



OEM INTERFACE SPECIFICATIONS

SC18-2275-00

for

IBM-H3xxx-Ax (133/171/256/342 MB)

3.5-Inch Hard Disk Drive with ATA Interface

Revision (0.0)





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1.0 General

1.1 Introduction

This specification describes the host interface for ATA hard disk drives. The interface conforms to the ATA draft proposal for an AT attachment (AT Attachment Interface for Disk Drives. ANSI X3.221) with certain limitations that are described on 2.0, “Conformance” on page 3.

1.2 Terminology

Throughout this specification “drive” will be used to refer to the ATA interface drives. “Host” will be used to refer to the system that the drive is attached to.

1.3 References

- ISO/IEC Draft. ANSI X3.221 (Information technology AT Attachment Interface for Disk Drive)

The references above will be called “ATA” in this specification.

2.0 Conformance

The drive conforms to the referenced specifications, with the limitations described below.

Format Track	A drive will not perform a physical format. Instead, it will simply write a data pattern of all zeros to the sectors which have been specified by the Format Track command.
Format Track Interleave Factor	The drive only supports an interleave factor of 1:1, and may ignore any other specified interleave, without returning an error.
Format Track Sector Count	The drive will return an abort error if the specified sector count is not the same as the number of sectors per track designated by the drive in the Initialize Drive Parameters command, or default setting as reported by Identify Drive command.
Initialize Drive Parameters	The parameters specified in the Initialize Drive Parameters command are only in effect until the next power off, soft reset, or hard reset operation. Afterwards, the default parameters in the Identify Drive information will be in effect.
Write Long	Write Long command should be executed for the same sector after Read Long command execution. Otherwise, unexpected ECC correctable errors may occur due to the limitation of the emulation technique to support 4-byte ECC mode which is implemented in the drive.
Seek Overlap	The drive will wait for the seek to complete before interrupting the host. Therefore, no seek overlap can occur. This will be transparent to the host except that performance may be degraded in certain environments where the host could perform other work while waiting for seek complete, such as multitasking operating systems.
Set/Read/Write Multiple	32KB ROM version of the drives does not support the Set/Read/Write Multiple commands.
Idle/Standby Immediate	32KB ROM version of the drives does not support the Idle/Standby Immediate commands.

3.0 Registers

Address	Input Register	Output Register
1F0h	Data	Data
1F1h	Error	Features
1F2h	Sector Count	Sector Count
1F3h	Sector Number	Sector Number
1F4h	Cylinder Low	Cylinder Low
1F5h	Cylinder High	Cylinder High
1F6h	Drive/Head	Drive/Head
1F7h	Status	Command
3F6h	Alternate Status	Device Control
3F7h	Drive Address	Not Used

Figure 1. Register Set

The host uses the register interface to communicate to and from the drive. The registers are accessed through the host port addresses shown in Figure 1.

The host should not read or write any registers when the status register BSY bit equals 1.

3.1 Alternate Status Register

Alternate Status Register							
7 BSY	6 RDY	5 DWF	4 DSC	3 DRQ	2 COR	1 IDX	0 ERR

Figure 2. Alternate Status Register

This register contains the same information as the status register. The only difference is that reading this register does not imply interrupt acknowledge and it does not clear pending interrupt. See 3.13, “Status Register” on page 9 for the definition of the bits in this register.

3.2 Command Register

This register contains the command code sent to the drive. Command execution begins immediately after this register is written. The command set is shown in Figure 8 on page 15.

All other registers required for the command must be set up before writing the command register.

3.3 Cylinder High Register

This register contains the high order bits of the starting cylinder address for any disk access. At the end of the command, this register is updated to reflect the current cylinder number.

3.4 Cylinder Low Register

This register contains the low-order eight bits of the starting cylinder address for any disk access. At the end of the command, this register is updated to reflect the current cylinder number.

3.5 Data Register

This register is used to transfer data blocks between the device data buffer and the host. It is also the register through which sector information is transferred on a Format command, and configuration information is transferred on an Identify Drive command.

All data transfers are 16-bits wide, except for ECC byte transfers, which is eight bits wide. Data transfers are PIO only.

The register contains valid data only when DRQ equals 1 in the status register.

3.6 Device Control Register

Device Control Register							
7	6	5	4	3	2	1	0
—	—	—	—	1	SRST	—IEN	0

Figure 3. Device Control Register

Bit Definitions

SRST (RST) Software Reset. The drive is held reset when RST equals 1. Setting RST to 0 re-enables the drive.

The host must set RST to 1 and wait for at least five microseconds before setting RST to 0, to ensure that the drive recognizes the reset.

— **IEN** Interrupt Enable. When IEN equals 0, and the drive is selected, drive interrupts to the host are enabled. When IEN equals 1, or the drive is not selected, drive interrupts to the host are disabled.

3.7 Drive Address Register

Drive Address Register							
7 HIZ	6 -WTG	5 -H3	4 -H2	3 -H1	2 -H0	1 -DS1	0 -DS0

Figure 4. Drive Address Register

This register contains the inverted drive select and head select addresses of the currently selected drive.

