APLOT

APL FUNCTIONS FOR PLOTTING ON DTC TERMINALS

Sheldon Linker

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Systems Group

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Center for Research in Management Science

University of California

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1. Introduction

The APLOT plotting package for CRMS APL is designed for operation with a DTC terminal. The DTC terminal prints 30 characters per second and will handle 30 commands per second in plot mode. The print head can be moved in units of 1/60" in the horizontal direction and 1/48" in the vertical direction. This document describes the use of the APL routines within the plotting package.

2. <u>Global Data</u>

In the following paragraphs, a positive X direction means to the right. A positive X position is to the right of the extreme left-hand side of the paper. A positive Y direction is towards the top of the page. The zero position for the Y axis is the starting point.

The values of ΔXY and ΔXYI are dynamically maintained during plotting.

ΔXY is a two-element vector which is the X and Y position of the print-head in units from the origin. (A unit is 1/60" in the X direction and 1/48" in the Y direction.)

ΔXYI yields a two-element vector which is the X and Y positions of the print-head in inches from the origin.

ΔDOT is the current default plotting character. The initial value is period (.) . To change the default, use $\Delta DOT \leftarrow$ 'character' . Any character or character pair is legal. For instance, 'O+' would print as ⊕ .

$\Delta GRID\_ON$ is the grid-control bit. If $\Delta GRID\_ON$ is 1, then an entire grid is drawn by $\Delta PLOT$ and $\Delta GRID$. If $\Delta GRID\_ON \leq 0$, only a border is drawn. If $\Delta GRID\_ON$ is -1, only the left and lower sections of the border are drawn.

3. <u>Routines for Plotting Graphs</u>

ΔINIT

must be called to initialize the plotting package. Omission
will cause a *VALUE ERROR* .

ΔEXIT

is used to exit plotting mode. The print head is not moved
by this function.

ΔPAGE

starts a new page and puts the print head at the new origin.

ΔPLOT[◦XL;◦YL;◦T;◦GS;◦CHAR;◦SIZE;◦MODE;◦XA;◦YA]VECT

plots a graph.

XL , if given is the *X-AXIS* title. If there is more than one
graph on the page, *X*-labels will not be overprinted, but they
will be printed 1/6" below the old label.

YL , if given, is the *Y-AXIS* title. To avoid overprinting, the
Y-label will be moved to the right in 1/10" increments.

T , if given, is the title. Titles are only printed once on
a page.

GS is a two-element vector or scalar which if given, will set
the grid size. If *GS* is a scalar *N* , then the grid will be
N×N inches. If *GS* is a vector *N M* , then the grid will be
N×M inches. If *GS* is omitted, then a 10×10-inch grid is drawn
if there is no grid on the page already. The grid is also
affected by *ΔGRID_ON* (see page 2).

CHAR is the character to plot with. If *CHAR* is omitted, then
DOT is used.

SIZE , if given, is a 4-element vector containing (1) the
virtual *X*-coordinate of the left border, (2) the virtual
Y-coordinate of the lower border, (3) the virtual *X*-
coordinate of the right border, and (4) the virtual *Y*-
coordinate of the top border. If not given, it is computed.

MODE , if given, is the line-drawing mode. A mode of *N* will
cause a straight line (using character Δ*DOT*) to be drawn
between all the points specified in *VECT* . The dots will be
N units (1/48" or 1/60") apart. If *MODE* is not given, or is
zero, then the points of *VECT* are plotted without interconnecting
lines.

VECT is a *N*×2 matrix of points to be plotted. *VECT*[*N*;] is the
*N*th point to be plotted. *VECT*[;1] is the *X*-coordinate vector,
and *VECT*[;2] is the *Y*-coordinate vector.

XA , if given, is the *X*-axis scalar. *XA* must have either 0 or 2
or more elements. *XA* is written along the *X*-axis. If *XA* is
null, then there is no *X*-axis scaling. If *XA* is not given,
it is computed with length 11.

YA is like *XA* except that it is for the *Y*-axis.

