



**ADDENDUM TO  
GRAPHICS CP/M PREFACE**

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This manual describes GRAPHICS CP/M 2.2 revision 1.2.0. Use this manual with the Graphics CP/M Preface.

Revision 1.2.0 differs from revision 1.1.0 in the following ways:

- o CP/M now supports 5-1/4 inch hard disk drives of various capacities.
- o Access speed to hard disk files has been increased.
- o The Graphics Manager now includes three additional geometric routines.
- o CPMGEN can now set the CP/M system disk to automatically execute a program named "AUTO.COM" when CP/M is loaded from floppy disk.
- o Errors CP/M encounters when you try to log onto a nonexistent disk drive do not cause the system to hang.

**Information  
Covered in  
This Manual**

The utility programs used to install CP/M and the new geometric routines are described in this manual. Other CP/M utility programs and graphics routines are described in the Graphics CP/M Preface.

**Chapters**

Each chapter in this manual contains an introduction. Read the chapter introduction to determine which sections apply to your computer configuration.

**Procedures**

Procedures are included to guide you through the installation of CP/M and the use of the new geometric routines.

Procedures contain step numbers and actions. The action column explains what to do and contains samples of what you can expect to see displayed on the screen.

<b>Purpose</b>	The information given below explains terms that are used throughout this manual. Use this information to clarify the meaning of the text contained in this manual:
<u>DESCRIPTION</u>	<u>EXPLANATION</u>
CP/M	Means North Star Graphics CP/M.
[RETURN]	Means press the "RETURN" key on the computer keyboard.
[CONTROL]	Means press and hold the [CONTROL] key on the keyboard, then type the key that follows [CONTROL].
<b>OTHER TEXT</b>	Other information which is displayed in bold type should be typed on the computer keyboard.
FACTORY MASTER DISK	Means the floppy disk that is packaged with your copy of CP/M.
WORKING DISK	Means a copy of the factory master disk.
DRIVE 1	Means the top floppy disk drive in a two-drive system, the bottom floppy disk drive in a system with a hard disk.
DRIVE 2	Means the bottom floppy disk drive in a two-drive system.
HARD DISK	Means a 5-1/4 inch hard disk drive.

The method you use to create a work copy of CP/M depends on the type of computer you are using.

IF YOUR COMPUTER...

THEN...

contains two floppy  
disk drives

do the procedures in sections 2.1, 2.2  
and 2.3 of this chapter.

contains one floppy  
disk drive and one  
hard disk drive

do the procedures in sections 2.1, and  
2.3 through 2.9 of this chapter.

**Introduction** This procedure explains how to load the CP/M operating system into the computer. CP/M must be loaded into the computer before you do any other procedures.

**Procedure**

STEP ACTION

1 Turn on the power. The screen will display:

LOAD SYSTEM

2 Insert the CP/M factory master disk into disk drive number 1.

3 Type [RETURN].

CP/M will be loaded into the computer's memory and will display:

64K Graphics CP/M 2.2 rev 1.2.0 Advantage QD from  
North Star Computers, Inc.

A>



**Purpose** This procedure explains how to copy the factory master disk on a computer that has two floppy disk drives. Use the COPY program. The program uses both floppy disk drives to create the copy.

**Procedure**

**STEP ACTION**

1 Insert a blank floppy disk into drive 2.

2 Type **COPY[RETURN]**

The program displays:

Mount the Diskettes to be processed and-

Enter INPUT Drive number(1-4):

Or Mount System Diskette and RETURN to Exit:

3 Type **1[RETURN]**

The program displays:

To Surface Check Only, Enter "N",

To Verify-Compare two diskettes, Enter "V",

To Copy, Enter OUTPUT Drive number(1-4):

4 Type **2[RETURN]**

The program displays:

Proceeding to copy 70 track diskette

5 The drive motors start and the information contained on the floppy disk in drive 1 is copied onto the floppy disk in drive 2. When the copy is complete, the program displays:

Copy COMPLETE

Mount the Diskettes to be processed and-

Enter INPUT Drive number(1-4):

Or Mount System Diskette and RETURN to Exit:

6 Remove the factory master disk from drive 1 and store it in a safe place.

HOW TO COPY THE FACTORY MASTER DISK ON  
A COMPUTER WITH TWO FLOPPY DISK DRIVES (continued)

Procedure

STEP    ACTION

7        Remove the floppy disk from drive 2 and label it:

          GRAPHICS CP/M RELEASE 2.2 VERSION 1.2.0  
          WORK DISK

8        Insert the work disk into drive number 1.

9        Type [RETURN]

          The program displays:

          A>

**Introduction** The CP/M work disk that you made can be used on your computer without modification. This procedure explains how to generate a customized work disk.

**What is a Customized Work Disk** A customized work disk contains a copy of the CP/M system that has been tailored to a particular computer configuration.

**When to Customize** There are four conditions that require the work disk to be customized:

1. You do not want CP/M to use the entire computer memory.

CP/M normally uses the entire 64K of memory. The CP/M system program itself is located in the uppermost memory area. If you want to reserve any high memory for special purposes, such as unique input/output routines, then you need to create a CP/M system that uses less than 64K of memory. CP/M requires at least 54K of memory to operate.

2. You have a printer attached to the serial interface card that uses a BAUD rate other than 9600 BAUD, or you have a printer attached to a parallel interface card.

CP/M expects an SIO interface card to be installed in slot 1. The default BAUD rate is set to 9600 BAUD.

3. You want CP/M to automatically load and execute an application program, such as MICROPLAN, whenever you load CP/M from floppy disk.

CP/M enters the command mode after it is loaded. You can set CP/M to load and execute an application program automatically.

## THE WORK DISK (continued)

### How to Customize a Work Disk

Use the table below to determine whether you need to create a customized work disk.

<u>IF...</u>	<u>THEN...</u>
you want CP/M to use less than 64K of memory	
or	
your printer uses a BAUD rate other than 9600 BAUD	
or	
your printer is attached to a parallel interface card	
or	
you want CP/M to automatically load and execute an application program	do the procedure described on the next page
-----	-----
your system requires specialized routines the input/output, or the interception of error messages	refer to the Graphics CP/M Preface, Chapter 8
-----	-----
you do not require a customized CP/M system	skip the remainder Section 2
-----	-----

**Introduction** Use the CPMGEN program with your work disk to perform customization procedure. The program asks you to enter the "destination disk drive number", and to load the "output diskette". The destination disk drive number is 1. The output diskette is your work disk.

**Procedure**

**STEP ACTION**

1 Insert your work disk into disk number 1.

2 Type **CPMGEN[RETURN]**

The program displays:

North Star Graphics CP/M 2.2 System Generator

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

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

3 If you want CP/M to use all 64K of memory,

Type **[RETURN]**

If you want CP/M to use less than 64K of memory,

Type **amount of memory[RETURN]**  
(EXAMPLE: **54[RETURN]**)

The program displays:

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

4 Type **Q[RETURN]**

The program displays:

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

## HOW TO CUSTOMIZE THE WORK DISK (continued)

---

### Procedure

#### STEP ACTION

5 Type F[RETURN]

The program displays:

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

6 Type Q[RETURN]

The program displays:

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

7 Type F[RETURN]

The program displays:

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

8 Type [RETURN]

The program displays:

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

9 Type N[RETURN]

The program displays:

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

10 Type Y[RETURN]

The program displays:

Q6. Enter baud rate of serial printer (9600 to 300)  
(for parallel printer, enter RETURN?)

## HOW TO CUSTOMIZE THE WORK DISK (continued)

---

### Procedure

#### STEP ACTION

- 11 If your computer contains a serial interface card (SIO) in slot 1,

Type baud rate[RETURN]  
(EXAMPLE: 9600[RETURN])

If your ADVANTAGE contains a parallel interface card (PIO) in slot 1,

type [RETURN]

If you want CP/M to use a printer that is attached to an interface card in slots 2, 3, 4, 5 or 6, you will need to create specialized input/output routines. The input/output routines are described in Chapter 8 of the Graphics CP/M Preface.

The program displays:

Q7. Do you want the program AUTO.COM automatically started when you Cold Boot (Y or N)?

- 12 If you want CP/M to automatically load and execute a program when it is initially loaded,

Type Y[RETURN]

otherwise,

Type N[RETURN]

The program displays:

CPMGEN complete, the Herald for your version is:

xxK Graphics CP/M 2.2 rev 1.2.0 Advantage QD from North Star Computers, Inc.

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

## HOW TO CUSTOMIZE THE WORK DISK (continued)

### Procedure

#### STEP ACTION

- 13 Examine the herald which CPMGEN has displayed. Verify that the number xxK represents the amount of memory you want CP/M to use.

