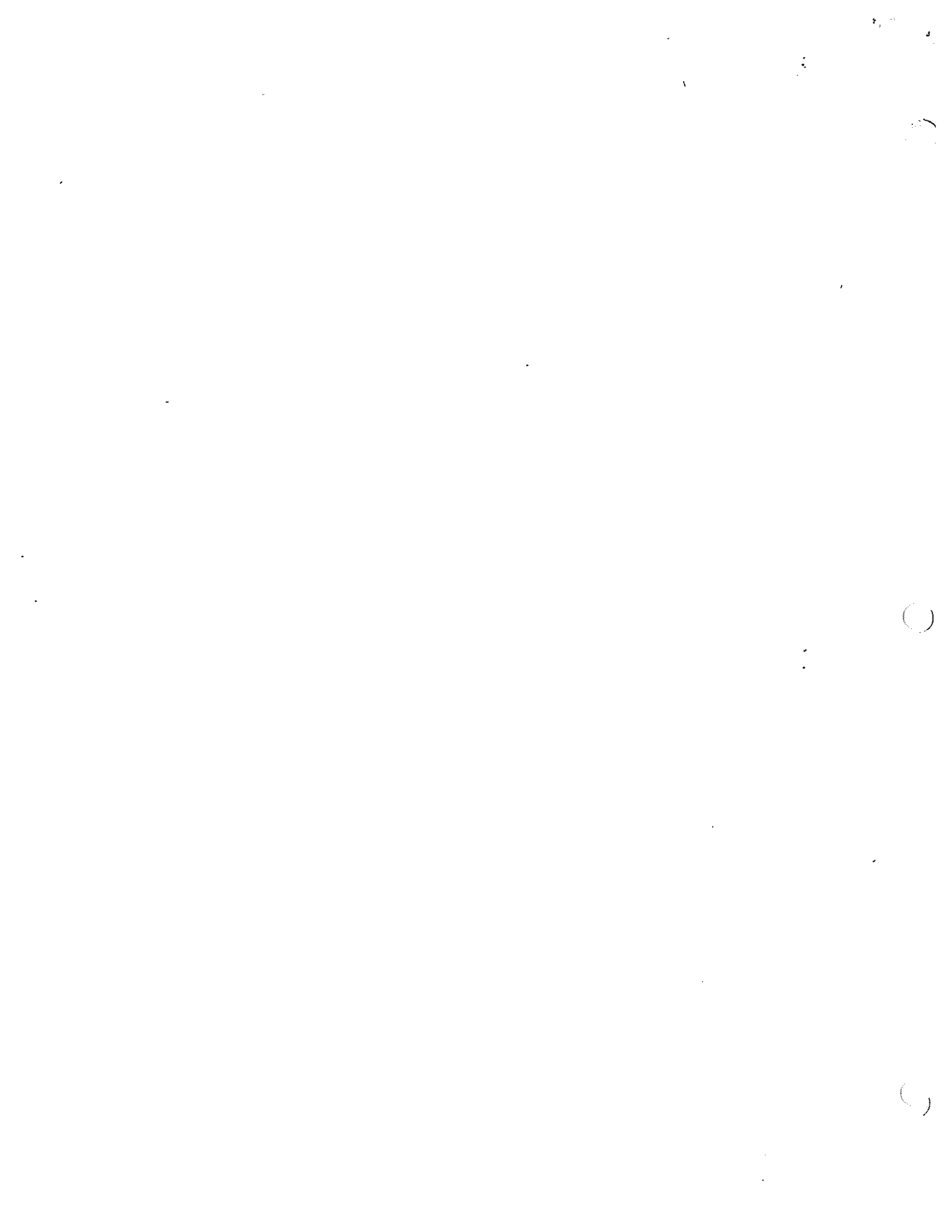


Hard Disk BASIC Upgrade Package

This package includes all the supplementary documentation for the package to upgrade Hard Disk BASIC from version 4.1 to version 5.0. It includes the following topics:

1. Hard Disk Sector Format - the arrangement of information in a disk sector.
2. Controller Commands - the format and action of the controller's firmware commands.
3. Error Codes - the meaning of the firmware error flags that are transmitted to the computer through I/O port 161 octal.
4. Firmware Data Flow Diagram - shows the flow of data and status signals between the computer and the controller.
5. File Manager Error Messages - conditions recognized by the file manager and reported by BASIC as DISK I/O ERRORS.

