



SECTION 4 DM/PL COMMAND SPECIFICATIONS

NOTE

If you have purchased a plotting software package, you may skip this section of the manual since that program will correctly handle the plotter's DM/PL inputs and outputs. You only need to read this section if you are developing your own plotting programs.

4.1 INTRODUCTION

This section contains the information necessary to write plotter programs using the DM/PL plotting language. This includes general information for using DM/PL, detailed descriptions of the various DM/PL commands for this plotter, and programming tips.

4.2 COMMAND FORMAT

The general format of the DM/PL commands is:

MNEMONIC(parameter)

- *Mnemonic* is the one or two character mnemonic (or abbreviation) of the command. This is how the command must be sent to the plotter.
- *Parameter* is additional data required for some of the commands. The parameters (if any) are explained with the command.

DM/PL COMMAND SPECIFICATIONS

4-2

4.3 COMMAND ORGANIZATION

The DM/PL commands are described fully in the *DM/PL Command Language Manual*, part number MI-1044. The DM/PL manual describes all DM/PL commands used with various Houston Instrument plotters that support this language. Because of technical differences between the plotters, some of the commands require different parameters in order to operate properly with a given plotter. These commands are noted in the DM/PL manual. However, you will find that most of the commands operate exactly the same for all DM/PL-based plotters.

The DM/PL commands that the DMP-60 plotters support are listed in Section 4.4. These commands are listed by related functional groups for ease of reference. Section 4.4 also lists any required parameters when using a given command with these plotters. Unless otherwise noted in the descriptions of the commands, all listed DM/PL commands are fully supported and operate exactly as described in the DM/PL manual. Otherwise, be sure to observe the parameters given for the command to ensure predictable operation of the plotter.

Note that these are the only DM/PL commands supported by the DMP-60 plotters. If the plotters receive a command that they do not support, the results cannot be predicted. Be sure to check this listing before running any software written for another DM/PL-based plotter to ensure predictable operation.



4.4 DMP-60 DM/PL COMMANDS

The DMP-60 DM/PL commands are listed below.

Select Commands:

Mode One Select

::

Mode Two Select

::lpc d,

or

::l(nn nn nn nn)pc d,

pc is your computer's prompt code and d is the delay time. (nn nn nn nn) are additional plotter response codes.

Plotter Deselect

@

Plot Setup Commands:

Set Velocity

Vn,

n is a numeric designator that specifies a pen down velocity as shown below. If English units are specified in the menu, the velocity is measured in inches per second. If metric units are specified, the velocity is measured in millimeters per second.

Pen up velocities are specified in the plotter menu.

DM/PL COMMAND SPECIFICATIONS

4-4

English Codes (n)	Velocity (ips)	Metric Codes (n)	Velocity (mm/sec)
1	1	2	25
2	2	6	50
4	4	10	76
6	6	15	127
8	8	20	177
10	10	25	228
12	12	30	279
14	14	35	330
16	16	40	381
18	18	45	431
20	20	50	482
22	22	55	533
24	24	60	584
28*	28	70*	685
32*	32	80*	787

*DMP-61 only. These velocities are mapped to 24 ips/584 mm/s if they are sent to the DMP-62.

Set Window/Viewport Limits

W wxdl,wyll,wxur,wyur,vpxll,vpyll,vpxur,vpyur,

x and y values must be between -999,999 and +999,999.

Frame Advance

Fn,

n is the number of increments that you want the plotter to advance the chart media (see Section 4.4.6).



DM/PL COMMAND SPECIFICATIONS

Small Chart (Left Plot-Origin)

EH

Large Chart (Right Plot-Origin)

EF

Mode Two Prompt Enable

EB nn ,

nn is your two-digit hexadecimal prompt enable character.

End of Text

ET nn ,

nn is your two-digit hexadecimal end of text character.

Addressing Commands:

Absolute Pen Positioning

A

Relative Pen Positioning

R

DM/PL COMMAND SPECIFICATIONS

4-6

Coordinate Addressing

EC*n*,

n specifies a different resolution setting:

0=normalized (see Section 4.4.1)

1=0.001 inch

5=0.005 inch

M=0.1 mm

N=0.025 mm

Home Position

H

When the plotter receives a Home command, the pen holder moves to the present left or right plot origin x-y-coordinate 0,0. All relative commands following a Home command are relative x-y-coordinate 0,0.

Set Plot Origin

O

Pen Control Commands:

New Pen

P_n ,

PEN COMMAND (P_n)	FUNCTION
P0	Return pen/move to home
P1	Select pen one
P2	Select pen two
P3	Select pen three
P4	Select pen four
P5	Select pen five
P6	Select pen six

Mapped DM/PL New Pen Commands:

P7	Select pen one
P8	Select pen two
P1+	Select pen two
P2+	Select pen three
P3+	Select pen four
P4+	Select pen five
P5+	Select pen six
P6+	Select pen one
P7+	Select pen two

DM/PL COMMAND SPECIFICATIONS

4-8

Pen Down

D

Pen Up

U

Line Type Commands:

Line Type

L*n*,

n specifies a line type. The Line type command also has a new option for these plotters. If the *n* line type designator is immediately followed by a plus (+), for example *n+*, the line types are drawn in proportion. A proportional line type begins and ends with a segment of a line that is one half the length of the first down move of the selected line type. This option enhances the appearance of rectangular plots when they are drawn with line type commands.

Vector Move Commands:

Vector Move

x,y,

x, is any number between -999,999 and +999,999.

y, is any number between -999,999 and +999,999.

