NorthStar

**ADDENDUM TO
GRAPHICS CP/M PREFACE**

TABLE OF CONTENTS

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.

INTRODUCTION

Purpose   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:

DESCRIPTION   EXPLANATION

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].

OTHER TEXT   Other information which is displayed in bold type
                       should be typed on the computer keyboard.

FACTORY   Means the floppy disk that is packaged with your
MASTER   copy of CP/M.
DISK

WORKING   Means a copy of the factory master disk.
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   do the procedures in sections 2.1, 2.2
disk drives   and 2.3 of this chapter.

contains one floppy   do the procedures in sections 2.1, and
disk drive and one   2.3 through 2.9 of this chapter.
hard disk drive

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

<u>STEP</u> <u>ACTION</u>

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.

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.

How to   Use the table below to determine whether you need
Customize   to create a customized work disk.
a Work Disk

IF...	THEN...
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)?

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?

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 ?

Procedure

<u>STEP</u>   <u>ACTION</u>

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

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):

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):

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.

Procedure

<u>STEP</u> <u>ACTION</u>

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?

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)?

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?

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?

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:

        CPMGEN.COM   SYSGEN.COM   COPY.COM   HDBOOT.COM
             .
             .
        USER.ASM   GMGRADD.COM   ED.COM   PIP.COM

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   Use GDDT when you want to test or debug a
GDDT   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 **G0[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   Polygons and rectangles can be rotated around
and   the axis of an x-y pivot point with the
Rectangle   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 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 hexidecimal 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   The printer must contain the GRAFTRAX option.
Required   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   Each of the example programs draws an image on
to CP/M   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.

REGISTER	VALUE	DESCRIPTION
A	9	Designates the extended polygon routine
B	1 to 64	
C	Command byte	
HL	Table address	See the Graphics CP/M Preface for a description of values used with these registers
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