This package also includes two other documents. One is the procedure for upgrading software systems from the old version to the new baseline version. The other is the information on the Hard Disk Boot Loader/Turnkey Monitor PROM set.



1. HARD DISK SECTOR FORMAT

Data stored on the hard disk is divided into sectors. The format of a sector is as follows:

Contents	Length
Header (see below)	
Sync byte (255_{10})	1 byte
Data	256 bytes
CRC	2 bytes

The header has the following format:

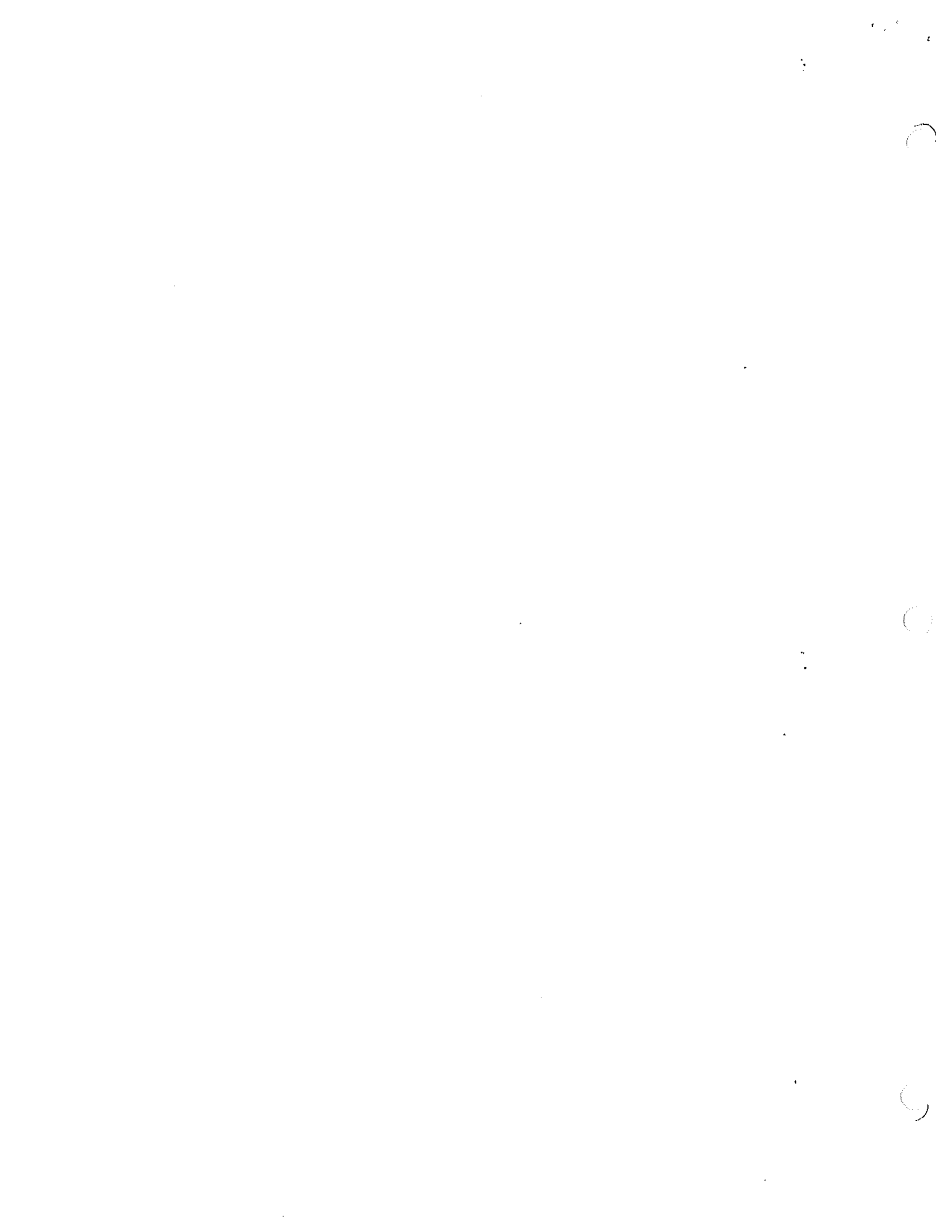
Contents	Length
Preamble	*
Sync byte (255_{10})	1 byte
Cylinder address	2 bytes
Head # + Sector #	1 byte**
Header CRC	2 bytes
Header gap	*

* The preamble and the header gap are strings of approximately 26 bytes of zeros. They provide a buffer zone to separate the sectors and allow for small head positioning errors.

