/Write heads (max)	16	16	16
Cylinders (max)	1,024	1,024	1,024

1.4 Default logical geometry

	ST9655AG	ST9550AG	ST9385AG
Sectors per track	63	59	51
Read/Write heads	16	16	14
Cylinders	1,016	942	934

1.5 Recording and interface technology

Specification	ST9655AG	ST9550AG	ST9385AG
Interface	ATA	ATA	ATA
Recording method	RLL (1,7)	RLL (1,7)	RLL (1,7)
Recording density (BPI)	72,100	59,124	59,124
Flux density (FCI)	44,360	44,360	44,360
Track density (TPI)	3,227	3,282	3,282
Spindle speed (RPM ± 0.5%)	3,980	3,980	3,980
Internal data transfer rate (Mbits per sec max—ZBR)	28.26	27.28	27.28
I/O data transfer rate (Mbytes per sec max)			
PIO Mode 3 with IORDY	11.1	8.0	8.0
Multiword DMA Mode 1	13.3	13.3	13.3
Interleave	1:1	1:1	1:1
Cache buffer (Kbytes)	120	120	120

1.6 Physical dimensions

Height (max) inches	0.754
(mm)	(19.15)
Width (max) inches	2.760
(mm)	(70.10)
Depth (max) inches*	4.010
(mm)	(101.85)
Weight (typical) ounces	7.4
(kg)	(0.21)

* Excludes I/O connector pins, which may extend up to 0.010 inches beyond the edge of the head/disc assembly.

1.7 Seek time

All seek times are measured using a 25 MHz 486 AT computer (or faster) with a 8.3 MHz I/O bus. The measurements are taken with nominal power at sea level and 25°C ambient temperature. The specifications in the following table are defined as follows:

- Track-to-track seek time is an average of all possible single-track seeks in both directions.
- Average seek time is a true statistical random average of at least 5,000 measurements of seeks between random tracks, less overhead.
- Full-stroke seek time is one-half the time needed to seek from the first data cylinder to the maximum data cylinder and back to the first data cylinder. The full-stroke average is determined by measuring 100 full-stroke seeks in both directions.

Seek type	Typical read (msec)	Typical write (msec)
Track-to-track	6	7
Average	16	20
Full-stroke	26	28

Average latency (msec): 7.54 msec

1.8 Start times

Power-on to Ready (sec)	7 typical (responds to selection and status commands within 2 seconds of power-up)
Standby to Ready (sec)	3 typical

1.9 Reliability

Nonrecoverable read errors	1 per 10^{13} bits read (with retries enabled)
Mean time between failures	300,000 power-on hours (nominal power, at sea level, 25°C ambient temperature)
Contact start-stop cycles	50,000 cycles (60 contact starts per hour max., with a 50% power-on duty cycle and nominal power, at sea level, at ambient temperature and relative humidity)
Preventive maintenance	None required
Mean time to repair	10 minutes

Service life	5 years

1.10 Drive acoustics

Drive acoustics are measured as sound pressure 1 meter from the drive.

Mode	Maximum
Idle (dBA)	30
Seek (dBA)	33

1.11 Environment

1.11.1 Ambient temperature

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

1.11.2 Temperature gradient

Operating	30°C/hr (54°F/hr) max, without condensation
Nonoperating	30°C/hr (54°F/hr) max, without condensation

1.11.3 Relative humidity

Operating	8% to 80% noncondensing (10% per hour max) Max. wet bulb temperature: 29.4°C (85°F)
Nonoperating	8% to 90% noncondensing (10% per hour max) Max. wet bulb temperature: 40°C (104°F)

1.11.4 Altitude

Operating	–1,000 ft to 10,000 ft (–300 m to 3,000 m)
Nonoperating	–1,000 ft to 40,000 ft (–300 m to 12,190 m)

1.11.5 Shock

All shock specifications assume that the drive is mounted in an approved orientation with the input levels at the drive mounting screws. The nonoperating specifications assume that the read/write heads are positioned in the shipping zone.

Note. At power-down, the read/write heads automatically move to the shipping zone. The head and slider assembly park inside of the maximum data cylinder. When power is applied, the heads recalibrate to Track 0.

1.11.5.1 Operating shock

The ST9655 family drives, which incorporate SafeRite™ components, can withstand a maximum operating shock of 100 Gs without nonrecoverable data errors (based on half-sine shock pulses of 2 and 11 msec).

1.11.5.2 Nonoperating shock

The maximum nonoperating shock that the ST9655 family drives can experience without incurring physical damage or degradation in performance when subsequently put into operation is 150 Gs (based on half-sine shock pulses of 2 and 11 msec).

1.11.6 Vibration

All vibration specifications assume that the drive is mounted in an approved orientation with the input levels at the drive mounting screws. The nonoperating specifications assume that the read/write heads are positioned in the shipping zone.

1.11.6.1 Operating vibration

The following table lists the maximum vibration levels that a ST9655 family drive may experience without incurring physical damage or degradation in performance.

5–22 Hz	0.020-inch displacement (double amplitude)
22–450 Hz	0.5 Gs acceleration (peak)
450–22 Hz	0.5 Gs acceleration (peak)
22–5 Hz	0.020-inch displacement (double amplitude)

1.11.6.2 Nonoperating vibration

The following table lists the maximum nonoperating vibration that a ST9655 family drive can experience without incurring physical damage or degradation in performance when the drive is operated.