Bit Definitions

- HIZ** High impedance. This bit is not driven and will always be in a high impedance state.
- **WTG** Write gate. This bit is 0 when writing to the disk drive is in progress.
- **H3,- H2,- H1,- H0** Head select. These four bits are the complement of the currently selected head.
– H0 is the least significant bit.
- **DS1** Drive select 1. This is the drive select bit for drive 1 and is active low. DS1 equals 0 when drive 1 (slave) is selected and active.
- **DS0** Drive select 0. This is the drive select bit for drive 0 and is active low. DS0 equals 0 when drive 0 (master) is selected and active.

3.8 Drive/Head Register

Drive/Head Register							
7 1	6 0	5 1	4 DRV	3 HS3	2 HS2	1 HS1	0 HS0

Figure 5. Drive/Head Register

This register contains the drive and head numbers.

Bit Definitions

- DRV** Drive. When DRV equals 0, drive 0 (master) is selected. When DRV equals 1, drive 1 (slave) is selected.
- HS3,HS2,HS1,HS0** Head select. These four bits select the head number. HS0 is the least significant bit.

3.9 Error Register

Error Register							
7 BBK	6 UNC	5 0	4 IDNF	3 0	2 ABRT	1 TK0NF	0 AMNF

Figure 6. Error Register

This register contains status from the last command executed by the drive, or a diagnostic code.

At the completion of any command except Execute Drive Diagnostic, the contents of this register are valid when ERR equals 1 in the status register.

After a power on, a reset, or completion of an Execute Drive Diagnostic command, this register contains a diagnostic code. See Figure 24 on page 36 for the definition.

Bit Definitions

BBK	Bad block. BBK equals 1 indicates a bad block mark was detected in the requested sector's ID field.
UNC	Uncorrectable data error. UNC equals 1 indicates an uncorrectable data error has been encountered.
IDNF (IDN)	ID not found. IDN equals 1 indicates the requested sector's ID field could not be found.
ABRT (ABT)	Aborted command. ABT equals 1 indicates the requested command has been aborted due to a drive status error or an invalid parameter in an output register.
TK0NF (T0N)	Track 0 not found. T0N equals 1 indicates track 0 was not found during a Recalibrate command.
AMNF (AMN)	Address mark not found. AMN equals 1 indicates the data address mark has not been found after finding the correct ID field for the requested sector.

3.10 Features Register

This register is used with the Set Features command to enable read look-ahead (AAh), disable read look-ahead (55h), specify the vendor unique ECC length (44h), or to use four byte ECC length (BBh).

3.11 Sector Count Register

This register contains the number of sectors of data requested to be transferred on a read or write operation between the host and the drive. If the value in the register is set to 0, a count of 256 sectors is specified.

If the register is zero at command completion, the command was successful. If not successfully completed, the register contains the number of sectors which need to be transferred to complete the request.

The contents of the register are defined differently for some commands. These definitions are given in the appropriate command descriptions.

3.12 Sector Number Register

This register contains the starting sector number for any disk data access for the subsequent command. The sector number may be from one to the maximum number of sectors per track.

See the command descriptions for contents of the register at command completion (whether successful or unsuccessful).

3.13 Status Register

Status Register							
7 BSY	6 DRDY	5 DWF	4 DSC	3 DRQ	2 CORR	1 IDX	0 ERR

Figure 7. Status Register

This register contains the drive status. The contents of this register are updated whenever an error occurs and at the completion of each command.

If the host reads this register when an interrupt is pending, it is considered to be the interrupt acknowledgement. Any pending interrupt is cleared whenever this register is read.

If BSY equals 1, no other bits in the register are valid.

Bit Definitions

BSY	Busy. BSY equals 1 whenever the drive is accessing the registers. The host should not read or write any registers when BSY equals 1. If the host reads any register when BSY equals 1, the contents of the Status Register are returned.
DRDY (RDY)	Drive ready. RDY equals 1 indicates that the drive is capable of responding to a command. RDY is set to 0 during power on until the drive is ready to accept a command.
DWF	Drive write fault. DWF equals 1 indicates that the drive has detected a write fault condition. DWF is set to 0 after the status register is read by the host.
DSC	Drive seek complete. DSC equals 1 indicates that a seek has completed and the drive head is settled over a track. When an error occurs, this bit is not changed until the status register is read by the host, at which time the bit again indicates the current seek complete status.
DRQ	Data request. DRQ equals 1 indicates that the drive is ready to transfer a word or byte of data between the host and the drive.
CORR (COR)	Corrected data. COR equals 1 indicates that a correctable data error was encountered and the data has been corrected using the drive's ECC. The sector buffer contains the corrected data and multi-sector reads continue. The bit is set to 0 when a command is received. During a multi-sector read verify operation, COR is set to 1 at the end of the operation if any of the verified sectors contained a correctable error.