Increment Move

n

n is a lower case alphabetic letter.

p=one +y increment

u=one -x,-y increment

q=one +x,+y increment

v=one -x increment

r=one +x increment

w=one -x,+y increment

s=one +x,y increment

y=pen up

t=one -y increment

z=pen down

Text Commands:

Simple Text

Srhh(text)___

r specifies rotation.

hh specifies height.

___ specifies end of text.

DM/PL COMMAND SPECIFICATIONS

4-10

Extended Text

S(*Sn,Wn,I/NI,Cn,Ln,Fn,Hn,Dn,P/NP/V,TR/TD,Gn, Xn, Yn*) (text)___

Sn specifies height/width. *n* is a numeric expression between one and 5461.

Wn specifies width only.

I/NI specifies italics or no italics.

Cn, specifies extra spacing between text characters (see Section 4.4.2).

Ln, specifies extra spacing between the text character lines (see Section 4.4.2).

Fn, *Hn*, and *Dn*, parameters specify types of fill for fillable character fonts (see Section 4.4.2).

P/NP/V parameter specifies proportional (*P*) or non-proportional (*NP*) text character spacing, or variable (*V*) text extent (see Section 4.4.2).

TR/TD parameter specifies the direction of the text path (see Section 4.4.2).

Gn selects a character set.

Fn selects a font type.

Xn is the x-slope point.

Yn is the y-slope point.

___ specifies end of text.

Curve Commands:

Arc Plot

 $CA(Pn,Hn,Dn,Xn,Yn,Ln) \ x,y,d,$

Pn selects a pen number for fill.

Hn selects a hatch fill pattern.

Dn specifies the fill density.

Xn , is the x-slope point for the fill.

Yn , is the y-slope point for the fill.

Ln , is the line type for the fill.

x,y must be between $-999,999$ and $+999,999$.

d , specifies the size of the arc in degrees.

See Section 4.4.4.

Circle Plot

 $CC(Pn,Hn,Dn,Xn,Yn,Ln) \ x,y,r,$

Pn selects a pen number for fill.

Hn selects a hatch fill pattern.

Dn specifies the fill density.

Xn , is the x-slope point for the fill.

Yn , is the y-slope point for the fill.

Ln , is the line type for the fill.

x,y must be between $-999,999$ and $+999,999$.

r , specifies the radius of the circle.

See Section 4.4.4.

DM/PL COMMAND SPECIFICATIONS

4-12

Ellipse Plot

CE(*Pn*,*Hn*,*Dn*,*Xn*,*Yn*,*Ln*,) *x*,*y*,*x1*,*y1*,*x2*,*y2*,

Pn selects a pen number for fill.

Hn selects a hatch fill pattern.

Dn specifies the fill density.

Xn, is the x-slope point for the fill.

Yn, is the y-slope point for the fill.

Ln, is the line type for the fill.

x,*y* must be between -999,999 and +999,999.

See Section 4.4.4.

Curved Move

CM(*Pn*,*Hn*,*Dn*,*Xn*,*Yn*,*Ln*,) *x1*,*y1*,*x2*,*y2*,*d*,

Pn selects a pen number for fill.

Hn selects a hatch fill pattern.

Dn specifies the fill density.

Xn, is the x-slope point for the fill.

Yn, is the y-slope point for the fill.

Ln, is the line type for the fill.

x,*y* must be between -999,999 and +999,999.

d, specifies the size of the curved move in elliptical arc degrees.

See Section 4.4.3.

Closed Figure

CF($P_n, H_n, D_n, X_n, Y_n, L_n$) *border list* CS

P_n selects a pen number for fill.

H_n selects a hatch fill pattern.

D_n specifies the fill density.

X_n is the x-slope point for the fill.

Y_n is the y-slope point for the fill.

L_n is the line type for the fill.

border list refers to any number of vector movements with the pen up or down to define the figure border.

See Section 4.4.5.

General Curve Plot

CG $x_1y_1, x_2y_2, \dots, x_ny_n$, CS

x,y must be between $-999,999$ and $+999,999$.

DM/PL COMMAND SPECIFICATIONS

4-14

Marker Commands:

Marker Plot

Mhhm,

hh specifies the height of the marker.

m specifies the marker type.

Extended Marker Plot

M(Sn)m,

(Sn) specifies an extended marker size. *n* must be between 0 and 255.

Inquiry Commands:

Report

ER

See Section 4.4.8.

Query

Q

The plotter sends *DMP(61 or 62) 1166xx2, 1167xx2 <CR>*. The last seven digits may differ with your plotter.

Digitize

ED

The plotter switches to local mode, and then transmits the present position of the pen holder to the computer if the ENTER key is pressed.



Plotter Elapsed Time

EE

This command causes the plotter to send plot time information (see Section 4.4.7).

Plotter Control Commands:

Plotter Test

T(*n*)

This command initiates test plot routines. The *n* designator enclosed in parentheses selects a test plot and can be numbers (0), (1), or (2). If (0) is selected, the plotter draws the DM/PL customer confidence test plot (see Section 2.3.2). If (1) is selected, the Europlot is drawn (see Section 2.3.2). The plotter draws the font demonstration if (2) is selected (see Section 4.4.2). If the (*n*) designator is not used or if T is not immediately followed by the left parenthesis, the test plot defaults to the customer confidence test plot.

Plotter Reset

Z

Plot Pause

EL

This command causes the plotter to enter local mode and pause. To resume remote plotting, press the LOCAL key.

DM/PL COMMAND SPECIFICATIONS

4-16

UART Setup

EU nnn

nnn specifies the type of format for the data transmitted from the plotter to the computer (200, 201, 206, or 222).

Pass-Through Port Enable

X

End of Plot

e

This command marks the end of a plot file (see Section 4.4.9).