5–22 Hz	0.162-inch displacement (double amplitude)
22–450 Hz	4 Gs acceleration (peak)
450–22 Hz	4 Gs acceleration (peak)
22–5 Hz	0.162-inch displacement (double amplitude)

1.12 Power specifications

ST9655 family drives receive DC power (+5V) through pin 41 and pin 42 of the ATA interface connector.

1.12.1 Power management

Power management is required for low-power and portable computer systems. In most systems, you can control power management through the system setup program. The ST9655 family drives feature several power-management modes, which are described briefly below:

Active mode. The drive is in Active mode during the read/write and seek operations.

Idle mode. At power-on, the drive sets the idle timer to enter Idle mode after 5 seconds of inactivity. You can set the idle timer delay using the system setup utility. In Idle mode, the spindle remains up to speed. The heads are parked away from the data zones for maximum data safety. The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disc access is necessary.

Standby mode. The drive enters Standby mode when the host sends a Standby Immediate command. If the standby timer has been set by the host system, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is system-dependent and is usually established using the system setup utility. In Standby mode, the buffer remains enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disc access is necessary.

Sleep mode. The drive enters Sleep mode after it receives a Sleep Immediate command from the host. The heads are parked and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard

Reset or Soft Reset command from the host. After receiving a Soft Reset command, the drive exits Sleep mode and enters Standby mode with all current emulation and translation parameters intact.

Rest/resume commands. Some host systems reduce drive power consumption by removing all power from the drive. Before shutting off power, the host must save drive state information (including current logical geometry, set feature parameters, cache status and task file registers). After restoring power to the drive, the host restores the drive to its prerest condition. This process is implemented using three commands: Rest, Read Drive State and Restore Drive State. The Rest command prepares the drive for a subsequent Read Drive State command. The Read Drive State command captures the state of the I/O registers. The Restore Drive State command reads the drive state data from memory and restores the drive state based on this data. These commands are described in greater detail in section 3.3.3 on page 27.

Idle and standby timers. The drive sets the default time delay for the idle timer at power-on. In most systems, you can set this delay using the system setup utility. Each time the drive performs an Active function (read, write or seek), the idle and standby timers are reinitialized and begin counting down from their specified delay times to zero. If the idle timer reaches zero before any drive activity is required, the drive makes a transition to Idle mode. If the host has set the standby timer, the standby countdown continues. If the host has not set the standby timer, the drive remains in Idle mode. If the standby timer reaches zero before any drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disc access is necessary.

Deferred spinup. ST9655 family drives may be factory-configured for deferred spinup. If configured for deferred spinup, the drive does not spin up immediately after power-on, but waits until it receives a command from the host. At power-on, the drive posts a status of 80_H and all master/slave protocols are completed before the drive reports a status of 50_H. After the drive receives a command from the host, it executes the spinup/upload process. If the host issues a soft reset before the drive spins up, the drive responds normally, except that it does not spin up until it receives a command from the host.

1.12.2 Power consumption

Power requirements for the ST9655 family drives are listed in the tables below. Typical power measurements are based on an average of drives tested under nominal conditions, using 5.0V input voltage at 25°C ambient temperature at sea level. Active mode current and power are measured with two spindle rotations between each operation and the drive in default logical geometry. Startup power is measured from the time the drive is powered on to the time the drive is ready for normal operation. Seeking power and currents are measured during one-third-stroke buffered seeks. Read/Write power and current are measured with the heads on track.

ST9655AG power consumption

Mode	Typical watts RMS (at nominal voltage)	Typical amps RMS (at nominal voltage)
Spinup	3.79	0.758
Active		
Seeking	1.78	0.356
Read/Write	1.92	0.384
Idle	1.03	0.206
Standby	0.30	0.060
Sleep	0.23	0.046

ST9550AG and ST9385AG power consumption

Mode	Typical watts RMS (at nominal voltage)	Typical amps RMS (at nominal voltage)
Spinup	3.90	0.780
Active		
Seeking	1.50	0.300
Read/Write	1.50	0.300
Idle	0.90	0.180
Standby	0.33	0.065
Sleep	0.28	0.055

1.12.2.1 Typical current profiles

Typical startup and operation current profiles for the ST9655 family drives are shown in Figures 1 and 2.

