C-ONE TECHNOLOGY CORPORATION

SAH05 2.5” IDE Flash Disk

Product Specification

APRIL, 2003

Contents

Document History

Version	Description	Date	Verify By
1	New Issue	April 03	Couger Liou

1. General Description

1.1 Introduction

C-One's SAH05 2.5"IDE Flash Disk uses Hitachi AND-based 256 Mbit ,512Mbit ,1G Mbit(DDP) flash memory devices, which possesses high-performance technology and comes with capacities of 32, 64, 96 128, 256, 320, 512, 640MB, 1.0G, 1.6G, and 2.0G unformatted. The flash disk makes use of the advanced flash technology and provides innovative solid-state mass-storage drive with IDE interface.

Besides having the unique "Plug-and-Play" solution, IDE solid-state disk's main advantages are its fast access time, flexible 44-pin portable design and non-volatile status. Being fully compliant with ATA and IDE Disk-Drive industry standards, the 2.5" IDE Flash disk provides high-speed data transfer rate and better performance quality than traditional magnetic platters and other flash memory solutions. C-One's SAH05 2.5" IDE Flash disk design features key requirements such as ruggedness, high reliability, compatibility, portability, and low power consumption.

The 2.5" IDE Flash disk drive also possesses the characteristics of Flash technology and can tolerate shock and vibration during operation. The non-recoverable error rate is less than 1 error per 10^{14} bits read. The mean time between failures (MTBF) is an astonishing 1,000,000 hours.

The IDE Flash Disk is built to work in harsh environments that exceed the endurance of a desktop PC. It is most suitable for IA products, Industrial Computers, Personal Handheld Devices, Networking, Communications and Telecommunications.

1.2 Features:

ATA/IDE interface

- ◊ Conform to ATA/ATAPI-4 Specification Standard
- ◊ Support auto Power Down Mode
- ◊ Programmable and auto-wait-state generation for compatibility with any host speed

Extremely Rugged and Reliable

- ◊ Solid-state reliability
- ◊ 1000-G operating and non-operating shock
- ◊ 15-G vibration
- ◊ 1,000,000 power-on hours MTBF
- ◊ Embedded ECC (3 bit error Correction, 5 bit error detection /2048B)

High Performance

- ◊ Fast ATA host-to-buffer burst transfer rates up to 20 Mbytes/second
- ◊ Burst transfer rates to and from flash memory up to 8.3 Mbytes/second

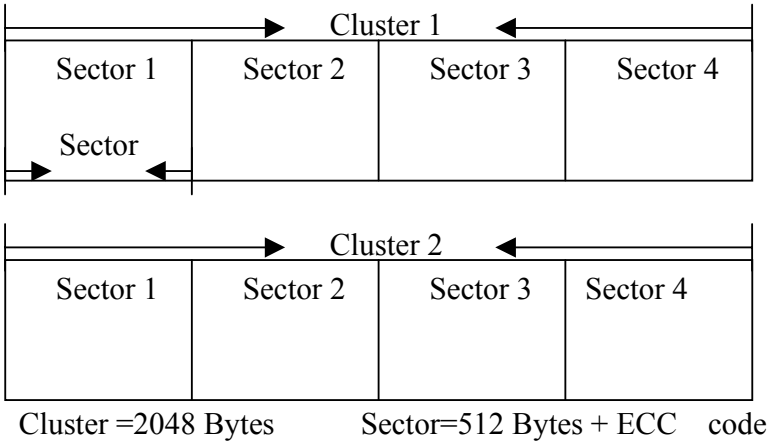
Enhanced Characteristics

- ◊ Support background erase operation
- ◊ Drive capacity of 32 MB to 2 GB available (unformatted)
- ◊ 5 Volt power supply, very low power consumption with automatic power management
- ◊ Two power manager modes (Normal and Power Down)
- ◊ Zero-power data retention, no batteries required

Endurance

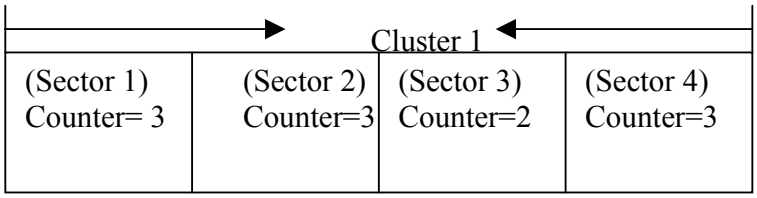
Each Flash cell's lifetime is limited by the numbers of its writing/erasing times. The typical erasable cycles of a Flash cell are 100k to 300k. Due to their specific applications, the FAT/Directory sectors would wear out faster than other sectors if no preventive scheme has been arranged. To overcome this inherent deficiency, an algorithm has been implemented within the flash controller to ensure all erase areas are evenly worn across the entire flash memory. For example, in an ordinary writing/erasing operation without the algorithm, the flash cell cannot be written after 300,000 times. The Hitachi's algorithm may flag each cell every time when a written/erased occurred, and the newly written data will not be written in the same memory cell with flagged signal. Hence this algorithm extends the lifetime of the Flash device and the logical write/erase cycle can be prolonged 10 times more than the physical write/erase cycle.

Description of Write/Erase Algorithm



（Figure 1）

1. There is a counter (2 Bytes) in each sector to record each write/erase.
2. The value of the counter will increase by 1 for each write/erase.
3. Refer to Figure 2, the controller will check the value of each sector before writing new data, and then the data will be written into the sector that has the lowest value. For example, as showed in Figure 2, the （sector 3） has the lowest counter value （Counter =2）, thus new data will be written into（Sector 3） and its counter will increase 1 to become "counter=3".



4. Refer to Figure 1, there are 4 sectors in each cluster. When the controller checks each counter in the same cluster, it will make comparisons among individual cluster respectively. If the value in each sector is the same in the first cluster, the controller would start checking the value in the second Cluster and so on

Bad Block Replacement

When bad block occurs in the FAT/Directory table, it will be replaced immediately by a spare block; there is roughly around 1.8% spare block available for back up replacement on each individual Flash chip. The Bad Sector Replacement function enables automatic data transfer from the bad sector to the readily spare block areas.

For example: in a 256Mb Flash chip the total spare block area is about 72.5 blocks;
1 block = 2048 bytes = 4sectors

2. Product Models

2.1 Logical Block Parameters (CHS)

The table below shows various capacities available with C-ONE's SAH05 2.5" IDE. It provides the default CHS (Cylinder, Head and Sector) for each product model. If the computer's BIOS support auto-detection, it is recommended that the Normal Mode be chosen (instead of the LBA Mode) to obtain more formatted disk space.

SAH05 2.5"IDE Flash Disk (Commercial Grade)

Item No	Product No	Unformatted Storage Capacity	Total Sector	Formatted Storage Capacity	Cylinder	Head	Sector
1	IEH032EH5C	32MB	62,592	32,047,104	489	4	32
2	IEH064EH6C	64MB	125,184	64,094,208	978	4	32
3	IEH096EH5C	96MB	187,392	95,944,704	732	8	32
4	IEH128EH5C	128MB	250,368	128,188,416	978	8	32
5	IEH256EH6C	256MB	500,400	256,204,800	695	15	48
6	IEH320EH6C	320MB	625,800	320,409,600	745	15	56
7	IEH512EH6C	512MB	1,000,944	512,483,328	993	16	63
8	IEH704EH6C	704MB	1,376,928	704,987,136	1366	16	63
9	IEH01GEH6C	1.0GB	2,002,896	1,025,482,752	1987	16	63
10	IEH1G6EH6C	1.6GB	3,128,832	1,601,961,984	3104	16	63
11	IEH02GEHGC	2.0GB	4,005,792	2,050,965,504	3974	16	63

2.2 Part Number Definition

IEX_1 X_2 X_3 X_4 X_5 X_6 X_7 X_8 – X_9

Code	Indication	Description
I	Interface	44-pin IDE
E	Form-factor	2.5” conventional Hard Drive Dimension
X_1	Controller Brand	H= Hitachi; W=Wildcat-E; J=Jaguar
X_2 X_3 X_4	Capacity	032=32MB; 512=512MB;01G=1GB; 1G6=1.6GB
X_5	Controller Version	A, B, C,….Refer to different controller brand
X_6	Flash Memory Brand	H=Hitachi; S=Samsung; T=Toshiba
X_7	Memory IC Capacity	Mono: 3=64Mb; 4=128Mb; 5=256Mb
X_8	Operating Temperature Range	C=Commercial Grade 0℃ ~+65℃ L= Extended Temp. -20℃ ~+70℃ C=Industrial Grade -40℃ ~+85℃
X_9	IDE Flat-cable	0=40-pin to 44-pin IDE Flat-cable 4=44-pin to 44-pin IDE Flat-cable