4.4.1 Coordinate Addressing

EC n

NOTE

The *EC0* command is a new feature developed for use with the DMP-60 plotters. If the coordinate addressing *EC* command description in your version of the DM/PL manual does not include this new command, then refer to the following paragraphs.

With the following exceptions, the coordinate addressing command for these plotters is identical to that described in the DM/PL manual:

The *EC0* command provides a normalized device coordinate system for these plotters. Simply stated, this allows plot code that has been written using *EC0* addressing to be automatically scaled to fit the presently installed chart size. This feature is used with the internal test plots that can be initiated from the plotter's control panel which produce designs scaled to the present chart size. (This excludes Europlot, which is always sized for A4.)



DM/PL COMMAND SPECIFICATIONS

4-17

DM/PL
COMMANDS

With the EC0 command, the plot increments (addressable units) vary according to the chart size. Each increment represents 0.01% of the y-axis length. The x-axis length is typically 1.5 times the y-axis length. Accordingly, the x-axis coordinates are 0 to 15000 units and the y-axis coordinates are 0 to 10000 units.

For engineering A, C, and E; metric A4, A3, A2, A1, A0, and B1; oversize metric A4, A3, A2, A1, and A0; and architectural A, C, E, F, and 30×42 inches the x-axis length is less than 1.5 times the y-axis. Therefore, the x-axis length is divided by 15000 to obtain the plot increment.

For engineering B and D, the x-axis length is more than 1.5 times the y-axis. Therefore, the y-axis length is divided by 10000 to obtain the plot increment.

For architectural B and D, the x-axis is exactly 1.5 times the y-axis. Because these two chart sizes are the only charts having an exact 1:1.5 ratio, they are the only charts which will be completely filled by plot codes using EC0 addressing.

An EC(0, 1, 5, M, N) command should precede any window (W) command. This is because an EC command causes the DM/PL window to return to its default limits.

Example: EC0 selects the normalized device coordinate system.

4.4.2 Extended Text

S(*Sn,Wn,I/NI,Cn,Ln,Fn,Hn,Dn,P/NP/V,TR/TD,Gn, Xn,Yn*) character string —

NOTE

The *Cn, Ln, Hn, Dn, P/NP/V,* and *TR/TD* parameters are new features developed for use with the DMP-60 plotters. The *Fn* parameter is not new, but it has newly-defined variables for use with these plotters. If the extended text (S) command description in your version of the DM/PL manual does not include these new parameters, then refer to the following paragraphs.

NOTE

Simple text is basically a subset of extended text. Only one set of text control parameters are maintained internal to the plotter. Extended text can set all parameters, but simple text can set only slope and size. If the extended text parameters are modified and then simple text is activated, the simple text character string will be plotted at the extended text parameter level except for slope and size. If extended text is then activated after simple text, it will retain all previous extended text parameter settings except slope and size. The new extended text slope and size are now the value of those specified in the previous simple text.

With the following exceptions, the extended text command for the DMP-60 is identical to that described in the DM/PL manual:

An unlimited number of characters can now be used in a text character string.

The new *Cn* parameter specifies **EXTRA** spacing between text characters in the user units presently in effect. This is a number in the range of -32768 through $+32767$. If *Cn* is not specified, then the default value of *C0* (no extra spacing) is used. Note that this parameter is only used if you wish to add additional space between text characters. The total space per character is defined as $6 \times Wn + Cn$. Character height is defined as $7 \times Sn$.

Example: C2 selects two user units as extra space between text characters. If user units were selected with an EC1 (0.001 inch addressing) command, then an extra 0.002 inch is added between characters.

The new L_n parameter specifies **EXTRA** spacing between text character lines in the user units presently in effect. This is a number in the range of -32768 through $+32767$. If L_n is not specified, then the default value of L0 (no extra spacing) is used. Note that this parameter is only used if you wish to add additional spacing between text character lines. Line spacing is defined as $9 \times S_n + L_n$, which is the distance from the character base line to the character base line of the next line. Character height is defined as $7 \times S_n$.

Example: L2 selects two user units as extra space between text character lines. If user units were selected with an EC1 (0.001 inch addressing) command, then an extra 0.002 inch is added between each character line.

The F_n parameter specifies the font index. The n specifies the desired font (character style) for drawing the text and is either number 0 or 1. F0 selects single-stroke font and F1 selects sans serif font. Whenever a different font is selected, the P (proportional spacing) parameter automatically goes into effect. If NP (non-proportional spacing) or V (variable text extent) is desired after a different font is selected, these parameters must be entered.

When plotting text near a window limit, be sure to consider text placement. This is because some of the parts of some text characters extend below the character base line, while some of the parts of other characters extend above the height of the uppercase alphabetic characters. For example, plotting lowercase letters such as *p*, *y*, or *g* along the lower window limit will clip the descenders on these characters. On a typeset quality font such as sans serif, plotting characters with curved bottoms such as *O*, *S*, *3*, or *c* will clip the bottom edge of these characters when plotted on the lower window limit. Likewise, plotting characters like *J* or *j* along the the upper window limit will clip the tops of these characters if they extend out of the window.

DM/PL COMMAND SPECIFICATIONS

4-20

Figure 4-1 shows the available fonts. Note that font 0 is the default font if F_n is not specified. To provide plotting software compatibility, F0 and F1 are similar to the sans serif and Roman fonts available on Houston Instrument DMP-50 and DMP-50 MP series plotters.

Example: F1 selects the sans serif font.

Font Demonstration

```
SticK - 1234567890 !@#$%^&*() + = < > . , / ? [ ] { } ; : " ' ` ~
ABCDEF GHIJKL MNOPQRS TUVWXYZ abcdefghijklmnopqrstuvwxyz

Sans - 1234567890 !@#$%^&*() + = < > . , / ? [ ] { } ; : " ' ` ~
ABCDEF GHIJKL MNOPQRS TUVWXYZ abcdefghijklmnopqrstuvwxyz
```

Figure 4-1.
TEXT FONTS

NOTE

The H_n and D_n parameters only apply to fillable character fonts (F1, sans serif). These parameters are ignored for F0 font.

The Hn parameter specifies the hatch (or fill) pattern for text characters. The n specifies the desired hatch pattern for drawing text. This is a number in the range of 0 (no hatch) to 15 (maximum hatch). Figure 4-2 shows the available hatch patterns. The default hatch pattern is 1 (vertical fill). These patterns are oriented with respect to the text characters. Therefore, the hatch pattern rotates with the characters. Likewise, the hatch pattern slants with slanted (italic) characters. The last specified hatch pattern remains in effect until changed with a new Hn parameter or until the plotter is reset at either the control panel or with the DM/PL Z command, or until the LOAD key is pressed. It is important to note that this hatch pattern is similar to the Hn hatch pattern that may be specified for various curve commands. However, these hatch patterns are independent—this hatch pattern only applies to text, while the other hatch pattern only applies to curve commands.

The Dn parameter specifies the density for the hatch pattern selected with the Hn parameter for text characters. The n specifies the desired density for the hatch pattern and can be a number in the range of 1 to 65535 user units. To calculate density, multiply the number given for n times the present EC command user units. The default density is 10 mils (0.010 inch), which produces solid fill characters, if the present addressing is 0.001 inch, 0.005 inch, 0.1 mm, or 0.025 mm. If the present addressing is ECO, the density is 15 mils since user units for ECO are mils.

The last specified density remains in effect until 1) it is changed with a new Dn parameter, or 2) the plotter is reset at the control panel or with a DM/PL Z command, or 3) the LOAD key is pressed, or 4) if a new EC command is sent. (A new EC command resets the density since the density of the fill is directly related to the present user units.) It is important to note that this density is similar to the Dn density that may be specified for various curve commands. However, these densities are independent—this density only applies to text, while the other density only applies to curve commands.

The Dn also has a proportional size option. If n is immediately followed by a plus (+), for example $Dn+$, the present density is scaled according to the present window size (both the DM/PL (W) settings and the control panel window settings). If a plus is not specified, the DM/PL W settings and the control panel scaling have no effect on the density of the fill.

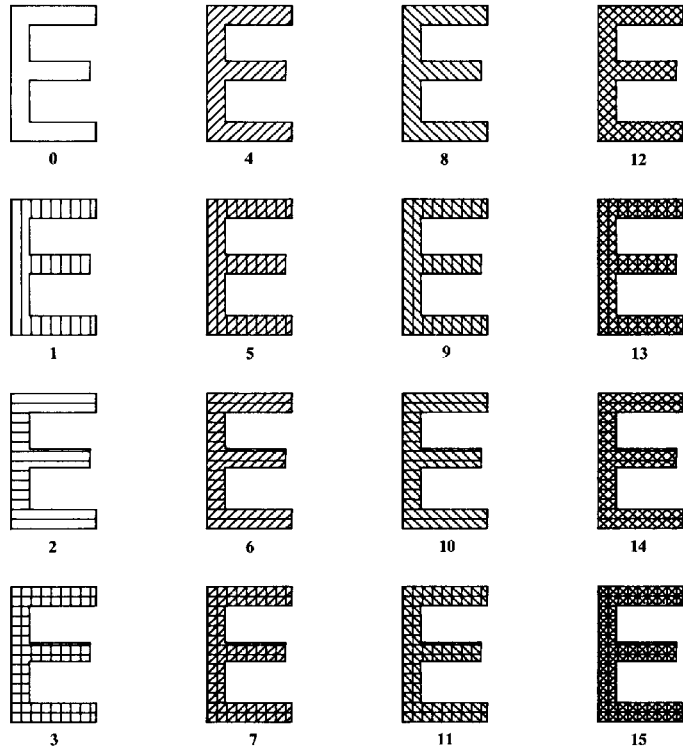


Figure 4-2.
TEXT HATCH PATTERNS

NOTE

It is important to note that the F_n and the P/NP/V parameters are closely related. Fonts F0 and F1 default to the P parameter value. If you wish to specify the NP or V values, then these parameters must be sent **AFTER** the F_n parameter. Otherwise, the default P value is used.

The P/NP/V parameter option enables you to select three different types of text character spacings.

The P and NP parameters specify P (proportional) or NP (non-proportional) text character spacing. The P parameter is the default for the fonts. The NP parameter is only used if fixed character spacing is desired. For example, NP is used if the characters in several rows must align in columns in a plot. The intercharacter spacing is adjusted for each individual character so that all characters are set at $6 \times W_n + C_n$ intervals.

The V parameter sets variable text extent. When this parameter is selected, the intercharacter spacing is adjusted according to the selected font. The length of the text string varies depending upon the characters in the string. For example, a string of "IIIII" will plot in less space than a string of "MMMMM," even though both strings have five characters.

The TR/TD parameter specifies the direction of the text path when plotted. The TR (text right) parameter plots all characters from left to right along a line slope defined by the X_n and Y_n parameters. The TD (text down) parameter plots all characters down the chart at a 90° angle to the line slope defined by the X_n and Y_n parameters with a character spacing of $9 \times S_n + 7 + C_n$. Any P and V parameters are ignored when the TD parameter is specified. A line feed character (10_{10} or $0A_{16}$) moves in the direction of the line slope a distance of $12 \times W_n + L_n$.

DM/PL COMMAND SPECIFICATIONS

4-24

Line slope parameters (X_n, Y_n) are as described in the DM/PL manual. The range for both is -32767 to $+32767$. The line slope parameters for the text also determine the slope of the fill.

Note that the plotter automatically simplifies text parameters as character size decreases to maintain readability. As character size decreases, fill is eliminated when the outline is sufficient to draw and fill the characters. The points at which these simplifications occur vary according to the selected font.

4.4.3 Curved Move

$CM(P_n, H_n, D_n, X_n, Y_n, L_n, x_1, y_1, x_2, y_2, d)$

NOTE

The curved move command is a new DM/PL command developed for use with this plotter. If the curved move CM command description is not in your version of the DM/PL manual, then refer to the following paragraphs.

The curved move command specifies a pen movement along an elliptical arc segment. This movement is either relative or absolute, depending upon the most recent R or A pen positioning command. The movement is with the pen either up or down, depending upon the most recent U or D pen positioning command. The starting point is the most recent pen position. Upon completion of this command, the pen position is the end point of the arc.

The P_n parameter specifies the plotter pen to use when filling the curved figure. The n specifies the desired pen number. This is a number in the range of 0 to 6. When the fill is completed, the pen is restored to the pen selected by the most recent New Pen P command. Specifying 0 tells the plotter to fill using the present pen selected by the most recent New Pen P command. If the P_n parameter is not specified, the pen used in the most recent curve fill is used. If no curve fill has been previously done, it defaults to 0, the presently selected pen.

The Hn parameter specifies the hatch (or fill) pattern for a curved move command figure. The n specifies the desired hatch pattern for filling the figure. This is a number in the range of 0 (no hatch) to 15 (maximum hatch). Figure 4-5 shows the available hatch patterns for a CE ellipse plot figure (the patterns are identical for a curved move command figure). The default hatch pattern is 1 (vertical fill). These patterns are oriented with respect to the plotter's x- and y-axes, not to the orientation of the curved figure. The last specified hatch pattern remains in effect until changed with a new Hn parameter. It is important to note that this hatch pattern is similar to the Hn hatch pattern that may be specified for the extended text command. However, these hatch patterns are independent—this hatch pattern only applies to curve commands, while the other hatch pattern only applies to text.

The Dn parameter specifies the density for the hatch pattern selected with the Hn parameter for curve command figures. The n specifies the desired density for the hatch pattern and can be a number in the range of 1 to 65535 user units. To calculate density, multiply the number given for n times the present EC command user units. The default density is 10 mils (0.010 inch), which produces solid fill characters, if the present addressing is 0.001 inch, 0.005 inch, 0.1 mm, or 0.025 mm. If the present addressing is EC0, the density is also 10 mils.

The last specified density remains in effect until 1) it is changed with a new Dn parameter, or 2) the plotter is reset at the control panel or with a DM/PL Z command, or 3) the LOAD key is pressed, or 4) if a new EC command is send. (A new EC command resets the density since the density of the fill is directly related to the present user units.) It is important to note that this density is similar to the Dn density that may be specified for text. However, these densities are independent—this density only applies to curve command figures, while the other density only applies to text.

The Dn also has a proportional size option. If n is immediately followed by a plus (+), for example $Dn+$, the present density is scaled according to the present window size (both the DM/PL (W) settings and the control panel window settings). If a plus is not specified, the DM/PL W settings and the control panel scaling have no effect on the density of the fill.

DM/PL COMMAND SPECIFICATIONS

4-26

The fill X_n, Y_n parameter determines the horizontal slope of the fill lines much like the extended text command X_n, Y_n parameter determines the slope of the text. X_n, Y_n specifies a point relative to the present x, y -axis orientation. The angle created by the X_n, Y_n point specifies the angle of the horizontal slope. The number used for n must be between -32767 and $+32767$. The default for X_n, Y_n is $X1, Y0$, which parallels the horizontal slope along the present x -axis. Note that a capital X or Y must precede the respective coordinate value for n .

The L_n parameter specifies the line type to be used for the fill. The different line types and the specifiers for n , are listed in the Line Type command section in the DM/PL manual. If the n line type designator is immediately followed by a plus (+), for example $n+$, the line types are drawn in proportion. A proportional line type begins and ends with a segment of a line that is one half the length of the first down move of the selected line type.

The starting point of the curved move is the most recent x, y point before the CM command. Refer to Figure 4-3.

The x_1, y_1 coordinate pair indicates the center point of the elliptical arc segment. In effect, this specifies a vector from the x, y starting point to the center point of an imaginary ellipse.

The x_2, y_2 coordinate pair indicates a point that is 90 elliptical arc degrees (as opposed to 90 circular degrees) from the x, y starting point of the curved move. (The angle formed by the x, y, x_1, y_1, x_2, y_2 points is always 90 arc degrees.) In effect, this specifies a vector from the center point of an imaginary ellipse such that the two points are a conjugate diameter pair.

The d specifies the size of the curved move in elliptical arc degrees from the x,y starting point. The curve is drawn toward the x_2,y_2 point if the degrees are positive. The curve is drawn away from the x_2,y_2 point if the degrees are negative. Note that it is possible to draw a full ellipse by specifying 360° as the size.

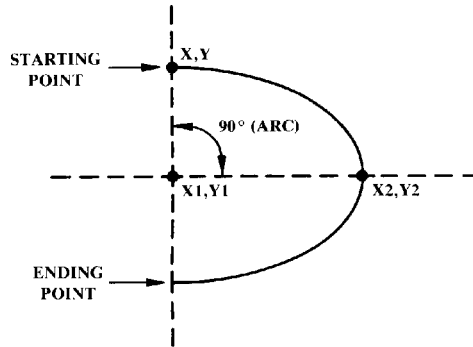


Figure 4-3.
CURVED MOVE

DM/PL COMMAND SPECIFICATIONS

4-28

Example: ;:H EC5 R 1000,1000 D CM 0,-80,120,0,180 0,-300 U,

In this example, the plotter is selected (;:). The plotter is sent to home position (H). Addressing resolution 0.005 inch is selected (EC5). Relative pen positioning is specified (R). The plotter is sent to relative coordinate point 1000,1000 as the starting point and the pen is placed down (D). A curved move is specified (CM) with an elliptical arc center point of 0,-80 and a second point is specified as 120,0 on the 180° arc. A line segment is then drawn (0,-300) and the pen is raised (U). Figure 4-4 shows how this drawing looks when plotted.



Figure 4-4.
EXAMPLE CURVED MOVE

4.4.4 Curve Commands $CA(Pn, Hn, Dn, Xn, Yn, Ln) \ x, y, d$ $CC(Pn, Hn, Dn, Xn, Yn, Ln) \ x, y, r$ $CE(Pn, Hn, Dn, Xn, Yn, Ln) \ x, y, x1, y1, x2, y2$ **NOTE**

The Pn , Hn , Dn , Xn , Yn , and Ln parameters are new features developed for use with the curve commands for the DMP-60 plotter. If the arc plot CA, circle plot CC, and ellipse plot CE command descriptions in your version of the DM/PL manual do not include these new parameters, then refer to the following paragraphs.

With the following exceptions, the curve commands for the DMP-60 are identical to those described in the DM/PL manual:

The Pn parameter specifies the plotter pen to use when filling the curved figure. The n specifies the desired pen number. This is a number in the range of 0 to 6. When the fill is completed, the pen is restored to the pen selected by the most recent New Pen P command. Specifying 0 tells the plotter to fill using the present pen selected by the most recent New Pen P command. If the Pn parameter is not specified, the pen used in the most recent curve fill is used. If no curve fill has been previously done, it defaults to 0, the presently selected pen.

DM/PL COMMAND SPECIFICATIONS

4-30

The Hn parameter specifies the hatch (or fill) pattern for a curve command figure. The n specifies the desired hatch pattern for filling the figure. This is a number in the range of 0 (no hatch) to 15 (maximum hatch). Figure 4-5 shows the available hatch patterns for a CE ellipse plot figure (the patterns are identical for other curve command figures). The default hatch pattern is 1 (vertical fill). These patterns are oriented with respect to the Xn, Yn , line slope parameter. The last specified hatch pattern remains in effect until changed with a new Hn parameter. It is important to note that this hatch pattern is similar to the Hn hatch pattern that may be specified for the extended text command. However, these hatch patterns are independent—this hatch pattern only applies to curve commands, while the other hatch pattern only applies to text.

The Dn parameter specifies the density for the hatch pattern selected with the Hn parameter for curve command figures. The n specifies the desired density for the hatch pattern and can be a number in the range of 1 to 65535 user units. To calculate density, multiply the number given for n times the present EC command user units. The default density is 10 mils (0.010 inch), which produces solid fill characters, if the present addressing is 0.001 inch, 0.005 inch, 0.1 mm, or 0.025 mm. If the present addressing is EC0, the density is also 10 mils.

The last specified density remains in effect until 1) it is changed with a new Dn parameter, or 2) the plotter is reset at the control panel or with a DM/PL Z command, or 3) the LOAD key is pressed, or 4) if a new EC command is sent. (A new EC command resets the density since the density of the fill is directly related to the present user units.) It is important to note that this density is similar to the Dn density that may be specified for various curve commands. However, these densities are independent—this density only applies to curve command figures, while the other density only applies to text.

The Dn also has a proportional size option. If n is immediately followed by a plus (+), for example $Dn+$, the present density is scaled according to the present window size (both the DM/PL (W) settings and the control panel window settings). If a plus is not specified, the DM/PL W settings and the control panel scaling have no effect on the density of the fill.

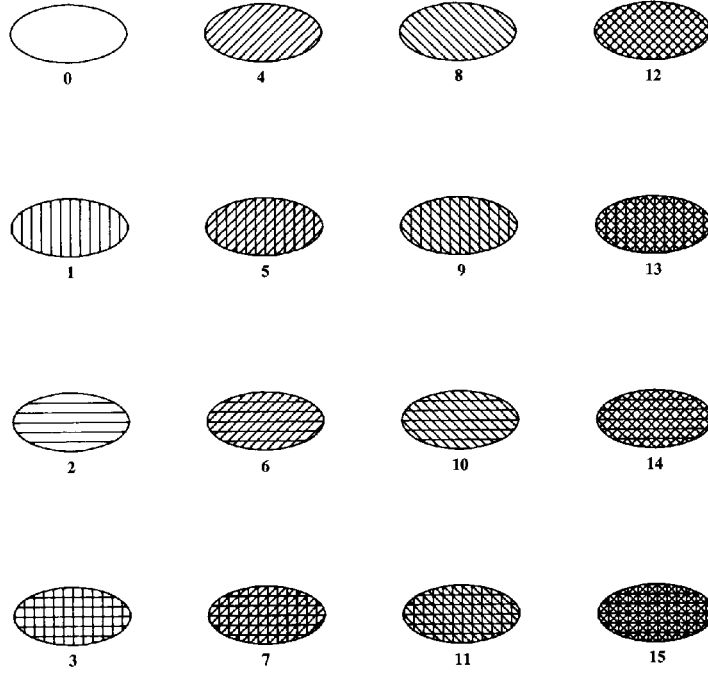


Figure 4-5.
CURVE COMMAND HATCH PATTERNS

DM/PL COMMAND SPECIFICATIONS

4-32

The fill X_n, Y_n , parameter determines the horizontal slope of the fill lines much like the extended text command X_n, Y_n , parameter determines the slope of the text. X_n, Y_n , specifies a point relative to the present x-y-axis orientation. The angle created by the X_n, Y_n , point specifies the angle of the horizontal slope. The number used for n must be between -32767 and $+32767$. The default for X_n, Y_n , is $X1, Y0$, which parallels the horizontal slope along the present x-axis. Note that a capital X or Y must precede the respective coordinate value for n .

The L_n , parameter specifies the line type to be used for the fill. The different line types and the specifiers for n , are listed in the Line Type command section in the DM/PL manual. If the n line type designator is immediately followed by a plus (+), for example $n+$, the line types are drawn in proportion. A proportional line type begins and ends with a segment of a line that is one half the length of the first down move of the selected line type.

4.4.5 Closed Figure

$CF(P_n, H_n, D_n, X_n, Y_n, L_n)$ *border list CS*

NOTE

The closed figure command is a new DM/PL command developed for use with the DMP-60 plotters. If the closed figure CF command description is not in your version of the DM/PL manual, then refer to the following paragraphs.

The closed figure command allows you to easily specify a series of plotter pen movements to draw a user-defined character or symbol.

DM/PL COMMAND SPECIFICATIONS

4-34

The last specified density remains in effect until 1) it is changed with a new Dn parameter, or 2) the plotter is reset at the control panel or with a DM/PL Z command, or 3) the LOAD key is pressed, or 4) if a new EC command is sent. (A new EC command resets the density since the density of the fill is directly related to the present user units.) It is important to note that this density is similar to the Dn density that may be specified for various curve commands. However, these densities are independent—this density only applies to curve command figures, while the other density only applies to text.

The Dn also has a proportional size option. If n is immediately followed by a plus (+), for example $Dn+$, the present density is scaled according to the present window size (both the DM/PL (W) settings and the control panel window settings). If a plus is not specified, the DM/PL W settings and the control panel scaling have no effect on the density of the fill.

The fill Xn, Yn parameter determines the horizontal slope of the fill lines much like the extended text command Xn, Yn parameter determines the slope of the text. Xn, Yn specifies a point relative to the present x-y-axis orientation. The angle created by the Xn, Yn point specifies the angle of the horizontal slope. The number used for n must be between -32767 and $+32767$. The default for Xn, Yn is $X1, Y0$, which parallels the horizontal slope along the present x-axis. Note that a capital X or Y must precede the respective coordinate value for n .

The Ln parameter specifies the line type to be used for the fill. The different line types and the specifiers for n , are listed in the Line Type command section in the DM/PL manual. If the n line type designator is immediately followed by a plus (+), for example $n+$, the line types are drawn in proportion. A proportional line type begins and ends with a segment of a line that is one half the length of the first down move of the selected line type.

The term *border list* refers to any number of vector movements with the pen up or down to define the figure border. In addition, curved move CM commands may also be used in the border list to define elliptical arc segments, if desired. The first point specified in the border list is always an implicit pen up movement to go to the figure starting point. Thereafter, vector command movements are made with the most-recent pen down or pen up command to draw the figure with visible or invisible edges. The CF command parameter limit is 2500 bytes.

Complex figures may be easily drawn by using the close partial CP command within the border list. A CP causes the plotter to automatically close the figure to the first point in the border list or to a previous CP, if specified. Any move after a CP is relative to the close point. The first point after a CP is also an implicit pen up movement. Note that any number of CP commands may be enclosed within the border list, and these may be "nested" within each other as required.

The closed figure command is terminated by the CS command. Any move after a CS is relative to the first point in the border list or the first point after the last CP.

Example: `::H A D CF 100,100, 100,200, 150,200, CM 150,150, 180,150, 180, CP 120,120, 120,180, 150,180, CM 150,150, 170,150, 180 CS`

In this example, the plotter is selected (`::`). The plotter is sent to the home position (H) and absolute pen positioning is specified (A). A pen down command (D) is specified so that the movements in the border list are made with the pen down. A closed figure command is specified with CF. The first coordinate move (100,100) is made with the pen up to the start of the figure. Moves to coordinates 100,200 and 150,200 are made with the pen down. The curved move command (CM 150,150, 180,150, 180) is also made with the pen down. The figure is closed from the end of the curved move to the starting point with the close partial (CP) command. The move to coordinate point 120,120 is made with the pen up. Moves to coordinates 120,180 and 150,180 are made with the pen down. The curved move command (CM 150,150, 170,150, 180) is also made with the pen down. The CS command completes the drawing. Figure 4-6 shows how this figure looks when plotted.



Figure 4-6.
EXAMPLE CLOSED FIGURE

4.4.6 Frame Advance

Fn ,

n is the number of increments between the present home position and the new home position.

The frame advance (F) command is used to advance the media between plots. The total length of the media must not exceed 20 feet. (The plotter's ROM will allow a dimension of up to 20 feet; however, Houston Instrument does not guarantee the plotter's tracking and repeatability beyond 50 inches.)

The F command advances the media by establishing a new home position. The location of the new home position is determined by the number of units used for n in the frame advance command. The number of units which can be used for n depends on the present addressing resolution. Each resolution and its numerical unit range is listed below.

EC5 (0.005 inch), $n = 0 - 48,000$

EC1 (0.001 inch), $n = 0 - 240,000$

ECM (0.1 mm), $n = 0 - 60,960$

ECN (0.025 mm), $n = 0 - 243,840$

When the plotter processes a frame advance command, the pen lifts to an up position and then moves to the new home position. The new home position becomes the present origin.