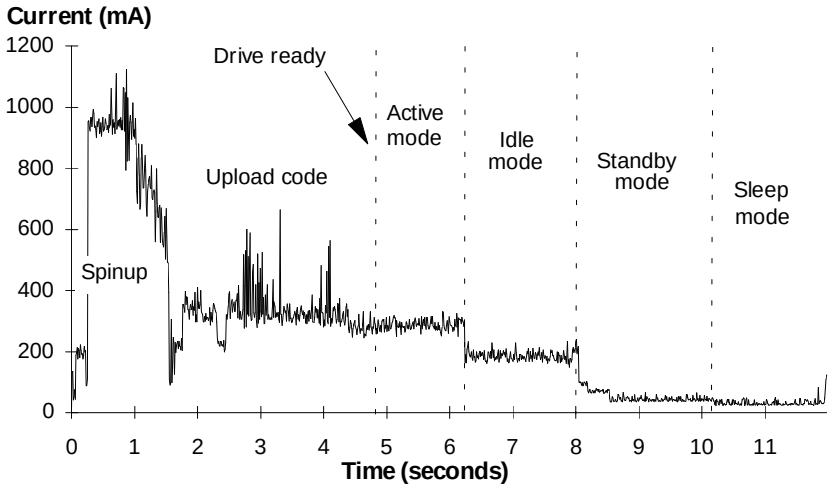


Figure 1. Typical startup and operation current profile for the ST9655AG

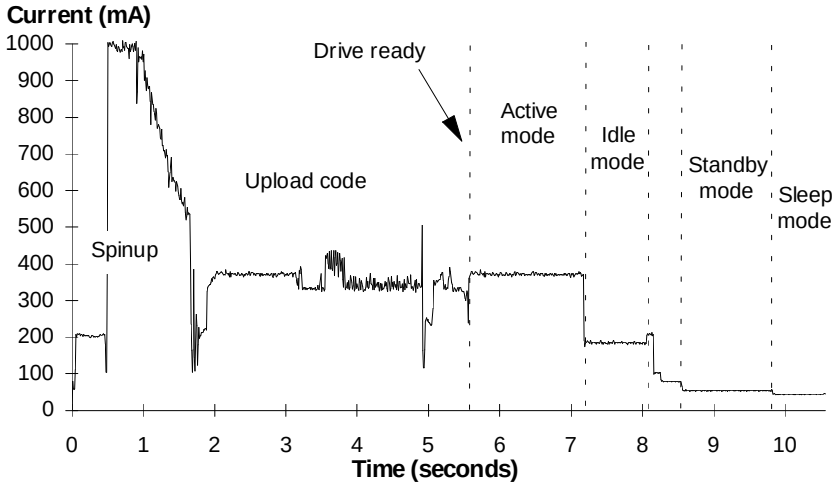


Figure 2. Typical startup and operation current profile for the ST9550AG and ST9385AG

1.12.3 Conducted noise

The drive is expected to operate with a maximum of:

- 150 mV peak-to-peak triangular-wave injected noise at the power connector. The frequency is 10 Hz to 100 KHz with equivalent resistive loads.*
- 100 mV peak-to-peak triangular-wave injected noise at the power connector. The frequency is 100 KHz to 10 MHz with equivalent resistive loads.*

* Equivalent resistance is calculated by dividing the respective voltage by the typical RMS read/write current.

1.12.4 Voltage tolerance

Voltage tolerance (including noise): +5 volts + 5%, – 10%

1.13 Agency certification

1.13.1 UL/CSA listing

The ST9655 family drives are listed in accordance with UL 1950 and CSA C22.2 (950-M89) and meet all applicable sections of IEC 380, IEC 435, IEC 950, VDE 0806/08.81 and EN 60950 as tested by TUV-Rheinland, North America.

1.13.2 FCC verification

The ST9655 family drives are intended to be contained solely within a personal computer or similar enclosure (not attached to an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate Technology, Inc. has tested this device in enclosures 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, 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 computer 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, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

1.14 Compatibility notes

1.14.1 ECC testing

When an ST9655 family drive performs hardware-based ECC error correction on-the-fly, the drive does not report an ECC error. This allows ECC correction without degrading drive performance. Some older drive diagnostic programs test ECC features by creating small data errors and then checking to see if they are reported. Such tests, when run on an ST9655 family drive, may incorrectly report an ECC detection failure because the drive hardware corrects the data automatically, avoiding the error rather than reporting it. Such a report does not indicate a drive malfunction.

2.0 Drive mounting and configuration

2.1 Handling and static-discharge precautions

After unpacking, and prior to installation, the drive may be exposed to potential handling and ESD hazards. Observe standard static-discharge precautions. A grounded wrist-strap is preferred.

Handle the drive only by the sides of the head/disc assembly. Avoid contact with the printed circuit board, all electronic components and the interface connector. Do not apply pressure to the top cover. Always rest the drive on a padded antistatic surface until you mount it in the host system.

2.2 Mounting the ST9655 family drives

You can mount ST9655 family drives in any orientation. Allow a minimum clearance of 0.030 inches (0.76 mm) around the entire perimeter of the drive for cooling airflow.

Figure 3 on page 14 provides mounting dimensions for the ST9655 family drives. These drives conform to the industry-standard MCC direct-mounting specifications and require MCC-compatible connectors in direct-mounting applications.

Caution. To avoid damaging the drive:

- Use M3X0.5 *metric* mounting screws *only*.
- Do not insert mounting screws more than 0.150 inches (3.81 mm) into the mounting holes.
- Do *not* overtighten the screws (maximum torque: 3 inch-lb).