If the amount of memory represented is incorrect,

Type [CONTROL] C

and go back to step 1. Otherwise,

Type 1

The program displays:

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

- 14 Type [RETURN]

The drive motor starts and the customized CP/M is written onto your work disk. When the customization is complete, the program displays:

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

- 15 Type [RETURN]

The program displays:

LOAD SYSTEM



## HOW TO CUSTOMIZE THE WORK DISK (continued)

---

### Notes

- o If you told CPMGEN to automatically start an application program, then you must rename the program to "AUTO.COM". Use the CP/M "REN" command to rename the program and place it on CP/M unit A:.

(EXAMPLE: REN A:AUTO.COM=A:MICROPLAN.COM)

If CP/M does not find AUTO.COM during the boot process, the message "AUTO.COM?" will be displayed and CP/M will enter the command mode.

- o The installation of CP/M for your system is complete. The remainder of Section 2 applies to computers which contain a hard disk. Skip the remainder of this section.

**Introduction**     The CP/M "COPY" program cannot be used on a hard disk computer because it requires the use of two floppy drives. To create a CP/M work disk for your hard disk computer use the following programs:

- o FORMAT
- o ONECOPY
- o SYSGEN
- o CPMGEN

The procedures for these programs are described in sections 2.6 through 2.9

**Introduction** A floppy disk that has never been used must be initialized before files can be stored on it. The initialization process is called formatting. Locate a new floppy disk and follow the procedure below. The disk drive in your computer is a "Quad-Capacity" disk drive.

**Caution** The format program destroys any information that is contained on a floppy disk. The factory master disk should have a write-protect tab installed over the cutout on the right side of the disk. The write-protect tab ensures that the information stored on the disk cannot be destroyed. If the write-protect tab is missing, install one before you do this procedure.

### Procedure

#### STEP ACTION

1 Insert the work disk into drive 1.

2 Type **FORMAT[RETURN]**

The program displays:

North Star Graphics CP/M 2.2.0 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):

3 Type **Q[RETURN]**

The program displays:

Enter Drive number(1-4):

## HOW TO FORMAT A BLANK DISK (continued)

---

### Procedure

#### STEP ACTION

4 Type 1[RETURN]

The program displays:

Load Diskette in Drive: 1,  
Strike RETURN <cr> when ready,  
To format as: Quad-Capacity Diskette:

5 Remove the factory master disk from drive 1 and insert a blank disk.

Type [RETURN]

The program displays:

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

Diskette Successfully Initialized

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):

6 Remove the formatted disk from the drive 1.

7 Insert the factory master disk into drive 1.

8 Type X[RETURN]

The program displays:

A>

**Introduction**     The files contained on the factory master disk need to be copied onto the work disk. The "ONECOPY" program copies these files.

**Functional**        The ONECOPY program copies files in the following manner:

1. Asks for the INPUT diskette to be mounted.
2. Reads files from the INPUT diskette into the computer memory until the memory is full.
3. Asks for the OUTPUT diskette to be mounted.
4. Writes files from the computer memory onto the output diskette.
5. Repeats steps 1 through 4 until all files have been copied.

**Notes**            The factory master disk is the INPUT disk. The the disk you formatted in the last section is the OUTPUT disk.

### **Procedure**

#### STEP   ACTION

1        Insert the factory master disk into drive 1.

2        Type **ONECOPY[RETURN]**

          The program displays:

          Mount INPUT Diskette and type RETURN

3        Type **[RETURN]**

          The program displays:

          This program copies one or more files (ala PIP) between two diskettes alternately mounted in the logged-drive.

          Procedure:

          Enter a filename (may be wildcard like \*.\* ) then Return

          The name is validated and staked in a list.

          To end the list and begin the actual copying,

          Enter a null line (simply a return)

          Enter filename (just RETURN begins copying):

## HOW TO USE THE 'ONECOPY' PROGRAM (continued)

### Procedure

#### STEP ACTION

4 Type \*.\*[RETURN]

The program displays:

Enter filename (just RETURN begins copying):

5 Type [RETURN]

6 The program will read some of the files contained from the factory master disk into the computer's memory. When the program is ready to write the files to the formatted disk, the program will display:

Mount OUTPUT Diskette and type RETURN

7 Remove the factory disk from the drive and insert the work disk.

8 Type [RETURN]

9 The program will write the files contained in the computer's memory onto the formatted disk. When all of the files have been written to the formatted disk, the program will display:

Mount INPUT Diskette and type RETURN

10 Remove the formatted disk from drive 1 and insert the factory master disk.

11 Type [RETURN]

12 Repeat steps 6 through 11 until the program displays:

Mount SYSTEM Diskette and type RETURN

13 Insert the factory master disk into the drive.

14 Type [RETURN]

The program displays:

A>

**Introduction** The CP/M system controls the computer. The instructions that provide this control are stored on a portion of the factory master disk called the system tracks. The "ONECOPY" program does not copy the system tracks. Use the "SYSGEN" program to make the work disk a complete copy of the factory disk.

**Procedure****STEP    ACTION**

1        Insert the factory master disk into drive 1.

2        Type **SYSGEN[RETURN]**

The program displays:

North Star Graphics CP/M 2.2 Sysgen

Any response of CONTROL-C causes Warm Boot

If System RAM Image already in RAM (@1400H), Enter RETURN-  
To read System into RAM Image, Enter Drive number (1-4)?

3        Type **1[RETURN]**

The program displays:

Load input diskette in drive 1  
and RETURN to read CP/M system from it?

4        Type **[RETURN]**

The drive motor starts and CP/M reads the system  
tracks into memory. The program displays:

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

5        Remove the factory master disk from the drive and insert  
the work disk.

## HOW TO COPY THE SYSTEM INFORMATION TRACKS (continued)

---

### Procedure

#### STEP ACTION

6 Type [RETURN]

The drive motor starts and CP/M writes the system tracks onto the work disk. The program displays:

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

7 Type [RETURN]

The program displays:

LOAD SYSTEM

8 Store the factory master disk in a safe place.

9 Remove the work disk from the drive and label it:

GRAPHICS CP/M RELEASE 2.2 VERSION 1.2.0  
WORK DISK



**Introduction** The CP/M system contained on the work disk must be customized before CP/M can use the hard disk. Use the CPMGEN program to customize the work disk.

In this procedure, you specify:

- o The amount of system memory which CP/M will use
- o The name of the hard disk file which will contain the CP/M's hard disk connections
- o Whether CP/M will Automatically load and execute the file named "AUTO.COM" into memory when a cold boot is in process

**Note** If your computer system requires specialized routines for input/output or for the interception of error messages, consult the Section 8 of the Graphics CP/M Preface.

### **Procedure**

#### **STEP ACTION**

- 1 If the work disk has a write-protect tab installed, remove the tab. Insert the work disk into the disk drive.

Type **CPMGEN[RETURN]**

The program displays:

North Star Graphics CP/M 2.2 System Generator

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

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

## HOW TO CUSTOMIZE THE WORK DISK (continued)

### Procedure

#### STEP ACTION

2 If you want CP/M to use all 64K of memory,

Type [RETURN]

If you want CP/M to use less than 64K of memory,

Type amount of memory[RETURN] (EXAMPLE: 60[RETURN])

NOTE: CP/M requires at least 54K of memory to operate.

The program displays:

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

3 Type Q[RETURN]

The program displays:

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

4 Type F[RETURN]

The program displays:

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

5 Type [RETURN]

The program displays:

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

6 Type Y[RETURN]

The program displays:

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

7 Type [RETURN]

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

## HOW TO CUSTOMIZE THE WORK DISK (continued)

---

### Procedure

#### STEP ACTION

8 Type Y[RETURN]

The program displays:

Q6. Enter baud rate of serial printer (9600 to 300)  
(for parallel printer, enter RETURN?)

9 If your computer has a serial interface (SIO) card in slot 1:

Type baud rate[RETURN]  
EXAMPLE: 9600[RETURN])

If your computer has a parallel interface (PIO) card in slot 1:

type [RETURN]

The program displays:

Q7. Do you want the program AUTO.COM automatically started when you Cold Boot (Y or N)?

10 If you want CP/M to automatically load and execute an application program when it is first loaded from the floppy disk:

Type Y[RETURN]

otherwise:

Type N[RETURN]

The program displays:

CPMGEN complete, the Herald for your version is:

xxK Graphics CP/M 2.2 rev 1.2.0 Advantage HQ from North Star Computers, Inc.

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

**Procedure**

**STEP ACTION**

- 11 Examine the herald which CPMGEN has displayed. Verify that the number xxK represents the amount of memory you want CP/M to use.