** The head number is the high order three bits of the byte; the remainder is the sector number. The head numbers and their associated bit patterns are as follows:

Head Number	Bits 5 - 7
0	100
1	101
2	110
3	111

Head Number	Bits 5 - 7
4	000
5	001
6	010
7	011



2. COMMANDS

Command	Port	Bit							
		7	6	5	4	3	2	1	0
SEEK	163	0	0	0	0	drive	X	↑	
		High bit of cylinder address							
	167	low byte of cylinder address							
WRITE SECTOR	163	0	0	1	0	drive	buffer		
	167	head				sector			
READ SECTOR (FORMATTED)	163	0	0	1	1	drive	buffer		
	167	head				sector			
READ BUFFER	163	0	1	0	1	X	X	buffer	
	167	byte count							
WRITE BUFFER	163	0	1	0	0	X	X	buffer	
	167	byte count							

If the byte read from port 167 in the WRITE BUFFER and READ BUFFER commands is zero, the byte count is assumed to be 256.

READ STATUS	163	0	1	1	0	drive	X	X	
	167	status word address							
SET IV BYTE	163	1	0	0	0	X	X	X	X
	167	IV byte address							

This command reads port 167 twice. The first byte read is the address of the IV byte to be set. The second byte read is the data to be deposited in the selected IV byte.

READ UNFORMATTED	163	1	0	1	0	drive	buffer
	167	head		sector			
FORMAT	163	1	1	0	0	drive	X X
	167	head		X	X	X	X X
INITIALIZE	163	1	1	1	0	X	X X X X

3. ERROR FLAGS

Port 161

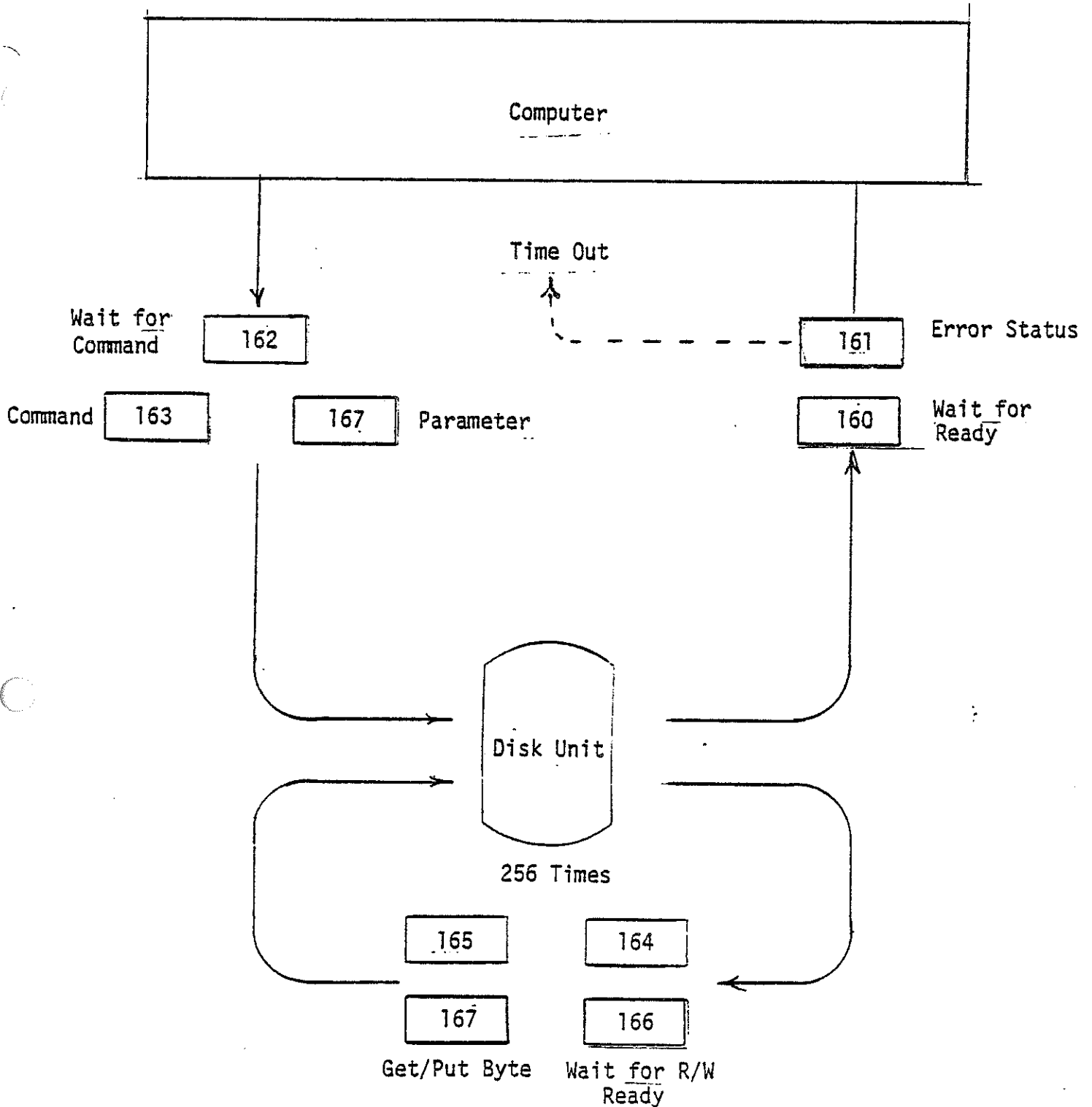
Bit	1 means: ¹	Error may occur in:
0	Drive not ready	Any command except INITIALIZE and SET IV BYTE
1	Illegal Sector	SEEK, READ SECTOR, WRITE SECTOR, FORMAT and READ UNFORMATTED commands
2	CRC error in sector read	READ SECTOR, READ UNFORMATTED ² commands
3	CRC error in header read	SEEK, READ SECTOR, WRITE SECTOR and FORMAT commands
-4	Header has wrong sector	Same as in bit 3
5	Header has wrong cylinder	Same as in bit 3 ³
6	Header has wrong head	Same as in bit 3
7	Write Protect	Same as in bit 1 ⁴