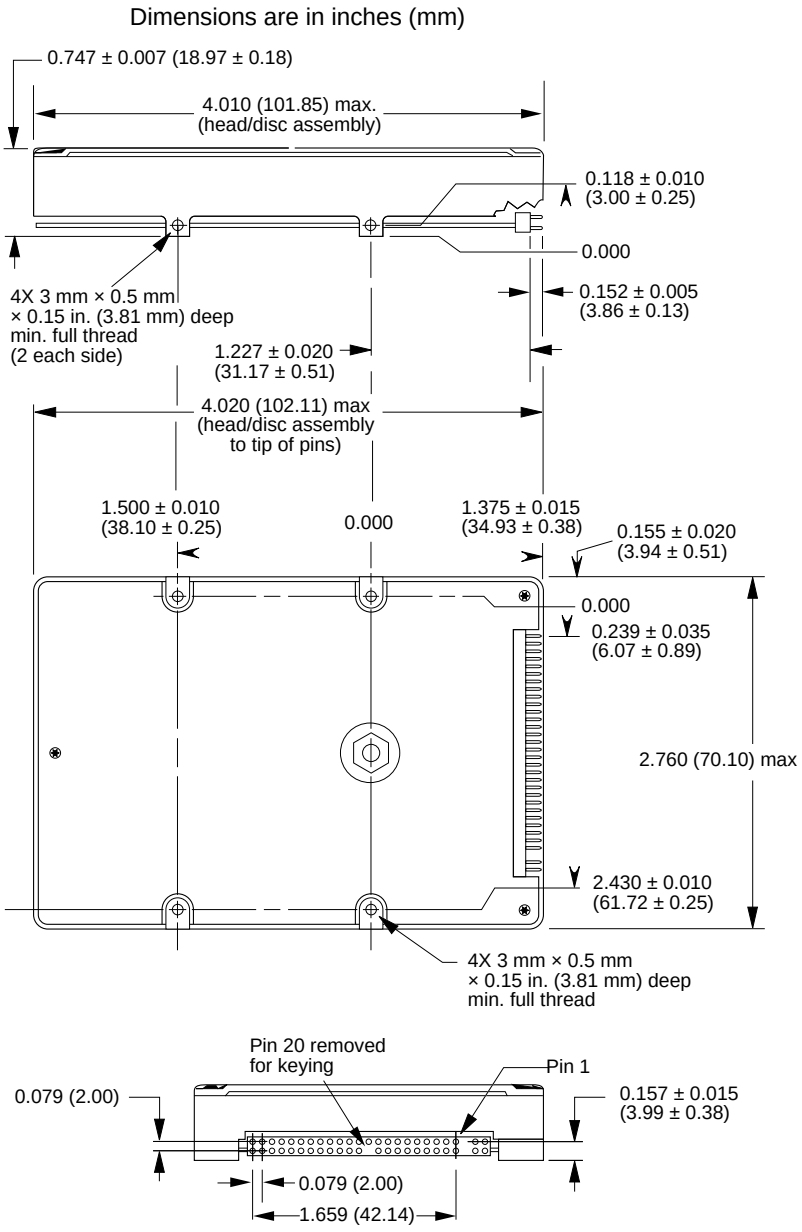


Figure 3. Mounting dimensions for the ST9655 family drives

2.3 Master/slave configuration

A master/slave relationship must be established between multiple drives attached to a single AT bus. You can configure a drive to become a master or slave by setting the master/slave jumpers, as described below and shown in Figure 4 on page 16.

Alternatively, you can configure an ST9655 family drive as a master or slave using the cable select option. This requires a specialized daisy-chain cable that grounds pin 28 (CSEL) on one of its two drive connectors. If you attach the drive to the grounded CSEL connector, it becomes a master. If you attach the drive to the ungrounded CSEL connector, it becomes a slave. To use this option, the host system and both drives must support cable select. To configure an ST9655 family drive for cable select, install both master/slave jumpers.

For the host to recognize the slave drive using the DASP– signal, the slave drive must assert the DASP– signal at power up, and the master drive must monitor DASP– at power up.

Jumper for pins A and B	Jumper for pins C and D	Configuration
Removed	Removed	Drive is master; slave drive may be detected using DASP– signal. CSEL is ignored.
Removed	Installed	Drive is master; slave drive is present. CSEL is ignored. DASP– is ignored.
Installed	Removed	Drive is slave (a master drive should be present also). CSEL is ignored.
Installed	Installed	Differentiate master and slave drives using cable select: If the drive is attached to a connector in which pin 28 is grounded, it becomes a master. If the drive is attached to a connector in which pin 28 is ungrounded, it becomes a slave.

2.4 Configuring a remote LED

The drive indicates activity to the host through the DASP– line (pin 39) on the ATA interface. This line may be connected to a drive status indicator driving an LED at 5V. The line has a 30 mA nominal current limit.

