



# **GRAPHICS CP/M**

## **PREFACE**



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## **Graphics CP/M Preface**

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This section provides a complete start-up procedure for the standard ADVANTAGE with two floppy disk drives. If you have a hard disk ADVANTAGE, with one floppy disk drive and one hard disk drive, you should use the start-up procedure in Section 3.

### 2.1 INSERT GRAPHICS CP/M SYSTEM DISKETTE

Turn the ADVANTAGE on by pressing the on/off switch on the back of the computer. A quiet "beep" sounds, the red light on the ALL CAPS key comes on, and the

LOAD SYSTEM

message appears. Beneath it, a cursor is displayed on the video screen.

#### TWO IMPORTANT PRECAUTIONS

The Computer. Be sure that you turn the computer on before you insert the CP/M diskette.

The Diskettes. Any computer storage medium can be damaged, and your factory supplied CP/M System Diskette is no exception. Handle it carefully, holding it by the plastic jacket or the label, being sure not to touch the shiny surface of the recording media. Do not remove the adhesive write-protect tab from the diskette.

Insert the diskette in the appropriate floppy disk drive. The correct procedure is described in the ADVANTAGE User Manual. If you have a standard ADVANTAGE with two floppy disk drives, floppy disk drive 1 is the upper drive. Hold the diskette so that its label is face up and its recording slot is nearest to the drive. Slide the CP/M diskette into the drive. After the diskette clicks into place, close the latch of the disk drive.

Press the RETURN key.

When the computer has loaded the program from the diskette into memory, the screen displays the message:

64K Graphics CP/M 2.2 rev 1.0.n for ADVANTAGE AQ  
from North Star Computers, Inc.

Slightly below it on the screen, the prompt appears:

A>

Before starting work with any new piece of software, you should duplicate the factory master diskette. The FORMAT program is the first step in this procedure, which consists of the following sequence of programs: FORMAT, CPMGEN, COLDBOOT, and PIP.

## 2.2 FORMATTING A BLANK DISKETTE

This stage of the start-up procedure requires you to format a blank diskette, so that it can store data properly.

In response to the prompt, type FORMAT, then press the RETURN key.

The screen responds with the following display:

North Star Graphics CP/M 2.20 Diskette Formatter  
Initializes Diskettes for use with CP/M

Select one of the format options below:

D= Double-Density Single-Sided = D  
Q= Quad-Capacity (Double-Sided)= Q  
X= eXit - Warm Boot from A: = X

Enter option letter (D,Q,X):

A quad capacity diskette provides twice the storage space available on a dual capacity diskette. To initialize a quad capacity diskette for the ADVANTAGE, type a Q and press RETURN.

The display responds with the request:

Enter Drive number (1-4):

The diskette you are to format should be inserted in the lower floppy disk drive, number 2. Type a 2, then press RETURN.

The display responds:

Load Diskette in Drive: 2  
Strike RETURN <cr> when ready,  
To format as: Quad-Capacity Diskette:

Insert the blank diskette into the lower floppy disk drive, then close the latch on the drive and press RETURN.

The display responds:

- Proceeding to Format 70 \* Tracks -...

A row of asterisks appears across the screen as each track of the diskette is formatted.

When the formatting is complete, the display reads:

Diskette Successfully Initialized

Select one of the format options below: ...

Enter option letter (D,Q,X):

Type an X and press RETURN to finish this procedure. In response, the screen displays the CP/M prompt:

A>

The next step of the procedure is to tailor the CP/M diskette to the exact configuration of your hardware. The North Star version of the standard CP/M program MOVCPM.COM is called CPMGEN.COM.

### 2.3 CPMGEN

The CP/M Distribution Diskette is single-sided for maximum flexibility. This diskette should not be used except to generate a system diskette that takes full advantage of your hardware. The CPMGEN procedure is the next step toward producing a general purpose diskette.

With the factory supplied CP/M System Diskette in place in floppy disk drive 1, enter:

CPMGEN

and press RETURN.

The CPMGEN program loads from the CP/M System Diskette into the memory, and the video screen displays the following prompt:

North Star Graphics CP/M 2.2 System Generator.

Note: All responses end with RETURN,  
- (minus sign) restarts at question 1,  
CONTROL-C aborts with warm boot.

The series of questions listed below enables you to tailor the CP/M diskette to your hardware. After each answer, press RETURN.

1. If you want to start the series of questions over again, type a minus sign (-), then press RETURN.
2. If you want to abort the entire procedure, press the CONTROL key and hold it down while pressing the letter C key.

Q1. Enter Memory Size in Kilobytes OR  
Simply type RETURN for 64K?

Pressing RETURN confirms the 64K value. If you wish, however, you may enter a number between 53 and 64, including fractions of .25, .5, or .75 to specify the size more precisely.

Q2A. Enter Drive 1 Capacity (Q=Quad, RETURN=none)?

Specify the capacity of floppy disk drive 1. For the standard ADVANTAGE, type a Q, for quad capacity disk drive (double-sided, double-density), then press RETURN.

Q3A. Enter Stepping Speed for Drive 1  
(F=Fast, N=Normal)?

For the standard ADVANTAGE, type F, then press RETURN.

Q2B. Enter Drive 2 Capacity  
(Q=Quad, RETURN=None)?

For the standard ADVANTAGE, type Q, then press RETURN.

Q3B. Enter Stepping Speed for Drive 2  
(F=Fast, N=Normal)?

For the standard ADVANTAGE, type F, then press RETURN.

Q2C. Enter Drive 3 Capacity  
(Q=Quad, RETURN=None)?

The standard ADVANTAGE has two floppy disk drives, so  
for this basic configuration, press RETURN.

Q4A. Is this a North Star HARD DISK System  
(Y or N)?

For the standard ADVANTAGE, type N for No, then press  
RETURN.

Q5. Do you want Read-After-Write Check (Y or N)?

If you enter a "Y", the system will verify the  
readability of all data written to a diskette. This  
read-after-write procedure extends run time, but is  
strongly recommended because it substantially  
increases system integrity.

Q6. Enter Baud Rate of Serial Printer (9600 to 300)  
(for Parallel Printer, enter RETURN)?

For most serial RS232 printers, the Baud Rate is 1200, in which case you type the digits 1200, and press RETURN. The screen now displays the following prompt:

Enter Destination Disk Drive number (1-4)-  
or RETURN to Cold-Boot from drive 1-  
or CONTROL-C to Warm-Boot?

If you have a standard ADVANTAGE with two floppy disk drives, enter:

2

to indicate that the Destination Disk Drive is to be the lower floppy disk drive, number 2. The program then prompts you to:

Load output diskette in drive '2'  
and RETURN to write CP/M system onto it?

If you skipped the FORMAT procedure described earlier, the screen will display a short line of characters and digits. Push the RESET button on the back of the ADVANTAGE. After the LOAD SYSTEM message appears, press RETURN, then follow the directions in Section 2.2 above.

If you followed the directions in Section 2.2, the program has copied the customized system tracks to the diskette, and the screen repeats the earlier message:

Enter Destination Disk Drive number (1-4)-  
or RETURN to Cold-Boot from drive 1-  
or CONTROL-C to Warm-Boot?

Enter a CONTROL-C to warm-boot the system. After a moment, the CP/M prompt reappears on the screen.

A>

## 2.4 USING PIP FOR THE STANDARD ADVANTAGE WORKING COPY

The diskette in the lower floppy disk drive now contains the customized CP/M tracks. To load the remaining files from the factory supplied system diskette onto the customized system diskette, use the program PIP. Enter:

PIP B:=A:.\*

and press RETURN. The floppy disk drive motors begin to whir and after a short pause, the screen displays the word:

COPYING -

followed by a list of files as each is copied, one by one, from the original CP/M system diskette to the system diskette you are generating. When the copying process is complete, the CP/M prompt reappears on the screen:

A>

## 2.5 COLDBOOT FOR THE STANDARD ADVANTAGE

It is now necessary to cold-boot the system. Enter:

COLDBOOT

and press RETURN. After a moment the screen displays the message:

LOAD SYSTEM DISKETTE AND RETURN TO COLD BOOT

Remove the CP/M system diskette from the upper floppy disk drive. Store this diskette in a safe place.

Remove the copy of the system diskette from the lower diskette and place it in the upper floppy disk drive. Close the floppy disk drive latch, and press RETURN.

The ADVANTAGE reads the newly configured system tracks into memory, thereby completing the configuration process. Before beginning work with this newly configured system diskette you should copy it to create several backup versions. Then, if your system diskette is damaged by operator error, system failure or wear, other properly configured copies are available to replace it.

## 2.6 COPYING THE SYSTEM DISKETTE

With the system diskette in the upper floppy disk drive, type COPY and press RETURN.

The screen displays the messages:

North Star Graphic CP/M 2.2 Diskette Copier (ver 1.1)  
Copies Double-Density or Quad-capacity Diskettes

Mount the Diskettes to be processed and-  
Enter INPUT Drive number (1-4):  
Or Mount System Diskette and RETURN to Exit:

The INPUT drive is number 1, so type a 1. The screen displays the message:

To Surface Check Only, Enter "N",  
To Verify-Compared two diskettes, Enter "V"  
To Copy, Enter OUTPUT Drive number (1-4):

The OUTPUT drive in this case is number 2, so place a blank quad-capacity diskette in the lower floppy disk drive. Then type a 2. The screen displays the message:

Input is CP/M Quad-Capacity Diskette  
Enter RETURN for normal two-sided Copy:

Press RETURN if the blank diskette is, as suggested, a quad-capacity diskette. The screen displays the messages:

Proceeding to copy 70 track diskette

The floppy disk drive motors whir for several seconds as the copying occurs, then the screen displays the message:

Copy COMPLETE

Mount the Diskettes to be processed and-  
Enter INPUT Drive number (1-4):  
or Mount System Diskette and RETURN to Exit:

Since the COPY process is complete, press RETURN. The screen displays the CP/M prompt:

A>

Remove the newly created system diskette from the lower floppy disk drive and label it clearly.