NOTES

1. All bits of port 161 are ones on the first read after the controller is turned on.
2. Always occurs on an unformatted read of a formatted sector.
3. Occurs spuriously when one of these commands is issued for a drive different from the one specified in the last seek. This spurious error is ignored by the write logic.
4. Only relevant during a Write Sector command. If a sector is write-protected, data may not be written into it. The Write Sector command is ignored and the error flag is set.

Error	Explanation
Drive not ready	Something has caused the drive to go off line. Check the drive number switch and the ready light.
CRC error in sector read	A Cyclical Redundancy Check exception was detected while the 256 data bytes of a sector were being read.
CRC error in header read.	A Cyclical Redundancy Check exception was detected while the header of a sector was being read. If the error persists, the sector is probably unusable. Reformat the disk
Header has wrong sector	The header did not contain the expected sector number. Indicates an anomaly in disk rotation. Try again.
Header has wrong cylinder	The header did not contain the expected cylinder address. Indicates a head positioning error. Try again.
Header has wrong head #	The header did not contain the expected head number. Indicates a problem in the drive electronics.
Write protect.	A command was issued for a write-protected sector. If the command was a Write Sector command, it is ignored. Other commands are executed normally.

4. FIRMWARE DATA FLOW DIAGRAM



The arrows show the direction of information flow. The boxes represent computer I/O ports with the octal addresses noted inside. The labels outside the I/O port boxes indicate the type of information transmitted through the ports.

For example, the controller waits for the presence of a command to be indicated through port 162. It then retrieves the command code from port 163 and the parameter(s) of the command from port 167.



5. AFMS Error Messages

The hard disk file manager recognizes several errors which are all reported by BASIC as DISK I/O ERRORS. The file manager prints an error message of its own in addition to BASIC's message which identifies the exact source of the error. The form of the AFMS error message is as follows:

```
AFMS ERROR CODE = HH
HH HH HH HH HH HH HH HH HH HH
DISK I/O ERROR
```

where HH represents two hexadecimal digits. The error codes are shown in the table on the next page. The ten numbers on the second line of the message have the following significance:

Field	Significance	Comment
1	Error Status 01 Drive not ready 02 Illegal sector 04 Data CRC 08 Header CRC 10 Header sector 20 Header cylinder 40 Header head 80 Write protect	The status displayed is the hexadecimal sum of the applicable error codes. These codes are explained further in section 3.
2	Head number	Disk location being accessed when the error occurred
3	Sector number	
4	Unit number	
5,6	Cylinder address (high byte, low byte)	
7	Parameter	Firmware command being executed when the error occurred.
8	Command	
9,10	Error total	Number of errors since the file manager was last loaded.