IDX	Index. IDX equals 1 once per revolution. Since IDX equals 1 only for a very short time during each revolution, the host may not see it set to 1 even if the host is reading the status register continuously. Therefore the host should not attempt to use IDX for timing purposes.
ERR	Error. ERR equals 1 indicates that an error occurred during execution of the previous command. The error register should be read to determine the error type. The drive sets ERR to 0 when the next command is received from the host.

4.0 Command Protocol

The commands are grouped into different classes according to the protocols followed for command execution. The command classes with their associated protocols are defined below.

For all commands, the host must first check if BSY equals 1, and should proceed no further until BSY equals 0. For all commands except Execute Drive Diagnostics and Initialize Drive Parameters, the host must also wait until RDY equals 1 before proceeding.

Interrupts are cleared when the host reads the status register, issues a reset, or writes to the command register.

Figure 25 on page 37 shows the drive timeout values.

4.1 Data In Commands

These commands are:

- Identify Drive
- Read Buffer
- Read Long
- Read Multiple
- Read Sectors

Execution includes the transfer of one or more 512-byte (>512 bytes on Read Long) sectors of data from the drive to the host.

1. The host writes any required parameters to the features, sector count, sector number, cylinder, and drive/head registers.
2. The host writes the command code to the command register.
3. For each sector (or block) of data to be transferred:
 - a. The drive sets BSY to 1 and prepares for data transfer.
 - b. When a sector (or block) of data is available for transfer to the host, the drive sets BSY to 0, sets DRQ to 1, and interrupts the host.
 - c. In response to the interrupt, the host reads the status register.
 - d. The drive clears the interrupt in response to the status register being read.
 - e. The host reads one sector (or block) of data via the data register.
 - f. The drive sets DRQ to 0 after the sector (or block) has been transferred to the host.
4. For the Read Long command:
 - a. The drive sets BSY to 1 and prepares for data transfer.
 - b. When the sector of data and ECC bytes are available for transfer to the host, the drive sets BSY to 0, sets DRQ to 1, and interrupts the host.
 - c. In response to the interrupt, the host reads the status register.
 - d. The drive clears the interrupt in response to the status register being read.

- e. The host reads the sector of data and ECC bytes via the data register.
- f. The drive sets DRQ to 0 after the ECC bytes have been transferred to the host.

The Read Multiple command transfers one block of data for each interrupt. The other commands transfer one sector of data for each interrupt.

Note that the status data for a sector of data is available in the status register **before** the sector is transferred to the host.

If the drive detects an invalid parameter, it aborts the command by setting BSY to 0, ERR to 1, ABT to 1, and interrupting the host.

If an uncorrectable error occurs, the drive sets BSY to 0, ERR to 1, and DRQ to 1. The drive then stores the error status in the error register, and interrupts the host. The registers contains the location (CHS) of the sector in error.

If an uncorrectable data error (UNC equals 1) occurs, the defective data is transferred from the media to the sector buffer, and is available to be transferred to the host, at the host's option. In case of the Read Multiple command, the host should complete the transfer of the block which includes error data from the sector buffer and terminate whatever type of error occurred.

If an error occurs that is correctable by using the ECC, the data is corrected and the transfer continues. The result appears like a normal transfer except that the drive sets COR to 1 in the status register.

If an error occurs that is correctable by retries, the data is corrected and the transfer continues normally. There is no indication to the host that any retry occurred.

All data transfers to the host through the data register are 16 bits, except for the ECC bytes, which are eight bits.

4.2 Data Out Commands

These commands are:

- Format
- Write Buffer
- Write Long
- Write Multiple
- Write Sectors

Execution includes the transfer of one or more 512-byte (>512 bytes on Write Long) sectors of data from the host to the drive.

1. The host writes any required parameters to the features, sector count, sector number, cylinder, and drive/head registers.
2. The host writes the command code to the command register.
3. The drive sets BSY to 1.
4. For each sector (or block) of data to be transferred:
 - a. The drive sets BSY to 0 and DRQ to 1 when it is ready to receive a sector (or block).
 - b. The host writes one sector (or block) of data via the data register.

- c. The drive sets BSY to 1 after it has received the sector (or block).
 - d. When the drive has finished processing the sector (or block), it sets BSY to 0, and interrupts the host.
 - e. In response to the interrupt, the host reads the status register.
 - f. The drive clears the interrupt in response to the status register being read.
5. For the Write Long command:
- a. The drive sets BSY to 0 and DRQ to 1 when it is ready to receive a sector.
 - b. The host writes one sector of data and ECC bytes via the data register.
 - c. The drive sets BSY to 1 after it has received the sector and ECC bytes.
 - d. When the drive has finished processing the sector and ECC bytes, it sets BSY to 0 and interrupts the host.
 - e. In response to the interrupt, the host reads the status register.
 - f. The drive clears the interrupt in response to the status register being read.

The Write Multiple command transfers one block of data for each interrupt. The other commands transfer one sector of data for each interrupt.

If the drive detects an invalid parameter, it aborts the command after the data transfer by setting BSY to 0, ERR to 1, ABT to 1, and interrupting the host.

