AVATAR Corporation

AR-2170NI

IDE/AT INTERFACE

PRODUCT MANUAL

Part Number 98001-0004

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NOTICE

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Windows 95 is a registered trademark of Microsoft Coporation.

CMOS Setup Parameters:

Model	Cylinders	Heads	Sectors
HD-170	651	16	32

Note: It is not necessary to specify precompensation or landing zone as these values have been determined by Avatar engineering and preset in microcode.

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1.0 INTRODUCTION

The AR-2170NI is a 2_" high capacity, high performance, removable cartridge disk drive. It is similar to a standard fixed disk drive with the exception that the media can be removed and other media inserted. The AR-2170NI is based on industry standard Winchester technology as used in many of today's fixed disk drives.

The cartridges used with the AR-2170NI are called HARDiskettes. The HARDiskette is designed around the Personal Data Cartridge (PDC) concept. The Personal Data Cartridge concept is based on the need of computer users to have a place to store their own personal data. Personal data may include documents, spreadsheets, email, presentations, video and sound files. The high performance and high capacity of the HARDiskette allow the personal data to be used on-line without the need to first copy them to a fixed disk.

The HARDiskette contains a single thin film glass disk encased in a metal and plastic shell. As the HARDiskette is inserted into the drive, a shutter slides open to allow access to the media. The drive contains all other mass storage elements, including the actuator, heads, load mechanism, bus controller, data buffer, read/write channel, spindle motor, air filter, and associated control subsystems.

When the HARDiskette is loaded, the disk is mechanically and magnetically coupled to the spindle motor.

The head positioning subsystem is controlled by a high performance, full quadrature, embedded sector servo with adaptives to ensure high performance. The adaptives compensate for repeatable runout, spring forces associated with the read/write flex, and servo offsets. These features assure cartridge interchangeability during the drive's service life.

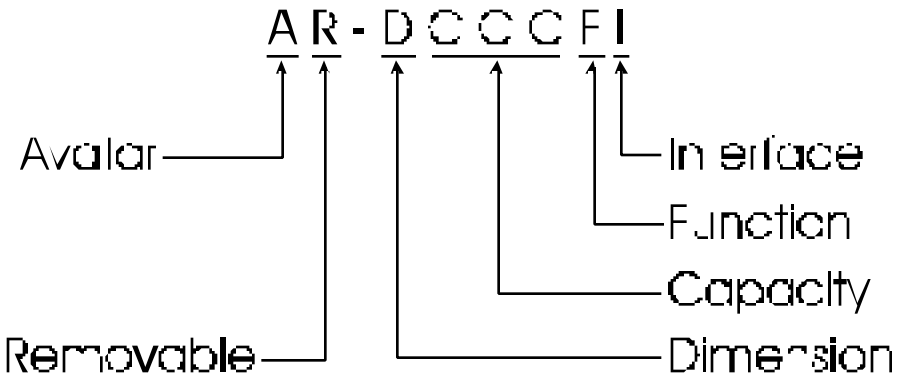
The drive has one microprocessor for support of the embedded controller and drive control functions.

Overview

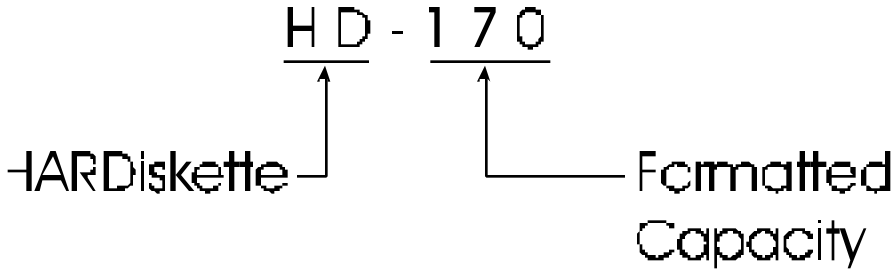
This Technical Manual describes all physical and electrical characteristics necessary to utilize the AR-2170NI in AT mode.

Nomenclature

Avatar part numbers carry information that may be helpful when identifying key attributes. Each character is described below:



Identifier	Variables
Dimension	2 = 2.5 inch footprint
Capacity	170 = 170 MBytes
Function	N = Normal
Interface	I = IDE



Key Features

AR-2170NI Drive

- Automatic Microprocessor Controlled Diagnostics
- Automatic Read Look Ahead Buffer Management
- 128 KB Buffer
- Embedded Servo System
- Low Power Requirement
- Air Filtration System
- Light weight at Less than 6 Ounces
- Programmable Low Power Modes
- Ramp Loaded Heads Never Contact the Disk
- 88 Bit Reed Solomon ECC (Multiple Burst)
- Seek Times Less Than 12 msec.
- 'Constant Density' Recording Method
- 150 G Non-Operating Shock Tolerance

HARDiskette

- 170 Megabytes Capacity
- Light Weight at Less Than 1.6 Ounces
- Rugged - Can Withstand a 36 inch Fall in Carrying Case

2.0 INSTALLATION

AR-2170NI Options

There are four pins located on the 50 pin male connector that can be used to configure the drive. These pins are designated in pairs on the top of the PCB as Ma (Master) and Sl (Slave). The AR-2170NI is shipped configured as a slave with a jumper installed in the Sl position.

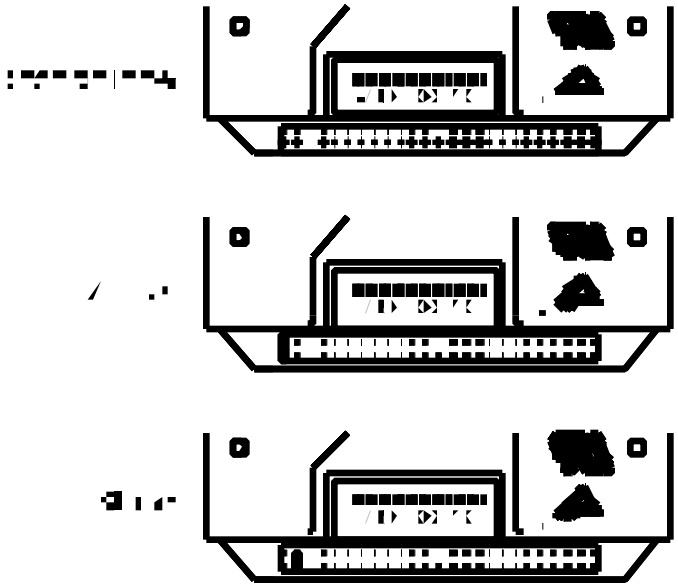


Figure 1: Drive Options

Jumper Position		Result
Ma	Sl	
Open	Open	Drive operates as a master with no slave.
Open	Closed	Drive operates as a slave (Default)
Closed	Open	Drive operates as a master with a slave
Closed	Closed	Invalid configuration

HARDiskette Options

The HARDiskette is equipped with a write protect switch. When viewed from the front of the cartridge, this switch is located at the top left hand corner. The switch is set as follows:

Write Protect Option	
red bar not exposed	read only
red bar exposed	writing allowed

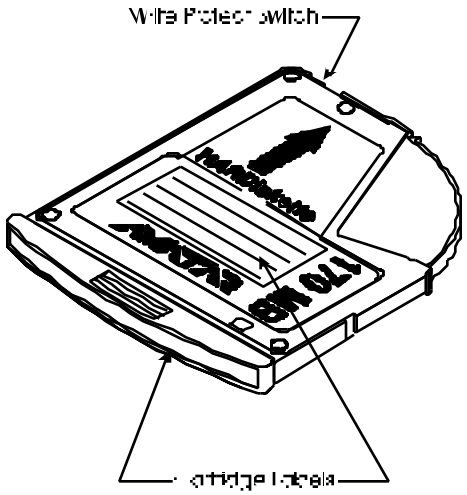


Figure 2: HARDiskette Options

The HARDiskette contains two labels, one on the top and the other on the grip, that can be used to identify the cartridge and its contents. These labels are designed to be written on using a permanent marking pen. These labels are reusable and can be cleaned off by gently rubbing off the ink with your finger. These labels are specially designed to last for the life of the cartridge. No other labels are allowed on the cartridge. Placing any other label on the cartridge will void the warranty, and will most likely damage both the drive and the cartridge.

> Caution: In order to avoid damaging the HARDiskette, the information label should only be written on with a soft-tipped permanent marker, such as a Sharpie.