AFMS Error Codes

Hex.	Decimal	Meaning
01	1	Undefined System Error
05	5	Invalid mode parameter
07	7	Unable to find buffer to allocate
09	9	Invalid drive number parameter
0A	10	Attempt to write to volume mounted as read-only
13	19	Volume already mounted
15	21	Invalid drive number parameter in mount
17	23	Drive not mounted
1F	31	File name not found
21	33	Attempt to open too many files
23	35	Out of index entry blocks (internal error)
27	39	Invalid file number parameter
29	41	File number not opened
2F	47	Attempt to open read only file in write mode
31	49	Not enough space on volume
33	51	File name already on volume
35	53	Not enough directory space for new file
4F	79	Unable to update directory
55	85	Attempt to read past end of file
57	87	Attempt to allocate to allocated group (internal)
59	89	Attempt to access invalid logical page
5B	91	No free bit found during allocation (internal)
5D	93	Attempt to write/kill read only file
5F	95	Unable to update directory entry
61	97	Unable to update volume descriptor
63	99	Invalid drive number for open file (internal)
67	103	Invalid index pointer for open file (internal)
69	105	Invalid seek mode parameter
6F	111	Error in closing file during dismount
71	113	Can't kill open file
73	115	Error in writing page from buffer pool
97	151	No response - timed out
99	153	Drive not ready
9B	155	Header CRC error

Hex.	Decimal	Meaning
9D	157	Wrong CRC
9F	159	Data CRC error
A1	161	Data doesn't verify
A3	163	Write protected
A5	165	Transient Error



HARD DISK SOFTWARE OPERATING PROCEDURES

OVERVIEW --

Enclosed with this package is a 5440 type hard disk cartridge that includes MITS Hard Disk BASIC Revision 5.0 and all currently available ASDC application programs incorporating revisions through number 44. The modifications that have been made to produce 5.0 BASIC mostly involve the file manager and hard disk controller firmware. These modifications establish a new data structure on the disk platter that allows for extensive error detection and correction. Also, PRINT USING operations and string pool management have been sped up.

We are sending this package to update hard disk end users to a point where all have the latest available software. To accomplish that end, you will be required to guide the end user through this procedure and provide him with the correct software. The correct software will depend upon the specific user. All will get 5.0 release BASIC. In addition, others may get one or more of the ASDC application programs.

IMPLEMENTATION --

There are two major things we need to accomplish for the hard disk end user:

- 1) Convert the format of all existing cartridges to operate with the new 4.3 firmware, and
- 2) Provide a freshly configured cartridge that has 5.0 BASIC, any ASDC programs he is licensed to have, and his current data files as necessary.

The following procedure should be followed to reach these goals.

I. -- READ THE ENTIRE PROCEDURE

I.A. -- ALL INFORMATION IMPORTANT

1. -- Please read the entire procedure from start to finish before attempting to convert your hard disk units to run with 5.0 BASIC and the new 4.3 firmware. The potential is here to render the information on currently existing cartridges useless. While you may feel you are sufficiently acquainted with the hard disk and its operation, there is new information contained within this document that has not been presented before.

II. -- FORMAT ALL EXISTING CARTRIDGES

Objective - The objective of this section of the procedure (II) is to make the data on all existing cartridges compatible with the format required by the new 4.3 version firmware. By doing this, all data the user may currently have is still accessible.

II.A. -- Ensure that there is no irreplaceable data on the BOTTOM platter of the drive you are going to use.

1. -- The bottom platter (logical drive 1) is used as a scratch platter during the reformatting procedure. If there is any data on the bottom platter that the user wishes to maintain, it must be first copied off onto another platter for later conversion.

a. -- Ensure that the hard disk controller has 3.26 or 3.27 version firmware.

b. -- Power on the system in the normal manner.

c. -- Place the disk drive on line via the RUN/STOP switch and WAIT at least 15 minutes to allow the cartridge to reach drive ambient temperature.

d. -- Load Hard Disk BASIC, version 4.02, in the normal manner.

e. -- Run the 'COPYHARD' program by issuing the BASIC commands:

```
MOUNT 0 : RUN "COPYHARD" , 0
```

f. -- When the 'COPYHARD' program prompts for the copy parameters do the following BEFORE you make a reply:

1 - Switch the hard disk controller to CPU RESET.