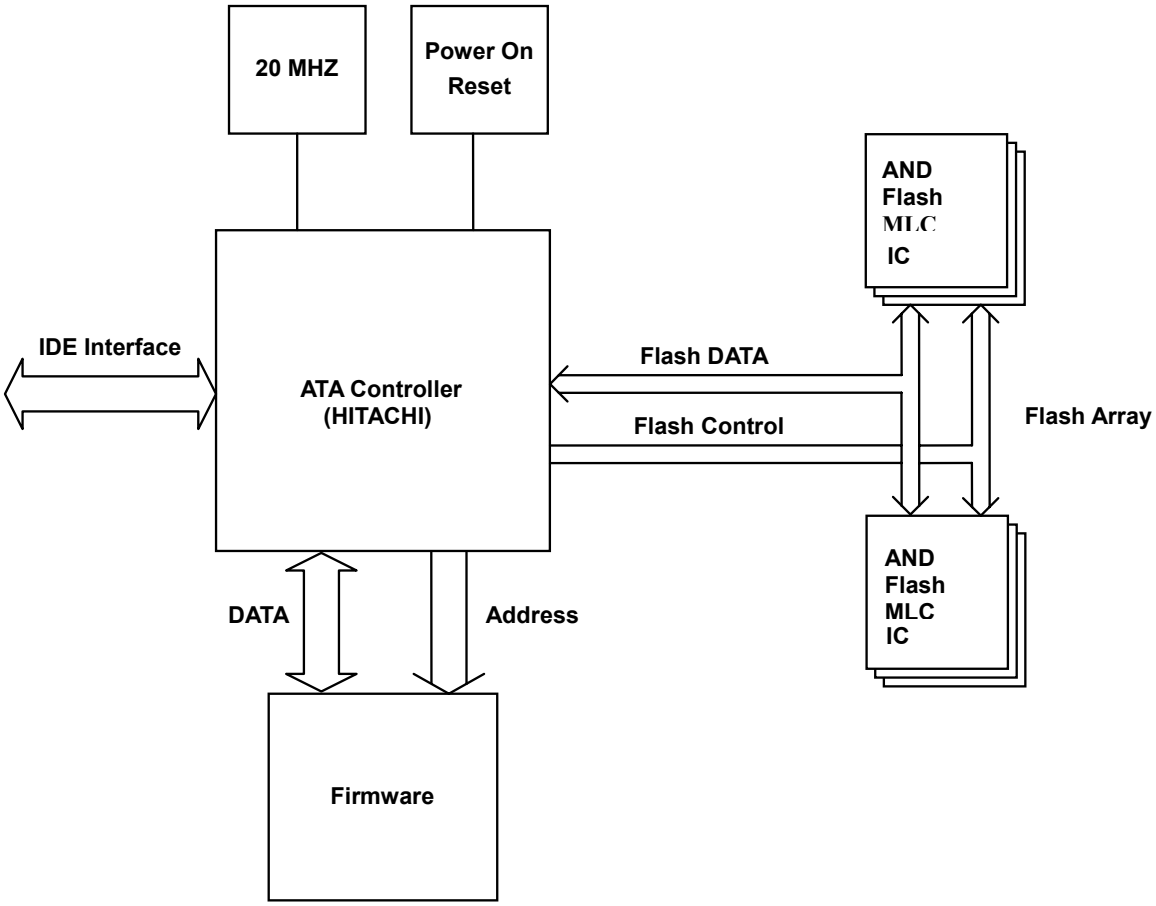
For example: IEH01GEH6C-0

1GB 2.5” IDE Flash Disk with Hitachi SAH05 controller, 512Mb Mono IC; supports Commercial Grade 0℃ ~+65℃; attaches one 40-pin to 44-pin IDE Flat-cable.

Product List:

Disk Capacity	Commercial Grade 0℃ ~+65℃	Extended Temperature -20℃ ~+70℃	Industrial Grade -40℃ ~+85℃
32MB	IEH032EH5C-0/4	IEH032EH5L-0/4	IEH032EH5H-0/4
64MB	IEH064EH6C-0/4	IEH064EH6L-0/4	IEH064EH6H-0/4
96MB	IEH096EH5C-0/4	IEH096EH5L-0/4	IEH096EH5H-0/4
128MB	IEH128EH5C-0/4	IEH128EH5L-0/4	IEH128EH5H-0/4
256MB	IEH256EH6C-0/4	IEH256EH6L-0/4	IEH256EH6H-0/4
320MB	IEH320EH6C-0/4	IEH320EH6L-0/4	IEH320EH6H-0/4
512MB	IEH512EH6C-0/4	IEH512EH6L-0/4	IEH512EH6H-0/4
704MB	IEH704EH6C-0/4	IEH704EH6L-0/4	IEH704EH6H-0/4
1GB	IEH01GEH6C-0/4	IEH01GEH6L-0/4	IEH01GEH6H-0/4
1.6GB	IEH1G6EH6C-0/4	IEH1G6EH6L-0/4	IEH1G6EH6H-0/4
2GB	IEH02GEHGC-0/4	IEH02GEHGL-0/4	IEH02GEHGH-0/4

3. Block Diagram:



4. Product Specification

4.1 Physical description:

1. Weight and Measures	2.5” IDE	Dimensions: 69.85mm(L) x 100.2mm(W) x 12.7mm(H)
		Weight: 192 g
		Pin-Pitch: 2.0 mm
2. Storage Capacities	Capacitance	32 MB to 2.0 GB (unformatted)
3. Performance:	Data Transfer Rates	To/from Flash memory (burst mode): up to 20 Mbytes/sec
		To/from host (PIO mode 2): up to 8.3 Mbytes/sec
	Data Access Time	<1.5 ms
4. Reliability:	MTBF	1,000,000 power-on hours
	Error Rate	less than 1 bit error in 10^{14} bits read (Min.)
	ECC	Embedded ECC (3 bit error Correction, 5 bit error detection /2048B)
	Endurance	1,000,000 Write/Erase cycles for any sector

4.2. Operation description:

1. Operating Voltage	Power modes	5V +/- 10%
2. Typical Power Consumptions:	5V	Read Mode: 40 mA
		Write Mode: 45 mA
		Standby Mode: 0.15 mA
		Idle Mode: << 1 mA
3.Environment Conditions:	Operating Temperature	0°C to 70°C
	Enhanced Storage Temp.	-20°C to 85°C
	Relative Humidity	5% ~ 95% (Max.)
	Shock	1000-G
	Vibration	15-G
4.System Compatibility	O/S supports DOS, Windows 98/ME/NT/2000/XP Professional	

5. IDE Interface

5.1. IDE Pin Assignments and Pin Type

Pin Num.	Signal Name	Pin Type
A	GND	Ground
C	#Slave	I
E	Key	Cut Pin
1	#Reset	I
3	Data 7	I/O
5	Data 6	I/O
7	Data 5	I/O
9	Data 4	I/O
11	Data 3	I/O
13	Data 2	I/O
15	Data 1	I/O
17	Data 0	I/O
19	GND	Ground
21	DMARQ	O
23	#IOW	I
25	#IOR	I
27	IORDY	I
29	DMACK	I
31	IRQ	O
33	A1	I
35	A0	I
37	#CS0	I
39	#DASP	I/O
41	Vcc	Supply Voltage
43	GND	Ground

Pin Num.	Signal Name	Pin Type
B	NSCEL	I
D	NSCEL	I
F	Key	Cut Pin
2	GND	Ground
4	Data 8	I/O
6	Data 9	I/O
8	Data 10	I/O
10	Data 11	I/O
12	Data 12	I/O
14	Data 13	I/O
16	Data 14	I/O
18	Data 15	I/O
20	Key	Cut Pin
22	GND	Ground
24	GND	Ground
26	GND	Ground
28	CSEL	I
30	GND	Ground
32	#IOCS16	O
34	#PDIAG	I/O
36	A2	I
38	#CS1	I
40	GND	
42	Vcc	Supply Voltage
44	TYPE	