If the amount of memory represented is incorrect:

Type [CONTROL] C

and go back to step 1. Otherwise:

Type 1

The program displays:

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

- 12 Type [RETURN]

The drive motor starts and the customized CP/M system is written onto your work disk. The program displays:

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

- 13 Type [RETURN]

The program displays:

LOAD SYSTEM

**Introduction** A CP/M hard disk unit is a file stored on the hard disk. Do this procedure to:

- o Create CP/M files on the hard disk
- o Create a connection table which associates both the hard disk CP/M files and the floppy disk drive with drive designations

Before continuing with this procedure read the Graphics CP/M Preface, Sections 9.1 through 9.4 and all of Section 10. These sections will help you to understand:

- o How to choose file sizes
- o How to create files on the hard disk

Continue with this section after you have read the information mentioned above.

**Procedure**

STEP ACTION

1 Reset your computer so that you see:

LOAD SYSTEM

2 If the work disk has a write-protect tab installed, remove the tab. Insert the CP/M work disk into the disk drive.

3 Type [RETURN]

The program displays:

Hard Disk Boot In-Process

To review connections, enter Semicolon (;) within a second or two

-----Current Connections in workfile: CPMWORK

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

## HOW TO CREATE CP/M HARD DISK UNITS (continued)

### Procedure

#### STEP ACTION

4 Type **T[RETURN]**

The program displays:

Entering HDOS (slight delay) to Create "units", etc.  
When finished, return to CP/M HDBOOT process with  
command "CP"

North Star Hard Disk Operating System, Subset V2.1.0

=

5 Determine the file names, sizes, and allocation factors  
for your CP/M hard disk units. This information is  
contained in the Graphics CP/M Preface, Sections 9.1  
through 9.4.

6 Create a CP/M unit:

Type **CR filename size allocation-factor[RETURN]**

(EXAMPLE: **CR CPMUNITA 4096 4[RETURN]**)

7 Repeat step 6 until you have created all of the CP/M units  
that you will require.

8 Type **CP[RETURN]**

HDOS will display:

-----Current Connections in workfile: CPMWORK  
-----ENTER A CONNECTION or T=To HDOS or  
S=SAVE or X=EXIT?

## HOW TO CREATE CP/M HARD DISK UNITS (continued)

### Procedure

#### STEP ACTION

9 Enter your CP/M connections:

Type letter:filename[RETURN]  
(EXAMPLE: A:CPMUNITA[RETURN])

The program displays:

```
-----Current Connections in workfile: CPMWORK
A:CPMUNITA
-----ENTER A CONNECTION or T=To HDOS or
          S=SAVE or X=EXIT?
```

10 Repeat step 11 until you have entered a connection for each CP/M hard disk unit.

11 Enter a connection for the floppy disk drive:

Type letter:,1[RETURN]  
(EXAMPLE: M:,1[RETURN])

The program displays:

```
-----Current Connections in workfile: CPMWORK
A:CPMUNITA
      .
      .
      .
M:,1
-----ENTER A CONNECTION or T=To HDOS or
          S=SAVE or X=EXIT?
```

12 Type S[RETURN]

The program displays:

64K Graphics CP/M 2.2 revision 1.2.0 Advantage HD  
North Star Computers Inc.

**Introduction** You created CP/M hard disk units and assigned connection letters to them in Section 2.8. You also assigned a connection letter to your floppy disk drive. When CP/M is loaded from floppy disk, it logs into unit "A". If you assigned CP/M unit "A" to a hard disk file, copy the files from your work disk onto unit "A".

**Procedure**

STEP ACTION

1 Log onto the floppy disk drive:

Type `unit:[RETURN]` (EXAMPLE: `M:[RETURN]`)

The drive motor starts and the screen displays:

`M>`

2 Copy the files:

Type `PIP A:=M:*. *[RETURN]`

The program copies the files from the floppy disk into unit "A". The name of each file is displayed as the file is copied. When the program displays:

`M>`

3 Type `A:[RETURN]`

to log onto unit "A". To verify that unit "A" contains the system files:

4 Type `DIR[RETURN]`

The program displays a list of files:

<code>CPMGEN.COM</code>	<code>SYSGEN.COM</code>	<code>COPY.COM</code>	<code>HDBOOT.COM</code>
.			
<code>USER.ASM</code>	<code>GMGRADD.COM</code>	<code>ED.COM</code>	<code>PIP.COM</code>

The installation of CP/M for your system is complete.



**Introduction** You may want to modify your hard disk connections eventually to add or delete units, extend file sizes, or change connection letters. You can cause CP/M to stop at the hard disk connection table when CP/M is being loaded from floppy disk.

### Procedure

#### STEP ACTION

- 1 Reset the computer. The computer displays:  
LOAD SYSTEM
- 2 Insert the CP/M work disk into the drive.  
Type [RETURN]
- 3 When CP/M displays the message:  
Hard Disk Boot In-Process  
To review connections, enter Semicolon (;) within a second or two
- 4 Type ;  
CP/M pauses at the connection table and displays:  
-----Current Connections in workfile: CPMWORK  
A:CPMUNITA  
.  
.  
.  
M:,1  
-----ENTER A CONNECTION or T=To HDOS or  
S=SAVE or X=EXIT?
- 5 Follow steps 4 through 14 of the procedure given in Section 2.8 to make your modifications and save the new connection table.

The Graphics CP/M disk contains two graphics utility programs:

- o GDDT
- o GMGRADD

These programs allow you to create programs which can make use of the graphics features of the computer.

GMGRADD appends a copy of North Star's Graphics Manager to programs.

GDDT (Graphics Dynamic Debugging Tool) contains copies of Digital Research's DDT (Dynamic Debugging Tool) and the North Star Graphics Manager.

GDDT was created for two reasons:

1. To allow graphics programs to be tested and debugged before the Graphics Manager is appended to them.
2. Because both GDDT and the Graphics Manager use of the same memory area in a hard disk system and, therefore, cannot be loaded in memory together.

**When to Use GDDT** Use GDDT when you want to test or debug a program that makes calls to the Graphics Manager.

**Note** If you have run GMGRADD against a program, do not use the program with GDDT.

### Procedure

#### STEP ACTION

- 1 Create an assembly-language source code file using a text editor. This file must have a file type of ".ASM".
- 2 Assemble your program using the CP/M program "ASM.COM". During the assembly process, "ASM" creates an intermediate file with a file type of ".HEX". You use the ".HEX" file with GDDT.
- 3 Load GDDT  
  
Type **GDDT[RETURN]**  
  
The program displays:  
  
DDT VERS 2.2  
-  
  
4 Specify the name of the input ".HEX" file with the DDT "I" command:  
  
Type **Ifilename.hex[RETURN]**  
(EXAMPLE: **IGRAPH.HEX[RETURN]**)  
  
NOTE: The ".HEX" file must be contained on the currently-logged CP/M unit.
- 5 Read the file into memory with the DDT "R" command:  
  
Type **R[RETURN]**
- 6 Use the DDT commands described in Digital Research's DDT manual.
- 7 When you finish using GDDT, exit to the CP/M command level:  
  
Type **GO[RETURN]** or **[CONTROL] C**

- Introduction** To conserve memory space, the Graphics Manager does not permanently reside in memory. It is loaded only when it is needed. GMGRADD is used to add graphics capability to machine-language programs.
- When to Use GMGRADD** Use GMGRADD any time you create a machine-language program that calls to the Graphics Manager entry point at memory address 000CH.
- What GMGRADD Does** GMGRADD performs the following functions:
- o It adds a copy of the Graphics Manager to the end of your program file.
  - o It moves the first three bytes of your program to a special area of the program file.
  - o It places a jump instruction, which points to the Graphics Manager loader, at the beginning of your program.
- Functional Description** After the Graphics Manager has been added to your program, the following process occurs each time you run your program:
1. When CP/M loads your program into memory, the jump instruction at memory address 0100H causes control to be passed to the Graphics Manager loader.
  2. The Graphics Manager loader shrinks the amount of memory available for use by your program to make room for itself.
  3. The Graphics Manager relocates itself in high memory, just below the CP/M system.
  4. The Graphics Manager restores the first three bytes of your program to memory addresses 0100H-0103H.
  5. The Graphics Manager transfers control to your program at memory address 0100H.

**Introduction** Do this procedure to add the Graphics Manager to your program.

### Procedure

#### STEP ACTION

- 1 Create a program with a text editor such as ED or WORDSTAR.
- 2 Assemble the program with the "ASM" program or another assembler.
- 3 Load the program with the "LOAD" program or another loader.
- 4 Type **GMGRADD drive:filename[RETURN]**  
(EXAMPLE: **GMGRADD B:GRAPH[RETURN]**)

After the Graphics Manager has been added to the file, the program will display:

GRAPHICS MANAGER HAS BEEN APPENDED TO YOUR COM FILE

- Notes:**
- o GMGRADD modifies program files and should only be used once with a file.
  - o GMGRADD can be used only with files that have a file type of ".COM". COM files contain machine-language instructions that CP/M loads directly into the computer's memory at address 0100H.
  - o Once GMGRADD has been run against a program, the program cannot be debugged with GDDT.