EXAMPLE 1 - POLYGON USING REGULAR ROUTINE   Section 3.8
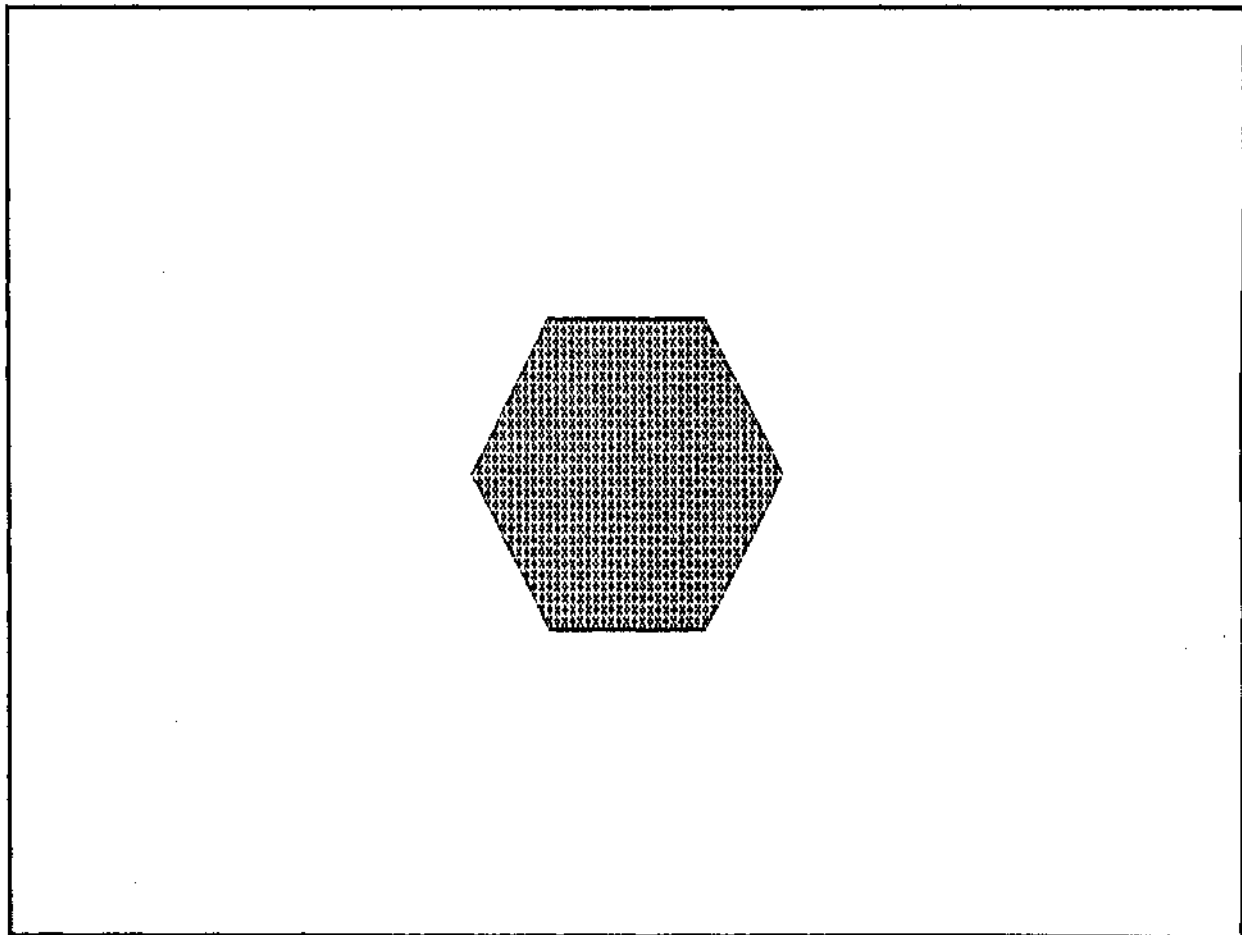
```
0100                      ORG    00100H
000C =       GRAF  EQU    0000CH      ;Graphics Manager
                                       ;entry point
0001 =       CINP  EQU    001H        ;Character input routine
0005 =       BDOS  EQU    00005H      ;CP/M BDOS entry point

             ;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 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

GRAPHICS

EXAMPLE 2 - POLYGON USING EXTENDED ROUTINE   Section 3.9