2 - Take the disk drive off line via the RUN/STOP switch.

3 - Remove the cartridge from which BASIC was loaded.

4 - Load the drive with a scratch cartridge onto which the information on the bottom platter is to be copied.

5 - Place the drive back on line via the

RUN/STOP switch.

6 - WAIT at least 15 minutes to allow the new cartridge to reach drive ambient temperature.

7 - Switch the hard disk controller back to RUN.

g. -- Reply to the 'COPYHARD' prompts so that a copy is done from logical drive 1 (fixed bottom platter) to logical drive 0 (removable cartridge).

1 - The 'COPYHARD' program will copy the contents of disk 1 to disk 0, printing one dot on the terminal for each of the 406 cylinders.

h. -- When the copy operation has ended, switch the drive off line and remove the cartridge. Mark it to indicate its contents.

II.B. -- INSTALL NEW 4.3 FIRMWARE

1. -- Turn the system power off.

2. -- Remove the rear cover of the hard disk controller. Locate the CPU board and remove it.

a. -- The CPU board is distinguished by the two small flat ribbon cables attached to it, and by a 4x4 array of IC sockets next to the edge connector.

3. -- Locate the current firmware chips and remove them. Put the new 4.3 version firmware chips in place.

a. -- The old firmware chips are marked '+++' and '---'. The chip marked '+++' is in IC socket E, while the chip marked '---' is in IC socket N.

b. -- The new 4.3 version firmware is marked '43X+' and '43X-'. The chip marked '43X+' goes in IC socket E, the chip marked '43X-' in IC socket N.

c. -- When placing the new firmware chips in their correct sockets, take care to note that the key or slotted end of the chips are placed adjacent to the arrow that is printed next to pin one of the sockets on the CPU controller board.

4. -- Reassemble the hard disk controller by replacing the CPU board in the controller chassis, and attaching

the rear cover.

5. -- Turn the system power on.

II.C. -- FORMAT THE EXISTING CARTRIDGES

1. -- Ensure that the hard disk system being used for the conversion procedure has at least one floppy disk drive (drive 0) included in the system configuration.

a -- For reasons of efficiency, the reformatting routine 'HDF' runs under floppy disk DOS. It is distributed on floppy disk, which means your system configuration must include a floppy disk drive, controller, and disk boot loader prom.

2. -- Load floppy disk DOS via the normal loading procedure for floppy diskettes.

a. -- Hard disk business systems that do not have a floppy disk included will possibly require some switch setting changes in order to load from the floppy disk.

1 - The auto-start address switches on the system turnkey module should be set to 177400 octal to load from floppy disk; 176000 octal to load from the hard disk.

a - If the system includes a turnkey monitor prom, the auto-start switches can be set to start at the turnkey monitor Prom, 176400 octal. This will allow the user to determine via console commands which device to load from, i.e., J176000 for hard disk and J177400 for floppy.

b - If the system includes the new Hard Disk/Turnkey Boot Loader prom, the auto-start switches can be set to 176400 octal to enter the monitor portion of the prom set. From there, hard disk can be loaded by issuing the 'L' command. Floppy disk can be loaded by issuing the command 'JFF00'. Refer to the attached document covering the operation of the new loader prom set.

2 - The answers to the DOS initialization dialogue should be: MEMORY SIZE? = <carriage return>; INTERRUPTS? = <Y or N>; HIGHEST DISK NUMBER? = 0; HOW MANY FILES? = 1; HOW MANY RANDOM FILES? = 0

3. -- When the DOS monitor responds with its prompt (a dot), type the DOS command 'MNT 0' to mount the diskette.

4. -- Switch the hard disk controller to 'CPU RESET'. Load the drive with a pack to be converted. Place the drive on line via the RUN/STOP switch.

5. -- WAIT at least 15 minutes for the cartridge to reach drive ambient temperature. Ensure that the ready light on the drive is on. Switch the hard disk controller to 'RUN'.

6. -- Run the reformatting program by typing the DOS command:

```
RUN HDF 0
```

The program will respond with a line of identification information.

a. -- HDF then will prompt 'DRIVE?'. Respond with a digit in the range 1-4. This digit is the same as appears on the thumbwheel switch on the front of the drive.