**Introduction** The Graphics Manager distributed with Graphics CP/M 2.2 Release 1.2.0 includes three additional geometric routines:

- o EXTENDED POLYGON
- o EXTENDED RECTANGLE
- o EXTENDED ELLIPSE

The original geometric routines are still recognized by the Graphics Manager. This makes previously-written programs compatible with Release 1.2.0. The Graphics CP/M Preface manual describes the original routines and how they are used.

**Description** The extended routines are described below:

**Polygon  
and  
Rectangle**

Polygons and rectangles can be rotated around the axis of an x-y pivot point with the extended routines. The numeric value for the rotation may be within the range of -32768 to 32767 degrees. If the value exceeds 360, then 360 is subtracted from the value. Subtraction continues until the value is less than or equal to 360.

**Ellipse**

The extended ellipse routine accepts numbers in the range of 0 to 65535 for the radii values. Ellipses may be rotated around the axis of an x-y pivot point. The numeric value for the rotation may be within the range of -32768 to 32767 degrees. If the value exceeds 360, then 360 is subtracted from the value. This subtraction is repeated until the remaining value is less than or equal to 360.

**Registers**

The Z80 CPU contains two sets of registers. The first set, called the primary registers, are named A, B, C, D, E, H, L, IX, and IY. The second set, called the alternate registers, are named AF', BC', DE', and HL'. The original geometric routines use the primary registers A, B, C, D, E, H, L, IX, and IY. The extended geometric routines use the same primary registers plus the alternate registers BC', DE' and HL'.

**Loading Values**

Values cannot be loaded directly into the alternate registers. To load the alternate registers, place the values into the standard registers (BC, DE, and HL), then issue the Z80 assembly language instruction "EXX". This instruction, represented by the hexadecimal value D9, causes the values in the BC, DE, and HL registers to be exchanged with the values in the BC', DE', and HL' registers. After the alternate register values are loaded, load the values for the primary registers.

- Purpose** The graphics examples which follow illustrate the programming differences between the original and extended graphics routines. The program listings of the extended routines contain areas of code that are screened. These areas identify the code that was changed from or added to the original programs.
- Hard Copy** The Graphics Manager contains a routine which can copy an image from the computer display to a dot matrix printer. This routine is invoked by typing CONTROL-T on the computer keyboard. To use this routine, you must have one of the following printers attached to a serial interface card in slot 1 of your computer:
- o North Star NS-100
  - o Epson MX-80
  - o Epson MX-100
- Options Required** The printer must contain the GRAFTRAX option. If the printer contains a serial interface card, the card must contain a buffer of at least 2K.
- Printer** The Demo/Diagnostic diskette shows how to set the switches on an Epson 8145 serial interface card. This information is located in the explanations section.
- Returning to CP/M** Each of the example programs draws an image on the computer display and waits for you to type a key. At this point a [CONTROL] T causes the display to be copied to the printer. Typing any other key causes the program to return to the CP/M command level. After typing a [CONTROL] T, wait for the printed copy to be completed, then type another key to exit from the program.



**Introduction** This section describes how to set the registers for the extended polygon routine. Additional information is contained in Section 6.3 of the Graphics CP/M Preface.

<u>REGISTER</u>	<u>VALUE</u>	<u>DESCRIPTION</u>
A	9	Designates the extended polygon routine
B	1 to 64	See the Graphics CP/M Preface for a description of values used with these registers
C	Command byte	
HL	Table address	
IX	Extra buffer address	
IY	Extra buffer size	
BC'	x pivot point	The horizontal coordinate around which rotation is to occur
DE'	y pivot point	The vertical coordinate around which rotation is to occur
HL'	Rotation angle	A value within the range of -32768 to 32767

```

0100          ORG      00100H
000C =       GRAF    EQU    0000CH      ;Graphics Manager
                                ;entry point
0001 =       CINP   EQU    001H       ;Character input routine
0005 =       BDOS   EQU    00005H     ;CP/M BDOS entry point

                                ;Set the viewport and draw a border on the screen

0100 3E02    SETVP  MVI    A,002H     ;Select rectangle routine
0102 0ECl    MVI    C,0ClH           ;Command byte for
                                ;viewport with border
0104 212301          LXI    H,VP      ;Point HL to viewport
                                ;coordinates
0107 CD0C00          CALL  GRAF       ;Call Graphics Manager

                                ;Draw a polygon

010A 3E01    DRAW  MVI    A,001H     ;Select original
                                ;polygon routine
010C 0606          MVI    B,006H     ;Specify 6 sides
010E 0E51          MVI    C,051H     ;Value for shading
                                ;the interior
0110 212B01          LXI    H,POLYG  ;Point HL to
                                ;polygon coordinates
0113 CD0C00          CALL  GRAF       ;Call Graphics Manager

                                ;Loop through this routine until the user
                                ;types a key on the keyboard. Then return
                                ;to CP/M

0116 0E01    LOOP  MVI    C,CINP     ;Set C to CP/M input code
0118 CD0500          CALL  BDOS       ;Call CP/M to get
                                ;a character
011B FE00          CPI    000H       ;If zero, no key
                                ;was typed
011D CA1601          JZ     LOOP      ;If no key was
                                ;typed, loop
0120 C30000          JMP    0000H     ;Re-enter CP/M
                                ;via warm boot

                                ;These values are the coordinates for the
                                ;viewport

0123 0000    VP   DW     0000H       ;X minimum
0125 0000          DW     0000H       ;Y minimum
0127 7F02          DW     027FH       ;X maximum
0129 EF00          DW     00EFH       ;Y maximum

```

EXAMPLE 1 - POLYGON USING REGULAR ROUTINE (continued)

;These values are the coordinates for the  
;polygon

012B	1701	POLYG	DW	0117H	;X1
012D	4F00		DW	004FH	;Y1
012F	6701		DW	0167H	;X2
0131	4F00		DW	004FH	;Y2
0133	8F01		DW	018FH	;X3
0135	7700		DW	0077H	;Y3
0137	6701		DW	0167H	;X4
0139	9F00		DW	009FH	;Y4
013B	1701		DW	0117H	;X5
013D	9F00		DW	009FH	;Y5
013F	EF00		DW	00EFH	;X6
0141	7700		DW	0077H	;Y6