If the plotter is in large chart:

$$Y \text{ new home} = Y \text{ present home} = 0$$

$$X \text{ new home} = X \text{ present home} + n$$

If the plotter is in small chart:

$$X \text{ new home} = X \text{ present home} = 0$$

$$Y \text{ new home} = Y \text{ present home} + n$$

If the plotter is in large chart and n is specified as 0:

$$Y \text{ new home} = Y \text{ present home} = 0$$

$$X \text{ new home} = \text{present } X \text{ position}$$

DM/PL COMMAND SPECIFICATIONS

4-38

If the plotter is in small chart and n is specified as 0:

X new home = X present home = 0

Y new home = present Y position

4.4.7 Plotter Elapsed Time

EE

NOTE

The plotter elapsed time command is a new DM/PL command developed for use with the DMP-60 plotters. If the plotter elapsed time EE command description is not in your version of the DM/PL manual, then refer to the following paragraphs.

The *pppppppppp* number indicates the number of seconds of plot time since the plotter was most recently powered on. This number is reset to zero when the plotter is powered off. This number is not affected by a plotter reset and may not be altered by the user or host computer. If user plot code is embedded between two elapsed time commands, the resulting numbers can be useful in monitoring plotter use for billing purposes in a multi-user system.

4.4.8 Report

With the following exceptions, the report command for these plotters is identical to that described in the DM/PL manual:

Position 0 and position 1 of status byte two now provide information about the plotter.

If the scanner accessory is installed on the plotter, it uses position 0 to see when the plotter has completed a vector move of any type. If status byte two position 0 is off (0), there are no vectors presently queued (move completed). If position 0 is on (1), there are vectors presently queued (move not completed).

Position 1 verifies that the plotter recognizes the presence or absence of the multi-pen changer accessory. If status byte two position one is off (0), either the multi-pen changer is not detected by the plotter or the pen stable assembly is in the up position. If position one is on (1), the multi-pen changer is detected by the plotter and the pen stable assembly is in the down position.

The remaining status byte two positions (2 through 7) are not used; however, they have been set in an on/off pattern to allow the code to be sure that the byte is not just random noise. The pattern is positions 2, 4, and 6 are on (1), and positions 3, 5, and 7 are off (0).

DM/PL COMMAND SPECIFICATIONS

4-40

4.4.9 End of Plot

e

NOTE

The end of plot (e) command is a new DM/PL command developed for use with the DMP-60 plotters. If the end of plot command description is not in your version of the DM/PL manual, then refer to the following paragraphs.

The end of plot (e) command causes the DMP-60 to stop plotting after it processes the command, and then flash its plot command condition LED code (see Appendix A). After inserting a clean sheet of chart media, press the LOCAL key to resume plotting. (If a deselect command is included in the code, the end of plot command should precede that command.)

4.5 DM/PL PROGRAMMING CONCEPTS AND RULES

The following paragraphs describe various considerations when writing and using DM/PL plotter programs.

- The plotter **MUST** be "on-line" with the host computer (ready or plot mode) in order to respond to DM/PL commands.
- When writing plotting programs, be sure to leave at least one space or comma as a delimiter between coordinate pairs and DM/PL commands, as explained in the DM/PL manual.

- The basic unit of measurement for the plotter is one increment. The size of the increment depends upon the coordinate addressing (ECn) command presently in effect. To convert a line length from inches to plotter increments multiply by 200 if 0.005 inch addressing (EC5) is in effect, multiply by 1000 if 0.001 inch addressing (EC1) is in effect, multiply by 254 if 0.1 mm addressing (ECM) is in effect, or multiply by 1016 if 0.025 mm addressing (ECN) is in effect. The actual length of a line is not a factor if programming with the EC0 command as long as a 1:1.5 ratio is maintained for x-y-axial moves.
- A number with either no sign or with a plus (+) sign is considered to be a positive value (for example, 256 or +128). A negative value must always have a minus (-) sign (for example, -64).
- The plotter uses the Cartesian coordinate system to locate the plots on the chart. This system consists of three orthogonal (mutually perpendicular) axes known as x, y, and z. The origin of the system varies according to the chart size as shown in Figures 1-6 and 1-7. The x and y values are both zero at the origin.

Movement in the x- or y-axis depends upon the chart orientation selected with the plotter menu (regardless of actual chart size). With full chart size selected, movement in the x-axis is done by moving the chart in and out of the plotter, and y-axis movement is by moving the pen carriage left and right. With half chart size selected, movement in the x-axis is done by moving the pen carriage left and right, and y-axis movement is by moving the chart in and out of the plotter. (With manual set selected, the origin location and axes orientation are as specified in the plotter menu for that particular chart. Movement thus depends upon the selected values.) Movement in the z-axis is simply moving the pen up or down regardless of chart orientation.

DM/PL COMMAND SPECIFICATIONS

4-42

- The deselect (@) command takes the plotter off-line from the host computer, and retains any plotter parameters presently in effect. The reset (Z) command also takes the plotter off-line from the host computer, but resets all plotter parameters to the default values. In general, it is better to use the deselect command to terminate plotter operation, as explained in the DM/PL manual.
- Note that these commands are not recommended for use in batch plotting since operator intervention is required or the plotter may send a response when the computer is not expecting it: UART Setup *EU*, Report *ER*, Mode Two Plotter Select *;I*, Query *Q*, or Digitize *ED*.
- After selecting the plotter and before sending any actual drawing data, be sure to first select a resolution, an addressing mode, a pen, a chart size, and define the plotting area to be used.