1 - If the 'DRIVES?' prompt does not appear immediately, switch the controller to 'CPU RESET', then back to 'RUN' and repeat step 'a' above.

b. -- HDF will then prompt 'FORMAT FIXED PACK?'. If you wish to format the fixed platter (see below), respond with a (capital) 'Y'. The program will acknowledge a 'Y' with 'FORMATTING FIXED PACK'. Formatting takes about 1 1/2 minutes.

1 - If this is the first pack you are converting you must respond 'Y' to format the bottom platter. Subsequent conversions do not require that the bottom platter be reformatted, since the sector formatting is not affected by a copy operation.

c. -- HDF will now print 'COPYING DOWN' followed by 406 dots. Each dot indicates that a cylinder has been copied down to the bottom platter. This process takes about 5 1/2 minutes. HDF then prints 'FORMATTING REMOVABLE PACK' followed in 1 1/2 minutes by 'COPYING UP' and 406 more dots. The program ends by displaying the number of errors encountered in the operation, if any.

1 - The format and copy operations check for errors. An error is not reported to the

console until the operation being performed has failed after five successive tries. If an error is encountered, it is possible to stop the program via a CONTROL-C and try again. This should only be done before the program starts formatting the removable cartridge. Once that phase has started, the data on the removable cartridge has been destroyed. The error message indicates the firmware command that failed (FORMAT, READ, WRITE, or READUN<Read Unformatted>), head (0-3) track (0-405), and sector (0-23) where the error occurred, as well as an explanation of the type(s) of error.

d. -- The conversion procedure is now complete. The disk pack can only be used with the new 4.3 version firmware. Take the hard disk drive off line via the RUN/STOP switch and remove the cartridge from the drive when the SAFE light comes on. Mark the cartridge for future reference to indicate it has been formatted.

e. -- If there are any more cartridges to convert, return to step II-C-2 and repeat the procedure for each one.

III. -- CONFIGURE NEW 5.0 CARTRIDGES

Objective - The objective of this section of the procedure (III) is to produce a cartridge for the end user that contains 5.0 BASIC plus only those applications programs he may be licensed to use. Additionally, we want to include on this cartridge any data and program files the user may already have.

III.A. -- COPY 5.0 BASIC AND ASDC PROGRAMS

1. -- Ensure that the hard disk controller has 4.3 version firmware installed. If it does not, refer to section II-B for procedure.

2. -- WRITE PROTECT the top removable platter in the disk drive and place the 5.0 cartridge with ASDC application programs into the drive. Place the drive on line via the RUN/STOP switch.

3. -- WAIT at least 15 minutes to allow the removable cartridge to reach drive ambient temperature.

4. -- Load 5.0 BASIC with your normal loading procedure.

a. -- Your system requires at least 48k of

memory. Your answers to the initialization questions should be as follows: MEMORY SIZE = <carriage return>; LINEPRINTER = <don't care>; HIGHEST DISK NUMBER = 1; HOW MANY FILES = <1-5>; CURRENT DATE = <today's date>.

5. -- MOUNT disk 0 and run 'HDCOPY' by issuing the following BASIC commands:

```
MOUNT 0 : RUN "HDCOPY" , 0
```

a. -- 'HDCOPY' is a new fast platter copy routine that replaces the old routine 'COPYHARD'. HDCOPY is superior to COPYHARD in that it is 3-4 times faster and does extensive error detection during the copy to verify the operation. COPYHARD can NOT be run with the new 4.3 version firmware. The two are incompatible.

6. -- Using HDCOPY, copy the contents of the 5.0 BASIC platter from drive 0 to drive 1. If the bottom platter has not been previously formatted, use the format option in HDCOPY to format it. If you do not know, format it anyway.

a. -- HDCOPY asks three questions: 1) FROM LOGICAL PLATTER (0-7)? 2) TO LOGICAL PLATTER (0-7)? and 3) FORMAT TARGET PLATTER (YorN) ?

7. -- Re-MOUNT drive 0 and run HDCOPY again as in section III-A-5.