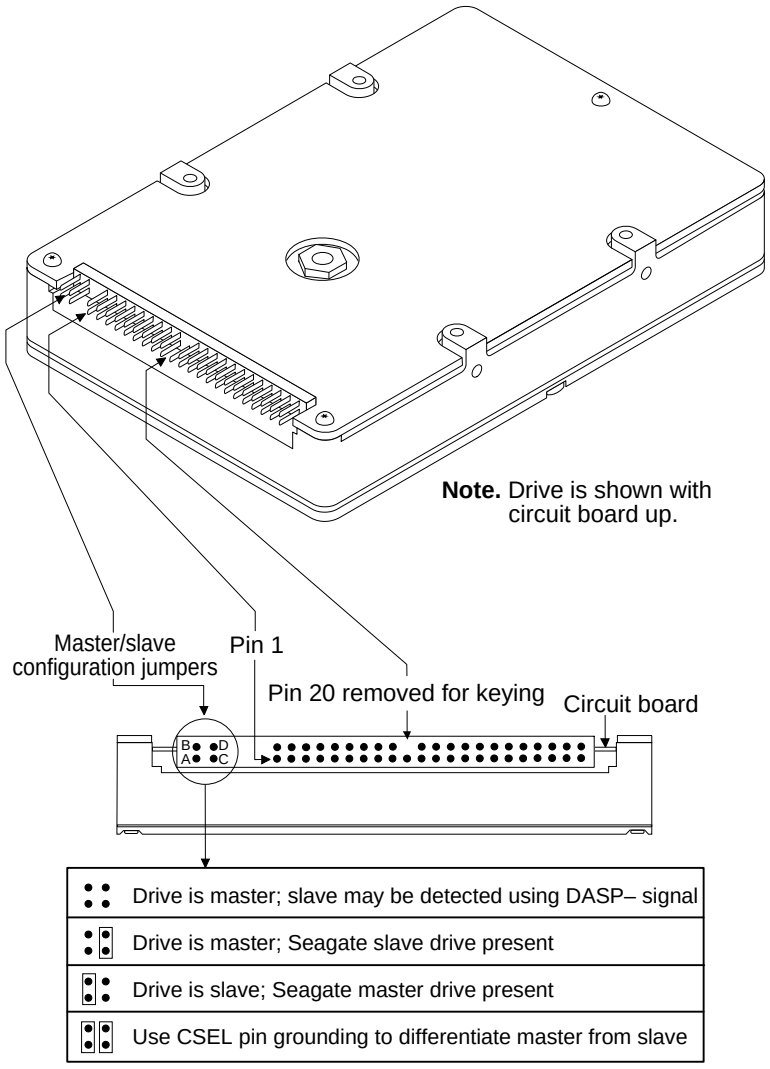


Figure 4. Master/slave jumpers for the ST9655 family drives

3.0 ATA interface

The ST9655 family drives use the industry-standard ATA task file interface. The drives support 8-bit and 16-bit data transfers. They support ATA programmed input/output (PIO) modes 0 through 3, single-word DMA modes 0 through 2 and multiword DMA modes 0 and 1.

The drives can differentiate between a hard reset and a soft reset while in Sleep mode. You can connect up to two drives on a single AT host bus. For detailed information regarding Seagate's implementation of the ATA interface, see the *Seagate ATA Interface Reference Manual,* publication number 36111-001.

3.1 ATA interface connector

The 44-pin drive connector has 2 rows of 22 pins on 0.079-inch (2 mm) centers (see Figure 5). The mating cable connector is a 44-conductor, nonshielded connector with 2 rows of 22 female contacts on 0.079-inch (2 mm) centers. The connectors should provide strain relief and should be keyed with a plug in place of pin 20.

The ST9655 family drives are designed to support the industry-standard MCC direct-mounting specifications. When installing these drives in fixed mounting applications, use only MCC-compatible connectors such as Molex part number 87368-442*x*. For applications involving flexible cables or printed circuit cables (PCCs), use Molex part number 87259-4413 or equivalent to connect the drive to the system. Select a connector that provides adequate clearance for the master/slave configuration jumpers if the application requires the use of such jumpers. The ATA interface cable should be no more than 18 inches long.

Dimensions are in inches (mm)

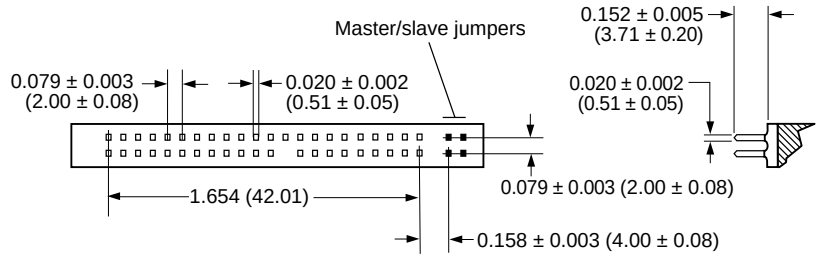
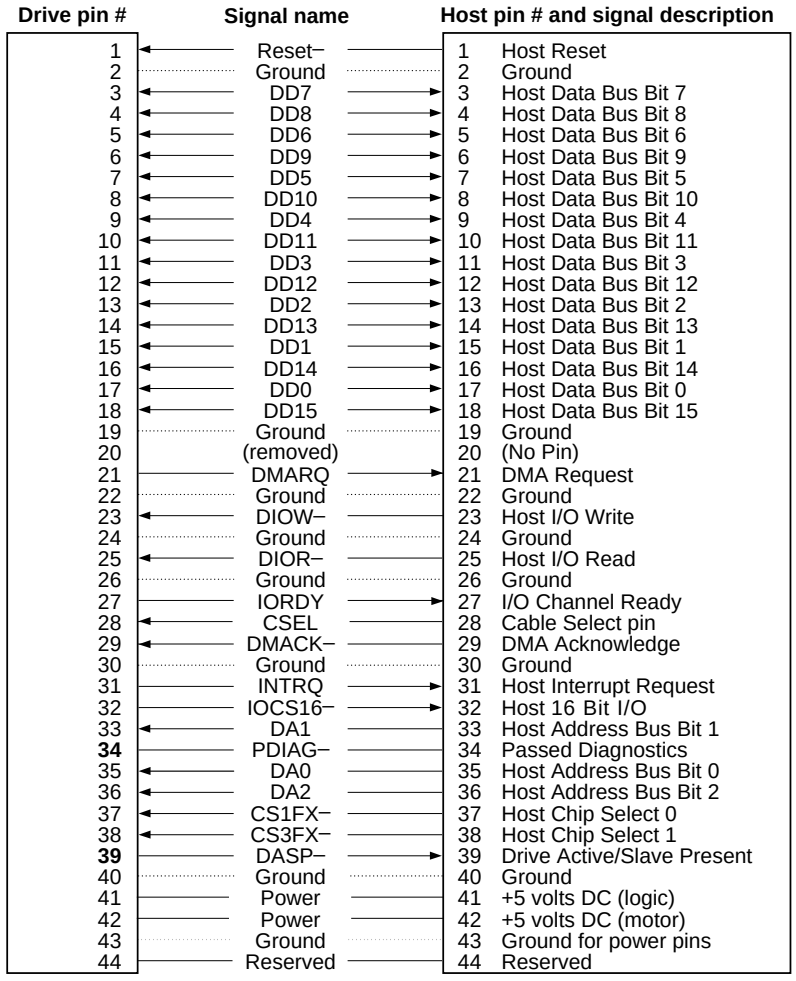