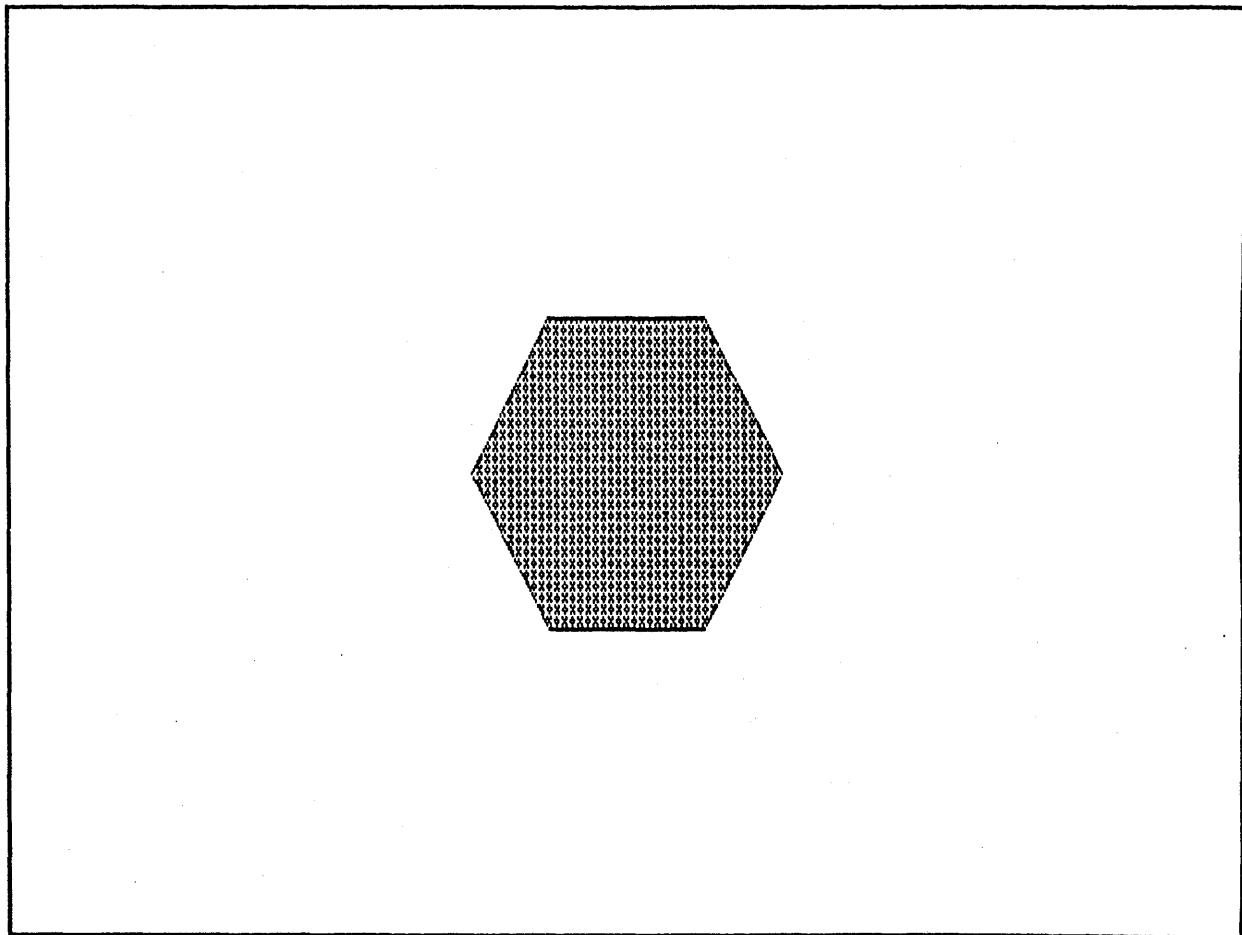


FIGURE 1  
REGULAR POLYGON

```

0100          ORG    00100H
000C =       GRAF  EQU    0000CH      ;Graphics Manager
                                ;entry point
0001 =       CINP  EQU    001H       ;Character input routine
0005 =       BDOS  EQU    00005H     ;CP/M BDOS entry point

                                ;Set the viewport and draw a border on the screen

0100 3E02    SETVP MVI    A,002H     ;Select rectangle routine
0102 0EC1          MVI    C,0C1H     ;Command byte for
                                ;viewport with border
0104 212D01          LXI    H,VP     ;Point HL to
                                ;viewport coordinates
0107 CD0C00          CALL  GRAF      ;Call Graphics Manager

                                ;Draw a polygon rotated 90 degrees

010A 013F01    DRAW  LXI    B,013FH   ;Rotation will occur
010D 117700          LXI    D,0077H   ;around the center of
                                ;the screen
0110 215A00          LXI    H,90     ;Rotate 90 degrees
0113 D9          DB    0D9H         ;Move values to
                                ;alternate registers
0114 3E09          MVI    A,009H     ;Select extended
                                ;polygon routine
0116 0606          MVI    B,006H     ;Specify 6 sides
0118 0E51          MVI    C,051H     ;Value for shading
                                ;the interior
011A 213501          LXI    H,POLYG  ;Point HL to
                                ;polygon coordinates
011D CD0C00          CALL  GRAF      ;Call Graphics Manager

                                ;Loop through this routine until the user
                                ;types a key on the keyboard. Then return
                                ;to CP/M

0120 0E01    LOOP  MVI    C,CINP     ;Set C to
                                ;CP/M input code
0122 CD0500          CALL  BDOS      ;Call CP/M to
                                ;get a character
0125 FE00          CPI    000H       ;If zero, no
                                ;key was typed
0127 CA2001          JZ     LOOP      ;If no key was
                                ;typed, loop
012A C30000          JMP    0000H     ;Re-enter CP/M
                                ;via warm boot

```

**EXAMPLE 2 - POLYGON USING EXTENDED ROUTINE (continued)**

---

;These values are the coordinates for the  
;viewport

012D	0000	VP	DW	0000H	;X minimum
012F	0000		DW	0000H	;Y minimum
0131	7F02		DW	027FH	;X maximum
0133	EF00		DW	00EFH	;Y maximum

;These values are the coordinates for the  
;polygon

0135	1701	POLYG	DW	0117H	;X1
0137	4F00		DW	004FH	;Y1
0139	6701		DW	0167H	;X2
013B	4F00		DW	004FH	;Y2
013D	8F01		DW	018FH	;X3
013F	7700		DW	0077H	;Y3
0141	6701		DW	0167H	;X4
0143	9F00		DW	009FH	;Y4
0145	1701		DW	0117H	;X5
0147	9F00		DW	009FH	;Y5
0149	EF00		DW	00EFH	;X6
014B	7700		DW	0077H	;Y6

014D                   END

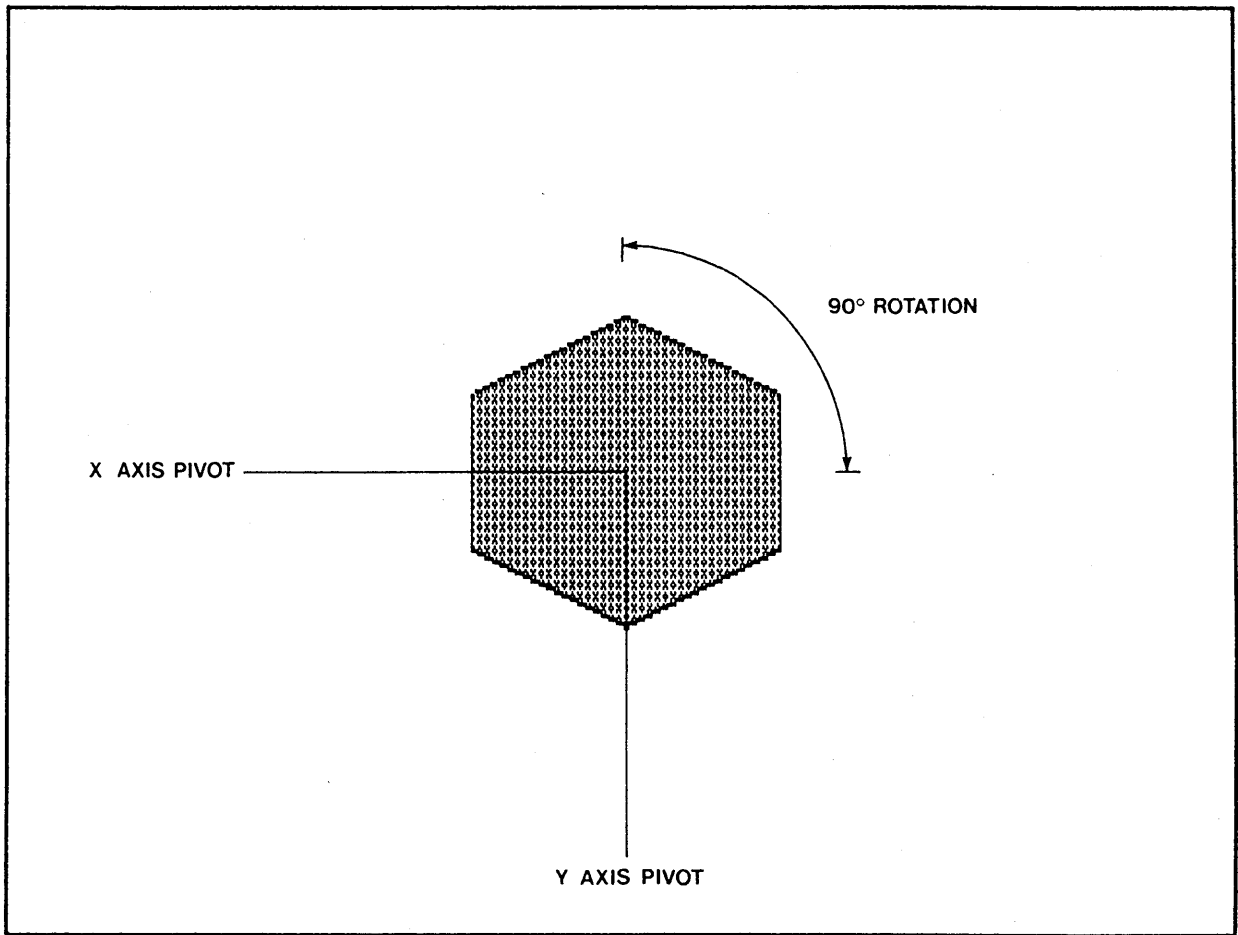


FIGURE 2  
ROTATED POLYGON

**Introduction** This section describes how to set up the registers for the extended rectangle routine. Additional information is contained in Section 6.3 of the Graphics CP/M Preface.

<u>REGISTER</u>	<u>VALUE</u>	<u>DESCRIPTION</u>
A	10	Designates the extended rectangle routine
C	Command byte	} See the Graphics CP/M Preface manual for a description of values used with these registers
HL	Table address	
BC'	x pivot point	
DE'	y pivot point	The horizontal coordinate around which rotation is to occur
HL'	Rotation angle	The vertical coordinate around which rotation is to occur
		A value within the range of -32768 to 32767

```

0100          ORG    00100H
000C =       GRAF  EQU    0000CH    ;Graphics Manager
                                ;entry point
0001 =       CINP  EQU    001H     ;Character input routine
0005 =       BDOS  EQU    00005H   ;CP/M BDOS entry point

                                ;Set the viewport and draw a border on the screen

0100 3E02    SETVP MVI    A,002H   ;Select rectangle routine
0102 0EC1          MVI    C,0C1H   ;Command byte for viewport
0104 212101          LXI    H,VP    ;Point HL to
                                ;viewport coordinates
0107 CD0C00          CALL  GRAF     ;Call Graphics Manager

                                ;Draw a rectangle

010A 3E02    DRAW  MVI    A,002H   ;Select original
                                ;rectangle routine
010C 0E51          MVI    C,051H   ;Value for shading
                                ;interior
010E 212901          LXI    H,RECT  ;Point HL to
                                ;rectangle coordinates
0111 CD0C00          CALL  GRAF     ;Call Graphics Manager

                                ;Loop through this routine until the user
                                ;types a key on the keyboard. Then return
                                ;to CP/M

0114 0E01    LOOP MVI    C,CINP    ;Set C to CP/M input code
0116 CD0500          CALL  BDOS     ;Call CP/M to
                                ;get a character
0119 FE00          CPI    000H     ;If zero, no key
                                ;was typed
011B CA1401          JZ     LOOP    ;If no key was
                                ;typed, loop
011E C30000          JMP    0000H   ;Re-enter CP/M
                                ;via warm boot

                                ;These values are the coordinates for the
                                ;viewport

0121 0000    VP   DW     0000H    ;X minimum
0123 0000          DW     0000H    ;Y minimum
0125 7F02          DW     027FH    ;X maximum
0127 EF00          DW     00EFH    ;Y maximum

```



EXAMPLE 3 - RECTANGLE USING REGULAR ROUTINE (continued)

;These values are the coordinates for the  
;rectangle

```
0129 B000      RECT   DW   00B0H   ;X1
012B 6000              DW   0060H   ;Y1
012D D001              DW   01D0H   ;X2
012F 9000              DW   0090H   ;Y2

0131                      END
```

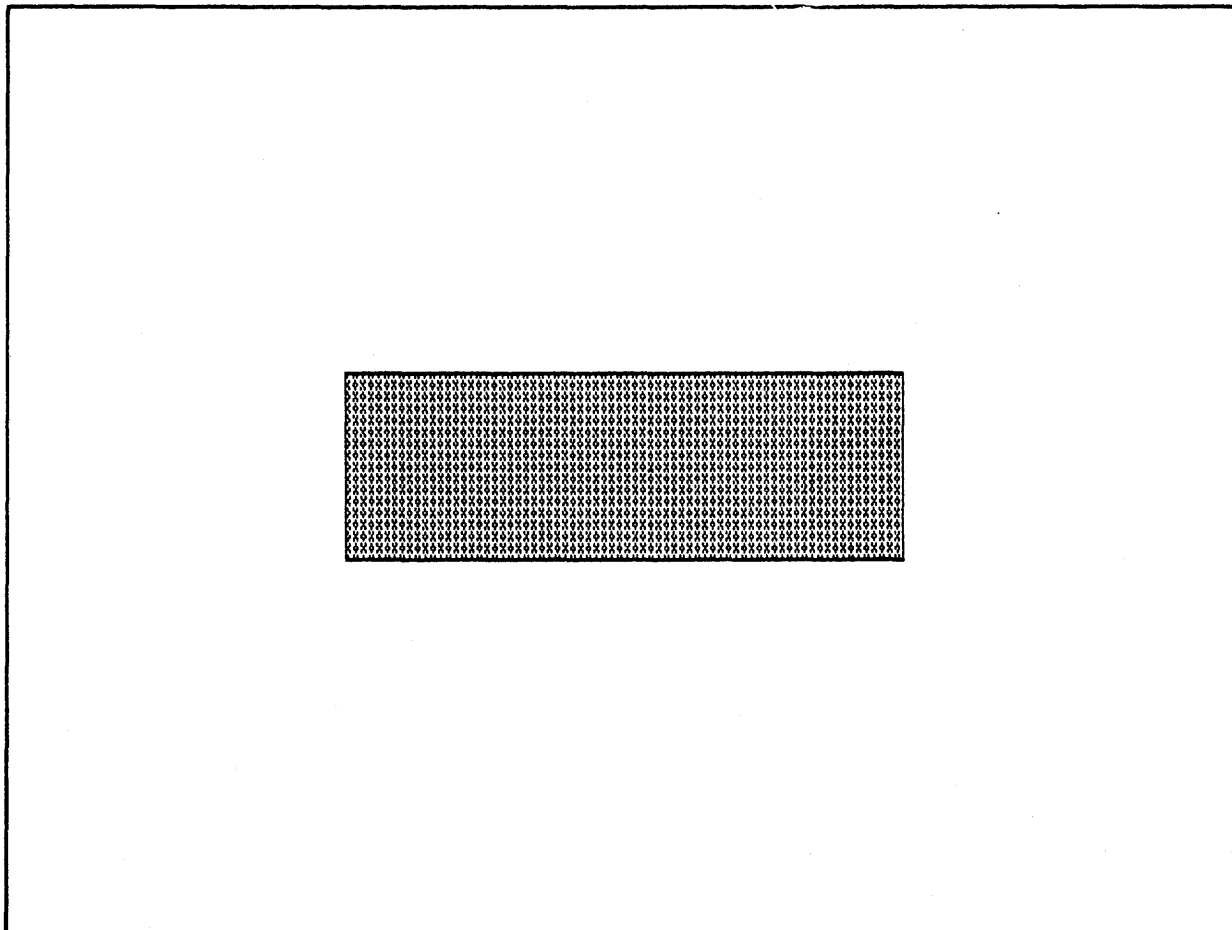


FIGURE 3  
REGULAR RECTANGLE

```

0100          ORG      00100H
000C =       GRAF    EQU    0000CH      ;Graphics Manager
                                           ;entry point
0001 =       CINP    EQU    001H       ;Character input routine
0005 =       BDOS    EQU    00005H     ;CP/M BDOS entry point

                                           ;Set the viewport and draw a border on the screen

0100 3E02    SETVP   MVI    A,002H     ;Select rectangle routine
0102 0EC1          MVI    C,0C1H     ;Command byte
                                           ;for viewport
0104 212B01          LXI    H,VP      ;Point HL to
                                           ;viewport coordinates
0107 CD0C00          CALL   GRAF      ;Call Graphics Manager

                                           ;Draw a rectangle rotated 45 degrees

010A 014001    DRAW   LXI    B,0140H   ;Rotation will
010D 117800          LXI    D,0078H   ;occur around
0110 212D00          LXI    H,45      ;the center of
0113 D9          DB     0D9H         ;the rectangle
0114 3E0A          MVI    A,00AH     ;Rotate 45 degrees
                                           ;Move values to
                                           ;alternate registers
0116 0E51          MVI    C,051H     ;Select extended
                                           ;rectangle routine
0118 213301          LXI    H,RECT    ;Value for shading
011B CD0C00          CALL   GRAF      ;interior
                                           ;Point HL to
                                           ;rectangle coordinates
                                           ;Call Graphics Manager

                                           ;Loop through this routine until the user
                                           ;types a key on the keyboard. Then return
                                           ;to CP/M

011E 0E01    LOOP   MVI    C,CINP     ;Set C to CP/M input code
0120 CD0500          CALL   BDOS      ;Call CP/M to
                                           ;get a character
0123 FE00          CPI    000H       ;If zero, no
                                           ;key was typed
0125 CA1E01          JZ     LOOP      ;If no key was
                                           ;typed, loop
0128 C30000          JMP    0000H     ;Re-enter CP/M
                                           ;via warm boot

```

**EXAMPLE 4 - RECTANGLE USING EXTENDED ROUTINE (continued)**

;These values are the coordinates for the  
;viewport

```
012B 0000    VP    DW    0000H    ;X minimum  
012D 0000    DW    0000H    ;Y minimum  
012F 7F02    DW    027FH    ;X maximum  
0131 EF00    DW    00EFH    ;Y maximum
```

;These values are the coordinates for the  
;rectangle

```
0133 B000    RECT  DW    00B0H    ;X1  
0135 6000    DW    0060H    ;Y1  
0137 D001    DW    01D0H    ;X2  
0139 9000    DW    0090H    ;Y2
```

```
013B                END
```

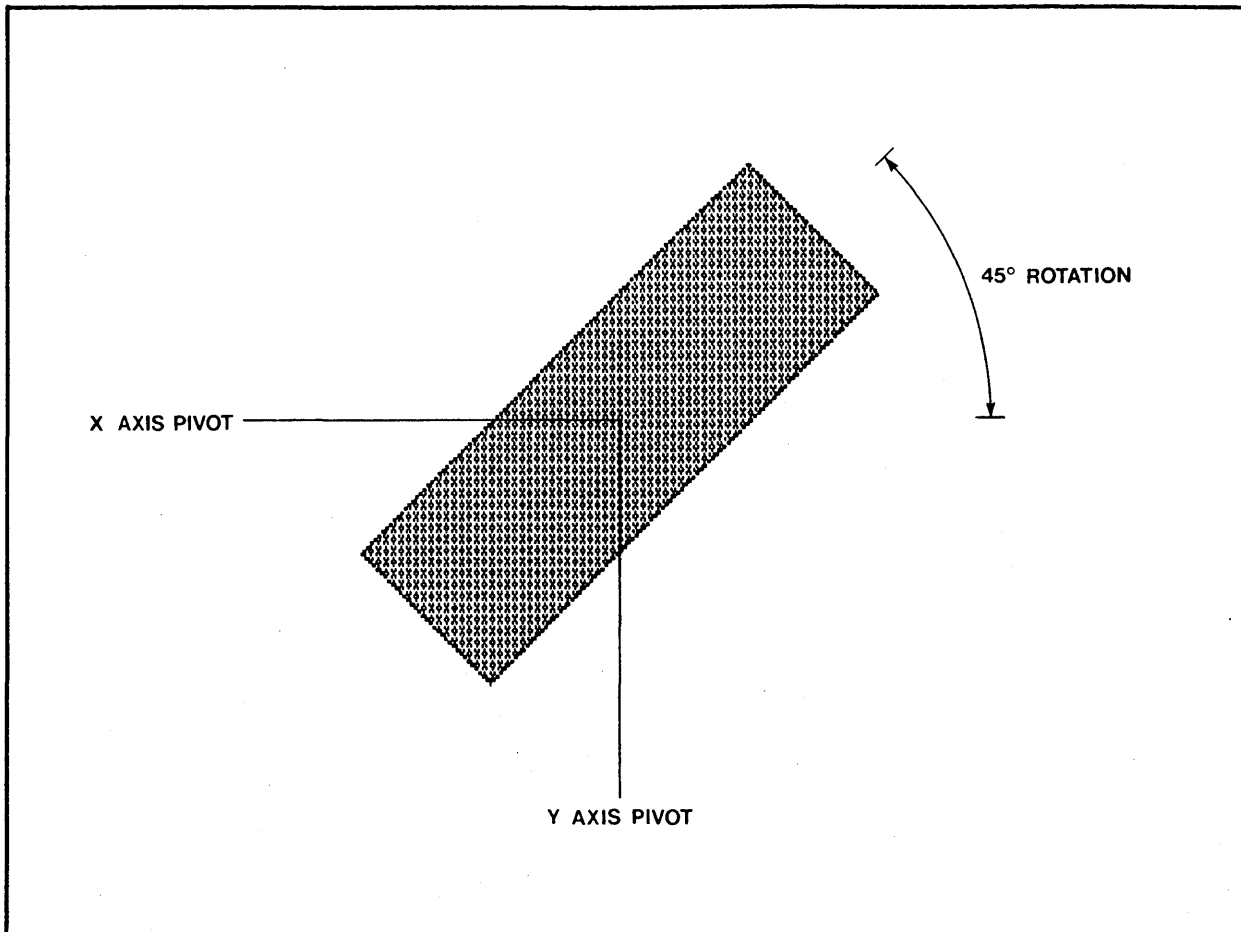


FIGURE 4  
ROTATED RECTANGLE

**Introduction** This section describes how to set the registers for the extended ellipse routine. Additional information is provided in Section 6.3 of the Graphics CP/M Preface.

<u>REGISTER</u>	<u>VALUE</u>	<u>DESCRIPTION</u>
A	11	Designates the extended ellipse routine
B	Type of ellipse	See the Graphics CP/M Preface manual for a description of values used with these registers
C	Command byte	
D		
E		Not used
HL	Table address	See the Graphics CP/M Preface manual for a description of values used with these registers
IX	Start angle	
IY	Stop angle	
BC'	Horizontal radius	Half the value of the horizontal radius. A number within the range of -32768 to 32767. This value is doubled in the resulting figure.
DE'	Vertical radius	The value of the vertical radius. A number within the range of -32768 to 32767.
HL'	Rotation angle	A value within the range of -32768 to 32767.

```

0100          ORG  00100H
000C =       GRAF  EQU  0000CH          ;Graphics Manager
                                         ;entry point
0001 =       CINP  EQU  001H           ;Character input routine
0005 =       BDOS  EQU  00005H        ;CP/M BDOS entry point

                                         ;Set the viewport and draw a border on the screen

0100 3E02    SETVP MVI  A,002H         ;Select rectangle routine
0102 0EC1          MVI  C,0C1H         ;Command byte for
                                         ;viewport with border
0104 212701          LXI  H,VP         ;Point HL to
                                         ;viewport coordinates
0107 CD0C00          CALL GRAF         ;Call Graphics Manager

                                         ;Draw an ellipse

010A 3E03    DRAW  MVI  A,003H         ;Select original
                                         ;ellipse routine
010C 0600          MVI  B,000H         ;Specify a whole ellipse
010E 0E51          MVI  C,051H         ;Value for shading
                                         ;the interior
0110 1648          MVI  D,048H         ;Set the 1/2 the
                                         ;horizontal size
0112 1E18          MVI  E,018H         ;Set the 1/2 the
                                         ;vertical size
0114 212F01          LXI  H,ELLIP     ;Point HL to
                                         ;ellipse coordinates
0117 CD0C00          CALL GRAF         ;Call Graphics Manager

                                         ;Loop through this routine until the user
                                         ;types a key on the keyboard.  Then return
                                         ;to CP/M

011A 0E01    LOOP  MVI  C,CINP        ;Set C to CP/M input code
011C CD0500          CALL  BDOS        ;Call CP/M to get
                                         ;a character
011F FE00          CPI  000H          ;If zero, no
                                         ;key was typed
0121 CA1A01          JZ   LOOP         ;If no key was
                                         ;typed, loop
0124 C30000          JMP  0000H        ;Re-enter CP/M
                                         ;via warm boot

```

**EXAMPLE 5 - ELLIPSE USING REGULAR ROUTINE (continued)**

---

;These values are the coordinates for the  
;viewport

```
0127 0000    VP    DW    0000H        ;X minimum
0129 0000                DW    0000H        ;Y minimum
012B 7F02                DW    027FH        ;X maximum
012D EF00                DW    00EFH        ;Y maximum
```

;These values are the coordinates for  
;the ellipse

```
012F 3F01    ELLIP DW    013FH        ;X1
0131 7700                DW    0077H        ;Y1
0133                END
```