Cabling

All 2.5 inch AT/IDE interface drives use a standard 44 pin male connector that incorporates power, control, and data signals. This configuration differs from 3.5 inch IDE drives which employ a 40 pin signal connector and a separate 4 pin power connector. Therefore, if you are using the AR-2170NI with a 40 pin cable, you will need to use an adapter card. Systems designed for 2.5 inch drives will already have a 44 pin cable and/or connector available.

Since power, ground and data are all in the same connector, improper connection could damage the computer, the drive, or both. Pin 20 on the IDE connector is keyed to prevent improper connection. Please ensure that pin 20 of the female mating connector is also properly keyed and that the cable is properly connected before turning on the system power.

> Caution: System power should always be turned off when connecting or disconnecting a cable to the drive.

Mounting Dimensions and Orientation

The AR-2170NI can be mounted in either of two orientations as shown in Figure 4. Screw holes are available on the bottom and sides of the drive for proper mounting. Shock mounts are not required to meet drive specifications, and therefore, no sway space is necessary. However, it is recommended that you leave a minimal amount of clearance for air flow to ensure proper operating temperatures.

Certain switching power supplies or other high frequency components may emit electrical noise that could degrade drive performance. For best results, install the drive in an area free of these interferences.

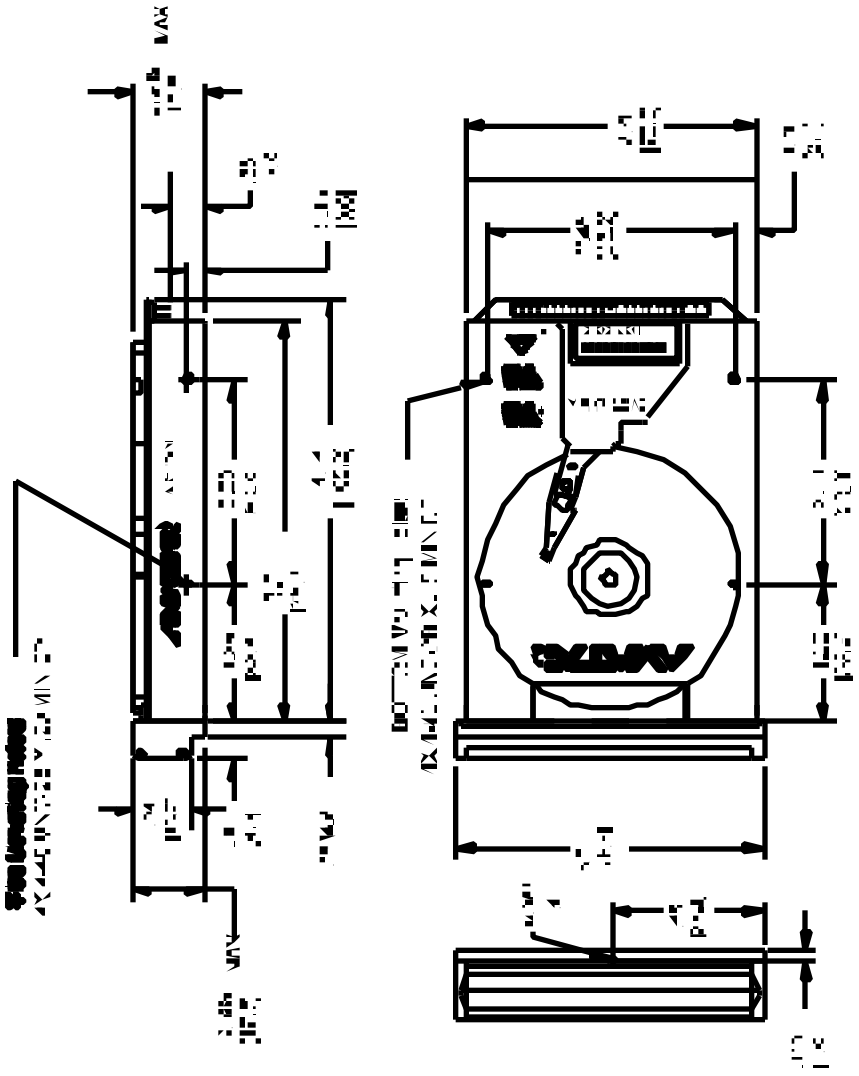


Figure 4: Mounting Dimensions

The AR-2170NI can be reliably operated in the two orientations pictured below.

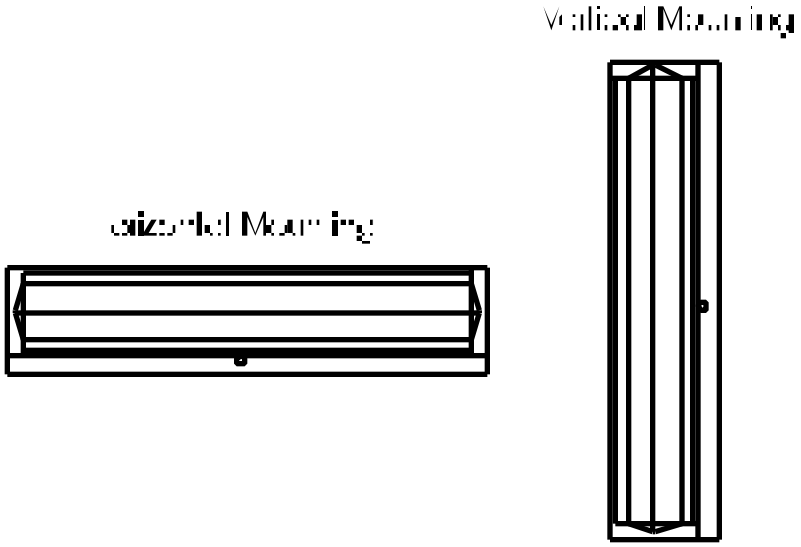


Figure 5: Mounting Orientations

HARDiskette Insertion and Removal

To insert the HARDiskette, hold the black plastic grip between your fingers with the arrow pointed away from your hand. With the cartridge label facing the same direction as the top of the drive, push the HARDiskette through the double doors until it clicks into place. The HARDiskette housing is designed to prevent the cartridge from being inserted incorrectly.

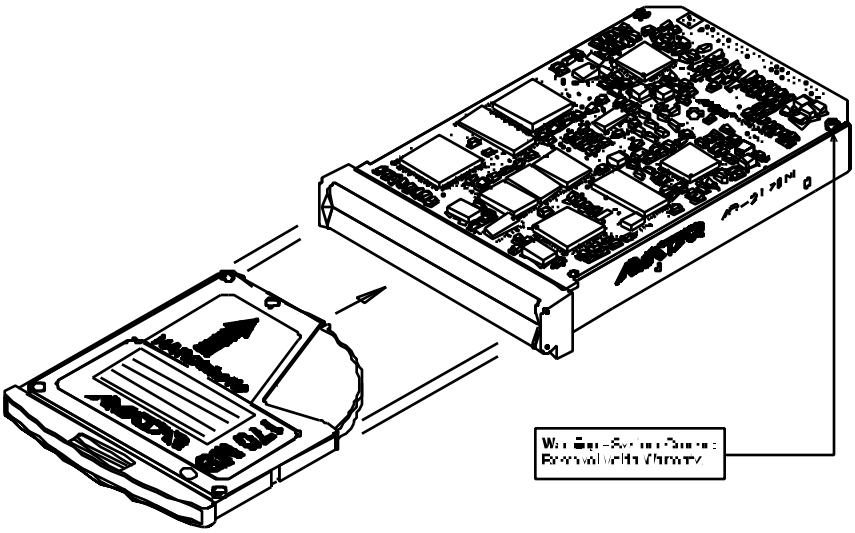


Figure 6: HARDiskette Insertion

The drive should now be ready for operation. To conserve power, the drive will not spin up the media until the computer sends a command to access the disk. Spin-up delay is about 2 seconds. If the drive does not come Ready, or experiences some other type of difficulty, eject the HARDiskette and repeat the process.

To eject the HARDiskette, issue a software 'eject' from the operating system. For example, under Windows 95, highlight the AR-2170NI drive, generally shown as "Removable Drive (D:), with the mouse and press the right mouse button to access the drop down menu for that drive. Select 'Eject' from the menu.

When the drive receives the eject command, it will move the heads onto the ramp away from the media, spin down the media, and ejects the HARDiskette. You can now pull the HARDiskette from the drive and place it back in its protective jacket.

It is best to keep the HARDiskette in its protective jacket when it is not inserted in the drive. This jacket provides an enclosed environment to help protect from contaminates and other conditions that might result in excessive contamination and shocks beyond the cartridge's specifications.