5.2. Interface Signals Description

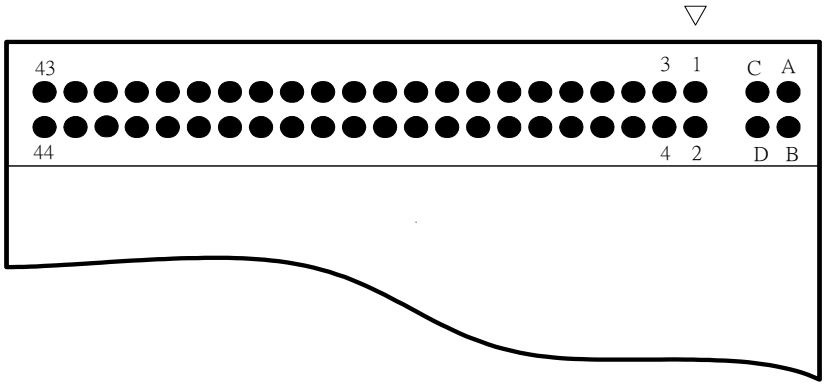
Signal Name	Pin	I/O	Description
#SLAVE	A,C	I	SLAVE Pins A and C are pulled-up input pins that are shorted together internally. (Pins B and D are ground.) These pins are used to configure the SSDdrive as Slave device. When all pins A, B, C and D are grounded, the SSDdrive is also configured as a Slave device. If both pins A and B remain open, the SSDdrive is configured as a Master or as the only drive in a single drive system.
#RESET	1	I	HOST RESET Reset signal from the host that is active on power up and inactive thereafter.
Data (15-0)	3 - 18	I/O	HOST DATA15-0 These 16 lines carry the Data between the controller and the host. The low 8 lines transfer commands, status, and ECC information between the host and the controller.
DMARQ	21	O	DMA REQUEST When ready to transfer data to or from the host, this signal used for DMA data transfers between host and device, shall be asserted by the device.
#IOW	23	I	I/O WRITE This strobe pulse is used to clock data or commands on the host data bus into the controller. The clocking will occur on the negative to positive edge of the signal (trailing edge).
#IOR	25	I	I/O READ This is a read strobe generated by the host. This signal gates data or status on the host bus and strobes the data from the controller into the host on the low to high transition (trailing edge).
IORDY	27	I	I/O READY This signal is negated to extend the host transfer cycle of any host register access (Read or Write) when the device is not ready to respond to a data transfer request.
Vcc	41,42	--	+5 V POWER

Signal Name	Pin	I/O	Description
CSEL	28	I	CABLE SELECT When grounded, the device is configured as a Master. When opened, this device is configured as a Slave.
DMACK	29	I	DMA ACKNOWLEDGE This signal shall respond to DMARQ by the host to initiate DMA transfers.
IRQ	31	O	INTERRUPT REQUEST This is an interrupt request from the controller to the host, asking for service. The output of this signal is tri-stated when the interrupt are disabled by the host.
#IOCS16	32	O	I/O SELECT 16 This open drain output is asserted low to indicate to the host the current cycle is a 16-bit word data transfer.
#PDIAG	34	I/O	PASS DIAGNOSTIC After an Execute Diagnostic command to indicate to the master it has passed its diagnostics, this bi-directional open drain signal is asserted by the slave.
A (2-0)	33,35,36	I	HOST ADDRESS 2-0 These address lines are used to select the registers within the controller task file.
#CS0	37	I	HOST CHIP SELECT 0 A chip select signal used to select the controller task file.
#CS1	38	I	HOST CHIP SELECT 1 A chip select signal that is used to select the control and diagnostic register.
#DASP	39	I/O	DISK ACTIVE/SLAVE PRESENT This open drain output signal is asserted low any time the drive is active. In a master/slave configuration, the slave uses it to inform the master of its present.
NC	E,F,20	-	These pins are reserved for the connector keys.
GND	A,D,2,19,22, 24,26,30,40,43	--	GROUND

5.3. Installing The SSD Drive In a Two-Drive Configuration

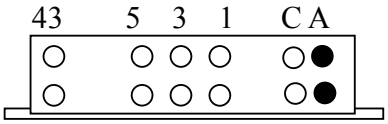
If Pin A and Pin B are jumped, the drive is in Cable Select mode.
If both pins A and B remain open, the SSD drive is configured as a Master in a Master/Slave configuration or as the only drive in a single drive system. Pins A and B are pulled-up input pins that are shorted together internally (Pins C and D are ground).

If the SSD drive is installed as the second, or Slave, drive in a two-drive configuration, either pin AC or none of the pins should be grounded. These pins will configure the SSD drive as a Slave device.



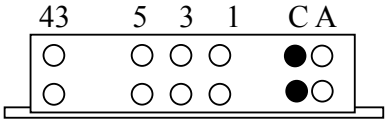
Master/Slave Configuration Pins

Cable Select:



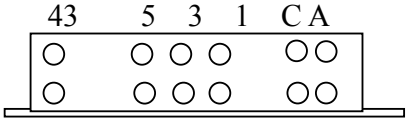
If Pin A and Pin B are jumped, the drive is in Cable Select

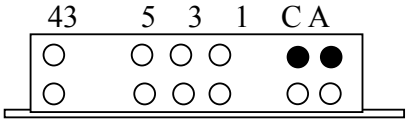
Master:



If Pin C and Pin D are jumped, the drive is in Master mode

Slave:





If all pins A, B, C, and D are open, or Pin A and Pin C are jumped, the drive is in Slave mode

6. Electrical Specification

6.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	RATING	UNITS
V_{cc}	**Power supply**	**-0.3 to +5.0**	**V**
V_{in}	**Input voltage**	**-0.3 to V_{CC} ± 10%**	**V**
V_{out}	**Output voltage**	**-0.3 to V_{CC} ± 10%**	**V**
T_{stg}	**Storage temperature**	**-20 to +85**	**℃**
Topr	**Operating temperature**	**0 to +70**	**℃**

Notes: T_{stg}/Topr for controller temperature resistance

6.2. General DC Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IL}	**Input low current**	**No pull-up or pull-down**	**-1**		**1**	**µA**
V_{IH}	**Input high current**	**No pull-up or pull-down**	**-1**		**1**	**µA**
V_{OZ}	**Tri-state leakage current**		**-10**		**10**	**µA**
C_{IN}	**Input capacitance**				**15**	**pF**
C_{OUT}	**Output capacitance**				**15**	**pF**

6.3 DC Electrical Characteristics for 5 Volts Operation

SYMBOL	PARAMETER	CONDI-TIONS	MIN	TYP	MAX	UNITS
V_{IN}	**Input voltage**		**0**		V_{CC}	**V**
V_{CC}	**Power supply**		**4.5**	**5.0**	**5.5**	**V**
T_{STG}	**Storage temperature**		**-20**		**85**	**℃**
T_{OPR}	**Operating temperature**		**0**		**70**	**℃**
V_{IL}	**Input low voltage**	**CMOS**	**-0.3**		**0.3×V_{DD}**	**V**
V_{IH}	**Input high voltage**	**CMOS**	**0.7×V_{DD}**		**V_{DD}+0.3**	**V**
V_{SIL}	**Schmitt input low voltage**	**CMOS**	**1.1**		**2.4**	**V**
V_{SIH}	**Schmitt input high voltage**	**CMOS**	**2.8**		**4.0**	**V**
V_{OL}	**Output low voltage**	**I_{OL}=8mA**			**0.4**	**V**
V_{OH}	**Output high voltage**	**I_{OH}=-2mA**	**V_{CC} – 0.8**			**V**
R_I	**Input pull-up/pull-down resister**	**V_{IN}=GND**	**10/550**	**45/ 110**	**90/50**	**µA/ KΩ**

6.4 AC Characteristics:

Description		Min	Max
tRISE	Rise time for any signal on AT interface (see note)	5 ns	
tFALL	Fall time for any signal on AT interface (see note)	5 ns	
Cin	Host input capacitance		25pf
Cout	Host output capacitance		25pf
Cin	Device input capacitance		20pf
Cout	Device output capacitance		20pf
NOTE —tRISE and tFALL are measured from 10-90% of full signal amplitude with a total capacitive load of 40 pf.			

7. IDE Modes Decoding

- Primary drive addresses at system ATA I/O address 1F0h-lF7h and 3F6h-3F7h. The host must provide chip-enable CS0# and CS1#. The drive decodes addresses A0-2.