If an uncorrectable error occurs, the drive sets BSY to 0 and ERR to 1, stores the error status in the error register, and interrupts the host. The registers contain the location (CHS) of the sector in error.

All data transfers to the drive through the data register are 16 bits, except for the ECC bytes, which are eight bits.

4.3 Non-Data Commands

These commands are:

- Execute Drive Diagnostics
- Initialize Drive Parameters
- Read Verify Sectors
- Recalibrate
- Seek
- Set Features
- Set Multiple

Execution of these commands involves no data transfer.

1. The host writes any required parameters to the features, sector count, sector number, cylinder, and drive/head registers.
2. The host writes the command code to the command register.
3. The drive sets BSY to 1.
4. When the drive has finished processing the command, it sets BSY to 0, and interrupts the host.

5. In response to the interrupt, the host reads the status register.
6. The drive clears the interrupt in response to the status register being read.

5.0 Command Descriptions

Command	Hex Code	Binary Code
		Bit 7 6 5 4 3 2 1 0
Execute Drive Diagnostics	90	1 0 0 1 0 0 0 0
Format Track	50	0 1 0 1 0 0 0 0
Identify Drive	EC	1 1 1 0 1 1 0 0
Initialize Drive Parameters	91	1 0 0 1 0 0 0 1
Read Buffer	E4	1 1 1 0 0 1 0 0
Read Long (retry)	22	0 0 1 0 0 0 1 0
Read Long (no retry)	23	0 0 1 0 0 0 1 1
Read Sectors (retry)	20	0 0 1 0 0 0 0 0
Read Sectors (no retry)	21	0 0 1 0 0 0 0 1
Read Verify Sectors (retry)	40	0 1 0 0 0 0 0 0
Read Verify Sectors (no retry)	41	0 1 0 0 0 0 0 1
Recalibrate	1x	0 0 0 1 — — — —
Seek	7x	0 1 1 1 — — — —
Set Features	EF	1 1 1 0 1 1 1 1
Write Buffer	E8	1 1 1 0 1 0 0 0
Write Long (retry)	32	0 0 1 1 0 0 1 0
Write Long (no retry)	33	0 0 1 1 0 0 1 1
Write Sectors (retry)	30	0 0 1 1 0 0 0 0
Write Sectors (no retry)	31	0 0 1 1 0 0 0 1

Figure 8. Command Set

Figure 8 shows the commands that are supported by the drive. The following symbols are used in the command descriptions:

Output Registers

- 0** Indicates that the bit must be set to 0.
- 1** Indicates that the bit must be set to 1.
- D** The drive number bit. Indicates that the drive number bit of the drive/head register should be specified. Zero selects the master drive and one selects the slave drive.
- H** Head number. Indicates that the head number part of the drive/head register is an output parameter and should be specified.
- R** Retry. Indicates that the retry bit of the command register should be specified.
- V** Valid. Indicates that the bit is part of an output parameter and should be specified.
- x** Indicates that the hex character is not used.
- Indicates that the bit is not used.

Input Registers

- 0** Indicates that the bit is always set to 0.
- 1** Indicates that the bit is always set to 1.
- H** Head number. Indicates that the head number part of the drive/head register is an input parameter and is set by the drive.
- V** Valid. Indicates that the bit is part of an input parameter and is set to 0 or 1 by the drive.
- Indicates that the bit is not part of an input parameter.

The command descriptions show the contents of the status and error registers after the drive has completed processing the command and has interrupted the host.

5.1 Execute Drive Diagnostics

Command Block Output Registers								
Register	7	6	5	4	3	2	1	0
Data	—	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—	—
Sector Count	—	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—	—
Drive/Head	1	0	1	—	—	—	—	—
Command	1	0	0	1	0	0	0	0

Command Block Input Registers								
Register	7	6	5	4	3	2	1	0
Data	—	—	—	—	—	—	—	—
Error	...See Below...							
Sector Count	—	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—	—
Status	...See Below...							

Error Register							
7	6	5	4	3	2	1	0
V	V	V	V	V	V	V	V

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	0	0	—	—	0	—	0

Figure 9. Execute Drive Diagnostics Command (90h)

The Execute Drive Diagnostics command performs the internal diagnostic tests implemented by the drive. The results of the test are stored in the error register.

The normal error register bit definitions do not apply to this command. Instead, the register contains a diagnostic code. See Figure 24 on page 36 for the definition.

5.2 Format Track

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	V	V	V	V	V	V	V
Sector Number	—	—	—	—	—	—	—
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	1	0	1	D	H	H	H
Command	0	1	0	1	0	0	0

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	V	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	V	V	—	0	—	V

Figure 10. Format Track Command (50h)

The Format Track command formats a single track on the drive. Each sector of data on the track is initialized to zero. Any data previously stored on the track is lost.

Note: The host writes a sector containing a format table to the drive. This table is ignored by the drive. Data of all sectors on the track are initialized as good sectors.

Output Parameters To The Drive

Sector Count The number of sectors to be formatted on the track. This value must be the same as the actual number of sectors per track reported by the drive in the Identify Drive command data. Or, the number must be the same as the designated track length by Initialize Drive Parameter command.