Figure 5. ATA interface connector for the ST9655 family drives

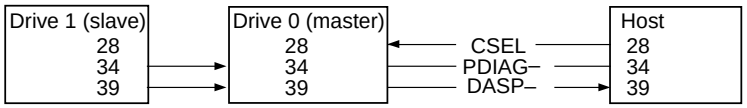
Note. The I/O connector pins may extend up to 0.010 inches beyond the edge of the head/disc assembly.

3.2 ATA interface signals and connector pins

The following diagram summarizes the signals on the ATA interface connector that are supported by the ST9655 family drives. For a detailed description of these signals, refer to the *Seagate ATA Interface Reference Manual.*



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



3.2.1 AT bus signal levels

Signals that the drive sends have the following output characteristics, as measured at the drive connector:

Logic low	0.0V to 0.4V
Logic high	2.5V to 5.25V

Signals that the drive receives must have the following input characteristics, as measured at the drive connector:

Logic low	0.0V to 0.8V
Logic high	2.0V to 5.25V

3.3 ATA interface commands

The following table lists ATA-standard and Seagate-specific drive commands that are supported by the ST9655 family drives. For a detailed description of these commands, refer to the *Seagate ATA Interface Reference Manual.*

Command name	Command code	Supported by ST9655 family drives
ATA-standard commands		
Execute Drive Diagnostics	90_H	Yes
Format Track	50_H	Yes
Identify Drive	EC_H	Yes
Initialize Drive Parameters	91_H	Yes
NOP	00_H	No
Read Buffer	$E4_H$	Yes
Read DMA (w/retry)	$C8_H$	Yes
Read DMA (no retry)	$C9_H$	Yes
Read Long (w/retry)	22_H	Yes
Read Long (no retry)	23_H	Yes
Read Multiple	$C4_H$	Yes
Read Sectors (w/retry)	20_H	Yes
Read Sectors (no retry)	21_H	Yes
Read Verify Sectors (w/retry)	40_H	Yes
Read Verify Sectors (no retry)	41_H	Yes
Recalibrate	$1x_H$	Yes
Seek	$7x_H$	Yes
Set Features	EF_H	Yes
Set Multiple Mode	$C6_H$	Yes
Write Buffer	$E8_H$	Yes
Write DMA (w/retry)	CA_H	Yes

Command name	Command code	Supported by ST9655 family drives
Write DMA (no retry)	CB_H	Yes
Write Long (w/retry)	32_H	Yes
Write Long (no retry)	33_H	Yes
Write Multiple	$C5_H$	Yes
Write Same	$E9_H$	No
Write Sectors (w/retry)	30_H	Yes
Write Sectors (no retry)	31_H	Yes
Write Verify	$3C_H$	No
ATA-standard power-management commands		
Check Power Mode	98_H or $E5_H$	Yes
Idle	97_H or $E3_H$	Yes
Idle Immediate	95_H or $E1_H$	Yes
Sleep	99_H or $E6_H$	Yes
Standby	96_H or $E2_H$	Yes
Standby Immediate	94_H or $E0_H$	Yes
Seagate-specific power-management commands		
Active and Set Idle Timer	FB_H	Yes
Active Immediate	$F9_H$	Yes
Check Idle Mode	FD_H	Yes
Idle Immediate	$F8_H$	Yes
Idle and Set Idle Timer	FA_H	Yes

The following commands are specific to the ST9655 family drives or contain drive-specific features.

3.3.1 Identify Drive command

The Identify Drive command (command code EC_H) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in the table below. All reserved bits or words should be set to zero. Parameters listed with an "*x*" are drive specific or vary with the state of the drive. See Section 1 of this manual for default parameter settings for the ST9655 family drives.