- Secondary drive addresses at system ATA I/O address 170h-177h and 376h-377. The host must provide chip-enable CS0# and CS1#. The drive decodes addresses A0-2.

Primary and secondary drive addressing modes allow hosts to use the AT-standard's reserved disk drive I/O addressee. This provides PC system designers with the simplest way to accommodate ATA-protocol devices. Once the PCMCIA socket adapter is configured for the primary or secondary drive address ranges, a PC can take advantage of the BIOS's standard disk access routines.

7.1. IDE MODE–

Primary address = 1F0h-1F7h, 3F6h-3F7h; Secondary address = 170-177, 376-377

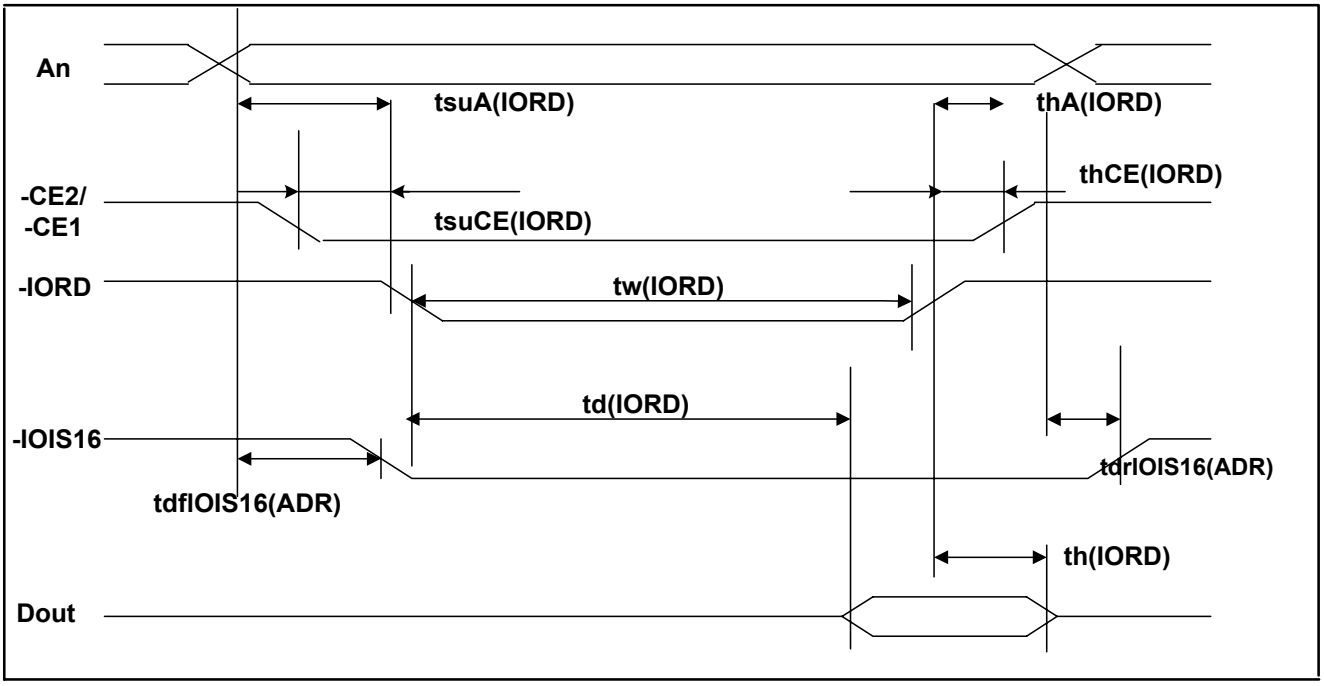
Address					Functions	
CS0	CS1	A2	A1	A0	Read(-IORD)	Write (-IOWR)
N	N	x	x	x	Data bus high impedance	Not used
					Control block registers	
N	A	0	x	x	Data bus high impedance	Not used
N	A	1	0	x	Data bus high impedance	Not used
N	A	1	1	0	Alternate Status	Device Control
N	A	1	1	1	(see note 1)	Not used
					Control block registers	
A	N	0	0	0	Data	Data
A	N	0	0	1	Error	Features
A	N	0	1	0	Sector Count	Sector Count
A	N	0	1	1	Sector Number LBA (7:0)(see note 2)	Sector Number LBA (7:0)(see note 2)
A	N	1	0	0	Cylinder Low LBA (15:8)(see note 2)	Cylinder Low LBA 15:8)(see note 2)
A	N	1	0	1	Cylinder High LBA (23:16)(see note 2)	Cylinder High LBA (23:16)(see note 2)
A	N	1	1	0	Device/Head LBA (27:24)(see note 2)	Device/Head LBA (27:24)(see note 2)
A	N	1	1	1	Status	Command
A	A	x	x	x	Invalid address	Invalid address

Key: A=signal asserted, N=signal negated, x=don't care
NOTES:
1 This register is obsolete. It is recommended that a device not respond to a read of this address. If a device does respond, it shall not drive the DD7 signal to prevent possible conflict with floppy disk implementations.
2 Mapping of registers in LBA translation.

7.2. I/O Read Timing

Item	Symbol	IEEE Symbol	Min ns.	Max ns.
Data Delay after IORD	td(IORD)	tlGLQV		100
Data Hold following IORD	th(IORD)	tlGHQX	0	
IORD Width Time	tw(IORD)	tlGLIGH	165	
Address Setup before IORD	tsuA(IORD)	tAVIGL	70	
Address Hold following IORD	thA(IORD)	tlGHAX	20	
CSx Setup before IORD	tsuCE(IORD)	tELIGL	5	
CSx Hold following IORD	thCE(IORD)	tlGHEH	20	
IOIS16 Delay Falling from Address		tAVISL		35
IOIS16 Delay Rising from Address		tAVISH		35

Notes: The maximum load on-IOIS16 is 1 LSTTL with 50pF total load. All times are in nanoseconds.
Dout signifies data provided by the drive to the system,



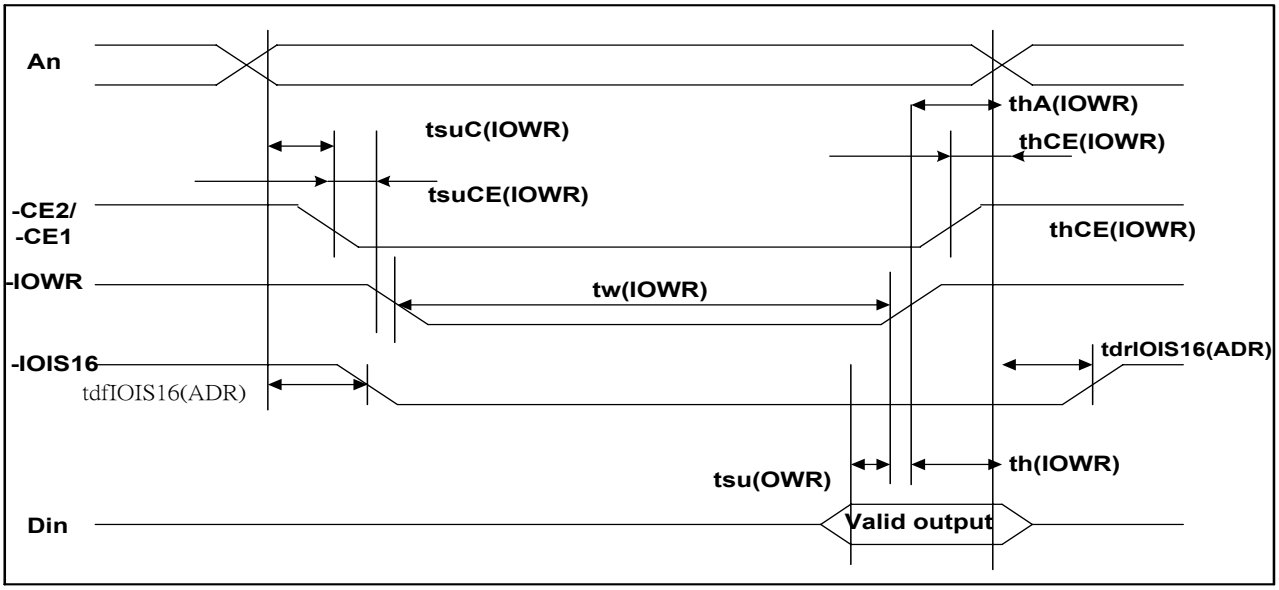
I/O Read Timing Diagram

7.3. I/O Write Timing

Item	Symbol	IEEE Symbol	Min ns.	Max ns.
Data Setup before IOWR[GC]	tsu(IOWR)	tDVIWH	60	
Data Hold following IOWR	th(IOWR)	tlWHDX	30	
IOWR Width Time	tw(IOWR)	tlWLIWH	165	
Address Setup before IOWR	tsuA(IOWR)	tAVIWL	70	
Address Hold following IOWR	thA(IOWR)	tlWHAX	20	
CSx Setup before IOWR	tsuCE(IOWR)	tELIWL	5	
CSx Hold following IOWR	thCE(IOWR)	tlWHEH	20	
IOIS16 Delay Falling from Address	tdfIOIS16(ADR)	tAVISL		35
IOIS16 Delay Rising from Address	tdrIOIS16(ADR)	tAVISH		35

Notes: The maximum load on-IOIS16 is 1 LSTTL with 50pF total load. All times are in nanoseconds.