Cylinder High/Low The cylinder number of the track to be formatted.

H The head number of the track to be formatted.

Input Parameters From The Drive

Error The error register. An abort error (ABT equals 1) is returned under the following conditions:

- The cylinder number is not valid.
- The head number is not valid.
- The sector count is greater than the actual number of sectors per track.

5.3 Identify Drive

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	1	0	1	D	—	—	—
Command	1	1	1	0	1	1	0 0

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	0	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	—	—	0	—	V

Figure 11. Identify Drive Command (ECh)

The Identify Drive command requests the drive to transfer configuration information to the host. The drive transfers a sector to the host containing the information in Table 1. The Identify Drive command information is not affected by the Initialize Drive Parameters command.

Table 1 (Page 1 of 3). Sector Contents for the Identify Drive Command		
Word	Content	Description
00	045AH	- Drive classification, bit assignments: 15 (=0): reserved for non-magnetic drives 14 (=0): format speed tolerance gap not required 13 (=0): track offset option not available 12 (=0): data strobe offset option not available 11 (=0): rotational speed tolerance < = 0.5% 10 (=1): disk transfer rate > 10 Mbps 9 (=0): disk transfer rate not (> 5 Mbps but < = 10 Mbps) 8 (=0): disk transfer rate not (< = 5 Mbps) 7 (=0): not removable cartridge drive 6 (=1): fixed drive 5 (=0): spindle motor control option not implemented 4 (=1): head switch time > 15 us 3 (=1): not MFM encoded 2 (=0): not soft sectored 1 (=1): hard sectored 0 (=0): reserved

Table 1 (Page 2 of 3). Sector Contents for the Identify Drive Command		
Word	Content	Description
01	1023	Number of cylinders. H3133-A2
	984	Number of cylinders. H3172-A2
	872	Number of cylinders. H3256-A3
	872	Number of cylinders. H3342-A4
02	0	Reserved
03	15	Number of heads. H3133-A2
	10	Number of heads. H3171-A2
	16	Number of heads. H3256-A3
	16	Number of heads. H3342-A4
04	30800	Number of unformatted bytes per track.
05	550	Number of unformatted bytes per sector.
06	17	Number of sectors per track. H3133-A1
	34	Number of sectors per track. H3171-A2
	36	Number of sectors per track. H3256-A3
	48	Number of sectors per track. H3342-A4
07-09	0	Vendor unique.
10-19	XXXX	Serial number in ASCII.
20	0003H	A dual ported, multi-sector buffer capable of simultaneous transfers with read caching.
21	00C0H	Buffer size in 512-byte increments.
22	0016H	Number of ECC bytes.
23-26	XXXX	Microcode revision. (ASCII)
27-46	H3085-A1	Model number in ASCII.
	H3171-A2	Model number in ASCII.
	H3256-A3	Model number in ASCII.
	H3342-A4	Model number in ASCII.
47	0020H	Number of sectors that can be transferred per interrupt on Read and Write Multiple commands.
	0000H	Read/write multiple commands not implemented. (32K ROM version)

Table 1 (Page 3 of 3). Sector Contents for the Identify Drive Command		
Word	Content	Description
48	0000H	Cannot perform doubleword I/O.
49	0000H	Neither LBA nor DMA is supported.
50	0000H	Reserved.
51	0000H	PIO data transfer cycle timing mode 2 is supported.
52	0000H	DMA data transfer cycle timing mode 2 is supported.
53	0001H	Words 54-58 are valid.
54		Number of current cylinders.
55		Number of current heads.
56		Number of current sectors per track.
57-58		Current capacity in sectors.
59	01xxH	Multiple Sector Setting is valid. xx equals current setting for multiple commands.
	0000H	Multiple Sector Setting is no valid. (32K ROM version)
60-61	0000H	Reserved
62	0000H	DMA Mode is not supported.
63	0000H	DMA Mode is not supported.
64-255	0000H	Reserved

5.4 Initialize Drive Parameters

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	V	V	V	V	V	V	V
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	1	0	1	D	H	H	H
Command	1	0	0	1	0	0	0 1

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	—	—	—	—	—	—	—
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	0	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	0	0	—	—	0	—	V

Figure 12. Initialize Drive Parameters Command (91h)

The Initialize Drive Parameters command enables the host to set the number of sectors per track and the number of heads minus 1, per cylinder. The parameters remain in effect until another Initialize Drive Parameters command is received, the drive is powered off, or a soft or hard reset occurs. The default parameters are defined in the Identify Drive information. The default parameters are in effect after power on, or a soft or hard reset occurs.

Output Parameters To The Drive

Sector Count	The number of sectors per track. 0 does not mean there are 256 sectors per track, it means there is no sector per track.
H	The number of heads minus 1, per cylinder. The minimum is 0 and the maximum is 15.

5.5 Read Buffer

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	1	0	1	D	—	—	—
Command	1	1	1	0	0	1	0 0

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	0	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	—	—	0	—	V

Figure 13. Read Buffer Command (E4h)

The Read Buffer command transfers a sector from the sector buffer to the host. The sector is transferred through the data register 16 bits at a time.