CMOS Setup

Whenever a peripheral device is changed or added, your computer's CMOS table may require modification. This table is typically accessed at power on by pressing a special key, or by running a setup program.

> Note: Some newer BIOS's can automatically detect the drive's parameters without requiring the user to set them manually.

Once inside the CMOS setup you will be able to specify various drive parameters. The AR-2170NI only needs the number of heads, sectors, and cylinders to be set in CMOS. Other parameters such as precomp, landing zone, etc. are preset and hard coded into the drive.

> Note: In order to maintain compatibility between systems, the AR-2170NI requires that only the specified drive parameters be set in the system CMOS. If any other parameters are used, the drive will reject commands to read or write data to the cartridge. This protects data on the cartridges from being destroyed by incorrect settings.

The AR-2170NI should be set with **651 cylinders, 16 heads, and 32 sectors**. These exact parameters will most likely not be available as one of the preset drive types. You will usually need to locate the user definable BIOS entries (typically 47 or 48) and enter the parameters listed above. From these parameters, you can calculate total capacity of the AR-2170NI for example as 651 x 16 x 32 x 512 = 170,655,744 bytes. Even on a freshly formatted disk this total capacity cannot be used by the user since some of the space is required for partition tables, FAT tables, etc.

3.0 SOFTWARE

Windows 95

Microsoft has gone to great lengths to properly handle removable media in Windows 95. The AR-2170NI is fully supported by Windows 95 in all versions of the OEM Preinstall Kit (OPK) delivered to Microsoft OEM customers since OPK Supplement 2 in December '95. Windows 95 automatically recognizes the AR-2170NI and assigns it a removable drive icon. Windows 95 includes support to eject a cartridge and will automatically detect when a new cartridge is installed.

Ejecting a HARDiskette

To eject a HARDiskette under Windows 95, bring up either 'My Computer' or 'Explorer' and click on the AR-2170NI using the right mouse button to bring up the drop down menu for that drive. Click on the 'Eject' menu option. The cartridge will be spun down and ejected from the drive.

Inserting a HARDiskette

When a HARDiskette is inserted into the AR-2170NI, Windows 95 will recognize the insertion and spin up the cartridge. If the cartridge is unformatted Windows 95 will prompt you to format the cartridge. If the cartridge is formatted, Windows 95 will display a window showing the contents of the cartridge.

> Note: If Windows 95 is started with no cartridge in the drive, the first insertion of a formatted cartridge will not display a window showing drive contents.

Using Multiple Cartridges

With Windows 95 you can work with multiple cartridges simultaneously. When an application requires a cartridge other than the one installed, Windows 95 will prompt you to insert that cartridge with a message showing the cartridge's label information.

Warning:	We highly recommend that you label each cartridge used with Windows 95. This can be done either in the format dialog box or after format in the drive's properties. You should also write this information on the outer cartridge label so that when Windows 95 prompts you to insert a particular cartridge, you will know which cartridge to insert.

DOS/Windows 3.X

The AR-2170NI will be recognized and can be accessed under both DOS and Microsoft Windows 3.X with the exception of exchanging cartridges. Since DOS buffers certain drive information and was not designed for removable media, exchanging media may cause it to overwrite the drive's tables, potentially causing severe data loss. Windows 3.X users should be encouraged to follow Microsoft's recommendation to upgrade to Windows 95.

4.0 SPECIFICATIONS

Capacity

Formatted (Megabytes).....170.6

Configuration

Actuator Type.....Voice Coil
Number of Disks.....1
Data Heads.....2
Servo System.....Embedded
Tracks per Surface.....1970
Bytes per Sector.....512
Sectors per Cylinder.....Varies by Zone
Sectors per Drive.....333,312
Spare Sectors per Drive.....1024
Flux Density (FCI).....62,000
Recording Density (BPI) 82,000
Recording Method.....1,7 RLL
Track Density.....4,300

Performance

Access Times (ms)
Track to Track .....<3
Average .....<12
Maximum 22
Average Latency (ms).....7.9
Rotational Speed (+/- .2%).....3805
Data Transfer Rate (MB/sec)
Host (burst).....13.3
Maximum (sustained).....2.1
Start Time (typical).....<2s
Stop Time (typical) 2s
Interleave ..... 1:1 (fixed)
Buffer Size ..... 128 KB
PIO Mode ..... Mode 3

Physical Characteristics

	AR-2170NI	HARDiskette
Height inches (mm)	0.689 (17.5)	0.180 (4.6)
Length inches (mm)	4.71 (119.63)	3.00 (76.2)
Width inches (mm)	2.86 (72.6)	2.69 (68.3)
Weight ounces (gms)	6.6 (187.4)	1.5 (41.0)

Power Requirements

Operational Mode	Power (Typ) 5 volts +/- 5%	
Spin-Up (peak)	770 mA	3.85 W
Idle	287 mA	1.42 W
Seek (random)	387 mA	1.93 W
Read/Write (random)	420 mA	2.10 W
Standby	99 mA	0.49 W
Sleep	17 mA	0.08 W

Environmental

Acoustic Noise (pressure)

- Seeking/Operating (1 meter) 45 dBA
- Idle (1 meter) 35 dBA

Altitude

- Non-Operating -400 to 40,000 feet
- Operating -400 to 10,000 feet

Humidity

- Maximum Wet Bulb 32ºC
- Non-Operating 8% to 80% non-condensing

Magnetic Field

- At Disk Surface 6 gauss maximum

Reliability and Maintenance

- Component Life 5 years
- Data Reliability 1 in 10e12 bits read
- MTBF 50,000 hours (POH)
- Preventive Maintenance None
- Start/Stop Cycles (minimum) 100,000
- Number of insertions (minimum) 10,000

Safety Standards

Avatar have been tested and comply with the following safety standards:

- CSA 22.2 #950
- TUV EN-60950
- UL 1950
- FCC Class B
- CE (Pending)

Shock

	AR-2170NI	HARDiskette
Operating	10 G's	10 G's
Non Operating (no cartridge in drive)	150 G's	24" fall to hard surface[1]
		36" fall in carrying case[1]

All shocks are 11 msec _ sine pulse

[1]Note: No loss of data after 2 drops

Vibration

Operating	0.25 G's 0 to peak
Non Operating	5 G's 0 to peak

Temperature

Non-Operating	- 40ºC to + 60ºC
Operating	5ºC to 55ºC
Thermal Gradient	20ºC per hour

5.0 DESIGN SUGGESTIONS

This chapter contains information and suggestions to assist in designing the AR-2170NI into a notebook computer.

BIOS Considerations

The following are topics to consider to increase the functionality of the AR-2170NI drive in your system.

Do not Translate

In order to maintain compatibility with a variety of systems and operating systems, the AR-2170NI does not allow any translation of its default parameters of 651 cyl, 16 hd, and 32 sect. The AR-2170NI follows the ATA-2 specification and will abort an "Initialize Device Parameters" command with other than the default parameters. It will then fail media access commands until the parameters are reset to default.

Spin up Delay

To help minimize power consumption the AR-2170NI does not spin up the media when powered on nor when new media is inserted. It will wait for the first identify or media access command before spinning up. The media takes about two seconds to spin up. The BIOS should be aware of this and allow enough time for the drive to respond on any media access commands. Most systems already allow more than 2 seconds to spin up.

Boot w/out Cartridge

Without a cartridge installed, the AR-2170NI will fail media access commands. Many BIOS's will assume a faulty drive (since they don't check for removability), and not allow DOS access. With a little additional code, the BIOS could check for a removable drive and provide DOS access. DOS could then report "Drive Not ready" until the media was inserted.

Boot Sequence

Many laptop BIOS's now allow the system to boot from any of the installed drives. As a bootable device, the AR-2170NI could be used to boot multiple operating systems or as an emergency boot disk in case the primary drive is damaged.

