348

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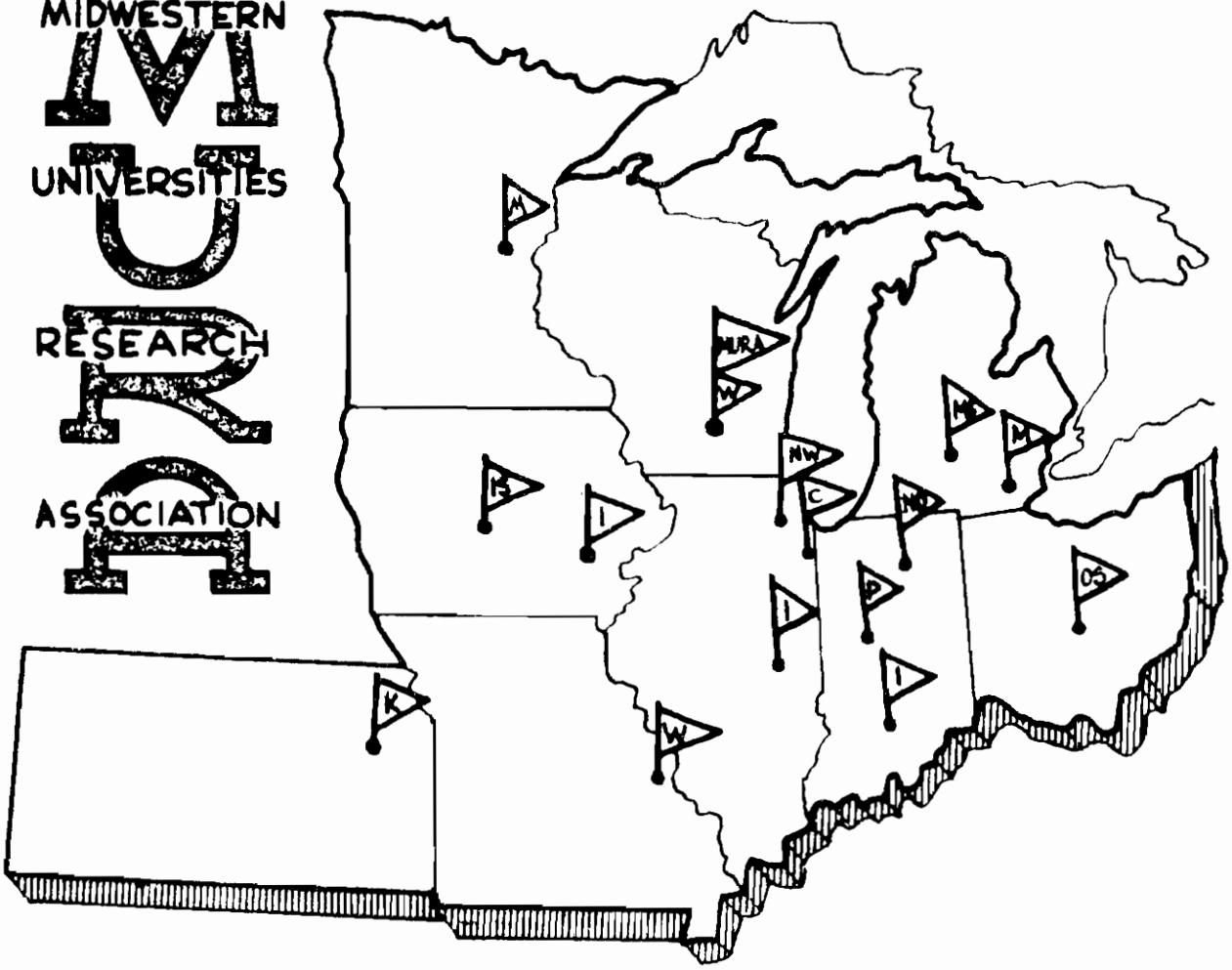

REPORT CATHODE RAY TUBE POINT PLOTTER, MU SCP8

NUMBER 348

Internal
IBM

APPROVED BY
J M Snyder

IDENTIFICATION

Cathode Ray Tube Point Plotter, MU SCP8

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PURPOSE

To display a sequence of points on the Type 740 Cathode Ray Tube Output Recorder with dim or bright spot intensity. Points are plotted at regular intervals along the x-axis, $y_i = y(x_i)$ where $x_i = x_{i-1} + C\Delta x$, $(i = 0, 1, 2, \cdots)$ and C is a parameter set by the user.

RESTRICTIONS

If the user desires the frames numbered, this program requires the Integer Cathode Ray Tube Display, MU SCP1, whose location must be defined at the time of assembly.

METHOD

Procedure: In normal use this subroutine will be entered many times. On the very first entry certain parameters, to be described later, must be specified. On subsequent entry, say the i-th entry, the subroutine is entered with y_i, the ordinate of the point to be plotted, in the accumulator, and the point will be plotted with abscissa $x_i = x_{i-1} + C\Delta x$. The parameter C must be specified on each entry as described below, and Δx is specified on the very first entry once and for all. Plotting will begin at $x_0 = 0$ and new abscissa values will be generated on each entry as indicated above until $x_i \geqslant 1024$ at which time the film is automatically advanced one frame and the point is plotted at $x_i = 0$.

Range: $-(1 - 2^{-35}) \leqslant \max |y_i|, y_i \leqslant +(1 - 2^{-35})$

USAGE

Calling Sequence:

UA SAP		MURASS	
Loc.	Instruction	Loc.	Instruction
α	TSX SCP8, 4	α	B TSX A 4
$\alpha + 1$	prefix C, D, N	$\alpha + 1$	C B CD N
$\alpha + 2$	return	$\alpha + 2$	return

where

prefix = B = 0 for subsequent entry
= 2 for subsequent entry and numbered frames
= 4 for first entry
= 6 for first entry and numbered frames

C = the number of Δxs that x is advanced at each step, $0 \leq C \leq 1024$

D = 0, the y coordinate of the x-axis = 0
= 1, the y coordinate of the x-axis = 256
= 2, the y coordinate of the x-axis = 512
= 3, the y coordinate of the x-axis = 768

N = the number of intervals along the x-axis per frame, the integer part of $\frac{1024}{N} = \Delta x$, $1 \leq N \leq 1024$. N = 0 will cause a divide-check stop in location SCP8 + 44.

Entry to this subroutine is made with y_i in the AC. If $C(AC)_p = 0$, a dim point will be displayed; if $C(AC)_p = 1$, a bright point will be displayed. If this is a first entry (i.e. i = 0), the maximum of the absolute value of the y_i to be plotted, max $|y_i|$, must be in the MQ.

On each first entry MU SCP8 advances the film, plots the axes with dim spot intensity and plots the point at $x_o = 0$. If B = 2 or 6, MU SCP8 will use MU SCP1 to number each frame consecutively starting with frame number 1. The frame number will be placed in the upper right hand corner of the frame at (1019, 1017).

On subsequent entry MU SCP8 plots the i-th point at $x_i = x_{i-1} + C\Delta x$. When $x_i \geq 1024$, MU SCP8 advances the film one frame and plots the point at $x_i = 0$.

If y is given out of the range of the scope (for the x axis and max $|y_i|$ specified) or if $|y_i| \geq$ max $|y_i|$, the y coordinate of the point will be plotted modulo 1024. If

$$\left| y_i(2^{-35}M) \right| \geq \max |y_i|$$

where $2^{-35}M = \left[|256D - 512| + 512 \right] 2^{-35}$,

a divide-check stop will occur in location SCP8 + 19.

The user should note that program parameters D, N, and max $|y_i|$ are used only when B = 4 or 6 (first entry). When subsequent entry is made to this subroutine the user must remember to change B accordingly.

Space Required:

	UA SAP	MURASS
73 words program at:	SCP8	A

The symbolic location of MU SCP1 must be defined by the user in the assembly of MU SCP8.

For an assembly by MURASS the locator B must be defined as the starting location of MU SCP1.

Relocatable Cards: The nominal addresses in the relocatable program deck have been defined as follows:

Symbolic address	Nominal address
SCP8	0
SCP1	1000_8

CODING INFORMATION

Timing: The average time per point plotted is

$$\left[0.93 + 501.07N_1 + (.22 + 500.34N_3)N_2 + (.12 + \text{MU SCP1 time})N_4\right]$$
milliseconds

where

$$N_1 = \begin{cases} 1 & \text{if first entry} \\ 0 & \text{all other entries} \end{cases}$$

$$N_2 = \begin{cases} 1 & \text{if subsequent entry} \\ 0 & \text{all other entries} \end{cases}$$

$$N_3 = \begin{cases} 1 & \text{if a film advance occurs on subsequent entry} \\ 0 & \text{all other entries} \end{cases}$$

$$N_4 = \begin{cases} 1 & \text{if the frame is numbered after advancing the film} \\ 0 & \text{all other entries} \end{cases}$$