You can now proceed to make another copy of the system diskette. With several copies of the system diskette on hand, you can begin working with CP/M. The CP/M procedures are described in Sections 4 through 8 of this manual.

This section details the start-up procedure for the ADVANTAGE with one floppy diskette drive and one hard disk drive.

### 3.1 TEST AND FORMAT ADVANTAGE HARD DISK

Turn on the ADVANTAGE by pressing the on/off switch on the back of the computer. A quiet "beep" sounds, the red light on the ALL CAPS key comes on, and the

LOAD SYSTEM

message appears. Beneath it, the screen displays a cursor.

#### CAUTION

Be sure that you turn the computer on before you insert the ADVANTAGE Hard Disk Supplement Diskette.

Insert the ADVANTAGE Hard Disk Supplement Diskette and run Option 2, "COMPLETE HARD DISK TEST AND REFORMAT" according to the directions given in the ADVANTAGE HARD DISK SUPPLEMENT GUIDE. This option formats your hard disk and creates a GDOS SYSTEM account.

This test goes through four passes of the PATTERN READ/WRITE TEST, and one each of the SERVO HARMONIC TEST and the SERVO RANDOM TEST. The complete test sequence takes about 50 minutes to run.

When the test is completed, reset the ADVANTAGE to begin configuring the CP/M System Diskette by entering:

7

the RESET SYSTEM option on the main ADVANTAGE HARD DISK SUPPLEMENT menu. Now, press RETURN.

You again receive the message:

LOAD SYSTEM

Remove the ADVANTAGE HARD DISK SUPPLEMENT DISKETTE from floppy disk drive 1 and insert the factory supplied Graphics CP/M System Diskette. You are now ready to create a copy of the system diskette for your own day to day use.

**CAUTION**

Any computer storage medium can be damaged, and your Graphics CP/M System Diskette is no exception. Handle it carefully, holding it by the plastic jacket or the label, and making sure not to touch the shiny surface of the recording media. Do not remove the adhesive write-protect tab from the diskette.

Insert the diskette into floppy disk drive 1. Hold the diskette so that the label is face up and its recording slot is nearest to the drive. Slide the diskette into the drive. After the diskette clicks into place, close the latch on the disk drive.

Press the RETURN key.

When the computer has loaded the program from the diskette into memory, the screen displays the message:

64K Graphics CP/M 2.2 rev 1.0.n for ADVANTAGE AQ  
from North Star Computers, Inc.

Slightly below it on the screen, the CP/M prompt appears:

A>

Before starting work with any new piece of factory supplied software, you should duplicate the factory master diskette. The FORMAT program is the first step in this procedure, which consists of the following sequence of programs: FORMAT, CPMGEN, ONECOPY, and COLDBOOT.

### 3.2 FORMATTING A BLANK DISKETTE

This stage of the start-up procedure requires you to format a blank diskette, so that it can store data properly.

In response to the CP/M prompt, type FORMAT, then press the RETURN key.

The screen responds with the following display:

North Star Graphics CP/M 2.20 Diskette Formatter  
Initializes Diskettes for use with CP/M

Select one of the format options below:

D= Double-Density Single-Sided = D

Q= Quad-Capacity (Double-Sided)= Q

X= eXit - Warm Boot from A: = X

Enter option letter (D,Q,X):

To initialize a quad capacity diskette for the ADVANTAGE, type a Q and press RETURN.

The display responds with the request:

Enter Drive number (1-4):

Enter the number 1.

The display responds:

Load Diskette in Drive: 1

Strike RETURN <cr> when ready,

To format as: Quad-Capacity Diskette:

Remove the CP/M System diskette from floppy disk drive 1, replace it with the blank diskette. Close the latch on the drive, and press RETURN.

The display responds:

- Proceeding to Format 70 \* Tracks -...

A row of asterisks appears across the screen as each track of the diskette is formatted.

When the formatting is complete, the display reads:

Diskette Successfully Initialized

Select one of the format options below: ...  
Enter option letter (D,Q,X):

Remove the formatted blank diskette from floppy disk drive 1 and replace it with the factory supplied CP/M System Diskette.

Type an X and press RETURN to finish this procedure. In response, the screen displays the CP/M prompt:

A>

The next step of the procedure is to tailor the CP/M diskette to the exact configuration of your hardware. The North Star version of the standard CP/M program MOVCPM.COM is called CPMGEN.COM.

### 3.3 CPMGEN

The Graphics CP/M System Diskette is double-sided for maximum flexibility. The factory supplied CP/M System Diskette should only be used to generate a copy of CP/M that takes full advantage of your hardware. The CPMGEN procedure is the next step toward producing your general purpose system diskette.

With the factory supplied diskette secured in the floppy disk drive, enter:

CPMGEN

and press RETURN.

The CPMGEN program loads from the System Diskette into the memory, and the video screen displays the following messages:

North Star Graphics CP/M 2.2 System Generator.

Note: All responses end with RETURN,  
- (minus sign) restarts at question 1,  
CONTROL-C aborts with warm boot.

The series of questions listed below enables you to tailor the CP/M diskette to your hardware. After each answer, press RETURN.

1. If you want to start the series of questions over again, enter a minus sign (-) and press RETURN.
2. If you want to abort the entire procedure, press the CONTROL key and hold it down while pressing the letter C key.

Q1. Enter Memory Size in Kilobytes OR  
Simply type RETURN for 64K?

Pressing RETURN confirms the 64K value. If you wish, however, you may enter a number between 53 and 64, including fractions of .25, .5, or .75 to specify the size more precisely.

Q2A. Enter Drive 1 Capacity (Q=Quad, RETURN=none)?

Specify the capacity of floppy disk drive 1. Enter:

Q

for quad capacity disk drive (double-sided, double-density), then press RETURN.

Q3A. Enter Stepping Speed for Drive 1  
(F=Fast, N=Normal)?

Enter:

F

then press RETURN.

Q2B. Enter Drive 2 Capacity (Q=Quad, RETURN=none)?

Since you have already configured your floppydisk, press RETURN.

Q4A. Is this a North Star HARD DISK System  
(Y or N)?

Enter:

Y

to answer YES to the prompt and press RETURN. You will receive the following question.

Q4B. Give the PATHNAME of the HARD DISK Work File  
OR Simply type RETURN for "CPMWORK"?

Press RETURN for the default PATHNAME, "CPMWORK" or enter a new name.

For further information, see the discussion on CP/M workfiles and hard disk account names in Section 9.3.

Q5. Do you want Read-After-Write Check (Y or N)?

Entering a "Y" will cause the system to verify the readability of all data written to a diskette. This read-after-write procedure extends run time, but is strongly recommended since it substantially increases system integrity.

Q6. Enter Baud Rate of Serial Printer (9600 to 300)  
(for Parallel Printer, enter RETURN)?

For most serial RS232 printers, the Baud Rate is 1200, in which case you enter the digits:

1200

and press RETURN.

The screen now displays the following prompt:

Enter Destination Disk Drive number (1-4)-  
or RETURN to Cold-Boot from drive 1-  
or CONTROL-C to Warm-Boot?

Enter:

1

to indicate that the Destination Disk Drive is to be the lower drive, floppy disk drive number 1.

The program then prompts:

Load output diskette in drive 1  
and RETURN to write CP/M system onto it?

If by chance you skipped the FORMAT procedure described earlier in this section, the screen will display a short line of characters and digits. Push the RESET button on the back of the ADVANTAGE. After the message:

LOAD SYSTEM

appears, press RETURN, then follow the directions in Section 3.2 above.

If you followed the directions in Section 3.2, the program writes the customized system tracks onto the diskette and the screen repeats the earlier message:

Enter Destination Disk Drive number (1-4)-  
or RETURN to Cold-Boot from drive 1-  
or CONTROL-C to Warm-Boot?

Press RETURN.

The ADVANTAGE prompts:

LOAD SYSTEM

Press RETURN again.

CP/M will boot-up with its hard disk herald, then prompt:

HDBOOT?  
A>

### 3.4 COPY THE CP/M SYSTEM DISKETTE WITH ONECOPY

The diskette in floppy disk drive 1 now contains the customized CP/M system tracks. To load the remaining CP/M utility files from the factory supplied CP/M System Diskette onto your customized copy, use the ONECOPY program.

Enter:

B:ONECOPY \*.\*<CR>

The console displays:

MOUNT B: IN DRIVE 1, TYPE ANY KEY

Remove the customized diskette from floppy disk drive 1. Insert the factory supplied CP/M system diskette into floppy disk drive 1 and press any key - the space bar will do.

The console displays:

Mount INPUT Diskette and type RETURN

The programs you want to copy are on the CP/M System Diskette in floppy disk drive 1, so press RETURN.

ONECOPY requests:

MOUNT A: IN DRIVE 1, TYPE ANY KEY

Leave the System Diskette in floppy disk drive 1 and press any key.

ONECOPY prompts:

Mount OUTPUT Diskette and type RETURN

Insert the customized copy of the distribution diskette into floppy disk drive 1 and press RETURN.

ONECOPY begins to copy the programs from the North Star CP/M System Diskette to your customized copy.  
\*\*\*\*\* There are several requests for diskette changes.

NOTE

Keep in mind that every request for the INPUT diskette refers to the North Star CP/M System Diskette, and every request for an OUTPUT diskette always refers to your customized copy.

When ONECOPY is completed, the program will prompt:

Mount System Diskette, type RETURN to Warmboot

Leave your working copy in drive 1 and press RETURN.

When you receive the CP/M prompt enter:

COLDBOOT

and press RETURN for a normal hard disk startup.

At this point you can make another copy of your customized system diskette, using SYSGEN and ONECOPY. This precaution is advisable, since it protects you from program loss due to operator error, equipment malfunction, and diskette wear.

### 3.5 ESTABLISHING HARD DISK GDOS FILES FOR CP/M USE

The following steps comprise the usual procedure for establishing GDOS files and connecting them to CP/M logical drives. A logical drive can be considered an image of a diskette on the hard disk complete with file directory. Using GDOS commands, the logical drive can be set to varying sizes to provide maximum flexibility for your CP/M applications and data. For a discussion of the considerations that might make various choices of logical drive length and CP/M allocation block size preferable, see Section 9.4.

Make sure that you have formatted the hard disk according to the procedures outlined in Sections 3.1 through 3.4 before inserting your floppy disk.

Insert a working copy of the CP/M System Diskette into the floppy disk drive.

Press the RETURN key to boot-up CP/M.

For purposes of illustration, this example will create two CP/M hard disk units and connect them to logical drives A and B. The following GDOS commands will create two CP/M logical drives of substantially different sizes. These choices permit it considerable expansion at a later time. See Sections 9.4.2 and 9.4.3 for a discussion of the procedures and constraints governing expansion of existing units and the use of application programs on the units.

1. To create a file for CP/M logical drive A with a total storage capacity of 500 Kilobytes, specify 2056 GDOS file blocks. Each GDOS file block contains 256 bytes. To store the data in CP/M blocks of 2 Kilobytes each, specify an allocation factor of 2. The GDOS 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 GDOS file blocks. To store the data in CP/M blocks of 4 Kilobytes, specify an allocation factor of 4. The GDOS command is:

```
=CR CPMUNITB 4112 4
```

To return to CP/M, enter:

```
=CP <CR>
```

The next step is to establish the connection between the GDOS files or "pathnames" 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 T=To HDOS 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 GDOS file you have established to the appropriate CP/M logical drives, as follows:

B:CPMUNITB

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

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 a connection to the floppy disk drive in your system.

The format for such a connection is slightly different. Enter:

Unitletter:,Drive Number

Each CP/M system diskette can handle up to sixteen logical drives at any time, so the unit letters can range from A to P. To access the floppy disk drive, you might assign the unit letter M.

Enter the command:

M:,1

The table of connections should now read:

----- CONNECTIONS IN WORK FILE: CPMWORK

A:CPMUNITA

B:CPMUNITB

M:,1

----- ENTER A CONNECTION OR T=To HDOS or S=SAVE or X=EXIT?

Enter an S to save the list of connections you have built.

The program now asks 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 B to allow you to review the connection table on cold-boot.

For further information, you should read the discussion on altering the connection table in section 9.2.2 below.

After you enter your response, the computer will write the connection table onto the CP/M hard disk 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  
present in the floppy disk drive.

Copy all the files from your working CP/M system diskette onto the hard disk. (Remember 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:\*.\*

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

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

You can now remove the CP/M system diskette from floppy disk 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.

### 3.6 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. This precaution is essential if you are going to physically move the ADVANTAGE, since data may be lost if the read/write heads land on a data sector.

Enter:

HDOFF

The program will prompt with the message:

LOAD SYSTEM DISKETTE AND RETURN TO COLD BOOT

The hard disk read/write heads have been reset at this point. You can either load another system diskette and continue processing or turn off the ADVANTAGE and move it safely.



#### 4.1 STARTING UP A WORK SESSION WITH CP/M

First, turn the ADVANTAGE on by pressing the on/off switch on the back of the computer. A "beep" sounds, the red light on the ALL CAPS key comes on, and the message:

LOAD SYSTEM

and a cursor appear on the screen.

Next, insert a working copy of the CP/M system diskette in floppy disk drive 1. Close the drive latch, and press the RETURN key.

The portion of CP/M that must always be resident in the internal memory, the "system tracks," is now read off the diskette and into the memory. When this process is complete, the CP/M herald appears on your screen:

64K Graphics CP/M vers 2.2 rev A for Advantage Ax  
from North Star Computers, Inc.

Note that the "x" in the herald will be replaced by a "Q" if you have configured a standard ADVANTAGE with two floppy disk drives, or by an "H" if you have configured a hard disk ADVANTAGE.

The CP/M system herald is followed by the CP/M prompt:

A>

You can now use any of the system routines that are part of the CP/M Console Command Processor (CCP). These built-in commands, DIR, TYPE, REN, and ERA, are described in more detail in Section 5.2.

#### 4.2 RUNNING UTILITY OR APPLICATION PROGRAMS

The CP/M diskette includes a number of utility programs as well as the system routines. The utility programs are described in Sections 5.4 - 5.5 of the next chapter. The special enhancements that North Star CP/M includes are described in Section 6.

CP/M also allows you to run a wide range of application programs. Consult the appropriate manual for the application program you want to use for instructions on the correct procedures.

#### 4.3 FLOPPY AND HARD DISK DRIVES

As the start-up procedure indicates, several CP/M programs (COPY, FORMAT, CPMGEN, AND SYSGEN), use numbers to designate disk drives. All other CP/M programs (including ONECOPY) use letters to designate disk drives. The upper floppy disk drive on the standard ADVANTAGE is referred to either as drive A, or 1; the lower floppy disk drive is either drive B, or 2.

With the hard disk ADVANTAGE, the lower floppy disk drive is always the number 1 for these CP/M programs. See Section 9 for a discussion of CP/M logical drive names on the hard disk.

The CP/M system prompt tells you into which drive you are logged. The prompt:

A>

means that you are logged onto drive A. If you want to log onto drive B, you enter:

B:

then press RETURN. The system prompt responds with:

B>

This shows that you are now logged onto drive B.

To use 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 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 drive B, but the editor program is on drive A, the complete command would read:

B>A:ED MEMO.TXT

#### 4.4 CHANGING PROGRAMS OR DISKETTES

When you want to change from one CP/M utility program to another, or from one application program to another, press CONTROL-C. This produces a "warm boot", which transfers control of the computer back to the Console Command Processor of CP/M. After a warm boot, you can direct CP/M to retrieve another program from diskette or hard disk, bring the program into memory, and shift control of the ADVANTAGE to that program.

Likewise, if you want to insert a different diskette into a floppy disk drive, you must enter a CONTROL-C before trying to read from or write into the new ...x Warm-boot, reset disk subsystems diskette. The warm-boot causes CP/M to reset the disk subsystems in the computer, and alerts the computer to the presence of a new diskette.

If you want to use a blank diskette in an ADVANTAGE, you must initialize the diskette with the FORMAT program before you can store data on it. The standard ADVANTAGE program, COPY, is the only exception to this requirement.

You can use the COPY program to transfer data to a blank diskette without having to format the diskette first. This is possible because the COPY program copies the formatting from the original diskette, along with the data.

The ONECOPY program used with the hard disk ADVANTAGE uses PIP style copying, and so requires blank diskettes that have been formatted with the FORMAT program.

#### 4.5 CHANGING OPERATING SYSTEMS

The North Star version of CP/M includes a special program for cold-booting the system. When you have finished working with CP/M and want to shift to another operating system, the first step is to enter a CONTROL-C to produce a warm-boot.

This procedure transfers control of the computer back to the Console Command Processor (CCP), and logs you back into the same drive.

Then, in response to the system prompt type A:COLDBOOT and press the RETURN key. The screen displays the message:

LOAD SYSTEM DISKETTE AND RETURN TO COLD BOOT

When you have ensured that a CP/M system diskette is present in the appropriate floppy disk drive, press the RETURN key to initiate the COLDBOOT program. Almost instantly the screen displays the ADVANTAGE prompt:

LOAD SYSTEM

This procedure brings your work in CP/M to an orderly termination. You can now remove the CP/M diskette(s) from the ADVANTAGE.

Insert the new system diskette you want to work with in floppy disk drive 1, close the disk latch, and press RETURN.

#### 4.6 DISKETTE CAPACITY

Quad capacity CP/M diskettes have a capacity of 64 directory entries.

For a quad diskette, (i.e., double-sided, double-density) the file storage area is 338K; for a dual diskette (single-sided, double-density) the file storage area is 163K.

All diskettes used on the ADVANTAGE must be double-density.

#### 4.7 FILE NAMES

A typical CP/M 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, here "TXT", can contain a maximum of 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 and are therefore known as .COM files. Files containing assembly language source code have a .ASM extension. Extensions are required for certain kinds of files such as .COM, .ASM, .HEX, 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 rather than 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.

For example, the command:

PIP A:=B:.\*.\*

will copy all files from one disk drive or unit to another, without having to specify each file name individually.

#### CAUTION

Since the command ERA \*.\* erases all files on the CP/M logged disk drive, you should be absolutely sure that this is what you really want to accomplish before rather than after you enter the command.



**5.1 INTRODUCTION**

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

**5.2 SYSTEM ROUTINES**

CP/M's Console Command Processor contains several intrinsic, or built-in commands that perform certain crucial functions. The most useful of these are described below.

**5.2.1 DIR**

This command produces a list of all the files stored on a given diskette or hard disk unit. 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 or hard disk unit in the drive into which you are logged. If you want to see the directory for a different diskette or unit, 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, described below in Section 5.4.1, furnishes a much more informative listing of the files, including space accounting.

### 5.2.2 TYPE

This command is useful for quickly reviewing a text file that 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 onto 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, enter the type command, then press the CONTROL key and hold it down while pressing the P key. Then press RETURN.

### 5.2.3 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 a file called ORIGINAL.TXT you might wish to change the name to REVISED.TXT and leave it stored on the same drive, A. If so, you would type:

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

CP/M then discards the old name and stores the file under the new name you have specified.

#### 5.2.4 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, when you are logged onto drive A, you would enter:

ERA REVISED.TXT

You can use the wild cards \* and ? with this command to specify a range of files. For example, to erase all the .PRN files that an assembler has generated from the diskette in drive A, when you are logged into drive A, the sequence is:

ERA \*.PRN

#### 5.3 CONTROL CHARACTERS

CP/M uses control characters to perform certain basic functions. Some of the most common control characters are listed below. See Section 6.2 for a description of other control characters that are operative under the \*\*\*\*\* character I/O sub-system of CP/M. To enter a control character, you should hold down the CONTROL key as you would a shift key, then press the specified letter key.

##### BACKSPACE

The backspace key functions as a destructive backspace. This North Star version of CP/M also contains a backspace using the F15 key. This key reverse-echoes the character to the console as it erases.

### CONTROL-X

\*\*\*\*\* Erases the current line, and moves the cursor back to the beginning of that line.

### CONTROL-C (only at the beginning of a line)

Transfers control back to the Console Command Processor portion of CP/M. This combination of keys often aborts whatever program might be under way, and may even destroy data. This command causes the operating system to do a warm boot, so it is needed after every change of diskettes.

### RETURN

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

### CONTROL-S

\*\*\*\*\* Halts or suspends a console output display to permit closer scrutiny. Indeed any key except CONTROL-C restarts the display.

### CONTROL-P

Toggles the printer on and off, starting and stopping printer output. CONTROL-P printing is cancelled with a warm boot.

## 5.4 UTILITY PROGRAMS

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

In general, the most valuable CP/M utility programs are STAT.COM and PIP.COM.

#### 5.4.1 STAT

\*\*\*\*\* STAT is the file status program. It lists all utility programs on a diskette or hard disk CP/M unit alphabetically, displays their status, and computes their size. This listing displays the number of records in each file, the number of bytes allocated to each file, and the number of physical extents consumed. On a quad diskette, an extent equals 256 records and each record equals 128 bytes. At the end of the listing the remaining available disk space is indicated.

To examine the contents of a CP/M diskette (not including the built-in system routines described in Chapter 4) give the command:

A>STAT \*.\*

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
114	16K	1	R/W A:CPMGEN.COM
38	6K	1	R/W A:DDT.COM

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

A>STAT B:

2. 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

3. 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 accidental erasures. Read/Only files can be neither ERAsed, RENamed, nor EDited!

\*\*\*\*\*

You may also want to prevent certain files from appearing 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. However, STAT.COM would always be listed in response to the command:

A>STAT \*.\*

#### 5.4.2 PIP

The Peripheral Interchange Program allows you to transfer data between I/O devices. It is primarily used to copy files between diskettes or between hard disk CP/M units.

\*\*\*\*\*

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

Give the command:

A>PIP

The screen then displays 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 this command, as shown in examples 3 and 4 below.

1. To copy a file from one disk into another, respond to the prompt \* by giving a command that follows the general format:

\* D:=S:FILENAME

The character s represents the source, or input drive and represents the destination, or output 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=S:ORIGINAL

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

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

That single line equals the series of commands:

A>PIP A:=B:WORKING.TXT  
A>REN A:FINISHED.TXT=A: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 the following 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, give the command:

A>PIP B:=A:\*

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

To copy a file named DUMP.PRN to the printer, give the command:

A> PIP LST:= DUMP.PRN[T8P60]

The [T8] expands tabs to every eighth column. Many printers require a generalized tab specification, which the TX option provides. The [P60] causes the printer to begin a new page after every 60 printed lines.

## 5.5 OTHER .COM FILES

### 5.5.1 SYSGEN

SYSGEN.COM moves the CP/M system between memory and the system tracks of a diskette. SYSGEN copies only \*\*\*\*\* the CP/M system, not data files or programs like STAT.COM that are listed in the directory. SYSGEN is the complement of PIP, since PIP only copies data files or programs. SYSGEN is also used (with DDT) to copy the CP/M system into memory at an address convenient for patching.

### 5.5.2 DDT

The DDT.COM program is a "Dynamic Debugging Tool." It can debug a .HEX file or a .COM file, and can be used to patch any file.

### 5.5.3 SUBMIT

SUBMIT.COM provides command batching facilities.

### 5.5.4 DUMP

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.

### 5.5.5 ED

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

### 5.5.6 ASM

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

### 5.5.7 LOAD

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

\*\*\*\*\*

### 5.6 ERASING UNNEEDED FILES FROM WORKING COPIES OF THE CP/M DISKETTE

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

You may, however, find it advantageous to erase certain utility programs from copies of your working system diskettes to increase the storage space available for other programs and data.

THE PIP.COM and STAT.COM programs are very practical and should almost always be retained.

\*\*\*\*\* However, Software development files, such as DUMP.ASM and DUMP.COM, may be eliminated if you are not putting CP/M to work in this fashion. It is possible to cut the storage space CP/M requires to about 40K, while retaining a very desirable set of capabilities.

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

## 6.1 NORTH STAR UTILITY PROGRAMS

North Star has added or enhanced several programs of CP/M. Some of these programs have already been introduced in the Start-Up section. These programs are summarized below:

1. CPMGEN.COM replaces the Digital Research program MOVCPM.COM. This program reconfigures CP/M to the exact memory and hardware in use, then writes this information onto the "system tracks" of the diskette.
2. COPY.COM lets you copy the contents of an entire diskette onto a blank diskette in another floppy disk drive. It does not allow you to copy selectively. PIP.COM, described in section 4.4.2, provides this option.

COPY also enables you to surface check a diskette after a non-recoverable error.

If you are using the hard disk ADVANTAGE, with only a single floppy disk drive, you must use the ONECOPY program to copy information from one diskette to another. However, you can still use the surface check option of the COPY program to check a diskette after a non-recoverable error.

3. ONECOPY.COM provides you with a means of copying any number of files from one diskette to another using only one floppy disk drive.
4. FORMAT.COM allows you to format a blank diskette properly for CP/M use.
5. LOCAL.COM provides a way to send control characters directly to the CRT display. This program is useful for turning on smooth scrolling, for example.
6. COLDBOOT.COM provides a way to reboot the system from the keyboard.
7. GMGRADD.COM is a program in which the graphics manager has been embedded. This program links the graphics manager to a program that has been written to use these graphics capabilities.

8. CONTROL T invokes the NS100 screen dump program. This program dumps the contents of the ADVANTAGE Video display to the NS100 printer on a pixel by pixel basis.
9. GDDT.COM provides a convenient way to debug graphics programs.
10. DIRDUMP.COM dumps the CP/M directory and translates CP/M block number and DOS sector number to facilitate error analysis and recovery.
11. SYSGEN.COM moves the CP/M system between memory and the system tracks of a diskette. SYSGEN only copies the CP/M system, not utility programs like STAT.COM that are listed in the directory. SYSGEN therefore, is the complement of PIP which only copies utility programs and never addresses the CP/M system. SYSGEN is also used (with DDT) to copy the CP/M system into memory, at an address convenient for patching.
- \*\*\*\*\* 12. USER.ASM 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 sequential I/O devices such as a printer, a punch, and a reader. All console I/O passes through the user area, so that special filtering can be done.

To enable North Star CP/M to work with non-standard peripherals, you must rewrite the USER.ASM file to include your modified I/O drivers, reassemble the code, and use SYSGEN and DDT to overlay the I/O area in an image of CP/M. See Section 8 for further details.

## 6.2 CHARACTER I/O SUBSYSTEM

### 6.2.1 Introduction

The ADVANTAGE screen can display both characters and graphic images. Some of these functions are performed by the character I/O subsystem; others are performed by the graphics subsystem.

Character output to the console evokes the character I/O subsystem. This allows you to manipulate the display in a variety of ways.

When the output consists of printable characters, either alphanumerics or special symbols, the video subsystem displays them on the screen. The location of each character is determined by a cursor. The characters are positioned within a grid that is 80 characters wide and 24 lines deep.

When you enter certain control codes or escape sequences, the display is altered accordingly:

- the screen is turned on or off,
- the screen is cleared wholly or partially,
- the cursor is moved or turned on or off,
- smooth scrolling is turned on or off,
- the speed of smooth scrolling is changed,
- auto-wraparound is turned on or off, or
- reverse video is turned on or off.

Other codes cause the audio tone to sound, and turn on or off audio feedback for characters typed at the keyboard. A further pair of codes masks or unmasks bit 7, on character codes typed on the keyboard.

### 6.2.2 Details on Character I/O Subsystem

\*\*\*\*\* The character I/O subsystem functions detailed in Table 6-1 can be incorporated into user programs by invoking the appropriate character output. Additionally, the CP/M LOCAL program allows you to output control characters to the console or printer.

#### A. LOCAL

To run the self-prompting program LOCAL, enter LOCAL and then press RETURN. This procedure provides a convenient way to turn on smooth scrolling, for example. Enter a CONTROL-C to exit from this program.

#### B. Machine Language Programs

You can incorporate character I/O functions into your programs. Load the appropriate code(s) into Register E, load the appropriate function number into Register C, and call the BDOS routine at location 0005H.

For example, the following machine language routine will clear the screen and home the cursor:

```
0100          ORG 0100H
0100 1E04      CLRSC  MVI E,004H  *SET UP CTRL-D
0102 0E02      MVI C,002H  *SPECIFY CONSOLE OUTPUT
0104 CD0500    CALL 0005H  *CALL BDOS ROUTINE
0107 C30000    JMP  0000H  *DO A WARM BOOT
010A          END
```

The next example moves the cursor to position 23 on line 14:

```
0100          ORG 0100H
0100 1E1B      SETCR  MVI E,01BH  *SET UP ESCAPE
0102 0E020     MVI C,002H  *SPECIFY CONSOLE OUTPUT
0104 CD0500    CALL 0005H  *CALL BDOS ROUTINE
0107 1E3D      MVI E,03DH  *SET UP =
0109 0E02      MVI C,002H  *SPECIFY CONSOLE OUTPUT
010B CD0500    CALL 0005H  *CALL BDOS ROUTINE
010E 1E2E      MVI E,02EH  *LINE 14 + OFFSET OF 32
0110 0E02      MVI C,002H  *SPECIFY CONSOLE OUTPUT
0112 CD0500    CALL 0005H  *CALL BDOS ROUTINE
0115 1E37      MVI E,037H  *COLUMN 23 + OFFSET OF 32
0117 0E02      MVI C,002H  *SPECIFY CONSOLE OUTPUT
0119 CD0500    CALL 0005H  *CALL BDOS ROUTINE
011C C30000    JMP  0000H  *DO A WARM BOOT
011F          END
```

TABLE 6-1  
VIDEO CONTROL CODES

CHARACTER	DECIMAL CODE	HEX CODE	DESCRIPTION
CONTROL-A	1	01H	REVERSE VIDEO ON Presents dark characters on a green background.
CONTROL-B	2	02H	REVERSE VIDEO OFF Displays green characters on a dark background.
CONTROL-D	4	04H	VIDEO RESET The screen blanks, the cursor moves to the top left corner, and all parameters are reset to the default state:  smooth scrolling off autowrap-around off mask bit 7 on cursor on keyboard audio feedback off screen on reverse video off hybrid mode off
CONTROL-E	5	05H	KEYBOARD AUDIO FEEDBACK ON When audio feedback is on a "click" will be heard every time a key is struck.
CONTROL-F	6	06H	KEYBOARD AUDIO FEEDBACK OFF No sound is heard when keys are struck.

### VIDEO CONTROL CODES (continued)

CHARACTER	DECIMAL CODE	HEX CODE	DESCRIPTION
CONTROL-G	7	07H	BELL Sounds the standard bell tone.
CONTROL-H	8	08H	BACKSPACE The cursor moves one space to the left. If auto-wraparound is on and the cursor is at the beginning of the line then a reverse line feed occurs and the cursor moves to the end of the previous line. No action occurs if the cursor is at the beginning of the line and auto-wraparound is off.
CONTROL-J	10	0AH	LINEFEED The cursor moves down one line. If the cursor is on the top line, then the screen scrolls down one line, the top line is blanked, and the cursor does not move.
CONTROL-K	11	0BH	REVERSE LINE FEED The cursor moves up one line. If the cursor is on the top line, then the screen scrolls down one line, the top line is blanked, and the cursor does not move.

### VIDEO CONTROL CODES (continued)

CHARACTER	DECIMAL CODE	HEX CODE	DESCRIPTION
CONTROL-L	12	0CH	FORWARD SPACE The cursor moves one space to the right. If auto-wraparound is on and the cursor is at the end of the line, then a line feed occurs and the cursor moves to the beginning of the next line. No action takes place if auto-wraparound is off and the cursor is at the end of the line.
CONTROL-M	13	0DH	RETURN The cursor moves to the beginning of the current line.
CONTROL-N	14	0EH	CLEAR TO END OF LINE All characters starting at the cursor position and continuing to the end of the line are erased. The cursor does not move.
CONTROL-O	15	0FH	CLEAR TO END OF SCREEN All characters from current cursor position to the end of the screen are erased. The cursor does not move.
CONTROL-Q	17	11H	SMOOTH SCROLLING ON-FAST Turns on smooth scrolling at fast speed.

### VIDEO CONTROL CODES (continued)

CHARACTER	DECIMAL CODE	HEX CODE	DESCRIPTION
CONTROL-R	18	12H	HYBRID MODE ON The screen is blanked, the top 200 scan lines are reserved for graphics, the bottom 4 lines are reserved for text and act as if they are the entire console, and the cursor is moved to the top text line. Smooth scrolling, if on, is suspended while hybrid mode is on.
CONTROL-S	19	13H	HYBRID MODE OFF Places the screen back in TEXT mode. Subsequent line feeds will scroll all 24 lines including any graphics image. If smooth scrolling was on prior to entering hybrid mode, then smooth scrolling continues.
CONTROL-T	20	14H	SMOOTH SCROLLING ON Turns on smooth scrolling at slow speed.
CONTROL-U	21	15H	SMOOTH SCROLLING OFF Subsequent line feeds will appear to be instantaneous.
CONTROL-X	24	18H	CURSOR ON The cursor becomes visible.

### VIDEO CONTROL CODES (continued)

CHARACTER	DECIMAL CODE	HEX CODE	DESCRIPTION
CONTROL-Y	25	19H	CURSOR OFF The cursor becomes invisible. All subsequent cursor controls work exactly the same way.
CONTROL-\	28	1CH	SCREEN ON Turns the video screen on.
CONTROL-]	29	1DH	SCREEN OFF Turns the screen off. Characters on the screen are maintained in the video memory, and further output is also stored. When the screen is turned back on, all output will reappear.
CONTROL-^	30	1EH	HOME CURSOR Moves the cursor to the upper left corner.
CONTROL-_	31	1FH	NEW LINE Has the effect of a return and then a line feed.
ESC	27	1BH	AUTO-WRAPAROUND ON Affects operations of backspace (CONTROL-H) and forespace (CONTROL-L).
\$	36	24H	
ESC	27	1BH	AUTO-WRAPAROUND OFF Affects operations of backspace (CONTROL-H) and forespace (CONTROL-L).
%	37	25H	

## VIDEO CONTROL CODES (continued)

CHARACTER	DECIMAL CODE	HEX CODE	DESCRIPTION
ESC	27	1BH	INSERT LINE
L	76	4CH	
* or			
ESC	27	1BH	The line the cursor is on and all lines below it move down one line. The line at the bottom of the screen disappears. The cursor line is erased and the cursor stays where it is.
l	108	6CH	
* Either upper or lower case L.			
ESC	27	1BH	DELETE LINE
M	77	4DH	
** or			
ESC	27	1BH	All lines below the cursor move up one line. The line at the bottom of the screen is erased. The cursor stays where it is.
m	109	6DH	
** Either upper or lower case M.			
ESC	27	1BH	DIRECT CURSOR ADDRESSING
=	61	3DH	The cursor moves to line Y, column X where the values used are the actual values plus an offset of 32.
line (row) Y	Y+32		
column X	X+32		
		EXAMPLE:	To move the cursor to line 14, column 23, output the following decimal values: 27 61 (14+32) and (23+32).
ESC	27	1BH	
=	61	3DH	
line 14	46	2EH	
column 23	55	37H	

### VIDEO CONTROL CODES (continued)

CHARACTER	DECIMAL CODE	HEX CODE	DESCRIPTION
DELETE	127	7FH	DESTRUCTIVE BACKSPACE The cursor is moved back one character space and the character at the new cursor position is erased.

### 6.3 OVERVIEW OF THE GRAPHICS SUBSYSTEM

The graphics subsystem includes two sets of functions: geometric routines and graphic support routines. The four geometric routines -- POLYGON, RECTANGLE, ELLIPSE, and SPECIAL LINE -- enable you to draw points, lines, and a wide range of two-dimensional figures. The three graphic support routines -- CLEAR, BLOCK, and CHAR -- are also useful. CLEAR enables you to clear and scroll the screen to bring line 0 to the top. BLOCK allows you to transfer a rectangular array of data between RAM and the screen, and CHAR permits you to display characters on the graphics screen.

To incorporate these graphic routines in your programs:

- (1) Set the registers as described later, then call the graphic subsystem at 000CH.
- (2) Convert the program to a COM file, as usual.
- (3) The first time you run the program issue the command:

GMGRADD your COMfile

This final step is necessary because the graphics subsystem does not permanently reside in memory. To conserve user RAM, this subsystem is only loaded into memory when it is needed. The procedure appends the graphics subsystem to the COM file, to provide that program with full graphic support.

#### 6.3.1 Geometric Functions: General

Before drawing a geometric figure you must specify the viewport within which the figure will be displayed. The entire ADVANTAGE screen has a horizontal dimension of 640 pixels and a vertical dimension of 240 pixels. The viewport can include the whole screen or any rectangular portion of it. The viewport, though not displayed on the screen, establishes the boundaries within which any geometric figure is displayed. When you specify a figure, only the portion that falls inside the viewport will be displayed on the screen. No error message results if you specify a figure that excluded portion extends beyond the designated viewport; the excluded portion is simply not displayed.

A wide range of alternatives is available for presenting the interior and perimeter of a two-dimensional geometric figure. Depending on what pixels are turned on, the interior can be dark, wholly lit, or partially lit, with one of six shades of grey, or one of eight textures. The interior can either replace the current screen display or be superimposed on it.

The perimeter can appear as a solid line around the interior, it can be shaded like the interior, or it can be omitted altogether. It is also possible to reverse the mode of the previous image, e.g., turn off, or omit, a perimeter that was shown as a solid line in the previous screen display.

All four geometric routines use the command byte structure shown in Table 6-2 to determine how the figure will be displayed. This command byte is loaded in register C.

A final general consideration applies to all four geometric routines. The HL register is loaded with the RAM start address of a table that contains the coordinates of:

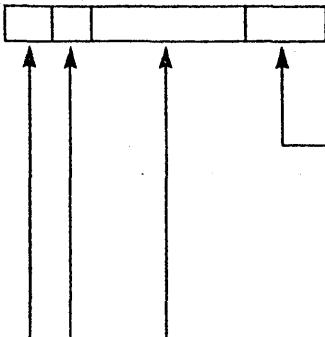
- the vertices of a polygon,
- the opposite corners of a rectangle,
- the center of an ellipse, or
- the end point of a special line.

The coordinate pair(s) X,Y consists of positive or negative two's complement 16-bit values. The coordinate values can lie anywhere between the decimal values -32,768 and +32,767, but only points whose coordinates fall within the viewport are displayed on the screen.

Table 6-2

COMMAND BYTE STRUCTURE  
FOR GEOMETRIC ROUTINES

7 6 5 4 3 2 1 0  
V D T P



P: PERIMETER OPERATION

- 00 = Perimeter to be treated as interior
- 01 = Perimeter on
- 10 = Perimeter off
- 11 = Reverse previous perimeter mode

T: INTERIOR TEXTURE

- 0000 = Dark
- 0001
- 0010
- 0011 = Shades of grey from dark to light
- 0100
- 0101
- 0110
- 0111 = Solidly lit
- 1000 = Diagonal lines - negative slope
- 1001 = Diagonal lines - positive slope
- 1010 = Diamonds
- 1011 = Checkers
- 1100 = Little squares
- 1101 = Dots & Dashes
- 1110 = Vertical lines
- 1111 = Horizontal lines

D: INTERIOR DISPLAY MODE

- 0 = Interior superimposed on existing screen image.
- 1 = Existing screen image erased, and replaced by figure interior.

V: SET VIEWPORT

- 0 = All operations except set viewport
- 1 = Set viewport

Note that when the command byte is 0, nothing happens.

## VALUES FOR COMMAND BYTE DISPLAY

PERIMETER ON	PERIMETER OFF
	00=00000000
	04=00000100
	08=00001000
	12=00001100
	16=00010000
	20=00010100
	24=00011000
	28=00011100
	32=00100000
	36=00100100
	40=00101000
	44=00101100
	48=00110000
	52=00110100
	56=00111000
	60=00111100

### 6.3.2 Geometric Routines - Input Parameters

#### RECTANGLE

The RECTANGLE function serves two purposes: it sets the viewport, and it draws rectangles. In both cases the sides must be parallel to the horizontal and vertical axes, X and Y, and the two points you designate are the opposite corners of the shape. It is possible to set the viewport and draw a rectangle in a single step.

To set the viewport, specify a rectangle that does not exceed the size of the screen. If the input parameters specify a rectangle that extends off the screen, the previous viewport will not be changed and error code 01H will be given.

#### Input Parameters:

Register	Description
A	Set to a value of 2 - for RECTANGLE routine.
C	See command byte explanation. Set bit 7 to 1 to set the viewport. Set bit 7 to 0 to draw rectangle. Set bit 7 to 1 to set viewport and draw rectangle simultaneously.
HL	RAM start address of 8-byte table containing coordinates of two points. Stored as X1, Y1, X2, Y2, these specify opposite corners of rectangle.

## POLYGON

The polygon routine draws points and lines as well as many-sided figures. This routine can only be guaranteed to succeed with convex figures. If you specify a concave figure, the graphics subsystem will attempt to draw it, but will return error code 02H if the effort fails. However, many concave polygons can be drawn as well as figures that are not well-defined polygons at all.

A polygon is well-defined if it has one contiguous interior and exterior. A set of ten random points, for example, will probably not form a well-defined polygon when connected in the order given, since the interior may be several separate regions. This is not an error, and shading of the interior will still occur in a well-defined manner. The POLYGON routine fills in the polygon one horizontal scan line at a time, from top to bottom. At each scan line it finds all places where an edge intersects the scan line, pairs them off in order from left to right, and fills between each pair. To accomplish this, the program uses a variable-length list of 'active edges.'

Sometimes the complexity of the shape of the polygon may become so great that the list of active edges gets too long to fit in the program's internal buffer. When this happens, the extra buffer feature must be used (see Input Parameters). 600H bytes is the maximum that will ever be needed to handle polygons of 64 or fewer sides. Some examples of polygons that can be drawn without using the extra buffer feature are:

- 1) Any 18 or fewer points whether or not they determine a well-defined polygon;
- 2) 64 or fewer points defining a convex polygon, if interior is to be shaded;
- 3) 64 or fewer points defining a perimeter only of any type of polygon.

**Input Parameters:**

Register	Description
A	Set to a value of 1 for POLYGON routine
B	Number of vertices: 1 = a point 2 = a line 3 - 100 = a polygon
C	Command Byte (plus, if bit 7 set, use extra buffer)
HL	RAM start address of table containing coordinates. These designate each individual point, or each endpoint for a line, or each vertex for a polygon. The table follows the form: X1, Y1,...XN, YN. Vertices must be specified in either a clockwise or a counterclockwise order.
IX	Starting address of extra buffer
IY	Length of extra buffer

NOTE: IX, IY are ignored if bit 7 of C is off.

## ELLIPSE

The ELLIPSE routine draws ellipses, circles, arcs, pie slices, and areas enclosed by an arc and a subtended chord. The greatest and the least diameters are drawn parallel to the axes. This routine cannot be used to draw a rotated ellipse.

For this routine, the vertical radius displayed on the screen has the value, i.e., the number of pixels, specified in register E. The horizontal radius displayed on the screen is twice the value, i.e., number of pixels, specified in register D. This doubling of the specified horizontal radius makes it possible to draw a circle by setting the horizontal and vertical radii equal, even though the horizontal pixel density is twice the vertical pixel density. If either radius is zero, nothing is drawn.

**Input Parameters:**

Register	Description
A	Set to a value of 3 for ELLIPSE routine.
B	Set to a value of: 0 = whole ellipse or circle; in this case IX and IY are ignored. 1 = arc 2 = pie slice 3 = area enclosed by arc and subtended chord
C	See command byte explanation.
D	Set to half value of desired horizontal radius. Value is doubled in resulting figure.
E	Set to value of desired vertical radius.
HL	RAM start address of 4-byte table containing coordinates of center point. Stored as X, Y.
IX	Start angle (0-360). Ignore for whole ellipse or circle.
IY	Stop angle (0-360). Ignore for whole ellipse or circle.

If IX or IY is greater than 360, the value mod 360 is used.

## SPECIAL LINE

The SPECIAL LINE routine provides a second method of drawing a line. The POLYGON routine allows you to draw a line by specifying its starting and ending points. The SPECIAL LINE routine draws a line with only the end point specified. The starting point is supplied by the end point of a previous line, drawn with either the POLYGON or SPECIAL LINE routine. If the last graphic command was a geometric routine that drew something other than a line, the line drawn with a SPECIAL LINE routine may start from an unpredictable location. The non-geometric graphic routines described below -- CLEAR, BLOCK and CHAR -- can be interspersed between SPECIAL LINE calls without losing track of where the next SPECIAL LINE should start.

### Input Parameters:

Register	Description
----------	-------------

A	Set the value to 6 for SPECIAL LINE routine.
C	See command byte explanation.
DE	Set the value to the Y coordinate of end point.
HL	Set the value to the X coordinate of end point.

### 6.3.3 Other Graphic Support Routines

The three additional graphic routines -- CLEAR, BLOCK, and CHAR -- are distinct from the geometric routines both in the capabilities they provide, and the structure of the command byte used in register C.

The CLEAR routine does not use the command byte. The BLOCK and CHAR routines use the following command byte structure.

Table 6-3

#### COMMAND BYTE STRUCTURE FOR NON-GEOMETRIC ROUTINES

7	6	5	4	3	2	1	0
A	Unused	D	X				
<hr/>							
X: DISPLAY MODE							
00 = overlay existing data							
01 = overlay inverse data*							
10 = inclusive-OR with existing data**							
11 = exclusive-OR with existing data***							
<hr/>							
D: DIRECTION MODE (not used by CHAR routine)							
0 = RAM to screen							
1 = screen to RAM							
<hr/>							
A: ALTERNATE CHARACTER SET MODE							
0 = use standard character set							
1 = use alternate character set							
<hr/>							
* Each bit that is turned on in the RAM data is turned off on the screen, etc.							
** The data in RAM is superimposed on the screen image, without erasing the previous display.							
*** If an individual bit in the RAM data is turned on, the corresponding bit on the screen display is reversed. If the individual bit in RAM is turned off, it does not affect the screen display.							

## **CLEAR**

The CLEAR routine clears the screen and scrolls it to line 0. In other words, if you had previously used a character I/O function to scroll the screen up so that line 10 appeared on the top of the screen, the CLEAR routine would restore the screen to its default setting, with line 0 positioned at the top of the screen.

This routine does not use the command byte at all.

### **Input Parameter:**

#### **Register      Description**

<b>A</b>	Set to a value of 0 for CLEAR routine.
----------	--

## BLOCK

The BLOCK routine makes it possible to move a rectangular array of data between main RAM and the screen. The data transferred is always a multiple of 8 bits. The data in RAM is stored starting from the upper left byte down to the lower left byte. It then continues down one column after another finishing at the lower right byte.

The data can be placed in a block anywhere on the screen. The position of the block is determined by the coordinates of the upper left hand corner of the block.

BLOCK uses the entire display memory, the 240 visible lines of pixels, as well as the 16 invisible lines at the bottom of the screen. If the data reaches the bottom of the screen, the transfer operation will write on the invisible lines, then wrap around to the top of the screen.

### Input Parameters:

Register	Description
A	Set to a value of 4 for BLOCK routine
C	See command byte explanation
D	Set to width of block in 8-bit columns
E	Set to height of block in lines
HL	RAM start address of block
IX	X coordinate of upper left corner of block in screen display. Data transfer between RAM and screen occurs with exceptional speed when IX is an exact multiple of 8 and the block is aligned on byte boundaries.
IY	Y coordinate of upper left corner of block in screen display in lower 8 bits of IY. The upper 8 bits of IY are ignored.

### 6.3.5 How Descenders are Displayed

If bit 7 of byte 1 (represented in the grid by a \*) is 1, the character matrix will begin in ROW2 and will end in ROW8. If bits 7 and 6 of byte 1 represented in the grid by \* and \*\* are 1, the character matrix will begin in ROW3 and will end in ROW9. Row 0 is always blank. The value of bits 7 and 6 of bytes 2, 3, 4, 5, 6, and 7 has no effect on the displayed character.



### 7.1 DISKETTE ERROR CODES

\*\*\*\*\* ADVANTAGE CP/M reports diskette errors just as North Star GDOS does. The error message format remains:

T x D y S zzz

where x= error type; y= number of the floppy disk drive where the error occurred; and zzz= the decimal address of the sector where the error occurred. The error codes and their meanings follow:

**NOTE**

For purposes of error messages, the drives are numbered rather than lettered. Floppy disk drive 1 = A, etc.

**T = 1 SYNC BYTE NOT FOUND**

Indicates that the diskette was not properly loaded into the floppy disk drive, the diskette was not initialized, or 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. "Seek error."

**4 NO INDEX PULSE**

Indicates that the wrong type of diskette or a badly seated diskette was present.

**5 DENSITY MISMATCH**

Indicates that single-density data was found.

**6 WRITE-PROTECT**

Indicates that a write operation was attempted on a write-protected diskette.

## 7.2 RESPONSES TO ERROR MESSAGES

You have several options when an error message appears.

### 7.2.1 Retry

Errors may occur because the diskette is improperly seated. Remove the diskette and replace it carefully. Press RETURN or type any other key (except Control-C or Control-A), and the computer will retry the operation. This procedure can be repeated any number of times and should always be your first response. Repeated failures may require more drastic measures.

### 7.2.2 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. Resolve the problem that prompted the error message before trying to run the program again.

### 7.2.3 CONTROL-A: Forcing Acceptance of Bad Data

This extreme response 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 occur. Differences in hardware tolerances can mean that one drive can read a diskette but another drive cannot. In such cases, if you have a standard ADVANTAGE with two floppy disk drives, use the COPY program to read the marginal diskette from the compatible drive, and make a copy on the incompatible drive.

Only those with experience 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, software development, and CP/M.

### 8.1 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, 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 After SYSGEN	Address in standard ADVANTAGE 64K system
DOS Directory	0	Not Applicable	Not Applicable
Graphics CP/M Bootstrap	4 - 4.5	1400H	EC00H briefly
Console Command			
Processor (CCP)	9 - 12	1500H	D700H transient
BDOS	13- 19	1D00H	DF00H resident
BIOS- disk portion	4.5 - 7	2B00H	ED00H resident
USER-Sequential I/O	8	3200H	F400H resident
BIOS- upper portion console section	1 - 3	3400-39FF	F600 resident
Buffer & Scratch space not on disk			FC00H-FFFFH
CP/M Directory 20, 21, 25, 26 (normal skew of 5)			
CP/M Data in 2k blocks 22,27,23,28 then 24,29,30,35,31,36			

## 8.2 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
31F8	00	CONFIG	DB 0 ;Like DOS CONFIG 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 CPMGEN ; 10H = Interrupts to be enabled after disk access ; 02H = Auto-start on warm-boot ; 01H = Auto-start on cold-boot

3200H 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 64K system.

F400	JMP INIT	; Cold-boot init for USART & Parity setup
F403	JMP CONST	; Get Console Status - A=0 or FF
F406	JMP CINL	; Console Input from the Standard Port
F409	JMP COUTL	; Console Output to the Standard Port
F40C	JMP COUTR	; Printer output to board 1
F40F	JMP COUTL	; CP/M punch device to board 2
F412	JMP CINL	; CP/M "Reader" to board 2
F415	JMP PRTTST	; Dummy Printer status test, always 0

Hooks into upper BIOS are provided in the CP/M documentation package.

### 8.3 PATCHING IN AUTO-START

The auto-start facility is enabled by turning on the bit flag in the option byte. If the flag is turned on, the Console Command Processor will then try to load AUTO.COM from logical drive A and execute it. Value (01H) causes auto-start on cold boot only. Value (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.

### 8.4 SYSTEM PATCHING PROCEDURE

Start with a working copy of the CP/M System Diskette in floppy disk drive 1. Do NOT use your factory supplied CP/M System Diskette for this purpose.

Run SYSGEN, or CPMGEN.

1. Tell SYSGEN (or CPMGEN) from which drive it must read the system. If you simply want to read CP/M from the system diskette in floppy disk 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-39FFH.
3. SYSGEN prompts you to output the system or boot. Since you have yet to patch, enter CONTROL-C to warm-boot.

Run DDT. It loads below 1400H so the system RAM image remains untouched. Apply your patches, for example, as follows:

S31FF	Allows you to set the Option Byte
41	Turn on auto-start and read-after-write

Enter a CONTROL-C to warm-boot the system.

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 floppy disk drive 1 unless you have copies of it.
4. Confirm with RETURN.
5. SYSGEN now writes the patched system, which you then can cold-boot and exercise.

## 8.5 ALTERING THE BIOS DYNAMICALLY

### 8.5.1 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.

### 8.5.2 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.

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

## 8.6 REPLACING THE USER AREA TO SUPPORT NON-STANDARD SEQUENTIAL DEVICES

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

(MEMSIZE\$IN\$KB\*400H) - 0C00H for diskette

2. Get a standard system memory image loaded at 1400H-39FFH by using SYSGEN or CPMGEN.
3. Use DDT to overlay the old user area at 3200H to 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 F400

(DDT responds 2600 3E00 - use the 3E00)

IUSER.HEX  
R3E00  
CONTROL-C

4. Run SYSGEN to write the system.

### 9.1 INTRODUCTION

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

- A. You can divide the 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. You can share the hard disk with North Star software other than CP/M.

The GDOS hard disk file becomes the functional equivalent of CP/M's logical drive. The GDOS file is designated by a pathname, the CP/M logical drive by a unit letter.

### 9.2 CONNECTIONS

You can pick any name you choose for a hard disk GDOS file, with the limitations that it cannot begin with a numeric, contain an embedded blank, or consist of more than 14 printing characters. Since CP/M can handle a maximum of 16 units at any time, the CP/M logical drive is designated by a single letter, in the range A-P. The minimum designation would be a floppy disk drive with a logical unit name of A, since, for warm boot purposes, there must always be a connection to A.

\*\*\*\*\* As you have already seen during the initial CP/M start-up procedure, establishing the connection between the Graphics DOS pathname and the unit is quite simple. The format is:

Unit letter:Pathname

We have already worked with the suggested connections, A:CPMUNITA and B:CPMUNITB.

### 9.2.1 The Table of Connections and the Work File

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

If you are using the subset of hard disk GDOS embedded within CP/M, all workfiles must be put in the hard disk SYSTEM account. Any attempt to create an alternate pathname during CPMGEN will result in an error during the HDBOOT procedure.

If you are using the complete hard disk GDOS, you may establish separate accounts to contain various CP/M workfiles and units using the GDOS Account Create (AC) \*\*\*\*\* command. See Chapter 6 of the North Star ADVANTAGE Graphics DOS Manual for a discussion of each of the GDOS account commands.

\*\*\*\*\* Each CP/M system diskette that you use with the hard disk units must contain a work file pathname that points to a table of CP/M unit connections located on the hard disk. It is very convenient and useful to establish different work file names and supply different tables of connections for separate CP/M system 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.

### 9.2.2 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.

To make your connections permanent, when you receive the HDBOOT prompt:

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

You should enter:

N

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. You should enter:

B

to the "N" or "B" prompt.

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

#### 9.2.3 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 GDOS pathname TAXES,SYSTEM type:

G:TAXES

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

If your application software runs under CP/M logical drive letters embedded in the code, 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 and press RETURN. For example, to delete the connection E:CPMUNITE enter:

E:

To replace a connection, enter it as a new connection.

### 9.3 ACCOUNTS AND DRIVE NUMBERS

If you are using the complete version of GDOS and CP/M is going to share space on the hard disk with non-CP/M software such as GHBASIC, you should use GDOS to create a CP/M account. For example, enter:

=>AC CPM

You must then qualify the account name when you create a particular GDOS file within this account. For example,

=>CR CPMUNITA, CPM

If you do not specify the account name, the default value, "SYSTEM" will be supplied automatically. Since you have only one hard disk drive you do not have to supply the hard disk drive number as part of the pathname.

If you use only the subset of GDOS embedded within CP/M, you cannot designate the account name or drive number.

### 9.4 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 5 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 2K for quad-capacity diskettes.

On the hard disk, the size of a CP/M block can vary from 2 Kilobytes 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 logical drive.

#### 9.4.1 Allocating CP/M Logical Drive Capacity and Block Size

Clearly, using CP/M with a 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 9.4.3 below.

Table 9.1 - 8 Bit CP/M Block Addresses

CP/M Unit in Kilobytes		CP/M Block Size in Kilobytes	GDOS "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 9.2 - 16 Bit CP/M Block Addresses

CP/M Unit in Kilobytes		CP/M Block Size in Kilobytes	GDOS "len" in 256 byte blocks		Allocation Factor
Min	Max		Min	Max	
514	2,062	2	2,056	8,248	2
1,028	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 sizeable files on a logical drive efficiently, use a CP/M block size of 16K.

#### 9.4.2 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 GDOS 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 GDOS 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 GDOS file blocks of 256 bytes, so you extend the logical drive's capacity by specifying the desired size in GDOS 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.

#### 9.4.3 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 9.1). Such a logical drive could later be extending to a maximum length 4,096 Kilobytes.

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 9.2). This latter drive could be extended to a maximum of 4 Megabytes. A logical drive that initially falls into the lower range cannot be extended into the upper range, since 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 4 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 GDOS command:

```
=CR TINY 100 1
```

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

2. The GDOS command:

**=CR HUGE 5600 4**

will create a GDOS file containing 5600 GDOS 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 GDOS command:

**=SL HUGE 16496**

## 9.5 HARD DISK SYSTEM PATCHING INFORMATION

The standard hard disk ADVANTAGE is assumed to have exactly 64 Kilobytes of RAM. You are allowed to specify a smaller CP/M to CPMGEN to preserve RAM above CP/M for spoolers, oversize SBIOS, etc. The Hard Disk BIOS Extension is fixed at the top of the 64K RAM area \*\*\*\*\* - from F300H to FFFFH.

EXAMPLE: a 56K CP/M would leave the space between CFOOH to D2FFH available.

### DISK MAP AND RAM IMAGE LOCATIONS BY COMPONENT \*\*\* HARD DISK

Component Name	Sector on Disk	RAM image addr after CPMGEN	Addr in a 64K Hard Disk System
DOS Directory	0	N/A	N/A
CP/M Bootstrap	4	1400H	EC00H briefly
Con Cmd Proc (CCP)	9	1500H	BA00H transient
BDOS	13	1D00H	C200H resident
BIOS-disk portion	4+100H	2B00H	E000H resident
SBIOS-sequential I/O	8	3200H	E700H resident
BIOS - upper portion			E900H resident
Spec Sys Area	8+180H	3380H	F300H initially
Buffer & Scratch	not on disk		FCOOH-FFFFH

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 TPA) 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.

### 10.1 OVERVIEW

This subset of the hard disk version of the Graphics DOS command processor allows you to work with files on the hard disk by entering selected GDOS commands from the keyboard. When you press the RETURN key, the command and its arguments are processed and executed. If the command is invalid, the system returns an error message to the console.

Using these hard disk GDOS commands, you can:

- \* Create and delete CP/M units as GDOS files.
- \* List the file directory.
- \* List hard disk statistics.
- \* Obtain help for the subset GDOS commands.
- \* Return to CP/M

### 10.2 SYMBOL CONVENTIONS

When the syntax of a hard disk GDOS command is given in this section, the commands and words indicated with uppercase letters must be entered exactly as shown. Words or arguments which require a value are indicated in lowercase. For example, the command syntax:

HE {[command]}

means that you must enter the letters HE followed by a valid command name. In the command:

HE LI

\*\*\*\*\* the command name LI replaces "command".

Certain optional arguments refer to the hard disk. These arguments are surrounded by square brackets [ ].

Other optional arguments listed with the HElp command refer to diskettes and are surrounded by braces { }. Ignore these references to diskettes if you are using subset GDOS, since the subset commands are only applicable for hard disk use.

If an argument has both braces and square brackets, as in:

HE {[command]}

the argument is optional for hard disk.

### 10.3 ARGUMENTS

Subset Graphics DOS command arguments, and the rules that govern them, are described below.

In general, numeric values that refer to disk addresses are expressed in decimal notation. Numeric values that refer to RAM or port addresses are usually expressed in hexadecimal notation. Any numeric argument (except a hard disk drive number appended to a file name or an account name) can be entered in hexadecimal notation if immediately followed by an H, or decimal notation if followed by a T.

Example:

CR JONES 20H

This command creates a 32-block (20 Hex) file named JONES in the hard disk SYSTEM account. Ordinarily the length of the file is specified in decimal notation. If you specify hex notation, GDOS makes the conversion to decimal notation for you.

<u>Argument</u>	<u>Description</u>
#n	Refers to an I/O device number from 0 to 6 inclusive. Generally, n is optional and defaults to 0. Hard disk GDOS assigns specific device numbers to specific peripheral devices. If your system has been customized, your device numbers may be different. The assigned device numbers are:
0	= Console terminal
1	= Printer
2 - 6	(not implemented by North Star)

<u>Argument</u>	<u>Description</u>
d	Hard disk drive number 101.
filename	Name of a file on hard disk. The filename may be from 1 to 14 printing characters. In Graphics CP/M using the GDOS subset, the filename corresponds to a CP/M unitname.
pathname	Uniquely identifies a file on the hard disk within the SYSTEM account. A hard disk pathname consists of a filename optionally followed by a comma, the accountname SYSTEM, another comma and hard disk drive number 101. The subset of hard disk GDOS creates pathnames only within the default SYSTEM account.
For example, the following are all valid pathnames:	
TESTFILE6 PAYROLLPROGRAM JONES,SYSTEM,101 jones,SYSTEM	
Upper and lowercase letters are different in a pathname. If you create a file named JONES, you cannot later refer to it as jones.	
len	Length of a file or part of a file on hard disk (in blocks of 256 bytes) expressed in decimal notation.
alloc	is the size, in DIBs (Data Incremental Blocks) of the areas on the hard disk allocated to a file. A DIB is a group of sixteen contiguous 8K byte sectors. The allocation factor is the number of DIBs grouped into a contiguous area or "Segment" on the hard disk.

<u>Argument</u>	<u>Description</u>
	Valid allocation factors are 1 (default), 2, 4, 8, and 16. An allocation factor of 8 will put segments on a hard disk consisting of eight DIBs times sixteen sectors per DIB, for a total segment of 128 sectors.
	If the file uses more than one megabyte of disk space, specify an allocation factor greater than 1. The allocation factor is approximately the same number as the maximum megabyte size by which a given file could expand.
<b>raddr</b>	RAM address. The RAM address is usually expressed in hexadecimal notation (00-FFFF).

## 10.4 COMMANDS

### 10.4.1 File Commands

These commands allow you to create new hard disk files, change the size and attributes of existing hard disk files, and delete specified hard disk files.

**CR**      Create File

This command creates a new file on the hard disk. The allocated file space is completely initialized to zeros. The syntax of the CR (Create) command is:

**CR pathname len [alloc]**

where: pathname      identifies the hard disk file to be created.

len      is the length of the new file in file blocks of 256 bytes each.

alloc      is the allocation factor.

**Example 1:**

**CR DATA,SYSTEM,101 10**

A new file named DATA is created in the SYSTEM account on hard disk drive 101, and given a length of 10 blocks.

**Example 2:**

**CR CPMUNITA 2056 2**

A new GDOS file named CPMUNITA is created on the hard disk in the default account SYSTEM. The length of the file is 2056 blocks and space is allocated in segments of two DIBs (32 sectors) each.

**SL Set Length**

This command changes the length of a file to the specified length. The syntax of the SL (Set Length) command is:

SL pathname len

where: pathname identifies the hard disk file.

len is the new length of the file, specified in blocks and assumed to be decimal.

Example:

SL JONES2 16

A file named JONES2 in the default SYSTEM account has its file length changed to 16 blocks of 256 bytes each.

**DE Delete File**

This command deletes any file on hard disk that has the attributes Read/Write and Deletable. The syntax of the DE (Delete) command is:

DE pathname

where: pathname identifies the file to be deleted.

Example 1:

The command:

DE DATA,101

deletes the file named DATA from hard disk drive 101.

Example 2:

The command:

DE CPMUNITA

will delete the GDOS file named CPMUNITA in the default hard disk SYSTEM account.

#### 10.4.2 Program Execution

##### JP      Jump to a RAM Address

The JP command executes programs currently in RAM by jumping to the specified RAM address. The syntax of the JP (Jump) command is:

JP raddr {args}

where: raddr      is the RAM address.

args      are the arguments to be sent to a program through the command string.

You can send arguments to the program as part of the command line. JP sets the HL register pair to point to the remainder of the command string.

#### 10.4.3 Listings And Statistics

These commands enable you to list the hard disk file directory and determine the available work space in RAM.

##### LI      List File Directory

This command produces a directory listing from the SYSTEM account on hard disk. The syntax of the LI (List File Directory) command is:

LI {[#n]} [account]

where: n      is the output device number on which the directory is displayed or printed.

account      optionally identifies the SYSTEM account. If no account is specified, the command defaults to the SYSTEM account.

For each file in a hard disk directory the LI command displays:

- Filename
- Length in blocks
- Allocation factor in DIBs
- Attributes
  - S = Scratch
  - W = Read/Write
  - U = Updated but not backed up
  - D = Deletable
- File type

Example 1:

LI #1 SYSTEM

The directory for accountname SYSTEM is printed on the printer.

Example 2:

LI

All the files in the default account SYSTEM are listed on the ADVANTAGE console.

#### ST Display Hard Disk Statistics

This command prints hard disk statistics on the number of bad spots, system overhead on the disk, and used and unused disk space. The syntax of the ST (Statistics) command is:

ST [d]

where: d is 101, the hard disk drive number.

The ST command displays all hard disk statistics in DIBs.

Example:

ST

could produce the following output to the console:

BAD: 1    OVERHEAD: 9    USED: 162    UNUSED: 139

#### 10.4.4 Miscellaneous Commands

##### HE Help

When this command is used without an argument it lists the subset hard disk Graphics DOS commands on your console. If you use one of the commands as an argument, the command syntax is displayed on your console. The syntax of the HE (HElp) command is:

HE {[command]}

where: command is the command for which you need help.

Example:

HE CP

##### CP Exit to CP/M

This command takes you from subset hard disk GDOS command level back to Graphics CP/M. The syntax of the CP command is:

CP

Returns to CP/M

## INDEX

The manuals used with Graphics CP/M are indexed in the following manner.

1. All manual references followed by a page number such as 4-12 or 1-5, etc., refer to the North Star ADVANTAGE Graphics CP/M Preface.
2. All manual references followed by a page number such as AUG-4, IN-5, etc., refer to one of the seven Digital Research Manuals. In this case, AUG-4 points to page 4 of the "Assembler Users Guide" while IN-5 refers to page 5 of the "Introduction to CP/M Features and Facilities". See the list below for the abbreviations used for each of these manuals.

IN = An Introduction to CP/M Features and Facilities  
UG = CP/M 2.2 User's Guide  
ED = ED: A Context Editor for the CP/M Disk System User's Manual  
AUG = CP/M Assembler User's Guide  
AG = CP/M 2 Alteration Guide  
IG = CP/M 2 Interface Guide  
DDT = Dynamic Debugging Tool (DDT) User's Guide

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