Automatic Standby

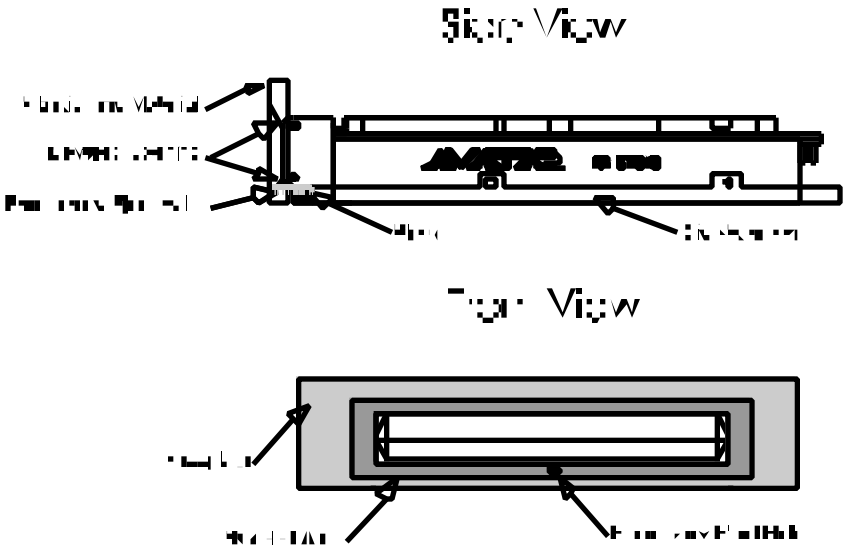
The AR-2170NI supports the optional ATA-2 Standby Timer. The BIOS can set the desired interval, and the AR-2170NI will automatically go into standby mode when no commands have been received for the specified interval.

Power off Eject

Like all removable media drives, the cartridge in the AR-2170NI should always be ejected before transporting the computer. Many high end laptops today have complete control over system power off. With this ability, the BIOS should be able to eject the cartridge from the AR-2170NI drive before power is completely cut off for any reason including operating system request, user request, or impending battery failure. An example of this would be the Macintosh floppy drive.

Hardware Considerations

Most notebook installations consist of the AR-2170NI installed into a tray that slides into the notebook's media bay. Here are some suggestions we would like to offer to assist in your design. The drive's full dimensions are shown in Chapter 2.



Creating an Opening

We recommend that the opening in the faceplate of the tray be designed to show a minimum amount of the AR-2170NI's bezel. The left and right sides of the opening should come to the edge of the beveled area on the sides of the bezel. The top and bottom of the opening should similarly come to where the beveled area on the sides of the bezel begin. To compensate for any difference in angle between the drive's bezel, and the tray's faceplate we recommend that the opening in the faceplate be beveled around the drive as shown in the drawing above. We believe this also enhances the overall appearance.

Emergency Eject Hole

The AR-2170NI is designed with an emergency mechanical eject mechanism. This is intended to be used only as a last resort to remove the media when the power is off. The hole is designed to accept a small paper clip. A small hole should be placed in the faceplate of the tray to match the hole in the bezel.

Bezel Placement

The AR-2170NI bezel is designed with a recessed portion at the bottom to assist accurate placement of the drive during assembly. By building a block of material at the front of the tray to match the recessed area on the drive, you can assure proper placement of the bezel in relationship to the front of the tray when assembled.

Side Mount

Due to the small 2.5” form factor of the AR-2170NI there is generally adequate area on the sides of the drive to attach it to the tray using the four side mounting holes on the drive.

Lower Tray Cut-out

In order to meet height restrictions in some installations you may want to consider cutting an opening in the material at the bottom of the tray to allow the bottom of the drive to drop down flush with the underside of the tray.

6.0 FUNCTIONAL DESCRIPTION

The AR-2170NI contains all necessary mechanical and electronic elements to position and maintain the heads, read and write data, control HARDiskette loading and unloading, and buffer data to and from the drive. The HD-170 is a 170 Megabyte HARDiskette that contains the thin film magnetic storage media used to store your data.

Air Filtration System

The HARDiskette contains a breather filter capable of operating without change for the service life of the drive.

Spindle Motor Mechanism

The sensorless spindle motor is mounted to the baseplate in a cam mechanism that raises and lowers the motor to engage or disengage the disk-hub assembly. When engaged, the spindle is mechanically and magnetically coupled to the disk. The motor is dynamically braked to a stop (typically 2 seconds) prior to ejecting the HARDiskette.

Error Correction

The AR-2170NI employs an 88 bit Reed Solomon polynomial for Data Field error detection and correction, in addition to a 16 bit CRC code for ID Field error detection. A burst of 11 bits or less will automatically be corrected on the fly with no impact in performance. Additionally, 2 bursts of 11 bits or less (or 1 burst of 22 bits or less) can be corrected through a software assisted algorithm.

Head Positioner Mechanism

The read/write heads are positioned by a full quadrature embedded sector servo, with adaptives to assure continued high performance. The adaptives compensate for repeatable run out, spring forces associated with the read/write, flex, and servo offsets. These features help assure HARDiskette interchangeability over the drive's service life.

Read/Write and Control Electronics

Internally, a single preamp IC is mounted in close proximity to the heads to control head selection, read preamplification, and the write data circuitry.

The microprocessor controlled circuit board provides the remaining electronic functions which include:

- Spindle Motor Control
- Interface Control
- Power Management
- Read/Write Circuitry
- Rotary Actuator Control
- Spin Speed Control

Read/Write Heads and Disks

Data is recorded on a single 65 mm diameter glass disk using Winchester type thin film heads.

7.0 AT INTERFACE

Physical Connection

Both power and control signals are supplied to the drive through a single 44 pin cable. Please note that separate filtered power is supplied to the logic and motor circuits to minimize noise coupling.

Maximum length of this 44 pin cable is 18 inches (457 mm) since it is TTL driven. Two drives may be daisy chained on this cable, however, cable length remains restricted to 18 inches.

Recommended mating connectors are as follows:

Connector Style	3M	Dupont	Elco
Flex Cable	N/A	86456-044	N/A
Ribbon Cable	N/A	N/A	20-8394-2044-04-101
PCBA Straight	N/A	86455-044	20-8390-2044-00-101
PCBA Right Angle	150250-5022TH	88333-044	20-8390-2044-04-101

Electrical Description

All signal levels are TTL compatible. A logic "1" is from 2.0 volts to 5.0 volts. A logic "0" is from 0.0 volts to 0.7 volts.

The interface between the host system IDE adapter and the AR-2170NI drive is termed the "Host Interface". The set of registers in the I/O space of the Host are known as the "Task File" registers.

All signals on the Host Interface have the prefix Host. All active low signals are prefixed with a "-" designation. All active high signals are prefixed with a "+" designation. Signals whose source is the Host are "outbound" and those whose source is the drive are "inbound".

The following table summarizes the 44 pin interface in AT mode:

Table 1: Interface Pinout

PIN	SIGNAL	PIN	SIGNAL
01	-HOST RESET	02	GND
03	+HOST DATA 7	04	+HOST DATA 8
05	+HOST DATA 6	06	+HOST DATA 9

07	+HOST DATA 5	08	+HOST DATA 10
09	+HOST DATA 4	10	+HOST DATA 11
11	+HOST DATA 3	12	+HOST DATA 12
13	+HOST DATA 2	14	+HOST DATA 13
15	+HOST DATA 1	16	+HOST DATA 14
17	+HOST DATA 0	18	+HOST DATA 15
19	GND	20	key
21	not connected	22	GND
23	-HOST IOW	24	GND
25	-HOST IOR	26	GND
27	-IOCHRDY	28	not connected
29	not used	30	GND
31	+HOST IRQ	32	-HOST IO16
33	+HOST ADDR 1	34	-HOST PDIAG
35	+HOST ADDR 0	36	+HOST ADDR 2
37	-HOST CS0	38	-HOST CS1
39	-HOST ACT/SLV	40	GND
41	+5V LOGIC	42	+5V MOTOR
43	GND	44	reserved
45	no pin	46	no pin
47	SLAVE[1]	48	SLAVE[1]
49	MASTER[1]	50	MASTER/SLAVE[1]

[1]Note: See Chapter 2 for more information on setting the Master and Slave Jumpers.