The sector transferred is from the same part of the buffer written to by the last Write Buffer command. The contents of the sector may be different if any reads or writes have occurred since the Write Buffer command was issued.

5.6 Read Long

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	0	0	0	0	0	0	0 1
Sector Number	V	V	V	V	V	V	V V
Cylinder Low	V	V	V	V	V	V	V V
Cylinder High	V	V	V	V	V	V	V V
Drive/Head	1	0	1	D	H	H	H H
Command	0	0	1	0	0	0	1 R

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	— V
Sector Number	V	V	V	V	V	V	V V
Cylinder Low	V	V	V	V	V	V	V V
Cylinder High	V	V	V	V	V	V	V V
Drive/Head	—	—	—	—	H	H	H H
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
V	0	0	V	0	V	0	V

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	V	—	0	—	V

Figure 14. Read Long Command (22h/23h)

The Read Long command transfers the data and ECC bytes of the designated sector from the drive to the host.

After 512 bytes of data have been transferred, the drive sets DRQ to 1 to indicate that the drive is ready to transfer the ECC bytes to the host. The data is transferred 16 bits at a time, and the ECC bytes are transferred eight bits at a time.

Output Parameters To The Drive

Sector Count The number of contiguous sectors to be transferred. The sector count must be set to one.

Sector Number The sector number of the sector to be transferred.

Cylinder High/Low The cylinder number of the sector to be transferred.

H The head number of the sector to be transferred.

R The retry bit. If set to one, then retries are disabled.

Input Parameters From The Drive

Sector Count The number of requested sectors not transferred.

Sector Number The sector number of the sector transferred.

Cylinder High/Low The cylinder number of the sector transferred.

H The head number of the sector transferred.

5.7 Read Sectors

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	V	V	V	V	V	V	V
Sector Number	V	V	V	V	V	V	V
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	1	0	1	D	H	H	H
Command	0	0	1	0	0	0	R

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	V	V	V	V	V	V	V
Sector Number	V	V	V	V	V	V	V
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	—	—	—	—	H	H	H
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
V	V	0	V	0	V	0	V

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	V	—	V	—	V

Figure 15. Read Sectors Command (20h/21h)

The Read Sectors command transfers one or more sectors from the drive to the host. The sectors are transferred through the Data Register 16 bits at a time.

If an uncorrectable error occurs, the read is terminated at the failing sector.

Output Parameters To The Drive

Sector Count	The number of contiguous sectors to be transferred. If zero is specified, then 256 sectors are transferred.
Sector Number	The sector number of the first sector to be transferred.
Cylinder High/Low	The cylinder number of the first sector to be transferred.
H	The head number of the first sector to be transferred.
R	The retry bit. If set to one, then retries are disabled.

Input Parameters From The Drive

Sector Count	The number of requested sectors not transferred. This will be zero, unless an irrecoverable error occurs.
Sector Number	The sector number of the last sector transferred.
Cylinder High/Low	The cylinder number of the last sector transferred.
H	The head number of the last sector transferred.

5.8 Read Verify Sectors

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	V	V	V	V	V	V	V
Sector Number	V	V	V	V	V	V	V
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	1	0	1	D	H	H	H
Command	0	0	1	0	0	0	R

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	V	V	V	V	V	V	V
Sector Number	V	V	V	V	V	V	V
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	—	—	—	—	H	H	H
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
V	V	0	V	0	V	0	V

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	V	—	V	—	V

Figure 16. Read Verify Sectors Command (40h/41h)

The Read Verify Sectors command verifies one or more sectors on the drive. No data is transferred to the host.

If an uncorrectable error occurs, the read verify is terminated at the failing sector.

Output Parameters To The Drive

Sector Count	The number of contiguous sectors to be verified. If zero is specified, then 256 sectors are verified.
Sector Number	The sector number of the first sector to be verified.
Cylinder High/Low	The cylinder number of the first sector to be verified.
H	The head number of the first sector to be verified.
R	The retry bit. If set to one, then retries are disabled.

Input Parameters From The Drive

Sector Count	The number of requested sectors not verified. This will be zero, unless an irrecoverable error occurs.
Sector Number	The sector number of the last sector verified.
Cylinder High/Low	The cylinder number of the last sector verified.
H	The head number of the last sector verified.

5.9 Recalibrate

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	1	0	1	D	—	—	—
Command	0	0	0	1	—	—	—

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	0	0	V	V	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	V	—	0	—	V

Figure 17. Recalibrate Command (1xh)

The Recalibrate command moves the read/write heads from anywhere on the disk to cylinder 0. If the drive cannot reach cylinder 0, T0N (Track 0 Not Found) is set in the error register.

5.10 Seek

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	1	0	1	D	H	H	H
Command	0	1	1	1	—	—	—

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	V	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	V	—	0	—	V

Figure 18. Seek Command (7xh)

The Seek command initiates a seek to the designated track and selects the designated head. The drive does not have to be formatted for a seek to execute properly. The drive waits for the seek to complete before setting BSY to 0, DSC to 1, and issuing the interrupt.