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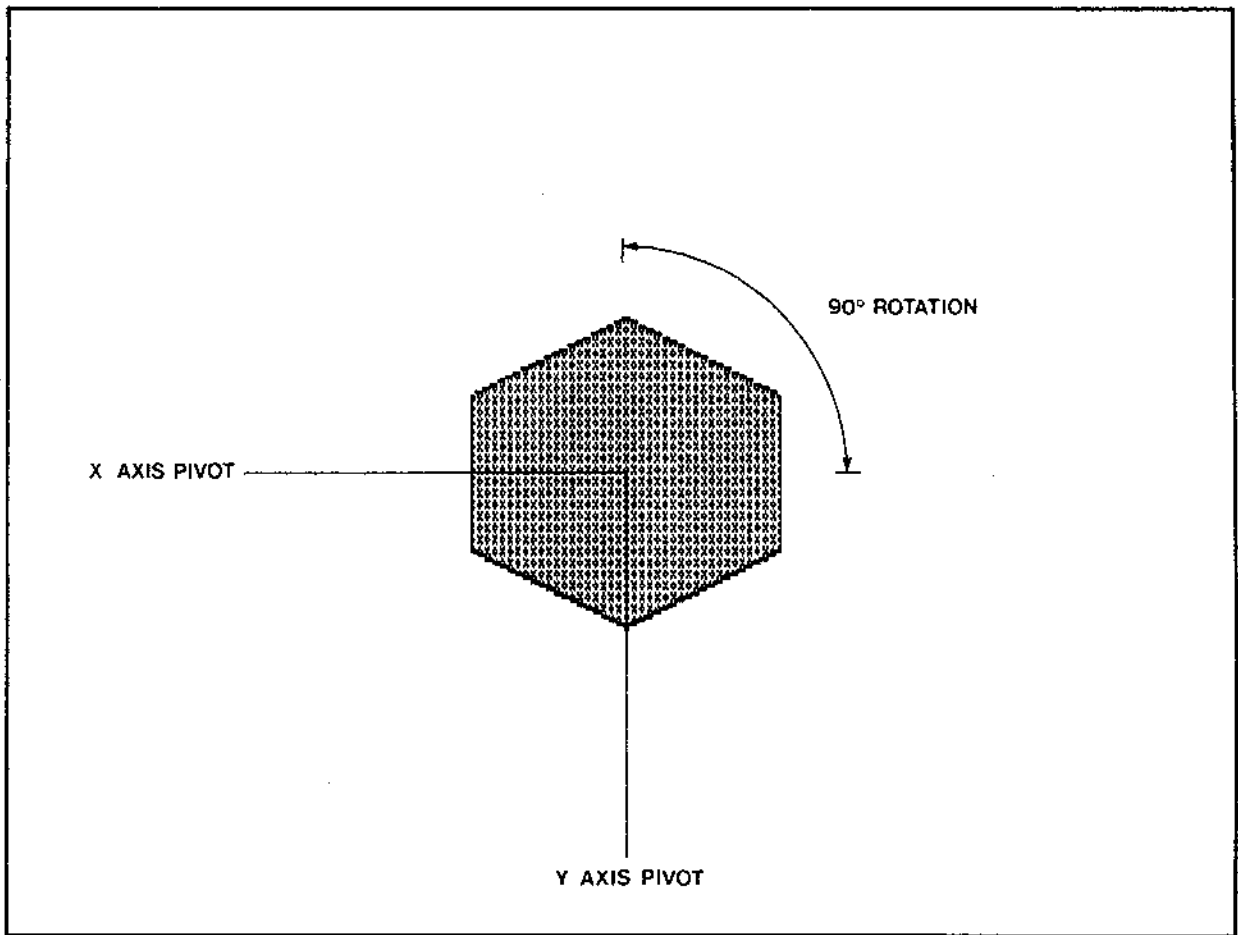
EXAMPLE 2 - POLYGON USING EXTENDED ROUTINE (continued)

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.

REGISTER	VALUE	DESCRIPTION
A	10	Designates the extended rectangle routine
C	Command byte	See the Graphics CP/M Preface manual for a description of values
HL	Table address	used with these registers
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

EXAMPLE 3 - RECTANGLE USING REGULAR ROUTINE   Section 3.11