Table 2: Signal Descriptions

SIGNAL	DIR	DESCRIPTION
Active/Slave	I	Indicates drive activity in a one drive system, or slave presence in two drive systems. Mode of this line is determined by selection of the Master/Slave jumpers. (see Chapter 2).
Address 0 - 2 CS0,1	O	These five lines contain the binary coded address used to select individual Task File registers 1F0-1F7,3F6 and 3F7.
Data 0 - 15	I/O	These are the bi-directional data lines connecting the drive with the Host. The lower 8 bits are used for register and ECC access. All 16 are used for data transfers.
DACK	O	When operating in DMA mode, this signal is issued by the Host acknowledging that a data transfer has occurred.
DREQ	I	When operating in DMA mode, this signal is issued by the drive requesting that a data transfer take place.
IOCHRDY	I	The drive uses this signal to slow down the data transfer when in danger of being overrun by a fast Host processor.
IOR	O	Read strobe, whose rising edge clocks data from the drive Data register on to the Host data bus.
IOW	O	Write strobe, whose rising edge clocks data from the Host data bus into the drive Data register.
IOCS16	I	Indication to the Host that the Data register has been addressed and the drive is ready to send or receive a 16 bit word. This line is tri-stated with 24 mA capability.
IRQ14	I	Interrupt sent by the drive when it requires servicing. It is enabled only when the drive is selected and the Host has activated the IEN bit in the Digital Output register. IRQ is reset to zero by a Host read of the Status register or write to the Command register. This line is tri-stated with 24 mA capability.
PDIAG	I	Indicates to the Master that the Slave has passed internal diagnostics. This line is tri-stated with 24 mA drive capability.

Reset	O	Reset signal from the Host which is active low. Minimum pulse width is 10 usec.
5 Volt Logic	O	Regulated + 5 volts (+/-5 %)
5 Volt Motor	O	Unregulated +5 volts (+/- 5 %)

where:

I = to Host

O = from Host

Timing Requirements

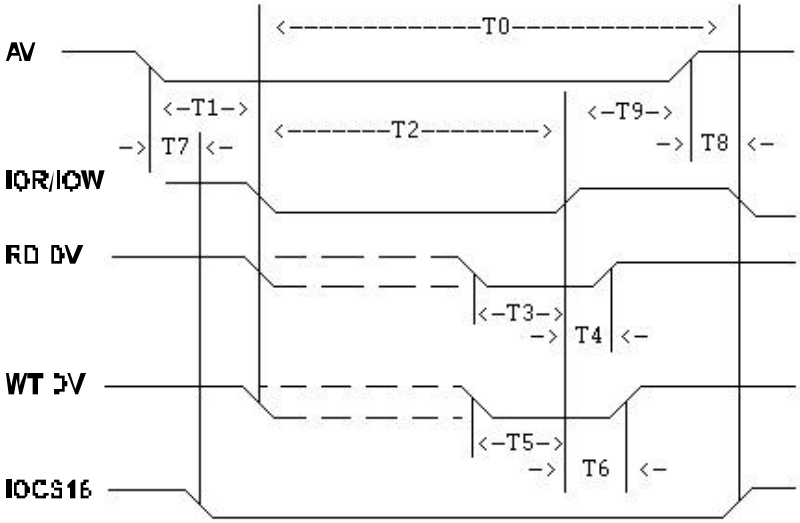


Figure 7: Timing Requirements

where:

AV = address valid (CS0, CS1, HA0 - HA2)

Rd DV/Wt DV = read data valid/write data valid.

Time	PIO Timing for AT	Min (ns)	Max (ns)
T0	Cycle Time	240	--
T1	AV to IOR/IOW	8	--
T2	IOR/IOW 16 bit	40	--
T3	IOW (data setup)	10	--
T4	IOW (data hold)	15	29
T5	IOR (data setup)	8	--
T6	IOR (data hold)	6	--
T7	AV to IOCS16 Assertion	--	20
T8	AV to IOCS16 Negation	--	8
T9	IOR/IOW to AV Hold	10	--

Host Address Decoding

The Host communicates with the drive using programmed I/O. this method requires the Host to drive HA0-2 to specify the desired register address, assert chip slect, and issue a read or write strobe (IOR/IOW).

Two different chip selects are utilized. The high order chip select (CS1) is used to select the Alternate Status register, the Digital Output register, and the Drive Address register. The low order chip select (CS0) is used to select all other registers.

CS0	CS1	HA	HA1	HA0	READ	WRITE
1	1	X	X	X	No Operation	No Operation
0	0	X	X	X	Invalid Address	Invalid Address
1	0	0	X	X	High Impedance	Not Used
1	0	1	0	X	High Impedance	Not Used
0	1	0	0	0	Data Register	Data Register
0	1	0	0	1	Error Register	Features Register
0	1	0	1	0	Sector Count	Sector Count
0	1	0	1	1	Sector Number	Sector Number
0	1	1	0	0	Cylinder Low	Cylinder Low
0	1	1	0	1	Cylinder High	Cylinder High
0	1	1	1	0	DH Register	DH Register
0	1	1	1	1	Status Register	Command Reg
1	0	1	1	0	Alt Status Reg	Dig Output Reg
1	0	1	1	1	Drive Addr Reg	Not Used

where: X is “don’t care”.

Register Descriptions

In the following descriptions, unused write bits should be treated as “don’t cares”, and unused read bits should be read as zeroes.

Alternate Status Register - 3F6 (read only)

This register contains information identical to the Status register, however, reading this register does not reset a pending interrupt. Contents are as follows:

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

Command Register - 1F7 (write only)

All commands (8 bits) are written to this register by the Host. Command execution begins immediately after this register is written. A list of executable commands with codes and parameters is included in the Command Description section.

Cylinder High Register - 1F5 (read/write)

This register contains the two high order bits of the starting cylinder number for any disk access. At the completion of each sector, and at the end of the command, this register is updated to reflect the current cylinder number.

Cylinder Low - 1F4 (read/write)

This register contains the low order 8 bits of the starting cylinder number for any disk access. At the completion of each sector, and at the end of the command, this register is updated to reflect the current cylinder number.

Data Register - 1F0 (read/write)

All data passed on read or write commands passes through this register. Additionally, sector table information for the Format command and associated data for the Identify command are transferred through this register. All data transfers are high speed 16 bit I/O operations, with the exception of the 8 bit transfer of ECC bytes following Read Long or Write Long commands.

Data is stored on the disk with the Least Significant Byte first, followed by the Most Significant Byte for each word. This is important to remember when testing the ECC circuitry.

Digital Output Register - 3F6 (write only)

This register contains two control bits as follows:

Bit #	7	6	5	4	3	2	1	0
	---	---	---	---	---	SRST	-IEN	---

where:

-IEN is the enable bit for the drive's interrupt to the Host. When this bit is active and the drive is selected, HOST IRQ14 is enabled through a tri-state buffer to the Host. When this bit is inactive, or the drive is not selected, the HOST IRQ14 pin will be in a high impedance state, even if an interrupt is pending.

SRST is used by the Host to reset the drive. When this bit is active, the drive is held reset. If two drives are daisy chained on the interface, this bit will reset both drives simultaneously.

Drive Address Register - 3F7 (read only)

This register contains the inverted drive select and head select addresses of the currently selected drive. The bits in this register are as follows:

Bit #	7	6	5	4	3	2	1	0
	RSVD	-WTG	-HS3	-HS2	-HS1	-HS0	-DS1	-DS0

where:

RSVD is reserved and not driven by the drive. When the Host reads the drive address register, this bit is in a high impedance state.

-WTG is the write gate bit, which is active when data is being written to the disk surface.

-HS3 through -HS0 are the one's complement of the binary coded address of the currently selected head. For example, if -HS3 through -HS0 are 1 1 0 0 respectively, head 3 is selected.

-DS1 is the drive select bit for drive 1, and should be active when drive 1 is selected and active.

-DS0 is the drive select bit for drive 0, and should be active when drive 0 is selected and active.

Error Register - 1F1 (read only)

Status from the last command executed by the drive is contained here. The contents of this register are valid only when the error bit (ERR) is set in the Status register. However, if the drive has just powered up or completed execution of its internal diagnostics, this register contains a status code. These status codes are discussed in the Diagnostic command section.

Bit #	7	6	5	4	3	2	1	0
	BBK	UNC	---	IDNF	---	ABRT	TKO	---

where :

BBK indicates that a bad block mark was detected in the requested sector's ID field. A bad block can only be created by the Format command and is used to indicate an unusable sector on the disk.

UNC indicates that a data error has occurred and it is not correctable through the use of ECC.

IDNF indicates that the requested sector's ID field could not be located.

ABRT indicates that the command issued by the Host has been aborted either because it is not a valid command code, or because the drive has a status error.

TK0 indicates that track 0 was not found during the Recalibrate command.

Drive/Head (DH) Register - 1F6 (read/write)

This register contains the drive and head numbers as defined below:

Bit #	7	6	5	4	3	2	1	0
	1	0	1	DRV	HEAD	HEAD	HEAD	HEAD

where:

DRV is the drive select number. When this bit is reset, the master drive is selected, and when this bit is set, the slave drive is selected.

HEAD is the four bit binary encoded head select number.