Output Parameters To The Drive

Cylinder High/Low The cylinder number of the seek.

H The head number of the seek.

5.11 Set Features

Command Block Output Registers								
Register	7	6	5	4	3	2	1	0
Data	—	—	—	—	—	—	—	—
Feature	V	V	V	V	V	V	V	V
Sector Count	—	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—	—
Drive/Head	1	0	1	D	—	—	—	—
Command	1	1	1	0	1	1	1	1

Command Block Input Registers								
Register	7	6	5	4	3	2	1	0
Data	—	—	—	—	—	—	—	—
Error	...See Below...							
Sector Count	—	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—	—
Status	...See Below...							

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	0	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	—	—	0	—	V

Figure 19. Set Features Command (EFh)

The Set Features command is used by the host to establish the following parameters which affect the execution of certain drive features as shown in Table 2. If the value in the register is other than one defined in the table, the drive posts an aborted command error.

Table 2. Set Feature Parameters	
	Description
44h	Vendor unique length of ECC on Read Long/Write Long command
55h	Disable read look ahead feature
82h	Disable Write Cache
AAh	Enable read look ahead feature
BBh	4 bytes of ECC apply on Read Long/Write Long commands

5.12 Write Buffer

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	1	0	1	D	—	—	—
Command	1	1	1	0	1	0	0 0

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	—
Sector Number	—	—	—	—	—	—	—
Cylinder Low	—	—	—	—	—	—	—
Cylinder High	—	—	—	—	—	—	—
Drive/Head	—	—	—	—	—	—	—
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
0	0	0	0	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	0	—	—	0	—	V

Figure 20. Write Buffer Command (E8h)

The Write Buffer command transfers a sector of data from the host to the sector buffer. The sectors are transferred through the data register 16 bits at a time.

The Read Buffer and Write Buffer commands are synchronized such that sequential Write Buffer and Read Buffer commands access the same 512 bytes within the buffer.

5.13 Write Long

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	0	0	0	0	0	0	0 1
Sector Number	V	V	V	V	V	V	V V
Cylinder Low	V	V	V	V	V	V	V V
Cylinder High	V	V	V	V	V	V	V V
Drive/Head	1	0	1	D	H	H	H H
Command	0	0	1	1	0	0	1 R

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	—	—	—	—	—	—	V
Sector Number	V	V	V	V	V	V	V V
Cylinder Low	V	V	V	V	V	V	V V
Cylinder High	V	V	V	V	V	V	V V
Drive/Head	—	—	—	—	H	H	H H
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
V	0	0	V	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	V	V	—	0	—	V

Figure 21. Write Long Command (32h/33h)

The Write Long command transfers the data and ECC bytes of the designated sector from the host to the drive.

The data is transferred 16 bits at a time, and the ECC bytes are transferred eight bits at a time.

If an uncorrectable error occurs, the write is terminated at the failing sector.

Output Parameters To The Drive

Sector Count The number of contiguous sectors to be transferred. The sector count must be set to one.

Sector Number The sector number of the sector to be transferred.

Cylinder High/Low The cylinder number of the sector to be transferred.

H The head number of the sector to be transferred.

R The retry bit. If set to one, then retries are disabled.

Input Parameters From The Drive

Sector Count The number of requested sectors not transferred.

Sector Number The sector number of the sector transferred.

Cylinder High/Low The cylinder number of the sector transferred.

H The head number of the sector transferred.

5.14 Write Sectors

Command Block Output Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Feature	—	—	—	—	—	—	—
Sector Count	V	V	V	V	V	V	V
Sector Number	V	V	V	V	V	V	V
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	1	0	1	D	H	H	H
Command	0	0	1	1	0	0	R

Command Block Input Registers							
Register	7	6	5	4	3	2	1 0
Data	—	—	—	—	—	—	—
Error	...See Below...						
Sector Count	V	V	V	V	V	V	V
Sector Number	V	V	V	V	V	V	V
Cylinder Low	V	V	V	V	V	V	V
Cylinder High	V	V	V	V	V	V	V
Drive/Head	—	—	—	—	H	H	H
Status	...See Below...						

Error Register							
7	6	5	4	3	2	1	0
BBK	UNC	0	IDN	0	ABT	T0N	AMN
V	0	0	V	0	V	0	0

Status Register							
7	6	5	4	3	2	1	0
BSY	RDY	DWF	DSC	DRQ	COR	IDX	ERR
0	V	V	V	—	0	—	V

Figure 22. Write Sectors Command (30h/31h)

The Write Sectors command transfers one or more sectors from the host to the drive. The sectors are transferred through the data register 16 bits at a time.

If an uncorrectable error occurs, the write is terminated at the failing sector.

Output Parameters To The Drive

Sector Count	The number of contiguous sectors to be transferred. If zero is specified, then 256 sectors are transferred.
Sector Number	The sector number of the first sector to be transferred.
Cylinder High/Low	The cylinder number of the first sector to be transferred.
H	The head number of the first sector to be transferred.
R	The retry bit. If set to one, then retries are disabled.

Input Parameters From The Drive

Sector Count	The number of requested sectors not transferred. This will be zero, unless an unrecoverable error occurs.
Sector Number	The sector number of the last sector transferred.
Cylinder High/Low	The cylinder number of the last sector transferred.
H	The head number of the last sector transferred.

6.0 Resets

6.1 Power On Reset

After power on, the drive performs hardware initialization and executes its internal diagnostics. During this time the spindle reaches its operating speed.

The registers are initialized as shown in Figure 23.

6.2 Hard Reset

A hard reset causes any task currently in progress to be aborted. The drive then re-initializes its internal variables and executes its internal diagnostics.

A hard reset occurs when the host asserts the bus RESET signal.

The registers are initialized as shown in Figure 23.

6.3 Software Reset

A software reset causes any task currently in progress to be aborted. The drive then re-initializes its internal variables and executes its internal diagnostics.

The registers are initialized as shown in Figure 23.

The host must set device control register bit RST to 1 and wait at least five microseconds before setting RST to 0, to ensure that the drive recognizes the reset.

6.4 Register Initialization

Register	Default Value
Error	Diagnostic Code
Sector Count	01h
Sector Number	01h
Cylinder Low	00h
Cylinder High	00h
Drive/Head	A0h
Status	00h
Alternate Status	00h

Figure 23. Default Register Values

After power on, a hard reset, or a software reset, the register values are initialized as shown in Figure 23.

Code	Description
01h	No error detected
02h	Formatter device error
03h	Sector buffer error
04h	ECC circuitry error
05h	Controller microprocessor error
8xh	Slave drive failed

Figure 24. Diagnostic Codes

The meaning of the error register diagnostic codes resulting from power on, a hard reset or the Execute Drive Diagnostic command are shown in Figure 24.

7.0 Timings

FUNCTION	INTERVAL	START	STOP	TIMEOUT
Power On	Drive Busy After Power On	Power On	Status Register BSY=1	400 ns
	Drive Ready After Power On	Power On	Status Register BSY=0 and RDY=1	31 sec
Software Reset	Drive Busy After Software Reset	Device Control Register RST=1	Status Register BSY=1	400 ns
	Drive Ready After Software Reset	Device Control Register RST=1	Status Register BSY=0 and RDY=1	6 sec
Hard Reset	Drive Busy After Hard Reset	Bus RESET Signal Asserted	Status Register BSY=1	400 ns
	Drive Ready After Hard Reset	Bus RESET Signal Asserted	Status Register BSY=0 and RDY=1	31 sec
Data In Command	Drive Busy After Command Code Out	OUT to Command Register	Status Register BSY=1	400 ns
	Interrupt, DRQ For Data Transfer In	Status Register BSY=1	Status Register BSY=0 and DRQ=1, Interrupt	10 sec
	Drive Busy After Data Transfer In	256th Read From Data Register	Status Register BSY=1	10 us
Data Out Command	Drive Busy After Command Code Out	OUT to Command Register	Status Register BSY=1	400 ns
	Data Request For Data Transfer Out	Status Register BSY=1	Status Register BSY=0 and DRQ=1	1 ms
	Drive Busy After Data Transfer Out	256th Write From Data Register	Status Register BSY=1	5 us
	Interrupt For Data Transfer Out	Status Register BSY=1	Interrupt	10 sec
Non-Data Command	Drive Busy After Command Code Out	OUT to Command Register	Status Register BSY=1	700 us
	Interrupt For Command Complete	Status Register BSY=1	Interrupt	6 sec

Figure 25. Timeout Values

The host must always give the drive sufficient time to perform each command or command phase. Figure 25 shows the commands and command phases, and the minimum timeout intervals that the host should wait before reporting an error. The abbreviations “ns”, “us”, “ms”, and “sec”, mean nanoseconds, microseconds, milliseconds and seconds, respectively.

The timeout values shown do not relate to normal drive performance. They are based on worst case conditions, with an added safety margin. Since timeout conditions are very rare events, host performance is not affected by the added safety margin.

It is recommended that the host use processor-independent timing loops, so that the timeout intervals are still valid when faster processors are implemented.

When issuing a software reset, the host must set device control register bit RST to 1 and wait at least five microseconds before setting RST to 0, to ensure that the drive recognizes the reset.

Appendix A. Cache

A.1 Read Look-Ahead

The drive keeps three, 32KB buffers for the read/write cache. Two of these are used to store look-ahead data under the following rules:

- The least-recent-used buffer is discarded to save the newly requested data.
- The look-ahead stores data shown in the following table.
- The look-ahead is terminated if another command is received.

Condition	Number of Blocks to read look-ahead
$A < 16\text{KB}$	$32\text{KB} - A$
$16\text{KB} < A < 32\text{KB}$	A
$32\text{KB} < A$	32KB

Note: A is the number of requested blocks in the read command.

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