Din signifies data provided by the system to the drive.



I/O Write Timing Diagram

8. ATA Compliant Commands

8.1. ATA Commands

Writing Command register codes and block-register parameters issues commands. The drive responds and executes a new command by aborting an in-progress command, even if it can be completed.

Command Code (hex)	Command Name	Features Register	Sector Count	Sector Number	Cylinder Register	Drive/ Head
10-1F	Recalibrate					Drv
20	Read Sector(s)(w/ retry)		Valid	Valid	Valid	Drv/Hd
21	Read Sector(s)(w/o retry)		Valid	Valid	Valid	Drv/Hd
22	Read Long(w/ retry)		Valid	Valid	Valid	Drv/Hd
23	Read Long(w/o retry)		Valid	Valid	Valid	Drv/Hd
30	Write Sector(s)(w/ retry)		Valid	Valid	Valid	Drv/Hd
31	Write Sector(s)(w/o retry)		Valid	Valid	Valid	Drv/Hd
32	Write Long(w/ retry)		Valid	Valid	Valid	Drv/Hd
33	Write Long(w/o retry)		Valid	Valid	Valid	Drv/Hd
40	Read Verify Sector(s)(w/ retry)		Valid	Valid	Valid	Drv/Hd
41	Read Verify Sector(s)(w/o		Valid	Valid	Valid	Drv/Hd
50	retry)		Valid		Valid	Drv/Hd
70-7F	Format Track			Valid	Valid	Drv/Hd
90	Seek					Drv*
91	Execute Drive Diagnostic		Valid			Drv/Hd
94, E0	Initialize Drive Parameters					Drv
95, E1	Standby Immediate					Drv
96, E2	Idle Immediate		Valid			Drv
97, E3	Standby		Valid			Drv
98, E5	Idle		Valid			Drv
99, E6	Check Power Mode					Drv
EF	Set Sleep Mode		Valid	Valid	Valid	Drv/Hd
C4	Set Features		Valid	Valid	Valid	Drv/Hd
C5	Read Multiple		Valid	Valid	Valid	Drv/Hd
C6	Write Multiple		Valid			Drv
E4	Set Multiple Mode					Drv
E8	Read Buffer					Drv
EC	Write Buffer					Drv
C0	Identify Drive		Valid	Valid	Valid	Drv
80-8F	Erase Sectors	Valid	Valid	Valid	Valid	Drv/Hd
03	Vendor Unique					Drv/Hd
87	Request sense		Valid	Valid	Valid	Drv/Hd
F5	Translate sector					Drv/Hd
CD	Wear Level		Valid	Valid	Valid	Drv/Hd
38	Write Multiple w/o Erase		Valid	Valid	Valid	Drv/Hd

Note *Addressed to drive 0. Both drives execute the command

8.2. Check Power Mode 98h/E5h

Check Power Mode Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	98h/E5h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							

Command Block specified by C-One upon completion/termination of Check Power Mode command (98h/E5h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	Power Mode Code. Will always be 00H							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.3. Execute Drive Diagnostic 90h

This command performs self-diagnostics on various internal components of the card. Results of the test are reported in the Error Register. Note that the bit definitions for the Error Register do not apply in this command; rather, the value in the Error Register is a diagnostic code.

Execute Drive Diagnostics Command Issued by Host

Task File Register	7	6	5	4	3	2	1	0
COMMAND	90h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							

Command Block specified by C-One upon completion/termination of Execute Drive Diagnostics command (90h)

Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V		V				V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
ERROR	Diagnostic Code. See Table 1 below							

Execute Drive Diagnostic Return Codes

Code	Description
01h	No error detected
02h	Formatter device error
03h	Sector buffer error
04h	ECC logic error
05h	Controller microprocessor error

8.4. Format Track 50h

This command erases 32 sectors starting at the sector specified by the Cylinder, Head, and Sector Number parameters in the task file. If the sector is not valid, an IDNF (ID Not Found) bit is set in the Error Register and the command terminates.

In CHS mode, the number of sectors to format per track will be set to the number of Current Sectors per Track in the Identify Drive data, by default 20h. Otherwise, it will be set to the number of sectors per track as set by an Initialize Drive Parameters command. It must be the same as the actual number of sectors per track reported.

In LBA mode, the number of sectors to be formatted per track is specified by the Host in the Sector Count register. The sector count must be set to 20h, otherwise the command will be aborted.

For backward compatibility, the card accepts one sector of data from the host. This data is not used. The "Erase" function is then called to erase the sectors indicated by this command (and any other sectors also marked "Old" by any previous operation).

Format Track Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	50h							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	[LBA mode only] LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	[LBA mode only] The number of sectors to be formatted on the track. Must be set to 20h							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Format Track command (50h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V				V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR				V		V		V

8.5. Identify Drive ECh

This command passes to the host one sector of data describing the card's parameters. See following table for a detailed description of the Identify Drive data.

Identify Drive Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	ECh							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Identify Drive command (ECh)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.6. Identify Drive Information

Word	Data	Description		
0	848Ah	General configuration bit-significant information:		
		bit	Data	Description
		15	1	Non-rotating disk drive
		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 is < 0.5%
		10	1	Disk transfer rate > 10Mbs
		9	0	10 Mbs <= Disk transfer rate > 5Mbs
		8	0	Disk transfer rate !<= 5Mbs
		7	1	Removable cartridge drive
		6	0	Not a fixed drive
		5	0	Spindle motor control option not implemented
		4	0	Head switch time !> 15 sec
		3	1	Not MFM encoded
		2	0	Not soft sectored
		1	1	Hard sectored
		0	0	reserved
1	Note 1	Default number of Cylinders		
2	0000h	reserved		
3	0008h	Default number of Heads		
4	4000h	Number of unformatted bytes per track		
5	0200h	Number of unformatted bytes per sector		
6	0020h	Default number of sectors per track		
7-8	XXXXh	Number of sectors per card (Word 7=MSB , Word 8= LSB)		
9	XXXXh	vendor unique		
10-19	2020h ...2020h	20 ASCII char serial number. Words 10-19 are filled with 20 ASCII pace' chars, 20h		
20	0003h	Buffer type: Dual ported, multi-sector, w/read cache		
21	0002h	Bufer size, in 512 byte increments		
22	0004h	ECC length		
23-26	'00001.02'	Firmware revision, 8 ASCII chars		
27-46	C-One	Model number, 40 ASCII chars. Note: ' denotes the ASCII pace' character, 20h		
47	0001h	Maximum Block Count=1 for Read/write Multiple commands		
48	0000h	Cannot perform doubleword I/O		
49	0200h	Capabilities: LBA supported, DMA not supported		
50	0000h	reserved		
51	0200h	PIO timing mode 2,		
52	0000h	DMA transfer not supported		
53	0001h	Translation parameters are valid		

54	Note 1	Number of Current Cylinders
55	Note 1	Number of Current Heads
56	Note 1	Number of Current Sectors Per Track
57	Note 1	LSW of the Current Capacity in Sectors (LSW)
58	0000h	MSW of the Current Capacity in Sectors (MSW)
59	0001h	Current Setting for Block Count=1 for R/W Multiple commands
60	Note 1	LSW of the total number of user addressable LBA
61	0000h	MSW of the total number of user addressable LBA
62-127	2020h ...	reserved. Words 64 through 255 are filled with the ASCII pace' character, 20h
128-159	... 2020h ...	vendor unique
160-255	2020h	reserved

Note 1: These values are dependent upon the total capacity of the IDE, be it a 32,64MB - 2.0G.