SIZE←Δ*SCALE VECT*

computes the *SIZE* parameter for a call to Δ*PLOT* . This is
used for multiple graphs. Example: assume function F(x)
was to be <u>overlaid</u> with the graph of G(x) . To maintain
scale, the following would be needed:

SIZE ← Δ*SCALE* (*VECT*1←Δ*X_VS* Fι100) , *VECT*2←Δ*X_VS* Gι100
Δ*PLOT*['F IS F(X)';;;;'F';*SIZE*;;] *VECT*1
Δ*PLOT*['G IS G(X)';;;;'G';*SIZE*;;] *VECT*2

$A \leftarrow B \ \Delta VS \ C$

>   takes the vectors B and C and turns them into a matrix which $\Delta PLOT$ and $\Delta DRAW$ will accept.

$A \leftarrow \Delta X\_VS \ C$

>   works like ΔVS , but uses the X axis instead of B .

4. <u>General Drawing Routines</u>

These routines have their position parameters specified in inches.

ΔDRAW[◊CHAR;◊MODE] POSN

 CHAR , MODE see ΔPLOT

 POSN is an N×2 matrix of positions as in ΔPLOT's VECT . The
 difference here is that there is a set scale (inches). A
 position that does not fall directly on a possible dot
 position is rounded down to the next 1/60" or 1/48".

TEXT ΔLX POSN

 This routine places the text in TEXT starting at position
 POSN (a two-element vector containing the starting X Y
 position). The text is written horizontally.

TEXT ΔLY POSN

 This routine is like ΔLX except that the tect is printed
 vertically (top to bottom).

ΔGRID[◊GS]

 draws a grid with heavy borders and 100 internal grid squares.
 GS , if given, is the grid size; if not given, it is assumed
 to be 10 (see ΔGRID_ON). If GS is a scalar N , then the grid
 size is N"×N". If GS is a vector N M , then the grid size is
 N"×M". The lower left-hand corner of the grid is always at
 1 3 .

6. Control Characters on the DTC Machine

Control Character	in plot mode	in print mode	octal
F	exit plot mode	enter plot mode	146
G	beep, exit plot mode	beep	147
H	move left 1/60"	backspace	150
I	tab	tab	151
J	move down 1/48"	linefeed	152
K	move up 1/48"	reverse linefeed	153
L	formfeed	fromfeed	154
M	Return	Return	155
space	move right 1/60"	space	