Word	Description	ST9655AG	ST9550AG	ST9385AG
0	Configuration information: Bit 10: disc transfer > 10 Mbits/sec Bit 6: fixed drive Bit 4: head switch time > 15 µsec Bit 3: not MFM encoded Bit 1: hard sectored disc	$045A_H$	$045A_H$	$045A_H$
1	Number of fixed cylinders (default logical emulation)	$03F8_H$	$03AE_H$	$003A6_H$
2	ATA reserved	0000_H	0000_H	0000_H
3	Number of heads (default)	0010_H	0010_H	$000E_H$
4	Number of unformatted bytes per track	$8D90_H$	$8D90_H$	$8D90_H$
5	Number of unformatted bytes per sector	0248_H	0248_H	0248_H
6	Number of sectors per track (default logical emulation)	$003F_H$	$003B_H$	0033_H
7–9	ATA reserved	0000_H	0000_H	0000_H
10–19	Serial Number: (20 ASCII characters, 0000_H = none)	ASCII	ASCII	ASCII

Word	Description	ST9655AG	ST9550AG	ST9385AG
20	Controller type = dual-port multisector buffer with caching	0003_H	0003_H	0003_H
21	Buffer size (number of 512-byte sectors)	$00F0_H$	$00F0_H$	$00F0_H$
22	Number of ECC bytes available	0010_H	0010_H	0010_H
23–26	Firmware revision (8 ASCII character string): *xx* = ROM version, *ss.tt* = RAM version	*xx.ss.tt*	*xx.ss.tt*	*xx.ss.tt*
27–46	Drive model number: (40 ASCII characters, padded to end of string)	ST9655AG	ST9550AG	ST9385AG
47	Read Multiple command (supported)	0010_H	0010_H	0010_H
48	Double word I/O (not supported)	0000_H	0000_H	0000_H
49	Support for DMA data transfer and use of IORDY (both supported)	0900_H	0900_H	0900_H
50	ATA reserved	0000_H	0000_H	0000_H
51	Default PIO data transfer cycle timing mode	0200_H	0100_H	0100_H
52	Single-word DMA transfer cycle timing mode (not used)	0000_H	0000_H	0000_H
53	Validity of words 54–58 and 64–70 (words are valid)	0003_H	0003_H	0003_H
54	Number of cylinders (current emulation mode)	$xxxx_H$	$xxxx_H$	$xxxx_H$
55	Number of heads (current emulation mode)	$xxxx_H$	$xxxx_H$	$xxxx_H$

Word	Description	ST9655AG	ST9550AG	ST9385AG
56	Number of sectors per track (current emulation mode)	*xxxx*$_H$	*xxxx*$_H$	*xxxx*$_H$
57–58	Number of sectors (current emulation mode)	*xxxx*$_H$	*xxxx*$_H$	*xxxx*$_H$
59	Number of sectors transferred during a Read Multiple or Write Multiple command (bits 1–7)	01*xx*$_H$	01*xx*$_H$	01*xx*$_H$
60–61	ATA reserved	0000$_H$	0000$_H$	0000$_H$
62	Single-word DMA active/modes supported*	0*x*07$_H$	0*x*07$_H$	0*x*07$_H$
63	Multiword DMA active/modes supported*	0*x*03$_H$	0*x*03$_H$	0*x*03$_H$
64	Advanced PIO modes supported (mode 3 supported)	0001$_H$	0001$_H$	0001$_H$
65	Minimum multiword DMA transfer cycle time per word (150 nsec)	0096$_H$	0096$_H$	0096$_H$
66	Recommended multiword DMA transfer cycle time per word (250 nsec)	00FA$_H$	00FA$_H$	00FA$_H$
67	Minimum PIO cycle time without IORDY flow control (363 nsec)	016B$_H$	016B$_H$	016B$_H$
68	Minimum PIO cycle time with IORDY flow control (nsec)	00B4$_H$	00FA$_H$	00FA$_H$
64–127	ATA reserved	0000$_H$	0000$_H$	0000$_H$
128–159	Seagate reserved	*xxxx*$_H$	*xxxx*$_H$	*xxxx*$_H$
160–255	ATA reserved	0000$_H$	0000$_H$	0000$_H$

* DMA mode settings are reflected in the following bit settings for words 62 and 63. Only one mode at a time should be set as currently active.

Word	Bit	Description (if bit is set to 1)
62	0	Single-word DMA mode 0 available
62	1	Single-word DMA mode 1 available
62	2	Single-word DMA mode 2 available
62	8	Single-word DMA mode 0 currently active
62	9	Single-word DMA mode 1 currently active
62	10	Single-word DMA mode 2 currently active
63	0	Multiword DMA mode 0 available
63	1	Multiword DMA mode 1 available
63	8	Multiword DMA mode 0 currently active *(default)*
63	9	Multiword DMA mode 1 currently active

3.3.2 Set Features command

This command controls the implementation of various drive features. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature supported by the drive, the command is aborted. Power-on default has the read look-ahead and write caching features enabled and 4 bytes of ECC. The acceptable values for the Features register are defined as follows:

- 02_H Enable write cache *(default)*
- 03_H Set transfer mode (based on value in Sector Count register)
  Sector Count register values:
  - 00_H Set PIO mode to default
  - 08_H PIO Mode 0 *(default for ST9550AG and ST9385AG)*
  - 09_H PIO Mode 1
  - $0A_H$ PIO Mode 2 *(default for ST9655AG)*
  - $0B_H$ PIO Mode 3
  - 10_H Single-word DMA Mode 0
  - 11_H Single-word DMA Mode 1
  - 12_H Single-word DMA Mode 2
  - 20_H Multiword DMA Mode 0
  - 21_H Multiword DMA Mode 1
- 44_H Sixteen bytes of ECC apply on read long and write long commands.
- 55_H Disable read look-ahead (read cache) feature.
- 66_H Disable reverting to power-on defaults.
- 82_H Disable write cache.
- AA_H Enable read look-ahead (read cache) feature *(default).*
- BB_H 4 bytes of ECC apply on read long and write long commands *(default).*
- CC_H Enable reverting to power-on defaults *(default).*

At power-on, or after a hardware reset, the default values of the features are as indicated above. A software reset also changes the features to default values unless a 66_H command has been received.