8.7. Idle 97h/ E3h

Although this command is supported for backward compatibility, it has no actual function. The card will always return good status at the completion of this command.

Idle Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	97h/E3h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	Timeout Parameter. This parameter is ignored by the card.							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Idle command (97h/E3h)								
Task File Register	7	6	5	4	3	2	1	0
STATUS	BSY V	DRDY V	DWF V	DSC V	DRQ V	CORR	IDX	ERR V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
ERROR	BBK	UNC	MC	IDNF	MCR	ABRT V	TK0NF	AMNF

8.8. Idle Immediate 95h/E1h

Although this command is supported for backward compatibility, it has no actual function. The card will always return good status at the completion of this command.

Idle Immediate Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	95h/E1h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Idle Immediate command (95h/E1h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.9. Initialize Drive Parameters 91h

This command allows the host to alter the number of sectors per track and the number of heads per cylinder. This enables Translation Mode, which maps the flash storage using the altered parameters. On Host Reset, the default is 32 Sectors per Track and 4 Heads per Cylinder. The current values used for mapping are returned in the Identify Drive command as Number of Current Sectors per Track, and Number of Current Heads.

Initialize Drive Parameters Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	91h							
DRIVE/HEAD	nu	nu	nu	D	Number of Heads per Cyl minus 1			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	The Number of Sectors per Track							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Initialize Drive Parameters command (91h)								
Task File Register	7	6	5	4	3	2	1	0
STATUS	BSY V	DRDY V	DWF	DSC V	DRQ V	CORR	IDX	ERR V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
ERROR	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF

8.10. Read Buffer E4h

This command transfers the current contents of the first page of the data buffer (512 bytes) to the host.

Read Buffer Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	E4h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Read Buffer command (E4h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.11. Read Long (w/ and w/o retry) 22h/23h

This command is similar to the Read Sectors command except the contents of the Sector Count register are ignored and only one sector is read. The 512 data bytes and 4 ECC bytes are read into the buffer (with no ECC correction) and then transferred to the host.

Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	22h (retries enabled) -or- 23h (retries disabled)							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the sector/LBA to transfer			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer. This should be set to 01 for compatibility							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Read Long command (22h/23h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	H[3:0] or LBA[27:24] of the sector requested			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the sector requested							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the sector requested							
SECTOR	Sector[7:0] or LBA[7:0] of the sector requested							
SECTOR COUNT	00 if the command proceeded without error. 01 if an error occurred							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V			V		V		V

8.12. Read Multiple C4h

This command is supported for backward compatibility. If R/W Multiple commands have been enabled by a previous valid Set Multiple command, the Read Multiple command is identical to Read Sectors operation except that several sectors are transferred as a block to the Host without intervening Host handshaking. The block count is the number of sectors to be transferred as a block. It is established using the Set Multiple command. Although the Set Multiple, and R/W Multiple commands are supported, the only valid block count is one.

If Read Multiple has not been enabled, the ABRT (Aborted Command) bit is set in the Error register and the command terminates.

Read Multiple Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	C4h							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Read Multiple command (C4h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V	V		V
DRIVE/HEAD	na	na	na	na	H[3:0] or LBA[27:24] last good sector transferred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the last good sector transferred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the last good sector transferred							
SECTOR	Sector[7:0] or LBA[7:0] of the last good sector transferred							
SECTOR COUNT	The number of sectors that were not transferred if an unrecoverable error occurred. Zero otherwise.							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V	V	V	V	V	V	V	V

8.13. Read Sectors 20h/21h

This command transfers data from the C-One card to the Host. Data transfer starts at the sector specified by the Cylinder, Head, and Sector Number registers in the Task File, and proceeds for the number of sectors specified in the Sector Count Register.

Read Sectors Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	20h (retries enabled) -or- 21h (retries disabled)							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Read Sectors command (20h/21h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V	V		V
DRIVE/HEAD	na	na	na	na	H[3:0] or LBA[27:24] last good sector transferred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the last good sector transferred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the last good sector transferred							
SECTOR	Sector[7:0] or LBA[7:0] of the last good sector transferred							
SECTOR COUNT	The number of sectors that were not transferred if an unrecoverable error occurred							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V	V	V	V	V	V		V

8.14. Read Verify Sectors 40h/41h

The Read Verify Sectors command verifies one or more sectors on the card by transferring data from the Flash media to the data buffer in the card and verifying that the ECC is correct. It is performed identically to the Read Sectors command, except that DRQ is not asserted, and no data is transferred to the host. If an uncorrectable error occurs, the read verify will be terminated at the failing sector. The Command Block Registers contain the CHS, or LBA of the sector in which the error occurred. Read Verify Sectors Command Issued by Host

Task File Register	7	6	5	4	3	2	1	0
COMMAND	40h (retries enabled) -or- 41h (retries disabled)							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to verify							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to verify							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to verify							
SECTOR COUNT	The number of sectors/logical blocks to verify							
FEATURES	nu							

Command Block specified by C-One upon completion/termination of Read Verify Sectors command (40h/41h)

Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V	V		V
DRIVE/HEAD	na	na	na	na	H[3:0] or LBA[27:24] last sector verified, or sector where an unrecoverable error occurred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the sector verified, or sector where an unrecoverable error occurred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the sector verified, or sector where an unrecoverable error occurred							
SECTOR	Sector or LBA[7:0] of the sector verified, or sector where an unrecoverable error occurred							
SECTOR COUNT	The number of sectors that not yet verified if an unrecoverable error occurred							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V	V	V	V	V	V		V

8.15. Recalibrate 1xh

Although this command is supported for backward compatibility, it has no actual function. The card will always return good status at the completion of this command.

Recalibrate Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	1xh							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Recalibrate command (1xh)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS		V	V	V				V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.16. Seek 7xh

This command is supported for backward compatibility. Although this command has no actual function, it does perform a range check of valid track, and posts an IDNF error if the Head or Cylinder specified is out of bounds.

Seek Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	7xh							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the track			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the track							
YLINDER LOW	Cylinder[7:0] or LBA[15:8] of the track							
SECTOR START	(Valid in LBA mode only) LBA[7:0] of the track							
SECTOR COUNT	nu							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Seek command (7xh)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR			V	V	V	V		

8.17. Set Features Efh

This command allows the host to alter the card's internal clock, choosing from three speeds to optimize performance and power. The Description table below shows the valid data, which may be set in the Feature Register by the Host. All other values are invalid and will cause the ABRT (Command Aborted) bit to be set in the Error Register and the command to terminate. A feature number of 97h specifies that the C-One card internal clock is to be set according to the code in the Sector Count register. The remaining valid values are essentially NOPs, simply returning command-completed status.

Set Features Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	Efh							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	If Feature Number = 97h, then specifies the card internal clock according to the table below							
FEATURES	Feature Number. Refer to the table below							
Command Block specified by C-One upon completion/termination of Set Features command (EFh)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

Description of Valid Feature Numbers

Code	Description
01h	Enable 8-bit data transfers
02h	Enable write cache *
03h	Set transfer mode based on value in sector count
33h	Disable retry *
44h	Vendor unique length of ECC on read long/write long commands
54h	Set cache segments to sector count register value*
55h	Disable read look-ahead feature
66h	Disable reverting to power on defaults
77h	Disable ECC *
81h	Disable 8-bit data transfers
82h	Disable write cache *
88h	Enable ECC *
99h	Enable retries *
AAh	Enable read look-ahead feature
ABh	Set maximum prefetch using sector count register value *
BBh	4 bytes of ECC apply on read long/write long commands
CCh	Enable reverting to power on defaults
	* These command are vendor-specified

8.18. Set Multiple C6h

This command is supported for backward compatibility. This command is used either to set the block count

(the number of sectors per block), simultaneously enabling R/W Multiple command support, or to disable support of R/W Multiple commands. Although setting, reading, and writing blocks are supported, the only valid block count is one. If

the block count specified by the Host is greater than one, the command will be aborted; the ERR bit in the Status Register will be set, and the ABRT bit in the Error Register will be set. If the contents of the Sector Count Register is 1,

Read Multiple and Write Multiple commands are enabled until the next Host RESET.

Invoking this command with Sector Count = 0 will disable R/W Multiple commands. In this case, the C-One card will abort all subsequent R/W Multiple commands, issued by the Host.