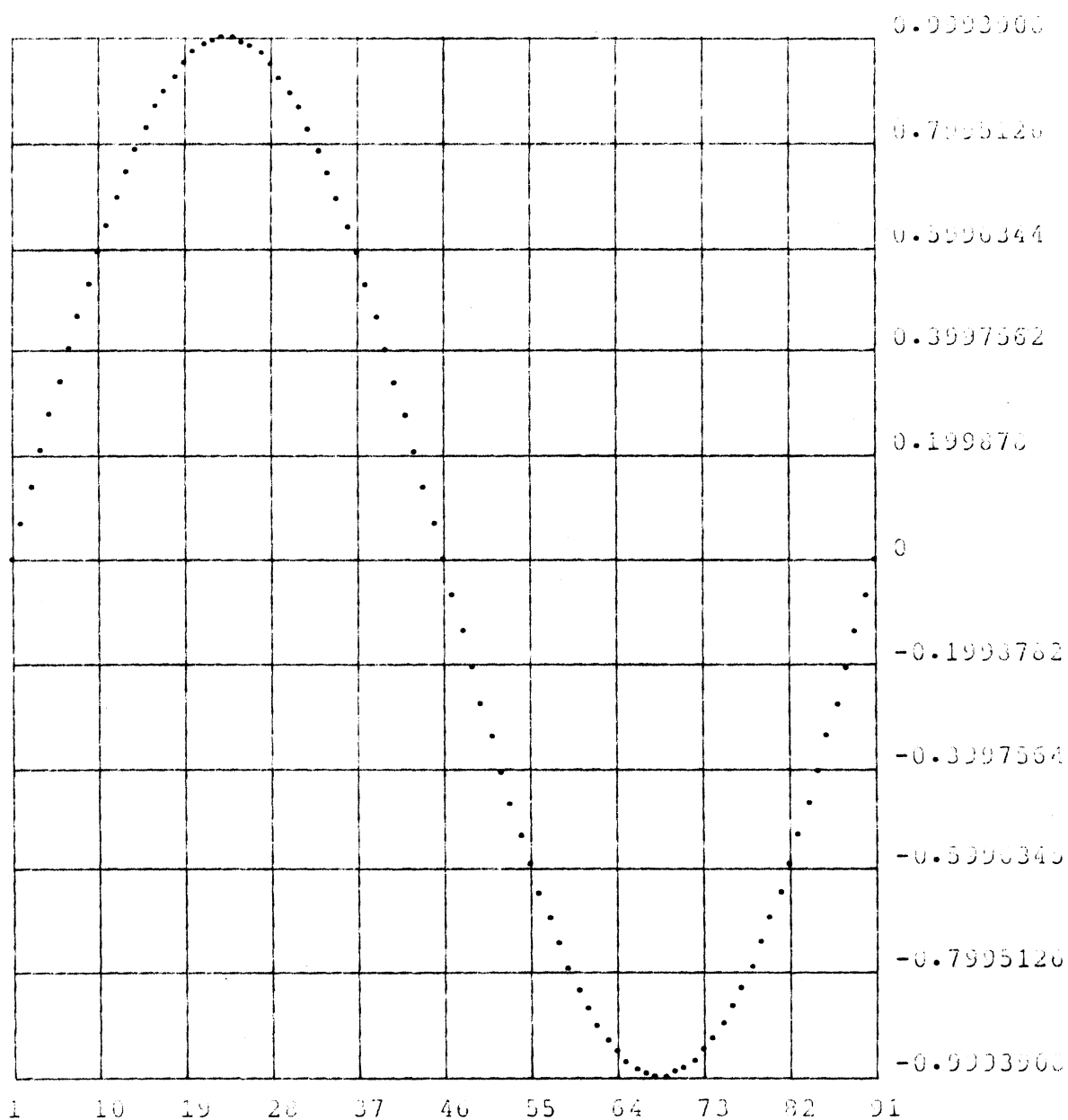RESET BUTTON resets line counter for from-feed control and homes the printer and exits plot mode.

<u>Examples</u>

In the near future (as soon as ⎕FMT is available), the Y-axis

scale values will be printed to the left of the graph.

```
       ∇ GRAPH1
[1]       ∩START UP
[2]       ΔINIT
[3]       ∩AUTOMATICALLY PLOT A SINE WAVE, 5×6 INCHES
[4]       ANGLES←○(÷180)×4×⁻1+ι91
[5]       ΔPLOT['X-AXIS';'Y|AXIS';'TITLE';5 6;;;;;] ΔX_VS 10ANGLES
[6]       ∩DONE
[7]       ΔEXIT
[8]    ∇
```