8. -- BEFORE responding to the questions asked by HDCOPY, do the following:

a. -- Switch the hard disk controller to CPU RESET.

b. -- Switch the hard disk drive off line via the RUN/STOP switch. REMOVE the 5.0 with ASDC master cartridge when the SAFE light comes on.

c. -- Load the drive with a new cartridge that you wish to configure with 5.0 Hard Disk BASIC and possibly some ASDC application programs. Place the drive back on line via the RUN/STOP switch.

d. -- WAIT at least 15 minutes to allow the new cartridge to reach drive ambient temperature.

e. -- Switch the controller back to RUN.

9. -- Now turn the WRITE PROTECT switch on the top cartridge off.

10. -- Finish answering the prompts for the copy operation to the new removable cartridge by copying from drive 1 to drive 0, formatting the pack if necessary.

11. -- You now have a cartridge that contains 5.0 Hard Disk BASIC and all ASDC application programs. Go to step III-A-7 and repeat this procedure until you have a cartridge like this for each system you are converting.

12. -- Mark all cartridges copied to indicate their contents.

III.B. -- CONFIGURE THE NEW CARTRIDGES

1. -- You now need to tailor the cartridges you produced in step III-A above for each individual end user. This is accomplished by determining which programs the user is licensed to use, be it BASIC or BASIC and one or more of the ASDC application programs. You also need to determine which programs and data files the user may currently have on re-formatted cartridges that he needs to maintain on his new 5.0 cartridge.

a. -- Copy from drive 0 to drive 1 a cartridge (that was reformatted as in step II-C above) that contains data and program files that the user needs to maintain with 5.0

1 - Load a 5.0 BASIC cartridge into the drive and place it on line. WAIT at least 15 minutes to allow the cartridge to reach drive ambient temperature. MOUNT the cartridge and run HDCOPY. BEFORE replying to the HDCOPY prompts, do the following:

a - Switch the hard disk controller to CPU RESET.

b - Switch the hard disk drive off line via the RUN/STOP switch and remove the 5.0 BASIC cartridge.

c - Load the drive with a reformatted cartridge that contains the programs and data files that the user wishes to maintain on the 5.0 cartridge.

d - Place the drive on line via the RUN/STOP switch. and WAIT at least 15 minutes to allow the cartridge to reach drive ambient temperature.

e - Switch the controller back to RUN.

2 - Finish replying to the HDCOPY prompts to copy the contents of drive 0 to drive 1.

3 - You now have on the bottom platter the data files that need to be transferred to a new 5.0 cartridge.

b. -- Configure a 5.0 cartridge. To do this, run the BASIC program 'CONFIG' to delete the ASDC application programs from the pack that the user is not entitled to.

1 - Load one of the cartridges into the drive that you reproduced in step III-A above. WAIT at least 15 minutes to allow the cartridge to reach drive ambient temperature, then load basic in the normal manner. Initialize BASIC as in step III-A-4-a above.

2 - Issue the following commands to BASIC :

```
MOUNT 0 : RUN "CONFIG" , 0
```

3 - The 'CONFIG' program will prompt you and ask which of the ASDC applications you wish to have on the final cartridge. Answer 'N' (No) to each application the user is not licensed for, 'Y' (Yes) to each he is.

4 - When CONFIG has finished, you will have a cartridge that contains 5.0 BASIC and its utility programs plus any applicable ASDC programs.

5 - Now run the program 'FILECOPY' by issuing the following BASIC commands:

```
MOUNT 0 : RUN "FILECOPY" , 0
```

6 - Using FILECOPY, copy from the bottom platter any of the programs or data files that the user may wish to maintain on the new 5.0 cartridge. Be careful not to copy any of the utility programs that are supplied with BASIC since they may not be as current as the ones supplied on the 5.0 cartridge.

a - For those users who are currently using ASDC programs and are receiving the new updated ASDC applications on their 5.0 cartridge, you explicitly need to copy the data files associated with the individual applications. To

determine the file names for these data files, refer to the ASDC APPLICATION PACKAGES DATA FILES LIST that is attached to this procedure.

b - If the user has program and data files on more than one cartridge and these files need to be placed on the new 5.0 cartridge, then repeat step III-B-1-a (page 8) to place those programs on the bottom platter. Then use FILECOPY as in step III-B-1-b-8 above.

C. -- You now have a completely configured cartridge for the end user. Repeat section III-B for each of the rest of the cartridges you need to make.

IV. -- ASSISTANCE

A. -- If you have any difficulty with this procedure, contact the Customer Service Department for the MicroSystems Division.

1. -- Mr. Bob Brousseau
Customer Service Department
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