At completion of each sector, and at the end of the command, this register is updated to reflect the currently selected head.

Sector Count Register - 1F2 (read/write)

This register defines the number of sectors of data to be read or written. If the value in this register is zero, a count of 256 sectors is specified. This count is decremented as each sector is read so that the register contains the number of sectors left to be transferred in the event of an error in a multi-sector operation. This register is also used to define the number of sectors per track when executing an Initialize Drive Parameters command, or the power down time-out parameter and status for the Power commands.

Sector Number Register - 1F3 (read/write)

This register contains the starting sector number for any disk access. At the completion of each sector, and at the end of the command, this register is updated to

reflect the 1st sector read correctly, or the sector in which an error occurred. During multiple sector transfers, this register is updated to point to the next sector to be read or written.

Status Register - 1F7 (read only)

This register contains the drive status, which is updated at the completion of each command. If the BSY bit is active, no other bits are valid. By reading this register when an interrupt is pending, the Host is considered to acknowledge that interrupt and it will be cleared.

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

where:

BSY indicates that the drive is executing internal operations and is not accessible to the Host. This bit is activated under the following conditions:

1. If a HOST RESET or a SRST has been issued to the drive and it is performing internal diagnostics.

2. When a command that requires immediate action has been issued by the Host, including Execute Drive Diagnostic, Identify, Initialize Drive Parameters, Read, Read Long, Read Buffer, Recalibrate, and Seek.

3. Immediately following transfer of a) 512 bytes of data following a Host write of the Command register when a Format Track, Write, or Write Buffer command has been issued, or b) 512 bytes of data and the 11 ECC bytes following a Host write of the Command register with a Write Long command. When BSY is active, any Host read of the Task File is inhibited, and the Status register is read instead.

DRDY is the drive ready indication. When there is an error, this bit is not changed until the Status register is read by the Host, at which time the bit again indicates the current status of the drive. This bit will be inactive at power up and remain inactive until the drive is up to speed and ready to accept a command.

DSC is the drive seek complete line used to indicate when the heads are over the desired track. When there is an error, this bit is not changed until the Status register is read by the Host, at which time the bit again indicates the current status of the drive. This bit will be inactive at power up until ths condition will not terminate a multi-sector read operation.

IDX (Index) is vendor specific.

ERR is the error bit used to indicate whether the previous command was successful or terminated in an error. Other bits in the Status register and in the Error register will contain additional information concerning any error.

8.0 AT COMMANDS

All commands are loaded into the Task File by the Host, decoded by the drive, and executed. When two drives are daisy chained on the interface, commands are written in parallel to both, but only the selected drive will execute the command. The only exception is the Diagnostic command, which both drives execute. The slave reports its status to the master using the HOST PDIAG line.

The Host selects a drive using the DRV bit in the Drive/Head register, and the drive responds according to the presence or absence of a jumper at pins A and B of the interface connector. If a single drive is used, it must be jumpered as master. If dual drives are present in a system, one must be jumpered as master, the other as slave (see Chapter 2).

To issue a command, the Host performs the following sequence:

1. load pertinent registers in the drive's Task File.

2. activate interrupt enable bit in the Digital Output Register.

3. write command code to the Command register.

Command execution starts immediately following the Command register update.

The following is a complete list of Task File interface commands as specified by the CAM (Common Access Method) committee. Many of these commands were not part of the defacto standard and were therefore denoted as optional by the ANSI committee X3.

Table 3: Command Set

CL	DESCRIPTION	ST	CODE	SC	SN	CY	DH
1	Check Power Mode	O	E5	Y	N	N	D
1	Execute Drive Diag	M	90	N	N	N	D
2	Format Track	M	50	Y	N	Y	Y
1	Identify Drive	O	EC	N	N	N	D
1	Idle	O	E3	Y	N	N	D
1	Idle Immediate	O	E1	N	N	N	D
1	Init Drive Parameters	M	91	Y	N	N	Y
1	Recalibrate	M	1x	N	N	N	D
1	Rd Buffer	O	E4	N	N	N	D
1	Rd DMA (w/retry)	O	- not supported -				
1	Rd DMA (w/o retry)	O	- not supported -				
1	Rd Multiple	O	- not supported -				
1	Rd Long w/retry)	M	22	Y	Y	Y	Y
1	Rd Long (w/o retry)	M	23	Y	Y	Y	Y
1	Rd Sectors (w/retry)	M	20	Y	Y	Y	Y

1	Rd Sectors(w/o retry)	M	21	Y	Y	Y	Y
1	Seek	M	7x	N	Y	Y	Y
1	Set Features	O	EF	N	N	N	D
1	Set Multiple Mode	O	- not supported -				
1	Set Sleep Mode	O	E6	N	N	N	D
1	Standby	O	E2	Y	N	N	D
1	Standby Immediate	O	E0	N	N	N	D
2	Ver Sectors (w/retry)	M	40	Y	Y	Y	Y
2	Ver Sectors (w/o retry)	M	41	Y	Y	Y	Y
2	Wt Buffer	O	E8	N	N	N	D
3	Wt DMA (w/retry)	O	- not supported -				
3	Wt DMA (w/o retry)	O	- not supported -				
3	Wt Multiple	O	- not supported -				
2	Wt Long (w/retry)	M	32	Y	Y	Y	Y
2	Wt Long (w/o retry)	M	33	Y	Y	Y	Y
3	Wt Same	O	not supported -				
2	Wt Sectors (w/retry)	M	30	Y	Y	Y	Y
2	Wt Sectors (w/o retry)	M	31	Y	Y	Y	Y
3	Wt Verify	O	- not supported -				

where:

CL indicates one of three classes of command as follows:

1 = upon receipt of command, the drive sets BSY within 400 nsec

2 = upon receipt of command, the drive sets BSY within 400 nsec, sets up the sector buffer for a write operation, sets DRQ within 700 usec, and clears BSY within 400 nsec of setting DRQ.

3 = upon receipt of command, the drive sets BSY within 400 nsec, sets up the sector buffer for a write operation, sets DRQ within 20 msec, and clears BSY within 400 nsec of setting DRQ.

CODE indicates Command code in Hex. Those commands that have two codes are accessible through different commands.

CY is cylinder registers.

DH is drive/head register.

SC is sector count register.

SN is sector number register.

ST is command status (O = optional, M = mandatory).

Check Power - E5

Please refer to the Power Commands later in this chapter.

Execute Drive Diagnostic - 90

This command directs the drive(s) to perform internal diagnostic tests. The DRV bit is ignored.

In a single drive system, drive 0 performs the following sequence:

1. complete its diagnostics and post the results
2. clear BSY and generate an interrupt

In a dual drive system, drive 0 performs the following sequence:

1. Complete its diagnostics.
2. Wait for the slave to report its diagnostic results (up to 5 seconds).
3. If both master and slave pass (assert PDIAG), the master sets bit 7 of the Error register to zero.
4. If the master fails, it sets the Error register as below:
5. If the slave fails, the master will "OR" 80h with the slaves status and set the Error register as follows:

ERROR CODE	DESCRIPTION
01	no error detected
03	sector buffer error
04	ECC circuitry error
05	control processor error
8x	slave drive failed

FormatTrack - 5X

Hard defects on the HARDiskette170 are "mapped out' during factory, low level formatting, however, if the drive later develops a defect, you might want to re-format. This Format Track command cannot access the hidden spare sectors. It will simply mark the BBK bit in the ID Field, causing your operating system to

deallocate the cluster. Depending on the capacity of your drive, this cluster size will vary from 1 - 4 KBytes.

The options available with this command are as follows:

BYTES	DESCRIPTION
00	Format Track Good
80	Format Track Bad

Choosing '00" will cause each sector's data field on the specified sector to be written with zeroes, and any defective sectors will be marked as usable. This could cause a problem if a previously marked defective sector is re-marked usable the operating system will try to save data there.

Choosing '80' requires that you specify which sector is defective. The drive will then mark the BBK flag with 'FF', informing your operating system that this sector should not be used. The remainder of the sectors on the track will only have their data fields written with zeroes.

Before issuing this command to the drive, the sector count register must contain the number of sectors per track and the Cylinder High and Low registers must contain the track address. The sector buffer must be filled with each sector's status followed by its sector number. The remainder of the sector buffer must be written with zeroes (see table below).

Word # 1	Word # 2	Word # 3	~ ~	Word # 32	Word # 33	~ ~	Word # 256
00 01 (good)	00 02 (good)	80 03 (bad)	~ ~	00 32 (good)	00 00 (fill 0's)	~ ~	00 00 (fill 0's)

In this example, there are 32 sectors and the third one is to be marked as unusable. Notice that the remaining 224 words are filled with zeroes.

Note: The drive will return an ID not found if a word is missing, words are not contiguous from the sector origin, there are more than 2 bytes of data per sector, or you specify an illegal cylinder/head combination.

Identify Drive - EC

The Identify command allows the Host to obtain parameter information from the drive. When the command is issued, the drive sets BSY, stores the required parameter information in the sector buffer, sets the DRQ bit, and generates an interrupt. The Host may then read the information out of the sector buffer.

Parameter words in the buffer are recorded in right justified, decimal format, unless otherwise noted.

WORD	F/V[1]	DESCRIPTION	AR-2170NI
00	F	General configuration bit significant information: Bit 7: 1=removable media. Bit 6: 1=not removable controller and/or device.	49a
01	F	Number of logical cylinders:	651
02	R	Reserved.	n/a
03	F	Number of logical heads:	16
04-05	X	Vendor specific (obsolete).	n/a
06	F	Number of logical sectors per track:	32
07-09	X	Vendor specific.	n/a
10-19	F	Serial number:	XXXXXXXXXX XXXXXXXXXX
20-21	X	Vendor specific (obsolete).	n/a
22	F	Number of ECC bytes reported on long commands:	11
23-26	F	Firmware revision:	XXXXXXXX
27-46	F	Model number: AVATAR AR-2170NI 170M 2.5	n/a
47	X	Maximum sectors/IRQ on multiple commands:	0
48	R	Reserved.	n/a
49	F	Additional capabilities: Bit 13: 1=Standby timer values are CAM compliant. 0=Standby timer values are vendor specific. Bit 11: 1=IORDY supported. 0=IORDY may be supported. Bit 10: 1=IORDY can be disabled. Bit 9: 1=LBA supported. Bit 8: 1=DMA supported.	800
50	R	Reserved.	n/a
51	F	PIO data transfer cycle timing mode:	200
52	F	DMA data transfer cycle timing mode:	0
53	F	Other information fields validity: Bit 1: 1=words 64-70 are valid. 0=words 64-70 are not valid. Bit 0: 1=words 54-58 are valid. 0=words 54-58 may be valid.	3
54	V	Number of current logical cylinders:	651
55	V	Number of current logical heads:	16
56	V	Number of current logical sectors per track:	32
57-58	V	Current capacity in (ns):	0
66	F	Recommended multiword DMA transfer cycle time (ns):	0
67	F	Minimum PIO transfer cycle time without IORDY (ns):	300
68	F	Minimum PIO transfer cycle time with IORDY (ns):	150
69-127	R	Reserved.	n/a
128-159	X	Vendor specific.	n/a
160-255	R	Reserved.	n/a

[1]Notes:
F = Fixed parameter.
V = Variable (changeable) parameter.
R = Reserved field.

Idle - E1

Please refer to the Power Commands section later in this chapter.

Idle Immediate - E3

Please refer to the Power Commands section later in this chapter.

Initialize Drive Parameters - 91

This command enables the Host to set the head switch and cylinder increment points for multiple sector operations. In translate mode, the logical head and sector numbers in the Task File will be translated into their native physical values as part of execution of the command. The sector, head, and cylinder values in the Task File are not checked for validity by this command, therefore if they are invalid, no error will be reported until an illegal access is made by some other command. Upon receipt of the command, the drive sets BSY, saves the parameters, resets BSY, and generates an interrupt.

To ensure that all sectors can be utilized, it is most efficient to use a translate mode of 16 heads x 32 sectors x 651 cylinders.

Power Commands - E0, E1, E2, E3, E5, E6

In order to conserve power, these commands allow the drive to operate in modes other than fully operational. These commands are listed below:

Table 4: Power Commands

CODE	DRIVE RESPONSE
E0	Drive enters STANDBY MODE immediately.
E1	Drive enters IDLE MODE immediately.
E2	Drive enters STANDBY MODE immediately. If the Sector count register is non-zero, Auto Power-Down is enabled and will take effect when the drive returns to IDLE MODE. If the sector Count register = 0, Auto Power-Down is disabled.
E3	Drive enters IDLE MODE immediately. If the Sector Count register is non-zero, Auto Power Down is enabled and will take effect when the drive returns to IDLE MODE. If the sector Count register is zero, Auto Power-Down is disabled.
E5	This command allows the Host to check the drive power status. If it is Active or Power Save mode, the Sector Count register will be set to FF. If the drive is in, going to, or recovering from STANDBY MODE, the Sector Count register will be set to 00.
E6	Drive immediately enters SLEEP MODE.

where:

IDLE MODE is drive up to speed and ready to accept a command.

SLEEP MODE is drive spun down, only interface chip is powered.

STANDBY MODE is drive spun down, interface chip and RAM powered.

Recalibrate - 1X

This command will move the heads to cylinder 0. Upon receipt of the command, the drive sets BSY and executes a seek to cylinder 0. The drive then waits for the seek to complete before updating its status, resetting BSY, and generating an interrupt. If the drive cannot reach cylinder 0, it sets both the "ERR" bit in the Status register and the "TK0" bit in the Error register. An aborted command response will be given if the drive is not spinning or is not on track. Upon successful completion of the command, the Task File registers will be as follows:

REGISTER	VALUE
Cylinder High	00
Cylinder Low	00
Error	00
DH	Unchanged
Sector Count	Unchanged
Sector Number	Unchanged

Read Buffer - E4

This command allows the Host to read the current contents of the drive's sector buffer. When this command is issued, the drive sets BSY, sets up the sector buffer for a read operation, sets DRQ, clears BSY, and generates an interrupt. The host then reads up to 512 bytes of data from the buffer.

Read Long - 22,23

The Read Long command performs similarly to the Read Sectors command, except that it returns the data and the ECC bytes contained in the data field of the desired sector. During a Read Long command, the drive does not check the ECC bytes to determine if there has been a data error. Only single sector read long operations are supported. The transfer of ECC bytes shall be 8 bits wide.

Read Multiple - C4 (currently not supported)

This command performs similarly to the Read Sectors command, except that only a single interrupt is generated per block transferred. The size of this block (number of sectors) is defined by issuing a Set Multiple command. DRQ qualification of the transfer is required only at the start of the data block, not on each sector. Interrupts are generated when DRQ is set at the beginning of each block or partial block.

The Sector Count register contains the number of sectors requested. If this number is not evenly divisible by the block count, as many full sectors as possible are transferred, followed by a final partial block transfer.

If the Read Multiple command is issued before a Set Multiple command has been executed, or when Read Multiple commands are disabled, the operation shall be rejected with an "ABRT" error in the Error register.

Disk errors encountered during the Read Multiple command are posted at the beginning of the block transfer, but DRQ is still set and the data transfer shall take place as it normally would, including transfer of corrupted data if any. Subsequent blocks are transferred only if the error was a correctable data error.

Read Sector(s) - 20,21

This command will read from 1 to 256 sectors as specified in the Task File, beginning at the specified sector. A sector count of 0 requests 256 sectors. As soon as the Command register is written, the drive sets BSY and begins execution of the command. If command register bits 2 and 3 are not equal to zero, the command will be aborted ("ABRT" set in Error register). An ID not found ("IDNF" set in Error register) is returned if incorrect task file parameters are passed. If the drive is not already on the desired track, a seek is initiated. When the sector ID is located, the data field is read into the sector buffer, error bits are set if necessary, the DRQ bit is set, and an interrupt is generated.

The DRQ bit is always set, regardless of the presence or absence of an error condition at the end of a sector. Upon command completion, the Task File registers contain the cylinder, head, and sector number of the last sector read. The sector count is zero after successful execution of the command.

Multiple sector reads set DRQ and generate an interrupt when the sector buffer is filled at completion of each sector, and the drive is ready for the data to be read by the Host. DRQ is reset and BSY is set immediately when the Host empties the sector buffer. If an error occurs during a multiple sector read, the read will terminate at the sector where the error occurs. The Host may then read the Task File to determine

what error has occurred, and in which sector. If the error was either a correctable data error or a non-correctable data error, the flawed data is loaded into the sector buffer. The read does not terminate if the error was correctable. If no error is detected, the cylinder, head, and sector registers are updated to point to the next sequential sector.

Read Verify - 40,41

This command functions identically to the Read Sectors command, except that no data is transferred to the Host. Up to 256 sectors will be read into the sector buffer and ECC bytes verified.

When each sector has been verified, the Task File is updated, but no DRQ or interrupt is set until all sectors have been verified. A value of 00 in the sector count register indicates that 256 sectors are to be verified.

Seek - 7X

This command initiates a seek to the track and selects the head specified in the Task File. The drive need not be formatted for a seek to execute properly. When the command is issued, the drive sets BSY, initiates the seek, resets BSY, and generates an interrupt. Only the Cylinder register is valid for this command. The drive does not wait for the seek to complete before returning the interrupt. Seek complete (DSC) will be set upon completion of the command. If a new command is issued while a seek is in progress, the drive will wait, with BSY active, until the seek is complete before starting the new command. No checks are made on the validity of the sector number. The "ERR" bit in the Status register and the "IDNF" bit in the Error register will be set if an illegal cylinder number is specified.

Set Multiple Mode - C6 - (currently not supported)

This command establishes the block count for Read and Write Multiple "ABRT" is set in the Error register, and Read and Write Multiple commands are disabled.

At power on, or after a hardware or software reset, the default mode is Read and Write Multiple disabled.

Set Sleep Mode - E6

Please refer to the Power Mode section later in this chapter.

Standby - E2

Please refer to the Power Mode section later in this chapter.

Standby Immediate - E0

Please refer to the Power Mode Section later in this chapter.

Write Buffer - E8

This command allows the Host to overwrite the contents of the drive's sector buffer with any data pattern desired. Only the command register is valid for this command. When this command is issued, the drive will set BSY, set up the sector buffer for a write operation, set DRQ, reset BSY, and generate an interrupt. The Host may then write up to 512 bytes of data to the buffer.

Write Long - 32,33

This command is identical to the Write Sector(s) command, except that it writes the data and ECC bytes directly from the sector buffer. The drive does not generate ECC for this command. Only single sector operations are supported.

Write Multiple - C5 - (currently not supported)

This command is similar to the Write Sector(s) command, except that the number of sectors to be transferred must have previously been established by the Set Multiple command. The desired number of blocks is transferred without intervening interrupts. DRQ qualification of the transfer is required only at the start of the data block, not for each sector.

When the Write Multiple command is issued, the Sector Count register contains the number of sectors, not blocks requested. If the sector count is not evenly divisible by the block count specified by Set Multiple, as many full blocks as possible are transferred, followed by a final partial block.

If the Write Multiple command is attempted prior to the Set Multiple command establishing the block size, it will be rejected with an aborted command error. If any

disk errors are encountered during the transfer of data, they are posted after the attempted disk write of the block or partial block. The command ends with the sector in error, even if it was in the middle of a block. Subsequent blocks are not transferred in the event of an error. Interrupts are generated when DRQ is set at the beginning of each block or partial block.

Write Sector - 30,31

This command will write from 1 to 256 sectors as specified in the Task File (sector count = 0 requests 256 sectors), beginning at the specified sector. As soon as the Command register is written, the drive waits for the Host to fill the sector buffer with the data to be written. No interrupt is generated to start the first buffer fill operation. Once the buffer is full, the drive sets BSY and begins command execution.

If bits 2 and 3 are on, the command terminates with an aborted command error. An ID not found error is returned if incorrect task file parameters are passed. If the drive is not already on the desired track, an implied seek is performed. Once at the desired track, the drive locates the appropriate ID field and writes data from the buffer, plus 11 bytes of ECC. Upon command completion, the Task File registers contain the cylinder, head, and sector number of the last sector written. The sector count is zero after successful execution of the command.

Multiple sector writes set DRQ and generate an interrupt each time the buffer needs filling by the Host. DRQ is reset and BSY set immediately when the Host fills the sector buffer. If an error occurs during a multiple sector write, it will terminate at the sector where the error occurs. The Task File indicates the location of the sector where the error occurred. The Host may then read the Task File to determine what error has occurred, and on which sector. If no error is detected, the cylinder, head, and sector registers are updated to point to the next sequential sector.

Write Verify - 3C (not supported)

This command is identical to the Write Sector(s) command, except that each sector is verified immediately after being written. The verify operation is a read without transfer and a check for data errors. Any errors encountered during the verify operation are posted. Multiple sector write verify commands write all the requested sectors and then verify all the requested sectors before generating the final interrupt.

9.0 AT OPERATIONS

Busy

The latch maintaining BSY is set each time the Host issues a hardware or software RESET, or when a command is issued.

For a Read type command, BSY is set immediately upon the Host writing the Command register, and stays set until the drive is ready to transmit the requested data to the Host.

For a Write type command, BSY is not set when the command is received, but is delayed until the Host has filled the drive buffer with the data to be written.

When the drive has activated BSY, it has access to the Task File registers and the Host can only read the Status or Alternate Status registers. When BSY is inactive, the Host has access to all of the Task File registers.

Error Reporting

When the drive receives a command from the Host, it checks for validity of the command, and with the exception of the Initialize Drive Parameters command, also checks register values for valid range. If the values are invalid, the drive does not execute the command, but instead posts the "ERR" bit in the Status register and the "ABRT" bit in the Error register.

If a data error occurs during command execution, the command is terminated immediately. Valid errors are listed below in table 6.

Table 5: Status Register

STATUS REGISTER					
COMMAND	**DRDY**	**DSC**	**DWF**	**CORR**	**ERR**
Execute Drive Diag					V
Format Track	V	V	V		V
Identify Drive	V	V	V		V
Init Drive Parms					V
Power Commands					V
Recalibrate	V	V	V		V
Read/Write Buffer					V
Read Long	V	V	V		V
Read Multiple	V	V	V	V	V
Read Sector(s)	V	V	V	V	V
Read Verify	V	V	V	V	V

Seek	V	V	V		V
Set Multiple	V	V	V		V
Write Long	V	V	V		V
Write Multiple	V	V	V		V
Write Sector(s)	V	V	V		V
Write Verify	V	V	V	V	V

where:

DRDY is drive not ready

DWF is drive write fault detected

DSC is drive seek complete not detected

CORR is data error corrected by ECC

ERR is error detected, see Error register for more detailed information

Table 6: Error Register

ERROR REGISTER						
COMMAND	**BBK**	**UNC**	**IDNF**	**ABRT**	**TKO**	**AMNF**
Execute Drive Diag				V		
Format Track			V	V		
Identify Drive				V		
Init Drive Parms				V		
Power Commands				V		
Recalibrate				V	V	
Read/Write Buffer				V		
Read Long	V		V	V		V
Read Multiple	V	V	V	V		V
Read Sector(s)	V	V	V	V		V
Read Verify	V	V	V	V		V
Seek			V	V		
Set Multiple				V		
Write Long	V		V	V		
Write Multiple	V		V	V		
Write Sector(s)	V		V	V		
Write Verify	V	V	V	V		

where:

BBK is bad block detected

UNC is non-correctable data error

IDNF is ID mark not found

ABRT is command aborted

TK0 is track 0 not located during Recalibrate command

AMNF is address mark not found

Reset

Resetting the drive will cause it to go BSY, and then perform the full initialization required for normal operation. A RESET condition can be generated in any of three ways:

1. **HOST RESET** - This is a hardware reset issued by the Host via the interface. This pulse will immediately reset the drive electronics, even if the drive is in the middle of an operation. This type of reset will cause the drive to initiate and complete its internal diagnostics.

2. **SRST** - This is a software reset issued to the drive when the Host sets the SRST bit in the Digital Output register. This type of reset waits for the drive to complete any current operation, then allows the Host to hold the drive in reset mode for an unlimited time period. This type of reset will not cause the drive diagnostics to be executed.

3. **INTERNAL RESET** - This reset is issued by the drive when it has sensed a low voltage condition. When voltage returns to acceptable limits, the drive will initiate its internal diagnostics to check for error conditions prior to coming RDY.

Retries

To ensure that data is never lost, the AR-2170NI employs an 88 bit Reed Solomon polynomial for Data Field error detection and correction. The ID Field uses 16 bits of CRC for error detection. The data recovery sequences are as follows:

1. Error is limited to a single 11 bit burst - In this case, correction happens in hardware 'on the fly' and is transparent to the user. No error is reported to the user.

Error is greater than a single 11 bit burst - In this case, the drive will run an exhaustive series of retries and software assisted correction attempts. If any correction attempt is successful, the data transfer is completed and the 'CORR' bit is

et in the Error register. If all of attempts fail, the drive will set the ‘ERR’ bit in the tatus register and the ‘UNC’ bit in the Error register.