3.3.3 Rest/Resume commands

Some host systems reduce overall power consumption by temporarily removing power from the disc drive. The Rest/Resume process allows drive-state information to be saved to disc before powering down the drive. After power is restored, the drive-state information is retrieved and used to return the drive to its prerest condition. The drive-state information is saved in a single 512-byte data block that includes current logical geometry, set features parameters, cache status and task-file registers.

The Rest/Resume process involves three commands: Rest, Read Drive State and Restore Drive State. The drive does not recognize and execute these commands unless the Features register contains the value $0AC_H$. Any other value in the Features register causes the drive to reject the command with a command abort error. Since these commands are not part of the ATA standard command set, their operation and bit settings are described on the following pages.

Note. The Rest/Resume process does not save the contents of data buffers or caches.

3.3.3.1 Rest command ($E7_H$)

The host prepares the drive for a subsequent Read Drive State command by issuing a Rest command. If two drives (master and slave) are present, the host must issue the Rest and Read Drive State commands to the slave before issuing them to the master.

If the BSY or DRQ bits are set, the host should wait up to 30 seconds for these bits to clear after the completion of any previous command before issuing a Rest command. This prevents conflicts between Rest/Resume commands and other power-management commands. If either the DRQ or BSY bits are set, the host may use the DASP– signal to determine when to initiate a Rest command. The drive asserts DASP– when a Rest command is received and negates it upon completion of the Rest command. After the Rest command is issued, the host should wait up to 10 seconds for the drive to assert INTRQ.

When the drive receives a Rest command, it captures the state of the I/O registers as they existed upon completion of the previous command, then enters Rest mode. After entering Rest mode, the drive rejects any command other than a Read Drive State command with an aborted command error. The Rest mode can be cleared only by power off or reset. After issuing the Rest command, the host should poll the Alternate Status register to monitor for completion status without clearing the interrupt flag that may have been set for an application program.

Bit settings for the Rest command:

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Command ($1F7_H$)	1	1	1	0	0	1	1	1
Cyl. High ($1F5_H$)	X							
Cyl. Low ($1F4_H$)	X							
Drv. Head ($1F6_H$)	1	0	1	D/S	X			
Sec. Num. ($1F3_H$)	X							
Sec. Cnt. ($1F2_H$)	X							
Features ($1F1_H$)	$0AC_H$							

3.3.3.2 Read Drive State command ($E9_H$)

The Read Drive State command allows the host system to save certain drive parameters to nonvolatile system memory before shutting down power to the drive. The host should only issue this command following a successful Rest command. If any command other than a Read Drive State command follows a Rest command, the Rest command is aborted. If a Read Drive State command follows any command other than a Rest command, the Read Drive State command is aborted.

If the drive receives a Read Drive State command while in Rest mode, it transfers essential drive-state information to disc, where the Restore Drive State command can recover it following power-on.

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Command ($1F7_H$)	1	1	1	0	1	0	0	1
Cyl. High ($1F5_H$)	X							
Cyl. Low ($1F4_H$)	X							
Drv. Head ($1F6_H$)	1	0	1	D/S	X			
Sec. Num. ($1F3_H$)	X							
Sec. Cnt. ($1F2_H$)	X							
Features ($1F1_H$)	$0AC_H$							

3.3.3.3 Restore Drive State command (EA_H)

This command allows the host system to restore the drive to the state it was in at the time of the power-down in Rest mode. If the host has previously caused a Rest mode, it must ensure that the first command issued to the drive (after the drive powers up and is ready to accept commands) is not one that will interfere with the intended resume operation.

The host should only issue a Restore Drive State command when powering up the drive after a successful Read Drive State command. Otherwise, the Restore Drive State command is aborted. When the drive receives a Restore Drive State command, it reads the 256 bytes of drive-state information that were saved with the Read Drive State command. This drive-state information is checked for validity. If there is a problem with the data, the drive hangs busy with the trap code set to $F5_H$ in all of the ATA interface registers. If bit zero of the last word transferred is 0_H (reset to 0), INTRQ is not asserted at the completion of this command. If bit zero of the last word transferred is set to 1, INTRQ is asserted following the command.

After issuing the Restore Drive State command, the host should poll the Alternate Status register to monitor for completion status without clearing any interrupt flag that may have been set for an application program.

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Command ($1F7_H$)	1	1	1	0	1	0	1	0
Cyl. High ($1F5_H$)	X							
Cyl. Low ($1F4_H$)	X							
Drv. Head ($1F6_H$)	1	0	1	D/S	X			
Sec. Num. ($1F3_H$)	X							
Sec. Cnt. ($1F2_H$)	X							
Features ($1F1_H$)	$0AC_H$							

Seagate

Seagate Technology, Inc.
920 Disc Drive, Scotts Valley, California 95066, USA

Publication Number: 36270-001, Rev. A, Printed in USA