Set Multiple Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	C6h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	01: R/W Multiple command transfer enabled, 00: R/W Multiple command transfer disabled							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Set Multiple command (C6h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.19. Sleep

Although this command is supported for backward compatibility, it has no actual function. The card will always return good status at the completion of this command.

Sleep Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	99h/E6h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Sleep command (99h/E6h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.20. Standby 96h/E2h

Although this command is supported for backward compatibility, it has no actual function. The card will always return good status at the completion of this command.

Standby Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	96h/E2h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	Timeout Parameter. This is ignored by the PRETEC card							
FEATURES	nu							

Command Block specified by C-One upon completion/termination of Standby command (96h/E2h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.21. Standby Immediate 94h/E0h

Although this command is supported for backward compatibility, it has no actual function. The card will always return good status at the completion of this command.

Standby Immediate Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	94H/E0h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							

Command Block specified by C-One upon completion/termination of Standby Immediate command (94H/E0h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR						V		

8.22. Write Buffer E8h

This command transfers 512 bytes of data from the host to the first page of the data buffer.

Write Buffer Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	E8h							
DRIVE/HEAD	nu	nu	nu	D	nu			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	nu							
FEATURES	nu							

Command Block specified by C-One upon completion/termination of Write Buffer command (E8h)								
Task File Register	7	6	5	4	3	2	1	0
STATUS	BSY V	DRDY V	DWF V	DSC V	DRQ V	CORR	IDX	ERR V
DRIVE/HEAD	na	na	na	na	na			
CYLINDER HI	na							
CYLINDER LOW	na							
SECTOR	na							
SECTOR COUNT	na							
ERROR	BBK	UNC	MC	IDNF	MCR	ABRT V	TK0NF	AMNF

8.23. Write Long (w/ and w/o retry) 32h/33h

This command is similar to the Write Sectors (w/ retry) except the contents of the Sector Count register are ignored and only one sector is written. The 512 data bytes and 4 ECC bytes are transferred from the host and then written from the buffer to the flash..

Write Long Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	32h (retries enabled) -or- 33h (retries disabled)							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer. Should be set to 1 for compatibility.							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Write Long command (32h/33h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na?	L	na?	na?	H[3:0] or LBA[27:24] last good sector transferred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the last good sector transferred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the last good sector transferred							
SECTOR	Sector[7:0] or LBA[7:0] of the last good sector transferred							
SECTOR COUNT	1 if an unrecoverable error occurred, 0 if the command proceeded successfully							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR				V		V		

8.24. Write Multiple C5h

This command is supported for backward compatibility. If R/W Multiple commands have been enabled by a previous valid Set Multiple command, the Write Multiple command is identical to Write Sectors (w/retry) operation except that several sectors are transferred as a block from the Host without intervening Host handshaking. Although the Set Multiple, and R/W Multiple commands are supported, the only valid block size is one.

If Write Multiple has not been enabled, the ABRT (Command Aborted) bit is set in the Error register and the command terminates.

Write Multiple Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	C5h							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Write Multiple command (C5h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na?	L	na?	na?	H[3:0] or LBA[27:24] last good sector transferred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the last good sector transferred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the last good sector transferred							
SECTOR	Sector[7:0] or LBA[7:0] of the last good sector transferred							
SECTOR COUNT	The number of sectors that were not transferred if an unrecoverable error occurred							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V		V	V	V	V		V

8.25. Write Multiple without Erase CDh

This command is similar to the Write Multiple command with the exception that an implied erase before write operation is not preformatted. The sectors should be pre-erased with the Erase Sectors command before this command is issued.

Write Multiple Command without Erase Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	CDh							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Write Multiple command (C5h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na?	L	na?	na?	H[3:0] or LBA[27:24] last good sector transferred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the last good sector transferred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the last good sector transferred							
SECTOR	Sector[7:0] or LBA[7:0] of the last good sector transferred							
SECTOR COUNT	The number of sectors that were not transferred if an unrecoverable error occurred							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V		V	V	V	V		V

8.26. Write Sectors 30h/31h

This command transfers data from the Host to the C-One card. Data transfer starts at the sector specified by the Cylinder, Head, and Sector Number registers in the Task File, and proceeds for the number of sectors specified in the Sector Count Register.

If the address of the starting sector is not within the range of addresses supported by this card, the IDNF (ID Not Found) bit is set in the Error Register and the command terminates.

Write Sectors Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	30h (retries enabled) -or- 31h (retries disabled)							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer							
FEATURES	nu							
Command Block specified by C-One upon completion/termination of Write Sectors command (30h/31h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na	L	na	na	H[3:0] or LBA[27:24] last good sector transferred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the last good sector transferred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the last good sector transferred							
SECTOR	Sector[7:0] or LBA[7:0] of the last good sector transferred							
SECTOR COUNT	The number of sectors that were not transferred if an unrecoverable error occurred							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V		V	V	V	V		V

8.27. Write Sectors without Erase 38h

This command is similar to the Write Sectors command with the exception that an implied erase before write operation is not performed. This command has the same protocol as the Write Sectors command. The sectors should be pre-erased with the Erase Sectors command before this command is issued. If the sector is not pre-erased with the Erase Sectors command, a normal write sector operation will occur.

Write Sectors without Erase Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	38h							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	The number of sectors/logical blocks to transfer							
FEATURES	nu							

8.28. Translate Sectors 87h

This command allows the host a method of determining the exact number of times a user sector has been erased and programmed. The controller responds with a 512 bytes buffer of information containing the desired cylinder, head, and sector, including its Logical Address, and the Hot Count, if available, for that sector. The following table represents the information in the buffer.

Translate Sectors Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	87h							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the first sector/LBA to transfer							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the first sector/LBA to transfer							
SECTOR START	Sector[7:0] or LBA[7:0] of the first sector/LBA to transfer							
SECTOR COUNT	nu							
FEATURES	nu							

Command Block specified by C-One upon completion/termination of Translate Sectors command (87h)								
Task File Register	7	6	5	4	3	2	1	0
	BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR
STATUS	V	V	V	V	V			V
DRIVE/HEAD	na?	L	na?	na?	H[3:0] or LBA[27:24] last good sector transferred			
CYLINDER HI	Cylinder[15:8] or LBA[23:16] of the last good sector transferred							
CYLINDER LOW	Cylinder[7:0] or LBA[15:8] of the last good sector transferred							
SECTOR	Sector[7:0] or LBA[7:0] of the last good sector transferred							
SECTOR COUNT	nu							
	BBK	UNC	MC	IDNF	MCR	ABRT	TK0NF	AMNF
ERROR	V			V		V		V

Translate Sector Information

Address	**Information**
00h-01h	Cylinder MSB(00), Cylinder LSB(01)
02h	Head
03h	Sector
04h-06h	LBA MSB(04) - LSB(06)
07h-12h	Reserved
13h	Erased Flag(FFh)=Erased; 00h= Not Erased
14h-17h	Reserved
18h-1Ah	Hot count MSB(18)-LSB(1A)
1Bh-1FFh	Reserved

8.29. Wear Level - F5h

This command is effectively a NOP command. The Sector Count Register will always be returned with an 00h indicating Wear Level is not needed.