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      REM MURA CATHODE RAY TUBE POINT PLOTTER                          MU   SCP8
SCP8  SXD SCP8+71,4        SAVE IR4                                   SCP8 0001
      STO SCP8+66          SAVE Y (I)                                 SCP8 0002
      ANA SCP8             EXTRACT P BIT(SPOT INTENSITY)              SCP8 0003
      STP SCP8+70          SPOT INTENSITY TO PARTIAL POINT WORD       SCP8 0004
      WTV                  SELECT CRT                                 SCP8 0005
      CLA 1,4              PARAMETERS TO AC                           SCP8 0006
      STP SCP8+71          SAVE BIT 1 OF AC                           SCP8 0007
      TMI SCP8+27          TRANSFER IF FIRST ENTRY                    SCP8 0008
      PAX 0,4              SET IR4 = C                                SCP8 0009
      CAL SCP8+70          PARTIAL POINT WORD                         SCP8 0010
      TXL SCP8+13,4,0      TRANSFER IF C = 0                          SCP8 0011
      ACL SCP8+60          + DELTA X                                  SCP8 0012
      TIX SCP8+11,4,1      LOOP, C PASSES                             SCP8 0013
      SLW SCP8+70          X COORDINATE TO PARTIAL POINT WORD         SCP8 0014
      ANA SCP8+60          EXTRACT X COORDINATE OF POINT              SCP8 0015
      SUB SCP8+68          TRANSFER IF X COORDINATE OF POINT          SCP8 0016
      TPL SCP8+44          GREATER OR = 1024                          SCP8 0017
      LDQ SCP8+66          Y (I)                                      SCP8 0018
      MPY SCP8+68          M (2EXP-35)                                SCP8 0019
      DVH SCP8+69          MAX ABSOLUTE VALUE Y                       SCP8 0020
      PXD                  CLEAR AC                                   SCP8 0021
      LLS 35                                                          SCP8 0022
      ADD SCP8+65          + Y COORDINATE OF X AXIS                   SCP8 0023
      STA SCP8+70          Y COORDINATE OF POINT TO POINT WORD        SCP8 0024
      CPY SCP8+70          PLOT POINT                                 SCP8 0025
      LXD SCP8+71,4        RESTORE IR4                                SCP8 0026
      TRA 2,4              TO MAIN PROGRAM                            SCP8 0027
      STQ SCP8+67          FIRST ENTRY,SAVE MAX ABS. VALUE Y(I)       SCP8 0028
      HTR SCP8+72,0,24576  SET FRAME COUNTER = 0                      SCP8 0029
      STD SCP8+69          SAVE N                                     SCP8 0030
      ARS 15               D TO ADDRESS OF AC                         SCP8 0031
      ANA SCP8+39          EXTRACT D                                  SCP8 0032
      PAX 0,4              SET IR4 = D, FORM X AXIS WORD              SCP8 0033
      PXD                  CLEAR AC                                   SCP8 0034
      TXL SCP8+37,4,0      TRANSFER IF D = 0                          SCP8 0035
      ADD SCP8+61          + 256 (2EXP-35)                            SCP8 0036
      TIX SCP8+35,4,1      LOOP, D PASSES                             SCP8 0037
      STA SCP8+65          X AXIS WORD                                SCP8 0038
      SUB SCP8+62          FORM M, -512 (2EXP-35)                     SCP8 0039
      SSP                  ABSOLUTE VALUE                             SCP8 0040
      ADD SCP8+62          + 512 (2EXP-35)                            SCP8 0041
      STO SCP8+68          = M (2EXP-35)                              SCP8 0042
      CLA SCP8+62          FORM DELTA X (2EXP-17)                     SCP8 0043
      ALS 2                1024 (2EXP-34)                             SCP8 0044
      DVH SCP8+69          N (2EXP-17)                                SCP8 0045
      SLQ SCP8+69          DELTA X (2EXP-17) TO STORAGE               SCP8 0046
      CFF                  ADVANCE FILM FRAME                         SCP8 0047
      CPY SCP8+65          PLOT X AXIS                                SCP8 0048
      SXD SCP8+70          SET X COORDINATE OF POINT = 0              SCP8 0049
      CPY SCP8+64          PLOT Y AXIS                                SCP8 0050
      CLA SCP8+71                                                     SCP8 0051
      ANA SCP8+65          EXTRACT BIT 1                              SCP8 0052
      TZE SCP8+17          TO FROM Y COORDINATE OF POINT              SCP8 0053
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CLA SCP8+72          FRAME COUNTER                          SCP8  0054
ADD SCP8+63          + 1                                    SCP8  0055
STO SCP8+72                                                 SCP8  0056
TSX SCP1,4           NUMBER THE FRAME                       SCP8  0057
PON 1017,0,1019                                             SCP8  0058
TRA SCP8+17          TO FORM Y COORDIANTE OF POINT          SCP8  0059
OCT 002000000000     CONSTANTS                              SCP8  0060
OCT 077777000000                                            SCP8  0061
OCT 000000000400                                            SCP8  0062
OCT 000000001000                                            SCP8  0063
OCT 000000000001                                            SCP8  0064
OCT 100000000000     Y AXIS WORD                            SCP8  0065
OCT 200000000000     X AXIS WORD                            SCP8  0066
HTR                  Y (I)                                  SCP8  0067
HTR                  MAX ABSOLUTE VALUE Y (I)               SCP8  0068
HTR                  M (2EXP-35)                            SCP8  0069
HTR                  N (2EXP-17), DELTA X (2EXP-17)         SCP8  0070
HTR                  POINT WORD                             SCP8  0071
HTR                  C (IR4) IN DECREMENT, B IN PREFIX      SCP8  0072
HTR                  FRAME COUNTER                          SCP8  0073
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