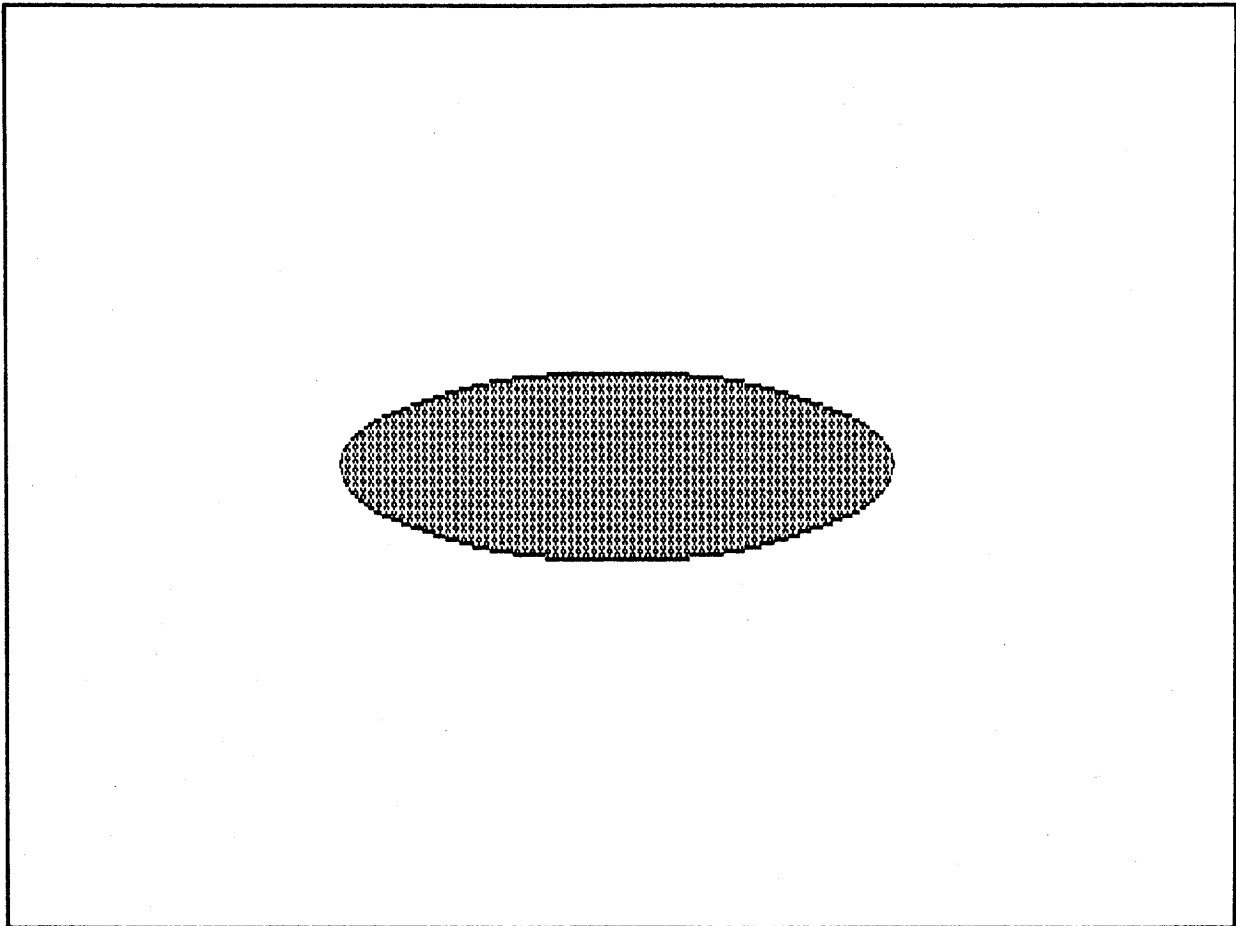


FIGURE 5  
REGULAR ELLIPSE

```

0100          ORG 00100H
000C =       GRAF EQU 0000CH          ;Graphics Manager
                                ;entry point
0001 =       CINP EQU 001H           ;Character input routine
0005 =       BDOS EQU 00005H        ;CP/M BDOS entry point

                                ;Set the viewport and draw a border on the screen

0100 3E02    SETVP MVI A,002H        ;Select rectangle routine
0102 0EC1          MVI C,0C1H        ;Command byte for
                                ;viewport with border
0104 212D01          LXI H,VP        ;Point HL to
                                ;viewport coordinates
0107 CD0C00          CALL GRAF        ;Call Graphics Manager

                                ;Draw an ellipse rotated 45 degrees

010A 014800    DRAW LXI B,0048H      ;Specify 1/2 the
                                ;horizontal size
010D 111800          LXI D,0018H      ;Specify 1/2 the
                                ;vertical size
0110 212D00          LXI H,045        ;Rotate 45 degrees
0113 D9          DB 0D9H             ;Move values to
                                ;alternate registers
0114 3E0B          MVI A,00BH        ;Select extended
                                ;ellipse routine
0116 0600          MVI B,000H        ;Specify a whole ellipse
0118 0E51          MVI C,051H        ;Value for shading
                                ;the interior
                                ;Note: registers D and E
                                ;are not used
011A 213501          LXI H,ELLIP      ;Point HL to
                                ;ellipse coordinates
011D CD0C00          CALL GRAF        ;Call Graphics Manager

                                ;Loop through this routine until the user
                                ;types a key on the keyboard. Then return
                                ;to CP/M

0120 0E01    LOOP MVI C,CINP        ;Set C to CP/M input code
0122 CD0500          CALL BDOS        ;Call CP/M to
                                ;get a character
0125 FE00          CPI 000H          ;If zero, no key
                                ;was typed
0127 CA2001          JZ LOOP          ;If no key was
                                ;typed, loop
012A C30000          JMP 0000H        ;Re-enter CP/M
                                ;via warm boot

```

EXAMPLE 6 - ELLIPSE USING EXTENDED ROUTINE (continued)

```
      ;These values are the coordinates for the  
      ;viewport  
012D 0000    VP    DW    0000H        ;X minimum  
012F 0000    DW    0000H        ;Y minimum  
0131 7F02    DW    027FH        ;X maximum  
0133 EF00    DW    00EFH        ;Y maximum  
  
      ;These values are the coordinates for  
      ;the ellipse  
0135 3F01    ELLIP DW    013FH        ;X1  
0137 7700    DW    0077H        ;Y1  
  
0139                END
```

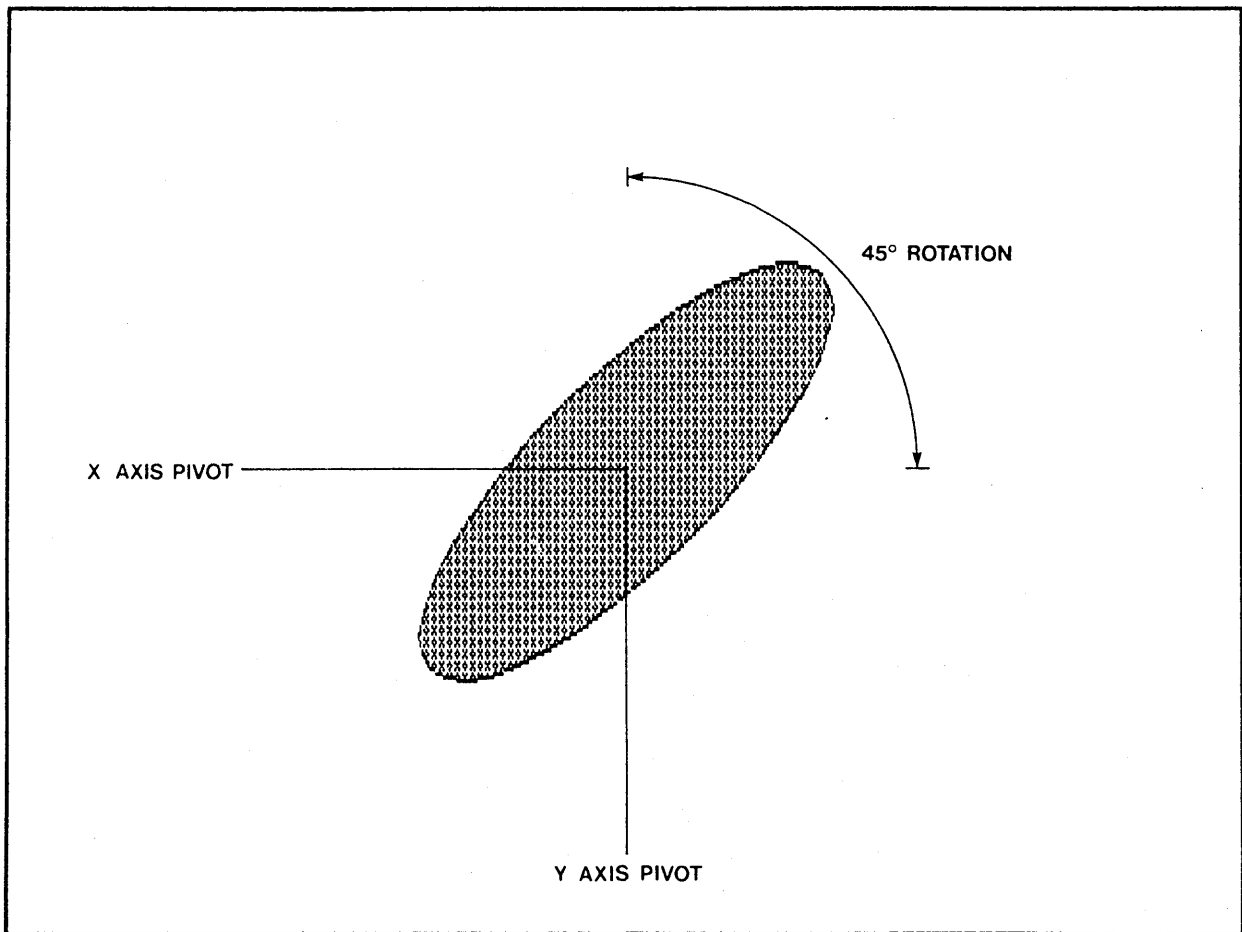


FIGURE 6  
ROTATED ELLIPSE