Wear Level Command Issued by Host								
Task File Register	7	6	5	4	3	2	1	0
COMMAND	F5h							
DRIVE/HEAD	nu	L	nu	D	H[3:0] or LBA[27:24] of the starting sector/LBA			
CYLINDER HI	nu							
CYLINDER LOW	nu							
SECTOR START	nu							
SECTOR COUNT	Completion Status							
FEATURES	nu							

8.30. Error Posting

The following table defines each command valid errors. See Error and Status register definitions.
Register Contents During Error Posting

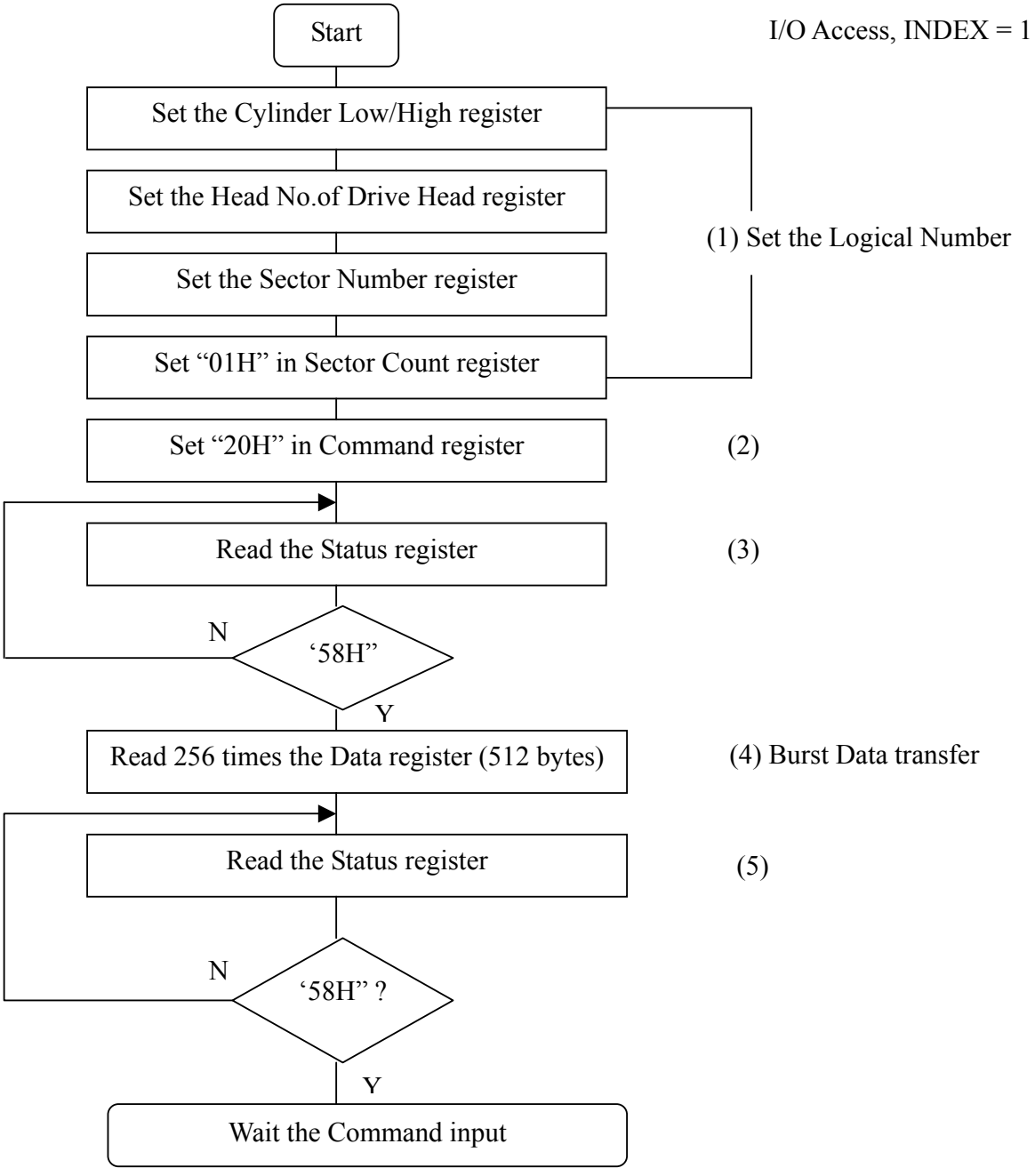
Command	Error Register						Status Register				
	BB	UN	IDN	ABR	T0N	AMN	DRD	EW	DSC	COR	ERR
Check Power Mode				y			y	y	y		y
Execute Drive											y
Diags			y	y			y	y	y		y
Format Track				y			y	y	y		y
Identify Drive				y			y	y	y		y
Idle				y			y	y	y		y
Idle Immediate							y	y	y		
Initialize Drive				y	y		y	y	y		y
params				y			y	y	y		y
Recalibrate	y	y	y	y		y	y	y	y	y	y
Read Buffer	y	y	y	y		y	y	y	y	y	y
Read Long	y	y	y	y		y	y	y	y	y	y
Read Multiple	y	y	y	y		y	y	y	y	y	y
Read Sector(s)			y	y			y	y	y		y
Read Verify				y			y	y	y		y
Sector(s)				y			y	y	y		y
Seek				y			y	y	y		y
Set Features				y			y	y	y		y
Set Multiple Mode				y			y	y	y		y
Sleep				y			y	y	y		y
Standby	y		y	y			y	y	y		y

y = Valid for this command

9. Sector transfer Protocol

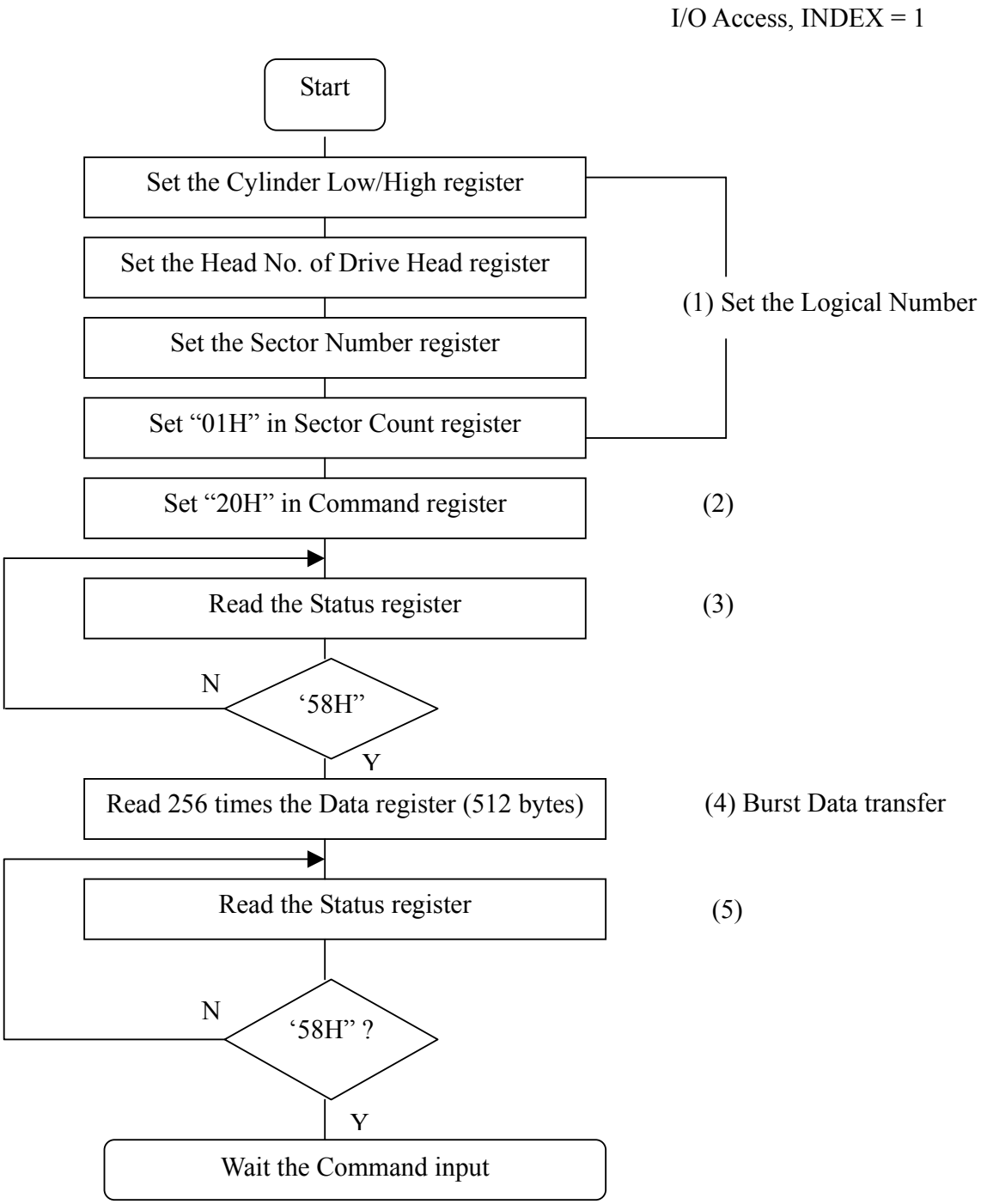
9.1. Sector read

Sector read procedure after the card-configured 1/0 interface is shown as follows.



9.2. Sector write

1 sector writes procedure after the card-configured 1/0 interface is shown as follows.



10. Physical specification

2.5” IDE: