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CP/M® 2.2
Preface

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CP/M for Horizon®
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Congratulations! You are now licensed to use CP/M from North Star Computers, Inc. CP/M, or Control Program/Microprocessor, is a powerful operating system created by Digital Research to facilitate program development on computers that use the 8080 or Z80 microprocessor.

This preface will provide a brief introduction to CP/M, and a description of how to tailor the operating system to the exact configuration and memory size of your North Star hardware. This document will also supply an overview of CP/M's capabilities, and outline the unique features of North Star CP/M. The group of manuals furnished by Digital Research explains in greater depth how to use and work with this operating system. Read this material carefully because it will enable you to derive maximum benefit from CP/M.

SECTION 1 INTRODUCTION

Like any other operating system, CP/M performs valuable services for application software, such as manipulating diskette files, controlling peripheral devices and allocating disk space.

Unlike many other operating systems, CP/M is largely isolated from the hardware environment. North Star has adapted CP/M to work with the Horizon. You provide the information that tailors CP/M to the particular configuration of your system's memory and peripherals. This arrangement allows CP/M to run on a wide range of machines.

Because of CP/M's versatility, it has become virtually an industry standard, and a great deal of software has been written to use with it. The version of CP/M that North Star now provides enables you to use all CP/M compatible software with your North Star hardware, both diskette and hard disk. You can also create and run programs written in high level languages such as BASIC and FORTRAN with the appropriate interpreter or compiler.

North Star CP/M is configured for the baseline system described below:

1. A Horizon computer
2. 32K RAM, starting at address 0
3. Two double-density diskette drives
4. A terminal connected to the standard serial port

The instructions in Section 2 will explain how to adapt CP/M to take full advantage of additional hardware:

1. Up to 56K RAM
2. Up to four diskette drives
3. Quad-capacity diskette drives
4. From one to four hard disk drives
5. A printer connected to either the second serial port or the parallel port

Non-standard terminals (such as a video-board) can be accommodated by making changes to the User Area of the CP/M code. Look in SECTION 7 for appropriate information, and a description of the procedure to follow.

SECTION 2 START-UP PROCEDURE

Any computer storage medium can be damaged, and your CP/M Distribution Diskette is no exception. Handle it with great care, and make a copy of it immediately (as described below). Leave the write-protect tab on this diskette in place to prevent inadvertent erasures from occurring. All changes to CP/M should be made to a copy of the Distribution Diskette, not to the original.

I. Copying the Distribution Diskette: COPY

- A. Turn the Horizon and the terminal on.
- B. Place the Distribution Diskette (with the write-protect tab in place) in diskette drive 1.
- C. Place a blank double-density diskette in diskette drive 2.
- D. Flick the red Reset switch on the back of the Horizon.

The following message should appear on the terminal screen:

```
32K CP/M Vers 2.2 Ver A for Horizon DQ
Product of North Star Computers, Inc.
```

```
32K Version 2.2
```

```
A>
```

A> is the system prompt, indicating that you are logged onto diskette drive 1, or A. Note: if the A> does not appear, you may need to reconfigure your memory to satisfy CP/M requirements. Changing the configuration is a simple process described in Appendix A (page 43).

- E. Type COPY, and press RETURN.

This starts the COPY program, which will announce itself on the terminal screen. Follow the directions it supplies.

- F. Designate the source drive as 1, since this contains the Distribution Diskette you are duplicating.*
- G. Designate the destination drive as 2.
- H. The Distribution Diskette is single sided, so press RETURN to confirm that the copy will also have one side.

- I. After the COPY program has run, the terminal will display the message COPY COMPLETE.

* Note: Previous experience with CP/M will have accustomed you to designate diskette drives with letters, as drive A, B, C, etc. North Star CP/M also follows this convention, except in the programs COPY, CPMGEN, FORMAT, and SYSGEN, where numbers are used instead.

Exit from the COPY program, by pressing RETURN. Remove the Distribution Diskette and put it away for safekeeping. Protect the Distribution Diskette in case your copies are lost or damaged. Prevent disaster: always provide ample back-up!

II. Tailoring CP/M to your Hardware and Memory: CPMGEN

To derive full advantage from your hardware resources, you must configure CP/M to fit them. The Distribution Diskette (and therefore the copy you are now working with) is perfectly adapted to the baseline hardware described on page 3. If the configuration of your system differs in any respect, you should adapt CP/M accordingly. The following procedure (CPMGEN) adjusts CP/M to the number and capacity of your diskette drives, and to the size of your memory. Incorporating non-standard devices is a more complicated task, described in Section 7 (page 26).

- A. Place the system diskette, i.e., the copy of your distribution diskette, in drive 1.
- B. Type CPMGEN and press RETURN.

The CPMGEN program will be loaded from the system diskette into the memory, and the terminal will display a series of questions about your hardware. After each answer, press RETURN. If you want to start the series of questions over again, type "-". If you want to abort the entire procedure, type CONTROL-C.

- Q1. ENTER MEMORY SIZE IN KILOBYTES OR SIMPLY TYPE RETURN FOR YOUR xxK SYSTEM.

CPMGEN has tested your memory size for 32, 48, or 56K and inserted this value in the message. Pressing RETURN will confirm this value. If you wish, however, you may enter a number between 24 and 64, including fractions of .25, .5, or .75 to specify the size more precisely.

Q2A. ENTER DRIVE 1 TYPE(Q=Quad-capacity, D=Double-Density,
RETURN=none)?

If you have quad-capacity diskette drives, type Q.
If you have double-density diskette drives, type D.

Q3A. ENTER STEPPING SPEED FOR DRIVE 1 (F=FAST, N=NORMAL)?

At this time, double-density diskette drives have a normal stepping speed. Quad-capacity diskette drives are fast stepping.

Q2B. ENTER DRIVE 2 TYPE (Q=Quad-capacity, D=Double-density,
RETURN=none)?

If you have only one drive, press RETURN.

Q3B. ENTER STEPPING SPEED FOR DRIVE 2 (F=FAST, N=NORMAL)?

Q2C. ENTER DRIVE 3 TYPE (Q=Quad-capacity, D=Double-density,
RETURN=none)?

CPMGEN continues on to inquire about drives 3 and 4 in like fashion. Simply press RETURN if you have only 2 drives.

Q4A. IS THIS A NORTH STAR HARD DISK SYSTEM (Y OR N)?

Type N for a North Star diskette system. Type Y for a North Star hard disk system.

Q5. DO YOU WANT READ-AFTER-WRITE CHECK (Y OR N)?

Y for yes will cause the system to verify the readability of all data written to a diskette, or disk. This read-after-write procedure extends run time, but because it increases system integrity it is strongly recommended.

Q6. IS THE PRINTER ATTACHED TO THE PARALLEL PORT OR
TO THE SECOND SERIAL PORT (P OR S)?

Enter P for a parallel port; S for a serial port. If you don't have a printer, enter S.

CPMGEN now takes the information you have provided, and quickly builds a customized image of your system in RAM.

- C. Next, CPMGEN asks where this newly configured version of CP/M should be loaded. To replace the baseline version of CP/M on your system diskette in drive 1 with the customized version of CP/M in RAM image, type a 1.

During the start-up procedure, ignore the repetition of this question. The function of the repetition is to allow you to update a number of existing CP/M diskettes, after adding more memory, or changing your hardware in some other respect.

- D. The program will now ask if the diskette is loaded. Since it is, press RETURN.

CPMGEN then writes the RAM image onto the system diskette in drive 1. This finishes the process of adapting CP/M to the context of your particular hardware, and produces a double-density diskette.

It is desirable to have at least two copies of this customized system diskette, as a protection against wear, inadvertent deletions, and other mishaps. If you have double-density drives, use the COPY program to produce several exact copies of the working system diskette. The COPY program cannot be used to transfer the material from a double-density diskette onto a quad-capacity diskette and provide full quad-capacity. To produce a quad-capacity system diskette, follow the steps in Section III.

III. Creating a Quad-Capacity System Diskette from a Double-Density System Diskette: FORMAT, PIP, SYSGEN

If you are using quad-capacity diskette drives, then you will want to convert your working CP/M system diskette to a quad-capacity format, so that you can use both sides of the system diskette. To do so, follow these steps:

- A. FORMAT: Initializing the Quad-capacity Diskette
 - 1. Put the double-density system diskette in drive 1.
 - 2. Type FORMAT, and press RETURN.

This brings the FORMAT program into memory, and allows you to specify the capacity of the destination diskette.

- 3. Type the letter of the proper option (Q for Quad-capacity, in this case).

4. Enter the number of the drive that contains the diskette you are formatting (in this case, 2).
5. Insert the blank quad-capacity diskette in drive 2.
6. Press RETURN.

The program will inform you that the computer is proceeding to format the disk, and a row of asterisks will extend across the screen, tracing its progress.

When the task is finished, the terminal should display the message, "Diskette successfully initialized".

7. Type an X to end the program.

B. PIP: Copying Files from a Double-Density to a Quad-Capacity Diskette

Type the command PIP B:=A:*. *

This copies all the files (as opposed to the system tracks, a distinction that will be explained in Section 4, below) on the diskette in drive 1 to the diskette in drive 2. This takes a while, and the terminal will list the names of the files as it copies them.

C. SYSGEN: Copying the CP/M System onto the Quad-Capacity Diskette

1. Type SYSGEN, to run the program that transfers the CP/M system onto the quad-capacity diskette.
2. Type 1, to indicate that the input diskette is in drive 1. 3. Type 2, to indicate that the output diskette is in drive 2.

This completes the process of transferring the customized CP/M from a double-density to a quad-capacity diskette. For protection, make additional copies of the quad-capacity system diskette using the COPY program and the diskette you have just created.

The FORMAT program places a value on the quad-capacity diskette that allows the COPY program to recognize and automatically copy both sides of it.

SECTION 3 USING CP/M WITH NORTH STAR DISKS

Section 3 describes the file storage capacity of different North Star disks, CP/M file names, and use of diskettes with the CP/M system.

I. File Capacity

CP/M diskettes have a capacity of 64 directory entries, and a file area capacity of 78K for single density diskettes, 163K for double density diskettes, and 338K for quad capacity diskettes. Hard disk units have a capacity of 256 directory entries and can be configured for from 9K to 8,192K, as described in Section 9, below.

II. File Names

A typical file name, such as INTRO.TXT consists of two separate elements. The primary name, "INTRO" in this case, can contain up to eight characters. The extension, "TXT" contains up to three characters. The primary name and the extension are always separated by a period. Both the primary name and the extension can contain any characters except <>,.,:=*?[].

The extension specifies the nature of the file. Programs that can be executed, such as the CP/M utility files, have the extension COM, so they are known as .COM files. Files written in assembly language are .ASM files. Extensions are required for certain kinds of files, .COM, .ASM, .HEX, among others, but are optional in other cases. You can make up your own extensions, such as TXT, for text files, or WRK, for working files.

The characters * and ? allow you to specify multiple, instead of individual files. That is, ? matches any character in the corresponding position. * matches any and all characters on that side of the period. For example,

INTR?.TXT	matches	INTRO.TXT and INTRA.TXT
*.ASM	matches	DUMP.ASM and USER.ASM
DUMP.*	matches	DUMP.ASM and DUMP.COM
.	matches	all file names

The command:

```
PIP A:=B:*.*
```

allows you, for example, to tell CP/M to copy all files from one disk to another, without having to specify each name individually.

III. Diskette Drives

For almost all purposes except the four procedures mentioned above (COPY, FORMAT, CPMGEN, and SYSGEN), diskette drives are designated by letter: A, B, C, or D. The system prompt "A>" tells you that the computer is now working with drive A. If you want to log onto drive B, you type

```
B:
```

then press RETURN. The system prompt will respond with B>, to show you that you are now logged onto drive B. On the terminal screen, the process will wind up looking like this:

```
A> B:  
B>
```

To refer to a file on the drive you are currently logged onto, you don't need to specify the drive. If you want to use a file from a different diskette drive, however, you must stipulate the drive so CP/M will know where to look for it. For example, if you are in drive B, and you want to edit a file named MEMO.TXT on diskette drive A, but the editor program is on diskette drive B, the completed command would read:

```
B> ED A:MEMO.TXT
```

Press RETURN.

IV. Changing Diskettes

After inserting a different diskette in a drive you must enter a CONTROL-C before trying to read from or write on this diskette.

If you want to insert a blank diskette, you must format it before you can write on it, to make it usable for CP/M.

SECTION 4. CP/M CAPABILITIES

Most of the information you need to use CP/M effectively is contained in the Digital Research manuals in this binder. However, the following section provides a quick overview of CP/M which may help orient you as you start to use this operating system.

There are also some minor respects (such as error reporting) in which the North Star version of CP/M refines the operating system described in the Digital Research documentation. This section will catalog the unique features of North Star CP/M, to help you in interpreting the Digital Research material properly.

I. CP/M System Area and Files; Cold-Booting and Warm-Booting

A CP/M diskette is divided into a system area and a file area. The system area is put into permanent residence in high memory, when you flick the Reset switch. The files, on the other hand, are stored on diskette, or disk, and are read into memory when you want to use them.

Flicking the Reset switch produces what is called a "cold-boot". In a cold-boot, the complete system area is read off the system tracks of the CP/M system diskette, and into high memory. A cold-boot always logs you into drive A, assuming, as should be the case, that the CP/M system diskette is inserted in drive A.

Pressing CONTROL-C produces what is called a "warm-boot". This procedure transfers control of the computer back to the Console Command Processor of CP/M, aborting whatever program may be running at the time. This may result in the loss of work that has been done, for example, in an editing session.

CONTROL-C has another basic function beside transferring control back to CP/M. CONTROL-C is the appropriate way to alert CP/M to a change of diskettes.

After a warm-boot, you can then direct CP/M to retrieve another program from a diskette, bring it into memory, and transfer control of the computer to it.

II. System Routines

CP/M's Command Control Processor comprises several intrinsic, or built-in commands that perform crucial functions every computer requires. The most useful of these are described below.

A. DIR

This command produces a list of all the files stored on a given diskette. The format for the command is

```
A>DIR
```

You do not need to designate the drive if you want to list all the files on the diskette in the drive you are logged onto. If you want to see the directory for a different diskette, you must specify the appropriate drive. For example,

```
A>DIR B:
```

The directory does not list the system commands described in this section, only the names of the programs and files stored on the diskette in question. The STAT.COM program that will be described in Section IV, below, furnishes a much more informative listing of the files, including a space accounting.

B. TYPE

This command is useful for quickly reviewing a text file you have just created, or revised. For example, to display the contents of a file ORIGINAL.TXT after you have finished editing it, type:

```
A>TYPE ORIGINAL.TXT
```

If you were logged into drive A at the time, and wanted to scan the contents of this file on drive B you would give the command:

```
A>TYPE B:ORIGINAL.TXT
```

This command can be used to print a file, as well as display it. To print a file, press the CONTROL key and hold it down while pressing the P. Then give the TYPE command, following the format shown above. See Section III below for further discussion of CONTROL-P.

C. REN

This command allows you to rename a file on a given diskette. The format for this command is:

```
REN NEW=OLD
```

For example, once you finished modifying the content of the file called ORIGINAL.TXT you might wish to change the name to REVISED.TXT, on the same drive. If so, you would enter:

```
A>REN REVISED.TXT=ORIGINAL.TXT
```

CP/M will discard the old name and store the file under the new name you have specified.

D. ERA

This command allows you to erase a file. The format is:

```
ERA FILENAME
```

This command should be used with great discretion, since it leads to file erasure. For example, to erase the file named REVISED.TXT on drive A, and you are logged onto drive A, the command will read:

```
A>ERA REVISED.TXT
```

III. Control Characters

CP/M uses control characters to perform certain basic functions. Some of the most useful of these control characters are listed below. (Hold down the control key as you would a shift key and press the letter key).

A. BACKSPACE

On CRT's, backspace removes the last character typed from the screen.

B. CONTROL-X

This erases the current line, and moves the cursor back to the beginning of that line.

C. CONTROL-C

Transfers control back to the Console Command Processor portion of CP/M. It aborts whatever program might be under way, with possible loss of work. It also is used after a change of diskettes, as described above.

D. RETURN

Enters the line just completed, or executes the current command.

E. CONTROL-S

Stops and restarts the display to permit closer scrutiny. It works only during display output, not input.

F. CONTROL-P

Stops and restarts printing of the console display. Control-P printing is cancelled with a warm boot.

IV. Utility Programs

The utility programs listed in the Directory provide a wide range of capabilities for transferring, editing, debugging programs, and so forth.

The two most valuable CP/M utility programs are STAT.COM and PIP.COM.

A. STAT

STAT is the file status program. It lists file names alphabetically, displays their status, computes their size, and available disk space.

To examine the contents of a CP/M diskette (not including the built-in system functions described in Sections II and III) give the command:

```
A>STAT *.*
```

This will produce a listing of all utility programs and other file names on the diskette.

This listing will display the number of records in each file (1 record = 128 bytes); the number of bytes allocated to each file, and the number of extents consumed.

An extent equals 128 records.

The STAT listing specifies the access of a file, Read/Write or Read/Only, the drive designation, and the file name. It also displays the number of bytes remaining on the drive. The following table gives a portion of a sample STAT.COM listing.

RECS	BYTES	EXT	ACC
64	8K	1	R/W A:ASM.COM
17	3K	1	R/W A:COPY.COM
102	13K	1	R/W A:CPMGEN.COM
38	5K	1	R/W A:DDT.COM

1. To find the number of bytes remaining on a diskette in another drive, for example, B, when you are logged onto drive A, give the following command:

```
A>STAT B:
```

2. To set all files on a disk to Read/Only status, give the command:

```
A>STAT B:*. * $R/O
```

You may wish to set the customized CP/M system diskette to Read/Only status, to prevent inadvertent erasures to it.

Read/Only files can be neither ERASed, RENamed, nor EDited!

You may want to arrange it so that certain files do not appear on your directory. For example if you have STAT.COM on every diskette, you may not want to see it listed in the directory. The command

```
A>STAT STAT.COM $SYS
```

causes STAT.COM to assume system status and behave like DIR, ERA, and other system commands. STAT.COM would always appear listed in response to the command

```
A>STAT *.*
```

3. To change the status of a single file on a diskette, give the command:

```
STAT  FILENAME $R/W
STAT  FILENAME $R/O
```

For example, to change the status of ED.COM to Read/Only, when you are logged onto drive B, and the program is on A, give the command:

```
B>STAT A:ED.COM $R/O
```

B. PIP

The Peripheral Interchange Program allows you to transfer data between I/O devices. It is primarily used to copy files between diskettes.

There are two ways to execute PIP.COM. One is to respond to the system prompt by calling the PIP program into memory.

```
A>PIP
```

The terminal will then display the PIP prompt, an asterisk (*). This is the method used in examples 1 and 2, below.

Alternatively, you can use a one-line version of the command, as shown in examples 3 and 4.

1. To copy a file from one disk onto another, respond to the prompt * by typing

```
* d'=d:FILENAME
```

The character d represents the source drive, and d' represents the destination drive.

For example, to copy a file called WORKING.TXT from A to B, give the command:

```
*B:=A:WORKING.TXT
```

2. To copy a file from one drive to another under a different name, follow the format:

```
*d':COPY=d:ORIGINAL
```

For example, if you are logged onto drive B, and want to copy WORKING.TXT on drive B onto drive A, renaming it to FINISHED.TXT, give the command:

```
*A:FINISHED.TXT=B:WORKING.TXT
```

This single line equals the series of commands:

```
A>PIP B:=A:WORKING.TXT
A>REN B: FINISHED.TXT=B:WORKING.TXT
```

3. File matches can be used to copy multiple files. For example, File A.TXT, File B.TXT, and File C.TXT can all be copied from drive A to drive B with a single line command.

```
A>PIP B:=A:*.TXT
```

4. PIP will copy all files on a disk, using a single file match. It is important to note, however, that PIP cannot copy the system area of the CP/M diskette. Use SYSGEN.COM for that purpose.

To copy all files from drive A to drive B, type:

```
A>PIP B:=A:*. *
```

PIP can also be used to copy a portion of a file, or to transfer a file from storage on disk to the printer. Consult the Digital Research manual on the PIP program for further details.

C. North Star Utility Programs

North Star has added several programs to CP/M. Some of these programs have already been introduced in the Start-Up section.

1. CPNGEN replaces the Digital Research program MOVCPM. This program reconfigures CP/M to the particular memory and hardware in use, then relocates this information to the "system tracks" of the diskette.
2. COPY.COM lets you copy the complete contents of a diskette. It does not allow you to copy selectively. PIP.COM, described above, provides this option.
3. FORMAT.COM lets you format a blank diskette properly, e. g., to the data density and capacity you designate.

4. SYSGEN.COM moves the CP/M system area between memory and the system tracks of a diskette. SYSGEN only copies the CP/M system, not utility programs listed in the directory like STAT.COM. SYSGEN therefore, is the complement of PIP which only copies files and never addresses the CP/M system.

SYSGEN is also used to copy the CP/M system into memory, at an address convenient for patching and to copy the CP/M system between diskettes.

D. Other .COM Files

The DDT.COM program provides a "dynamic debugging tool". It can debug a .HEX file or a .COM file, and can be used to patch any file.

SUBMIT.COM and XSUB.COM provide command batching facilities.

The DUMP.COM program displays the contents of any file in hexadecimal form. The DUMP.ASM file is the source code for DUMP.COM, provided by Digital Research as a sample CP/M assembly language program.

The ED.COM program is useful for text editing, particularly if you don't already have editing or word processing capabilities.

The ASM.COM program translates a source file written in assembly language into a .HEX file in machine language.

The LOAD.COM program turns a .HEX file (produced by ASM from a .ASM file) into a utility program, i.e., a .COM file.

The USER.ASM file contains the assembly source code of the User Area that North Star incorporates into this version of CP/M. This includes the code for controlling the standard Horizon serial and parallel port drives, and motherboard/parity initialization. To enable North Star CP/M to work with non-standard peripherals, you will have to write the appropriate code, and overlay the inapplicable section of the user area. See Section 7 for further details.

SECTION 5 SELECTIVE ERASURE

Never erase anything from the original CP/M Distribution Diskette. In fact, do not even remove the write-protect tab from the Distribution Diskette. This precaution will ensure that all of CP/M's capabilities remain available to you, even though some may now be irrelevant.

You may, however, find it advantageous to erase certain utility programs on copies of your working system diskettes, to increase the storage space available for other programs and data. PIP.COM and STAT.COM are Read/Only. These programs are very practical, and should almost always be retained. Files such as DUMP.ASM, DUMP.COM, and USER.ASM that primarily facilitate software development may be eliminated if you are not putting CP/M to work in this fashion. HDBOOT and HDOFF are only of value when your hardware includes a hard disk, so they are prime candidates for deletion if saving space is important. It is possible to cut the storage space CP/M requires almost in half (to around 40K), while retaining a very desirable set of capabilities.

You may find that what serves your purposes best is to copy the system area of CP/M onto a diskette, with SYSGEN, and to copy PIP and STAT onto the same diskette, then use the rest of the diskette for storing your own programs and data files.

SECTION 6 DISKETTE ERROR HANDLING

I. Diskette Error Codes

North Star CP/M for diskette reports errors just as North Star DOS does. The error message format remains:

T x D y S zzz

where x= error type; y= number of drive where the error occurred; and zzz= the decimal address of the sector where the error occurred. Note: for purposes of error messages, the drives are numbered rather than lettered. Drive 1 = A, etc.

The error codes have the following meanings:

- | | | |
|-----|---|---|
| T = | 1 | SYNC BYTE NOT FOUND
Indicates that the diskette was not properly loaded into the drive; or the diskette was not initialized, or the data was badly written on the diskette |
| | 2 | CRC COMPARE ERROR
Indicates badly written data. |
| | 3 | VERIFY COMPARE ERROR
Indicates that data just written on the disk does not match RAM. |
| | 4 | NO INDEX PULSE
Indicates the wrong type or diskette or a badly seated diskette. |
| | 5 | DENSITY MISMATCH
Indicates that single-density data was found where double-density data was expected, or vice versa. |
| | 6 | WRITE-PROTECT
Indicates that a write operation was attempted on a write-protected disk. |

II. Responses to Error Messages

You can choose one of several options when an error message appears.

A. Retry

Errors may occur because the diskette is improperly seated. Remove the diskette and replace it carefully. Press RETURN or type any other key, and the computer will retry the operation. This procedure can be repeated any number of times. It offers the safest recourse when an error message appears so it should always be your first response. Repeated failures may require more drastic measures.

B. CONTROL-C: Warm-Booting

Warm-booting the system will abort whatever program is running and return control of the computer to the Console Command Processor. Determine the problem that prompted the error message before reattempting the program.

C. CONTROL-A: Forcing Acceptance of Bad Data

This is an extreme response which should be reserved for emergencies. Forced acceptance of bad data violates data integrity, and can lead to unpredictable results or outright disaster. Nevertheless, CONTROL-A does make forced acceptance possible, except in Sector 0 which cannot be forced.

Do not write new data onto a disk after forcing acceptance of bad data.

It is a good idea to perform a surface check using the COPY program right after any non-recoverable errors. Differences in hardware tolerances can mean that one drive can read a diskette but another drive cannot. In such cases, use the COPY program to read the marginal diskette from the compatible drive, and make a copy on the non-compatible drive.

III. Other Diskette Error Messages

If you substitute one diskette for another and try a Read/Write operation without warm-booting the system, the terminal may display the message:

```
BDOS  ERR on  X: R/O
```

CP/M protects against such unexpected substitutions by checksumming directory sectors, and it responds to a mismatch with the above message. After a warm-boot you can write on the disk you have inserted.

Quad-capacity diskettes can be processed on double-density drives, but any attempt to access data on the second side will elicit the response:

```
SIDE 2 N/A (not available)
```

If a CP/M system diskette that has been tailored to fast-stepping hardware is inserted in normal-stepping hardware, the results are unpredictable. You must resolve the discrepancy between the CP/M disk and the hardware by cold booting a properly tailored system diskette.

SECTION 7 PATCHING OR DYNAMICALLY ALTERING CP/M

Only experienced people should undertake the procedures described below. This section explains how to alter CP/M to accomodate non-standard peripherals, and how to initiate changes such as a turn-key start. This discussion presupposes considerable familiarity with operating systems and software development, and a working acquaintance with CP/M.

I. Disk Map and RAM Image Locations by Component

Tracks 0 and 1 (sectors 4-19) are called the "system tracks". These are accessed only by CPMGEN, SYSGEN, (and by COPY and FORMAT). The remainder of the disk is managed by CP/M through the BIOS, which applies a 5 sector skew.

Component Name	Disk Sectors	RAM Image Address Afer SYSGEN	Address in 32K System
DOS Directory	0 - 3	Not Applicable	Not Applicable
CP/M Bootstrap	4 - 4.5	1400H	7200H briefly
Console Command Processor (CCP)	9 - 12	1500H	5D00H transient
BDOS	13 - 19	1D00H	6500H resident
BIOS- disk portion	4.5- 7	2B00H	7300H resident
USER-Sequential I/O	8	3200H	7A00H resident
Buffer & Scratch space	not on disk		7C00H-7F80H
CP/M Directory	20, 21, 25, 26 (normal skew of 5)		
CP/M Data in 1K blocks	22&27 then 23&28, 24&29, 30&35, 31&36		

II. BIOS and User Area Addresses of Interest

At the end of the disk BIOS are several locations that may be of interest for patching. These are shown below at their system generation locations.

```
31EA C9 DISKERR RET ;Disk errors may be intercepted here
31ED C9 JINIT RET ;Control comes here at each boot
31F0 C9 OFTEN RET ;Disk handler calls "often" at least
                    every 40 msec
31F7 00 HDPAGE DB 0 ;Non-zero causes HDBOOT to start
                    automatically on each cold-boot
31F8 00 CONFG DB 0 ;Like DOS CONFG byte
31F9 01 CNTRLA DB 1 ;See disk error interception below
31FF ?? OPTION DB ? ;Option flag meaning:
; 80H = Multi-drive simulation with one drive system
;       (set automatically by CPMGEN when only one drive
;       is present)
; 40H = Read-after-write option requested in OPTION
; 10H = Interrupts to be enabled after disk access
; 02H = Auto-start on warm-boot
; 01H = Auto-start on cold-boot
```

3200 is the beginning of the User Area and its jump table vector. The start of the User Area is a jump table, which follows. This example is for a 32K system.

```
7A00 JMP INIT ; Cold-boot init for USART & Parity setup
7A03 JMP CONTST ; Get Console Status - A=0 or FF
7A06 JMP CINL ; Console Input from the Standard Port
7A09 JMP COUTL ; Console Output to the Standard Port
7A0C JMP COUTR ; Serial Printer output to the Second Port
                    Only entered if CPMGEN told Serial
                    Printer
7A0F JMP COUTL ; CP/M punch device pointed at Console
7A12 JMP CINL ; CP/M "Reader" pointed at Console
7A15 JMP PRTTST ; Dummy Printer status test, always 0
7A18 JMP COUTP ; Parallel Printer output - only entered if
                    CPMGEN was told Printer was parallel
                    device
```

III. Patching in Auto-Start

The auto-start facility is enabled by turning on the bit flag in the option byte. If the flag in the option byte is turned on, the Console Command Processor will then try to load AUTO.COM from logical drive A and execute it.

Bit (01H) causes auto-start on cold boot only; whereas bit (02H) causes an auto-start every time the system is warm-booted. Caution: auto-start on warm-boot never gives you control of CCP.

You can alter the default command AUTO to any string of up to 128 bytes. Put the string length at 1507H. Put the string itself from 1508H to 1587H. For example, put "MBASIC B:MYPROG" at 1508H, so MBASIC can auto-start MYPROG on drive B. Make the length byte at 1507H correspond by setting it to 0FH.

IV. System Patching Procedure

- A. Start with a CP/M system diskette in drive 1. Do NOT use your Distribution Diskette for this purpose. Use a copy of your working system diskette.
- B. Run SYSGEN, or CPMGEN.
 1. Tell SYSGEN (or CPMGEN) which drive to read the system from. If you simply want to read CP/M from the system diskette in drive 1, type a 1.
 2. Ensure that the input diskette is loaded and press RETURN. The system tracks will be read into RAM at 1400H-33FFH.
 3. SYSGEN will now ask if you wish to output the system or boot. Since you have yet to patch, enter CONTROL-C to warm-boot.
- C. Run DDT. It loads below 1400H so the system RAM image remains untouched. Apply your patches, for example:

S31FF	Allows you to set the Option Byte
41	Will turn on auto-start and read-after-write
- D. Enter a CONTROL-C to warm-boot the system.

E. Run SYSGEN again

1. Bypass the request for the input drive number by pressing RETURN. Otherwise you would read over the patched RAM image.
2. Specify the output drive number.
3. Load a formatted diskette to receive the system. It is inadvisable to write on the working system diskette in drive 1 unless you have copies of it.
4. Confirm with RETURN. SYSGEN now writes the patched system, which you then cold-boot and exercise.

V. Altering The BIOS Dynamically

A. General Information

Location 0 contains a jump to the third byte of the BIOS (warm boot entry point). To access the OPTION byte, you could specify and assemble:

```
LHLD 1          ; HL = address of BIOS + 3
LXI D, 06FFH-3 ; Offset to option byte
DAD D          ; Add to HL
```

HL now points to the OPTION byte.

B. Dynamic Modification of the Error Interception Feature

Disk errors can be intercepted at DISKERR (BIOS + 06EAH), to use a user supplied error message. The instruction at DISKERR is called twice for each error, unless you keep control of the processor. First, before the error message is displayed, the instruction is called with A = the error type, HL = pointer to the standard message, and the Z flag off. If A is still non-zero when the error interception program returns control to the BIOS error handler, the message that HL points to will be printed until a zero byte terminates the message string. This allows you to substitute your own message for the standard error message.

After the message is displayed, DISKERR is called again. Now A will be 0 and the Z flag will be on. If you return with A still equal to 0, the console will be queried for error disposition. If A does not equal 0, then A is treated as if it were a console response. If A = 3 (CONTROL-C), a warm boot will result. If A = 1 (CONTROL-A), forced acceptance results. Any other value leads to a retry, which is not recommended.

The following is a sample intercept to accept all errors. Implementation of such a procedure is very risky, and therefore is not recommended. It is shown only as an example.

```

MYDERR  RNZ          ;Do not intercept when A<>0
        MVI  A,1     ;On second call, tell BIOS we
                   ;accept the error
        STA  ERRMARK ;Set flag to myself
        RET          ;Since A=1, force acceptance of
                   ;bad data

```

VI. Replacing the User Area to Support Non-Standard Sequential Devices

This method (A) applies if you have CP/M running on a system. If you only have North Star DOS running, a second method is described below (B).

A. User Area Alterations Using CP/M

1. Edit and assemble your new User code. Its origin should be:

(MEMSIZE\$IN\$KB*400H) - 600H for diskette

or

(MEMSIZE\$IN\$KB*400H) - 1300H for a hard disk

2. Get a standard system memory image loaded at 1400H-33FFH by using SYSGEN or CPMGEN.
3. Use DDT to overlay the old User Area at 3200H to 3380H (or 33FFH). Since the origin is not at 3200H, you must use an offset in DDT's R command.

Use the H command to calculate it by entering:

H3200 YOURORG

DDT calculates the sum first and the difference second. Use the second number in the R command. For example:

```
DDT
H3200 BA00
(DDT responds EC00 7800 - use the 7800)
I USER.HEX
R7800
CONTROL-C
```

4. Run SYSGEN to write the system.

B. User Area Alteration Using North Star DOS

1. Copy the Distribution Diskette and put the original in a safe place.
2. Put the North Star DOS diskette in drive 1, and the copy of the CP/M diskette in drive 2.
3. Flip the Reset switch to cold-boot DOS into low memory.

The following procedure is based on the fact that every North Star CP/M diskette has two directories, one for CP/M, and one for DOS. The names in the CP/M directory refer to actual files, such as PIP.COM, and STAT.COM. DOS believes that its directory entries also represent files, containing sections of code. In fact, however, the DOS directory is a dummy. The entries do nothing more than point to CP/M areas.

4. Command DOS to list the directory of files on drive 2, by typing:

```
+ LI 2
```

Watch for USER 8 2D 6 to appear on the screen. "USER" is an entry in the DOS directory, used to access the CP/M system area on the disk with the code governing interaction with peripherals.

5. Command DOS to load the USER file on drive 2 into memory at address 7A00 (the address of the user area in memory for a 32K CP/M system).

```
+ LF USER,2 7A00
```

6. Load the monitor, to enable you to display the file code.
 + GO M0000
7. Display the jump table.
 + DH 7A00, 100
8. By whatever means possible, modify the user code to suit your hardware.

Specific functions to change are:

	Starting Address
Console Status	7A45
Console Input	7A1B
Console Output	7A4D
Initialization	7A7E

9. After modifying the code, save the result as a DOS file on drive 2, starting from memory at location 7A00.

+ SF USER,2 7A00

This places the modified file back on the CP/M diskette in drive 2, at exactly the same spot the original User Area code occupied.

10. Remove the DOS diskette from drive 1. Move the CP/M diskette from drive 2 to drive 1, and cold-boot the system.

SECTION 8 CP/M FOR NORTH STAR HARD DISK: STARTUP

North Star Computers, Inc. has developed an interface that allows you to use CP/M with North Star's hard disk. This enables you to combine the capabilities of CP/M with the much greater storage capacity, and faster speed of the hard disk.

Using CP/M with a hard disk is quite similar to running it with a diskette. The first portion of the startup procedure is almost exactly the same for the diskette and hard disk, since you must boot both versions of CP/M off the diskette initially. The later steps in this startup procedure use the North Star Hard Disk Operating System (HDOS) to format the hard disk, establish the directory, allocate storage space, and perform back-up and recovery.

See Section III for an explanation of the procedure, HDOFF, you must follow when turning off the hard disk.

I. Cold-Booting CP/M System

- A. Refer to SECTION 2, above. Follow the steps for copying the CP/M Distribution Diskette and building a properly configured CP/M system diskette.

When you respond Y to the question

- Q4A. IS THIS A NORTH STAR HARD DISK SYSTEM?

the terminal will display a follow-up question.

- Q4B. GIVE THE PATHNAME OF THE HARD DISK WORK FILE.

Press RETURN, to confirm the default value, CPMWORK. The function of the "work file", specifically, and pathnames, generally, are explained in SECTION 8 below.

- B. After completing these procedures, remove the CP/M diskette(s), both the system diskette and copies you've made, from the drives.

II. Establishing HDOS Files for CP/M Use

The following steps comprise the usual procedure for establishing HDOS files and connecting them to CP/M logical drives. (A logical drive is a diskette image on the hard disk which can be set to varying sizes). For a discussion of the considerations that might make other choices of logical drive length and CP/M allocation block size preferable, see Section 9 below. Prior to this procedure, you must have installed and formatted the hard disk in accordance with Section 2 of the Hard Disk Manual.

- A. Insert your HDOS diskette in drive 1.
- B. Flick the Reset switch to boot-up HDOS.
- C. The following HDOS commands will create several CP/M logical drives of substantially different sizes. You might establish a different set of CP/M logical drive sizes, but these choices allow for considerable expansion at a later time. See Section 9 for a discussion of the procedures and constraints governing expansion of existing units.
 1. To create a file for CP/M logical drive A with a total storage capacity of 500 Kilobytes, specify 2056 HDOS file blocks. Each HDOS file block contains 256 bytes. To store the data in CP/M blocks of 2 Kilobytes each, specify an allocation factor of 2. The HDOS command is:

= CR CPMUNITA 2056 2
 2. To create a file for CP/M logical drive B, with a total capacity of 1 Megabyte, specify 4112 HDOS file blocks. To store the data in CP/M blocks of 4 Kilobytes, specify an allocation factor of 4. The HDOS command is:

= CR CPMUNITB 4112 4
 3. To create a file for CP/M with a total capacity of 250 Kilobytes, specify 1024 HDOS file blocks. Designate the allocation factor as 16, to store the data in CP/M blocks of 16 Kilobytes. The HDOS command is:

= CR CPMUNITC 1024 16

- D. Remove the HDOS diskette from drive 1. Replace it with a copy of the properly configured CP/M diskette. Flick the Reset switch to cold-boot CP/M.
- E. The next step is to establish the connection between the HDOS files you have just created, and the CP/M logical drives, or "units" they will match.

The HDBOOT program will automatically output the following message on the terminal:

```
_____ CONNECTIONS IN WORK FILE: CPMWORK  
_____ ENTER A CONNECTION OR S=SAVE OR X=EXIT
```

The work file name that appears will be CPMWORK if you accepted this default value in the CPMGEN procedure. If you supplied another name, it will appear instead.

The format for entering the connection is straightforward.

Unitletter:Pathname

The first connection is:

A:CPMUNITA

After you have supplied this information the program will review the table you are beginning to build, and ask for further input.

Proceed to connect the other two HDOS files you established to the appropriate CP/M logical drives, as follows:

B:CPMUNITB
C:CPMUNITC

After each connection you enter, the program will repeat its summary of connections, and request further input.

- F. The preceding steps allow CP/M to store and access data on the hard disk. To incorporate diskettes into this structure, you must also establish connections to the diskette drives in your system.

The format for such a connection is very slightly different.

Unitletter:,Drive Number

CP/M can handle up to sixteen logical drives at any time, so the unit letters can range from A up to P. To access two diskette drives, you might assign them the unit letters M and N. Give the command:

M:,1
N:,2

The table of connections should now read:

```
_____ CONNECTIONS IN WORK FILE: CPMWORK  
A:CPMUNITA  
B:CPMUNITB  
C:CPMUNITC  
M:,1  
N:,2  
_____ ENTER A CONNECTION or S=SAVE or X=EXIT?
```

- G. Type an S to save the list of connections you have built.
- H. The program will now ask whether you want to review this list of connections every time you cold-boot CP/M from a diskette that references the CPMWORK as the work file.

```
ENTER "N" TO MAKE FUTURE BOOTSTRAPS NON-STOP  
ENTER "B" TO REVIEW CONNECTIONS EVERY COLD BOOT
```

If you choose B, the next time you cold-boot CP/M, it will display the table of connections for you to review and change if you wish. If you choose N, the table that you have just created will be used automatically on future cold-boots. For now, type N to bypass future interactions with the list of connections.

The alternatives N versus B are discussed further in Section 9 below.

After you enter your response, the computer will write the connection table onto the CP/M workfile for future bootstraps. In addition, the CP/M system diskette in drive 1 is accessed, and the CP/M system is copied onto the workfile, so that subsequent warm boots can be made directly from the hard disk. Note: whenever you cold-boot the system, your CP/M system diskette must be in place in diskette drive 1.

- I. Copy all the files from the CP/M system diskette onto the hard disk. Note that the system diskette is now designated as unit M. The unit on the hard disk you are copying onto is unit A. The command you give is:

```
M:PIP A:=M:*.*
```

- J. Exercise the system with STAT.COM to see how much space is available in each logical drive. Give the commands:

```
A>STAT A:  
A>STAT B:  
A>STAT C:
```

To see complete characteristics for each logical drive, give the commands:

```
A>STAT A:DSK:  
A>STAT B:DSK:  
A>STAT C:DSK:
```

You can now remove the CP/M system diskette in drive 1. You will need to insert it again, the next time you want to cold-boot CP/M onto the hard disk, or run HDBOOT directly, so keep the diskette available.

III. Shutting Down the Hard Disk

Whenever you are going to shut down the hard disk, run the program HDOFF.COM to ensure that the Hard Disk read/write heads are retracted to their special landing zones on the disk before the drive motor stops. This precaution is essential, because if the read/write heads land repeatedly on a data sector, they can cause a data loss.

SECTION 9. THE RELATIONSHIP BETWEEN CP/M AND HDOS: CONNECTIONS AND ALLOCATIONS

I. Introduction

The North Star CP/M interface to the hard disk offers several useful features.

- A. You divide a hard disk drive into multiple CP/M "logical drives".
- B. You control the characteristics of the logical drive, both its total size, and the size of the CP/M block that governs allocation of storage space.
- C. A logical drive can be lengthened if space remains available.
- D. Use of the hard disk can be shared with North Star software other than CP/M.

For purposes of the user, the HDOS file becomes the equivalent of CP/M's logical drive. The HDOS file is designated by a pathname, the CP/M logical drive by a unit letter.

II. Connections

You can pick any name you choose for an HDOS file, within the limitations noted in the hard disk manual. The CP/M unit must be designated by a single letter, A-P, since CP/M can handle a maximum of 16 units at any time.

As we have already seen, establishing the connection between the pathname and the unit is quite simple. The format is:

Unit letter:Pathname

We have already worked with the suggested connections, A:CPMUNITA, B:CPMUNITB, AND C:CPMUNITC.

A. The Table of Connections and the Work File

The table of connections built in HDBOOT is stored in an HDOS file you name during the CPMGEN process. You can assign this file a particular name if you choose. Otherwise the default name CPMWORK will be used.

Each of your CP/M system diskettes contains a work file pathname. For convenience, you can establish different work file names, and therefore supply different tables of connections, on different CP/M diskettes. For example, on one diskette you might call the work file LEDGER, and build a table of connections that groups together accounting programs and associated data files.

The work file on another CP/M diskette might be named WP, for word processing, and the table of connections it contains might group together your word processing programs and text files. Thus, you can define as many different work files, and build as many different tables of connections, as your application of CP/M requires.

B. Reviewing The Connection Table

If the connections you assign are permanent, you can direct HDBOOT to implement the connection table automatically, on every cold boot. Respond N to the N or B? question in the HDBOOT procedure.

If you want to change existing connections, or make temporary ones, you can review and modify the table each time you cold boot the system. Respond B to the N or B? question.

To force review of the table, simply execute the HDBOOT program. Whenever you run HDBOOT, you must place the CP/M system diskette in drive 1.

C. Altering the Connections

If you want to add a new logical drive, up to the maximum of 16, you can simply use the format shown above:

Unitletter:Pathname

For example, to connect CP/M logical drive G to the HDOS pathname TAXES, type:

G:TAXES

Since CP/M can handle a maximum of 16 logical drives at any given moment, if your library of software consists of many logical drives, you can change the connections periodically and get access to all your programs and data files.

Alternatively, application software run under CP/M may have drive letters embedded in the code, and you may have to use drive letters more than once. You could assign the appropriate connections each time you cold-boot the system, but it is easier to build several CP/M system diskettes with different work file names on each one.

To delete a connection, simply type the unit letter, then press return. For example, to delete the connection E:CPMUNITE type:

E:

To replace a connection, just type it as a new connection.

III. Accounts and Drive Numbers

If CP/M is going to share space on the hard disk with non-CP/M software such as HBASIC, you should use HDOS to create a CP/M account. For example, type:

=AC CPM

You must then qualify the account name when you create particular HDOS files within this account. E.g.,

=CR CPMUNITA,CPM

Likewise, if you have more than one disk drive, you must qualify all references with the drive number. These are standard HDOS operating procedures. For example,

CPMUNITX,102

If you do not specify the hard disk drive number and account name, the default values, #101, and "SYSTEM" will be supplied automatically. So, if you have only one disk drive, and use only CP/M on the hard disk, you do not have to designate the account name or drive number.

IV. Allocation

When CP/M is used with diskettes, the characteristics of the CP/M logic are fixed. The storage capacity of the logical drive automatically equals the storage capacity of the diskette in the drive. On a hard disk, however, the capacity of the logical drive must be defined, since it could be as little as 9 Kilobytes, or as much as 8 Megabytes.

CP/M manages disk use by means of a disk directory; disk directory entries point to CP/M disk allocation blocks. CP/M for diskette allocates storage space in small blocks of 1K, for double-density, or 2K for quad-capacity. To allocate storage in a 4 Megabyte unit in blocks of 1K would be impractical, however.

The size of a CP/M block can vary, from 1 Kilobyte, up to as much as 16 Kilobytes. It is important to remember, that although the size of a CP/M block can vary from one logical drive to another, the size must remain constant within each.

A. Allocating CP/M Logical Drive Capacity and Block Size

Clearly, transferring CP/M to the hard disk not only permits, but actually requires a much greater flexibility in the use of storage space. North Star provides you with a range of options for handling the storage space on the hard disk. The various possibilities are tabulated below. The significance of the 8 versus the 16 bit CP/M block addresses is explained in Section C, below.

TABLE I - 8 Bit CP/M Block Addresses

CP/M Unit Size in Kilobytes		CP/M Block Size in Kilobytes	HDOS "len" in 256 byte blocks		Allocation Factor
Min	Max		Min	Max	
9	256	1	36	1,024	1
10	512	2	40	2,048	2
12	1,024	4	48	4,096	4
16	2,048	8	64	8,192	8
32	4,096	16	128	16,384	16

TABLE II - 16 Bit CP/M Block Addresses

CP/M Unit Size in Kilobytes		CP/M Block Size in Kilobytes	HDOS "len" in 256 byte blocks		Allocation Factor
Min	Max		Min	Max	
514	2,062	2	2,056	8,248	2
1,024	4,124	4	4,112	16,496	4
2,056	8,192	8	8,224	32,768	8
4,112	8,192	16	16,448	32,768	16

In general, your choice of the appropriate block size will be shaped by the trade-off between two considerations: the desirability of storing small files with minimum breakage, to reduce breakage, and space allocated but unused at the end of the file; and the desirability of addressing large files with as few directory entries as possible, to reduce program overhead, and wasted directory space.

For example, if the CP/M block size for a logical drive is 2K, a 9K file will consume 10K of storage space. If the CP/M block size for the same logical drive is 8K, the same file will require 16K for storage.

To pick the most advantageous block size and logical drive capacity, consider the number and size of the programs and files you intend to store on that logical drive. If you want to put sizable files on a logical drive, use a CP/M block size of 16K.

B. Lengthening the Unit Size

North Star CP/M for hard disk offers you a further convenience, the option of increasing the storage capacity of an existing logical drive. Take a logical drive whose initial capacity was set at 2 Megabytes, or 8,000 HDOS blocks, with an allocation factor of 16. You might fill this logical drive with data, then realize that you need an additional 2 Megabytes of storage space to accommodate the rest of the information you want to include.

The fastest and easiest solution would be to extend the original logical drive length, to gain the extra storage capacity you need. The HDOS Set Length command (SL) gives you this option, within certain bounds.

Just as you specified the original capacity of the CP/M logical drive in terms of its "len" in HDOS file blocks of 256 bytes, so you extend the logical drive's capacity by specifying the desired size in HDOS file blocks. The CP/M block size, or allocation factor, must remain the same. The amount a given logical drive can be extended depends on the ratio you first established between the drive size and the CP/M block size.

C. 8 Bit Versus 16 Bit CP/M Block Addresses

Logical drives fall into two different categories, as shown in the tables above. There is a lower range, and an upper range. This differentiation exists because CP/M chooses either 8 or 16 bit numbers for CP/M block addresses in a drive's directory, on the basis of the ratio between the drive size, and the CP/M block size. For example, a logical drive with a capacity of 3000 Kilobytes and a CP/M block size of 16K would fall into the lower range (Table I). Such a logical drive could later be extended to a maximum length of 4096 K bytes.

A logical drive with the same original capacity, 3000 Kilobytes, but a CP/M block size of 8K would fall into the upper range (Table II). This latter drive could be extended to a maximum of 8 M. A logical drive that initially falls into the lower range cannot be extended into the upper range, because this would invalidate the existing directory for the drive.

Consequently, whether and how much you could extend a 2 Megabyte logical drive would depend on the CP/M block size you had originally selected. If you selected a CP/M block size of 8K, the logical drive would fall into the lower range, and could only be extended to 2048 Kilobytes, a very marginal gain. If the original allocation was 2062 Kilobytes it could be extended to 8 Megabytes.

If you try to extend an existing logical drive beyond the maximum, HDBOOT will implement the defined maximum value, and warn you that you are wasting space.

Some further examples of this process of connection and allocation are given below.

1. The HDOS command:

```
=CR TINY 100 1
```

will create an HDOS file that contains 100 HDOS file blocks, each containing 256 bytes. The total capacity of the corresponding CP/M logical drive will be 25 KB. The allocation factor of 1 will cause the space to be allocated information in CP/M blocks of 1K. 8 KB will be used in the directory, so STAT will report 17 Kilobytes free.

2. The HDOS command:

```
=CR HUGE 32768 16
```

will create an HDOS file with a total capacity of 8 megabytes. The CP/M block size will be 16 KB. The CP/M directory will use the first 16 Kilobytes and STAT will report 8176 Kilobytes free.

3. The HDOS command:

```
=CR MEDIUM 5600 4
```

will create an HDOS file containing 5600 HDOS file blocks, each with 256 bytes. The corresponding CP/M logical drive will have a total capacity of 1400 kilobytes. The allocation factor of 4 will establish a CP/M block size of 4 KB. This logical drive could be extended to a maximum of 4124 Kilobytes with the HDOS command:

```
=SL MEDIUM 16496
```

SECTION 10 CP/M HARD DISK BACKUP AND RECOVERY

Backup and recovery of information stored in CP/M units is accomplished using the HDOS Backup and Recover systems. Consult the HDOS Manual for full explanations of the procedures. The HDOS procedures provide two major kinds of backup: total and selective. A total backup provides a method of saving and recovering all information stored on a hard disk drive. The first time a total backup is performed a complete backup of all information currently in files on the hard disk is saved on diskettes. Each subsequent total backup is incremental. That is, only those sectors of information which have been modified since the last backup are saved. The incremental backup feature allows for very fast and efficient backup on a regular basis.

In addition, the selective backup procedure can be used to save the entire contents to individual CP/M units. Remember that each CP/M unit is associated with an HDOS file. Therefore, to backup a particular CP/M unit, use the selective backup procedure and specify the associated HDOS file for backup. The total backup process, which uses the complete and incremental backup procedures can be used independently of the selective backup procedure. These two mechanisms are independent of each other.

The recovery procedure is independent of the backup procedure. There are two alternatives for recovery. One is the HDOS command:

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GO TOTREC,1
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which completely clears the hard disk and recovers some or all files from the previous total backup (i.e. the previous complete backup plus subsequent incremental backups).

The alternative,

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GO RECOVER,1
```

allows selective recovery. This allows you to specify the account, or the file that you want to replace on the hard disk. It does not affect other data stored on the disk.

Rerer to the HDOS manual for a full description of these procedures.

SECTION 11 HARD DISK PATCHING INFORMATION

HARD DISK SYSTEM PATCHING INFORMATION

The standard Hard Disk Horizon is assumed to have exactly 56 Kiloobytes of RAM. You are allowed to specify a smaller CP/M to CPMGEN to preserve RAM above CP/M for spoolers, oversize SBIOS, etcetera. The Hard Disk BIOS Extension is fixed at the top of the 56K RAM area - from D300H to DFFFH. EXAMPLE: a 56K CP/M would leave the space between CFOOH to D2FFH available.

DISK MAP & RAM IMAGE LOCATIONS BY COMPONENT *** HARD DISK

<u>Component Name</u>	<u>Sector on disk</u>	<u>RAM image addr after CPMGEN</u>	<u>Addr in a 56K HD Sys</u>
DOS Director	0	n/a	n/a
CP/M Bootstrap	4	1400H	C500H brieitly
Con Cmd Proc (CCP)	9	1500H	B000H transient
BDOS	13	1D00H	B800H resident
BIOS-disk portion	4+100H	2B00H	C600H resident
SBIOS-sequential I/O	8	3200H	CD00H resident
Spec1 Sys Area	8+180H	3380H	CE80H initially
Buffer & Scratch	not on disk		CF00H-D27FH

The Special system area intrudes upon the SBIOS (often called the USER area). It provides the CP/M Work-File pathname, some addresses within the BIOS, and code which causes CCP to load HDBOOT at a cold boot. After HDBOOT is complete, the area is free for use by other code - e.g. video-board custom SBIOS. If you clobber the Work-File pathname, you may not start HDBOOT.COM again (as in the Alternative Procedure).

DEBUGGING NOTE:

Saving low RAM (the rPA) after a blowup for a post-mortem analysis is easily done with a diskette-only system since CP/M is only loaded in high RAM. The HDBOOT process uses low RAM so the cold boot and Save trick will not work unless you cold boot a non-hard disk CP/M system.

APPENDIX A

Changing the Memory Configuration

CP/M requires contiguous memory, starting at address 0000. Many boards, however, are configured with the RAM address starting at 2000. To change the RAM address selection, follow this procedure.

1. Remove the Distribution Diskette and the blank diskette from the disk drives.
2. Turn off both the Horizon and the terminal. Pull the Horizon plug out of the socket.

WARNING

Do not take the cover off the Horizon until the power is disconnected, the fan has stopped, and the LED has gone out.

3. Lift the wooden cover off the Horizon and set it aside.
4. Locate the memory board (or boards). Both 16K and 32K RAM boards are distinguished by a conspicuous blue and white (or red and white) dipswitch located on the top row of components, near the center of the board. The exact position is 7A.
5. You change the address selection of the board by flipping the tiny white switches on the dipswitch. If you examine the dipswitch closely, you will find that the on-off positions are indicated at the top of the dipswitch. Depending on the number and size of your memory boards, the switches should be aligned as shown below. The bottom switch (number eight, as indicated on the side of the dipswitch) is always left off.

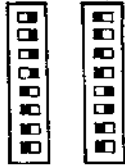
32K Board Only



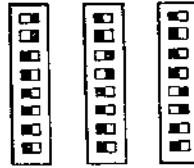
Two 16K Boards



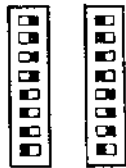
One 32K, One 16K Board



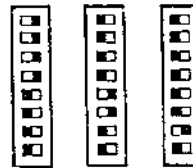
Three 16K Boards



Two 32K Boards



One 32K and Two 16K Boards



Four 16K Boards