X-AXIS

TITLE

```
      ∇ GRAPH2
[1]      ΔINIT
[2]      ⍝TURN GRID OFF, USE ONLY LOWER AND LEFT PART OF AXISES
[3]      ΔGRID_ON←¯1
[4]      ⍝PLOT 3 CONCENTRIC CIRCLES, THE LARGEST BEING 6 INCHES ACCROSS
[5]          ⍝FIND SCALES
[6]          ANGLES←O(÷180)×4×ι91
[7]          SIZE←ΔSCALE MAT←(1OANGLES) Δ/S 2OANGLES
[8]          ⍝PLOT THE CIRCLES
[9]              ΔPLOT[;;;6;;SIZE;1;'';''] MAT
[10]             ⍝VARY SIZE BY CHANGING MAT
[11]             ΔPLOT[;;;6;;SIZE;1;;] .5×MAT
[12]             ⍝VARY SIZE BY CHANGING SIZE
[13]             ΔPLOT[;;;6;;4×SIZE;1;;] MAT         ⍝NOTICE RECIPROCAL RELATIONSHIP
[14]         ΔPAGE
[15]     ΔEXIT
[16]  ∇
```
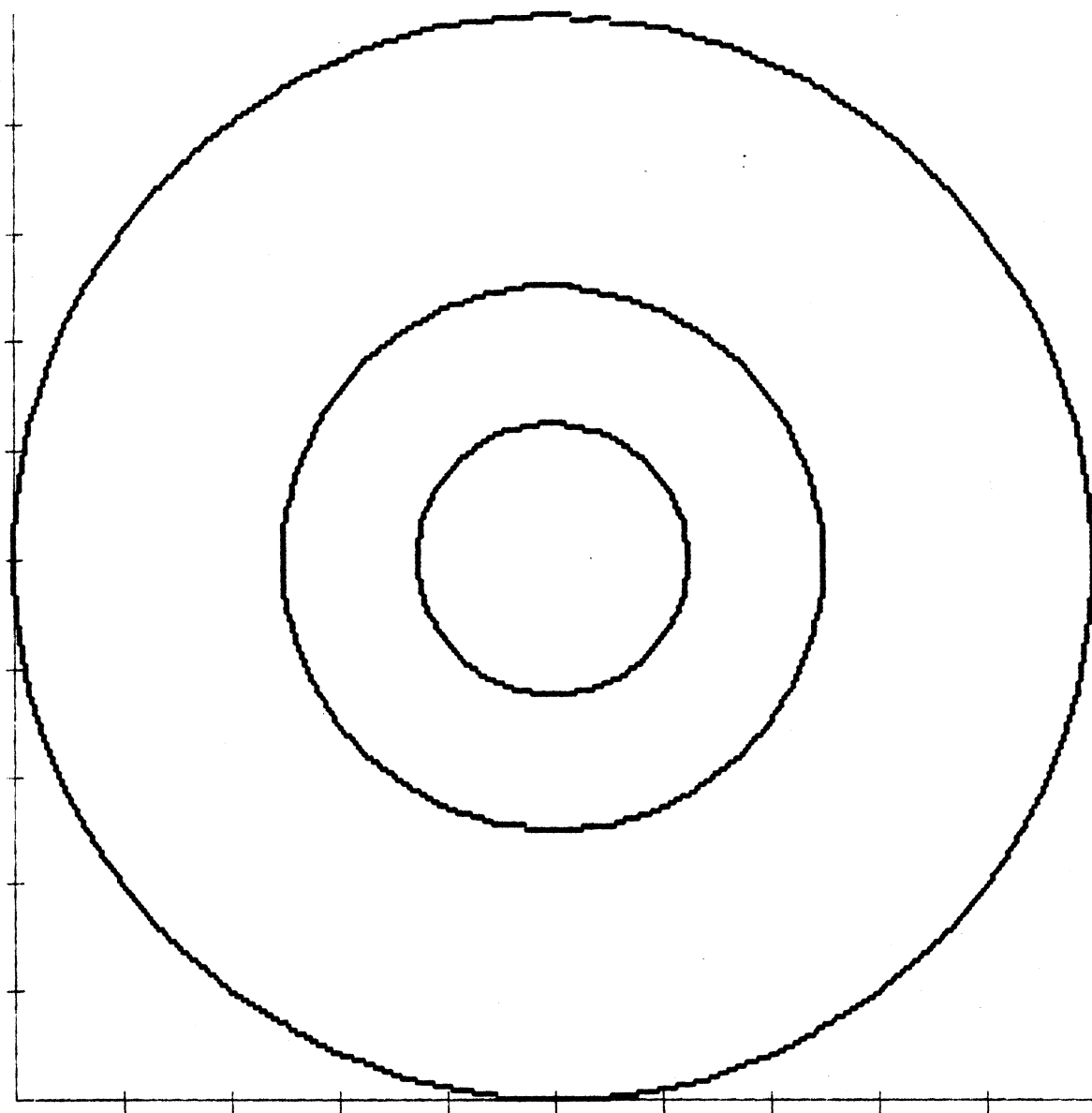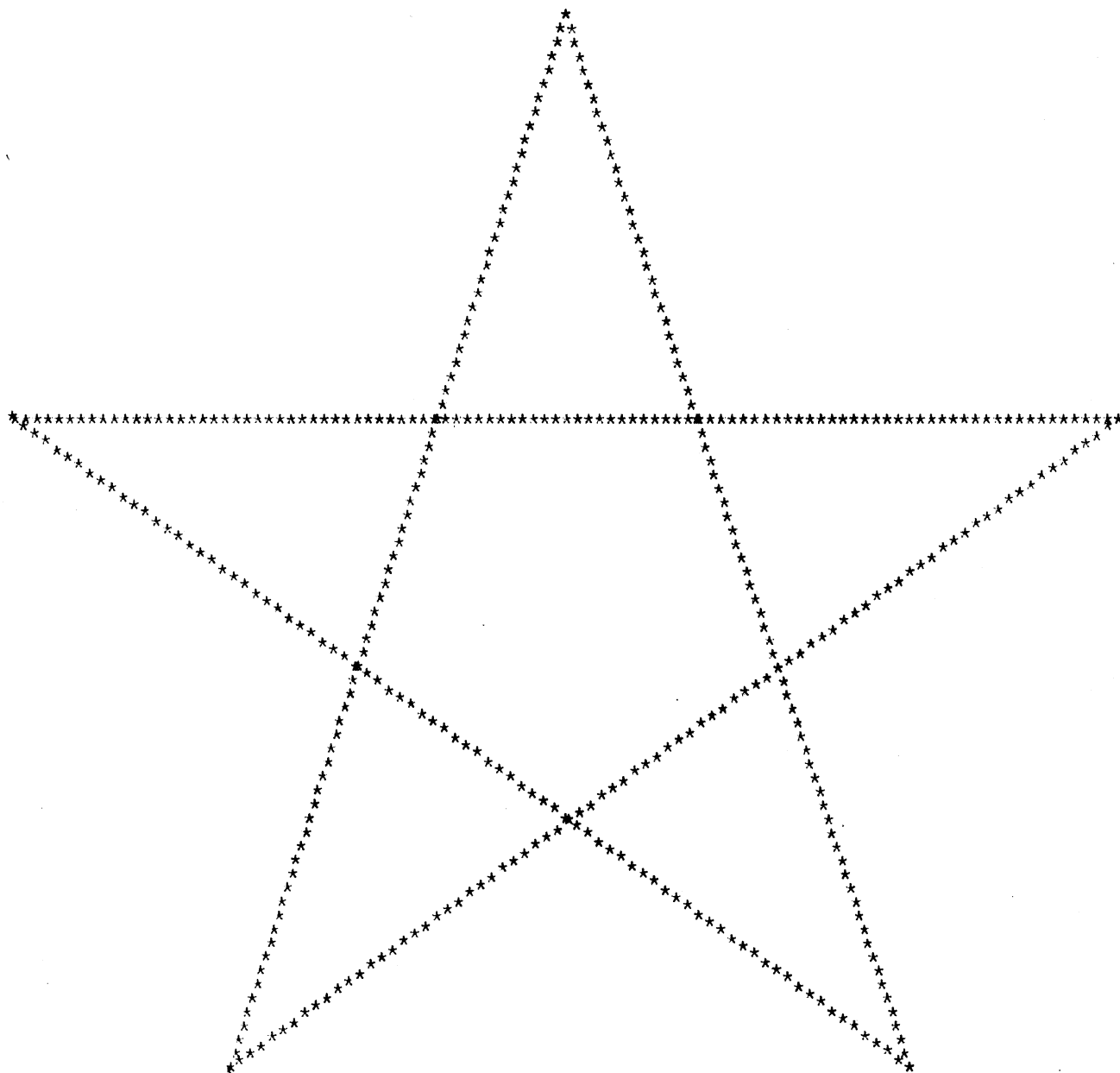
```
      ∇ GRAPH3
[1]      AINIT
[2]      ⍝PLOT A 7 INCH 5 POINTED STAR
[3]      ⍝MOVE TO FIRST POINT
[4]      ADRAW['=100';] 4 7.5
[5]      ⍝PLOT USING A LINE OF *S
[6]      APUT←'*'
[7]      ⍝SQUARE OF THE POINTS
[8]      ADRAW['*';4] 5 2p6.057 1.168 .671 5.082 7.329 5.082 1.943 1.168 4 7.5
[9]      ⍝LABEL IT
[10]     'STAR' ALX 3.8 0
[11]     ⍝STOP
[12]     AEXIT
[13]  ∇
```

STAR