```
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
```
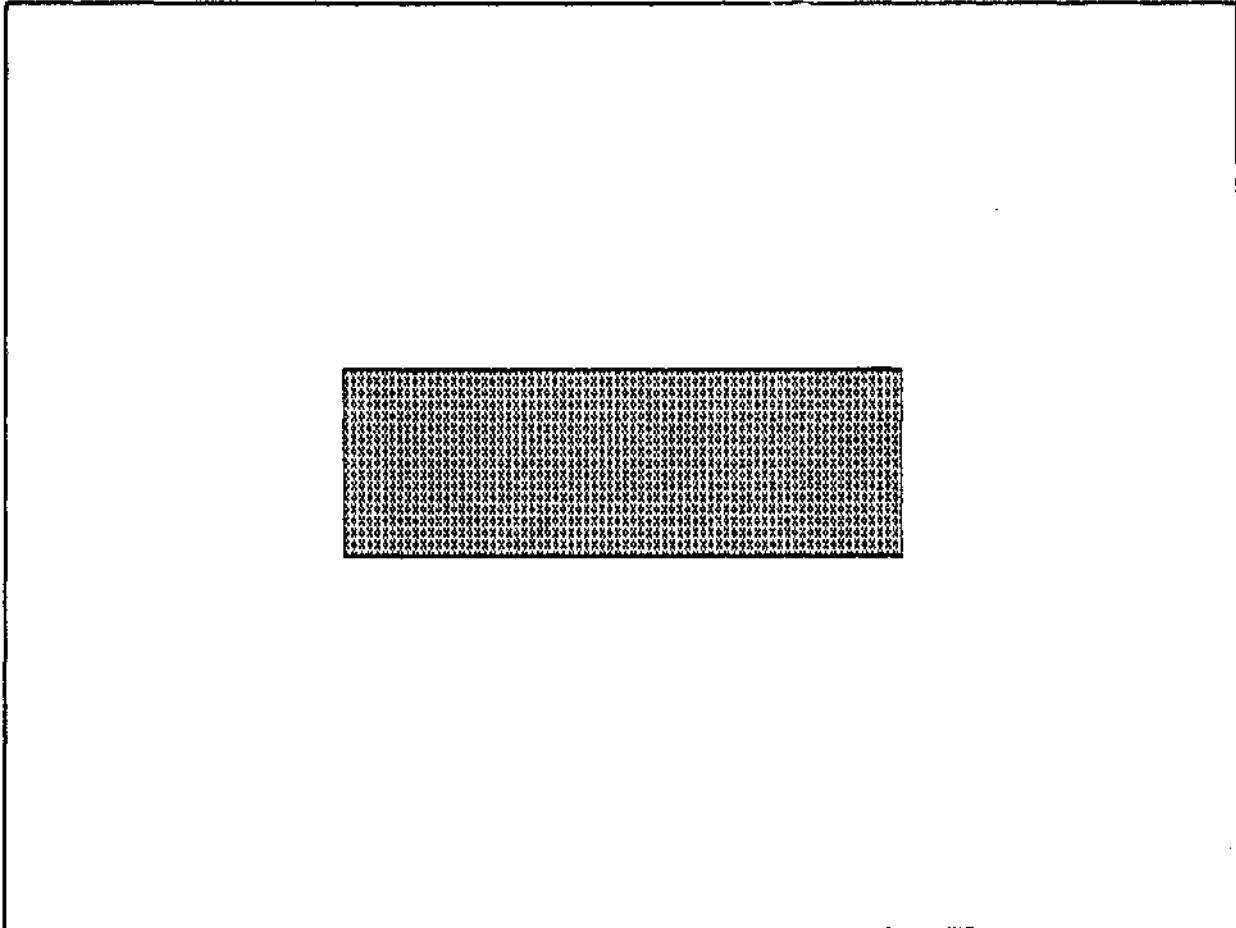
FIGURE 3
REGULAR RECTANGLE

EXAMPLE 4 — RECTANGLE USING EXTENDED ROUTINE   Section 3.12

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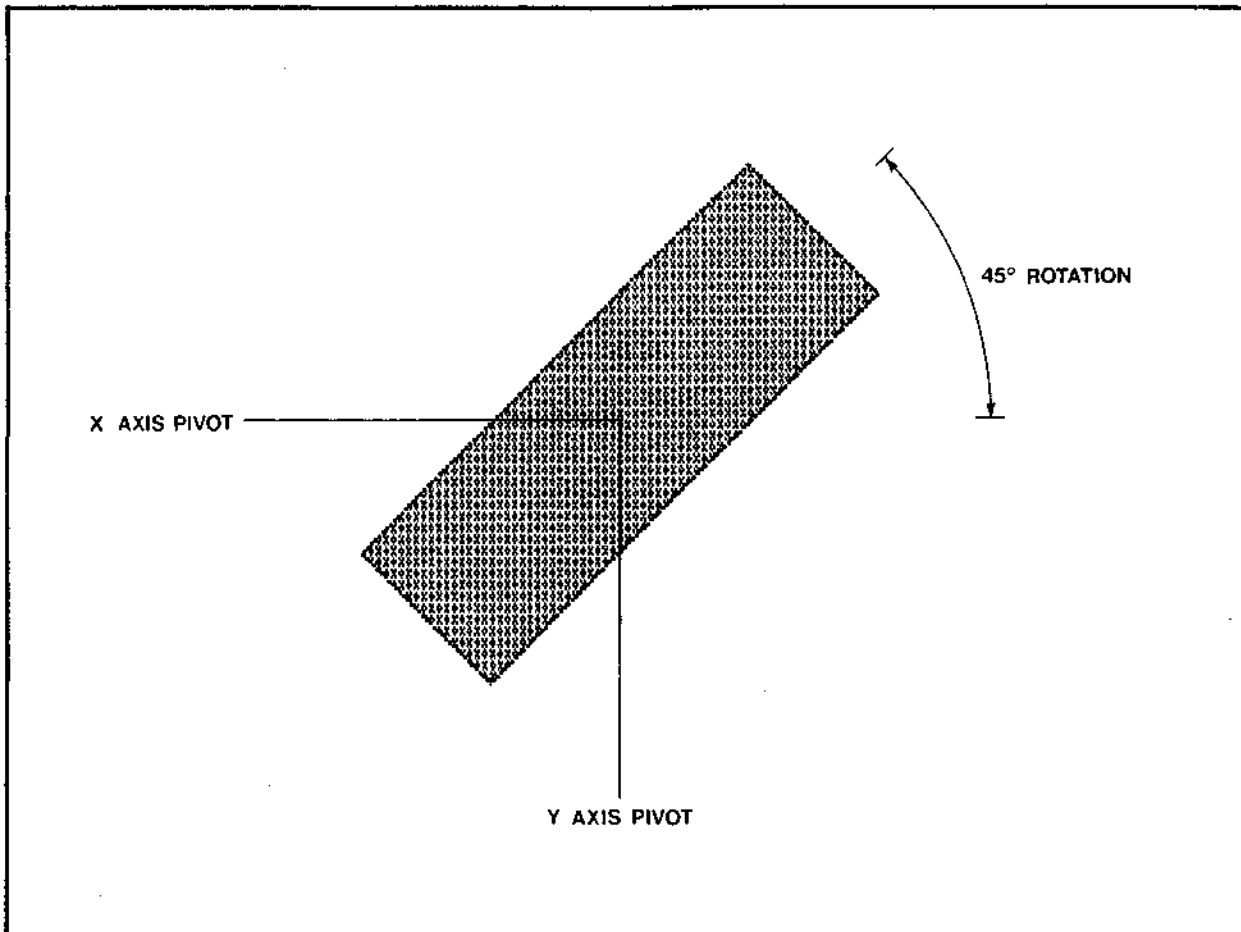

FIGURE 4
ROTATED RECTANGLE

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.

REGISTER	VALUE	DESCRIPTION
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		Not used
E		
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.

EXAMPLE 5 - ELLIPSE USING REGULAR ROUTINE   Section 3.14

```
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

GRAPHICS

EXAMPLE 6 - ELLIPSE USING EXTENDED ROUTINE   Section 3.15

```
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
```
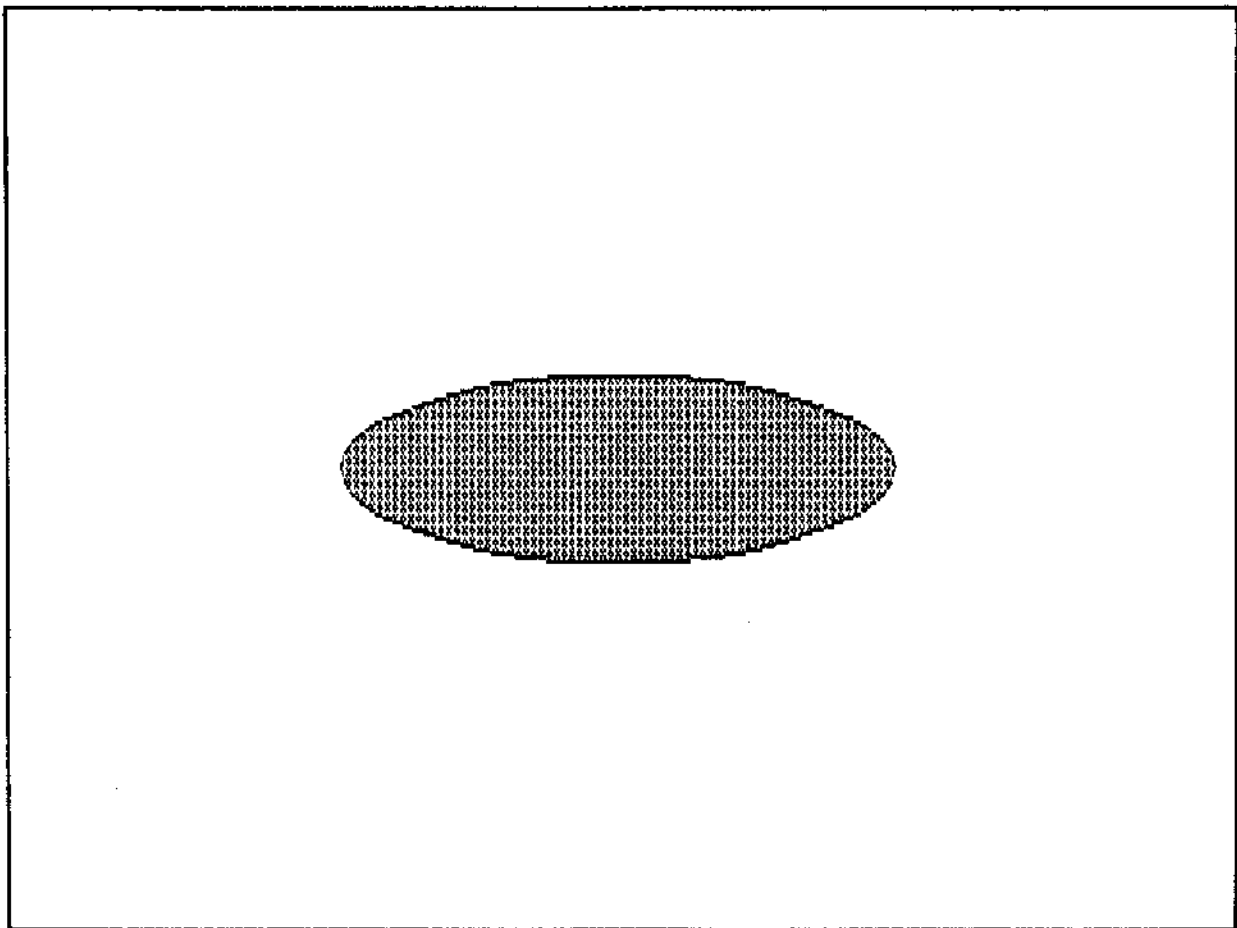
EXAMPLE 6 - ELLIPSE USING EXTENDED ROUTINE (continued)

```
                         ;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
```
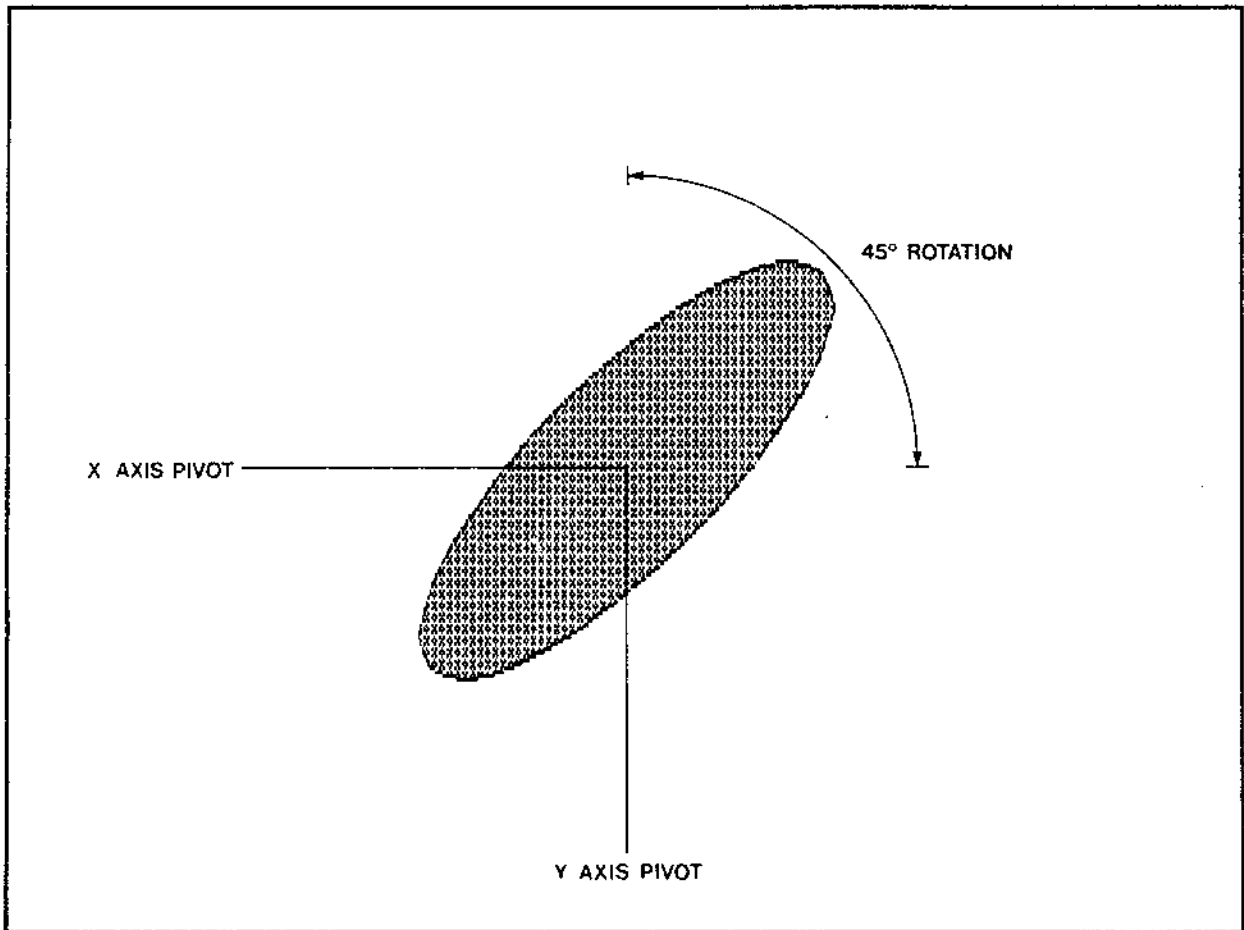

FIGURE 6
ROTATED ELLIPSE