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APPROVED BY
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IDENTIFICATION

General Alphanumeric Cathode Ray Display, MU SCP3

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Midwestern Universities Research Association, Madison, Wisconsin

PURPOSE

To display alphanumeric messages on the 740 Output Recorder.

USAGE

Calling Sequence:

UA SAP		MURASS	
Loc.	Instruction	Loc.	Instruction
α	TSX SCP3, 4	α	B TSX A 4
$\alpha + 1$	PZE M 0 N	$\alpha + 1$	C 0 M0 N
$\alpha + 2$	return	$\alpha + 2$	return

where N is a scale parameter defining the size of the character displayed and M is the address of the first word in the message to be displayed.

The characters are plotted on a 5 x 7 raster. The ratio of grid size of this raster to the grid size on the 1024 x 1024 740 raster is given by N + 1. Thus if N = 0 the grid size for the 5 x 7 raster is identical to the grid size for the 1024 x 1024 740 raster. For reasonable legibility $N \geq 1$ is recommended.

The message is stored in a block of locations starting at location M. Each character is defined by a six bit configuration, the standard BCD code with six such coded characters packed to the word. Certain six bit configurations tell the program to do special operations such as start a new line, change scale, etc. The dictionary for these characters is given below.

BCD	Symbol displayed or Operation performed
00	0
01	1
02	2
03	3

BCD	Symbol displayed or Operation performed
04	4
05	5
06	6
07	7
10	8
11	9
12	ten spaces (i.e. ten blanks)
13	=
14	-
15	not used
16	not used
17	not used
20	+
21	A
22	B
23	C
24	D
25	E
26	F
27	G
30	H
31	I
32	ten line advances
33	.
34	)
35	one line advance
36	not used
37	not used
40	-
41	J
42	K
43	L
44	M
45	N
46	O
47	P
50	Q
51	R
52	end of message
53	$
54	*
55	advance film
56	change scale, $N \rightarrow N - 1$
57	change scale, $N \rightarrow N + 1$
60	one space (i.e. blank)
61	/

BCD	Symbol displayed or Operation performed
62	S
63	T
64	U
65	V
66	W
67	X
70	Y
71	Z
72	change origin
73	not used
74	:
75	not used
76	not used
77	not used

It will be noted that eight of the octal number pairs define special operations to be executed by the subroutine. These operations are described below.

Ten spaces (12): A space of ten blanks will follow the character last written. This operation is used for indenting margins and so forth.

Ten line advances (32): A space of ten lines will follow the line currently being written. A line advance always implies a reset of the margin so that the first character on the new line appears at the left end of the line.

One line advance (35): Like the above but just one line advance is made. Whenever the writing reaches the right end of the scope a line advance operation must be specified, either by the number pair 35 or 32, since line advance is not performed automatically by the program.

End of message (52): This number pair must appear at the very end of the message. It acts as the signal to the subroutine to execute the exit transfer and return control to the "main program."

Advance film (55): A film frame advance instruction (PSE 24) will be executed and counters will be reset so that the "writing" will begin at the upper left corner of the scope.

Change scale, $N \rightarrow N - 1$ (56): This number pair in effect changes the scale parameter N to N - 1 thus decreasing the size of the characters. The word containing the program parameter N is not altered by this operation.

Change scale, $N \rightarrow N + 1$ (57): This number pair in effect changes the scale parameter N to N + 1 thus increasing the size of the characters.

[illegible] N is not altered by this operation.

Change origin (72). The number pair is used to define the coordinates of the next character to be written, where the coordinates of a character are defined by the coordinates of the upper left corner of the 5 x 7 raster onto which the character is written. This number pair must always be the first number pair in the word in which it is stored and the x and y coordinates being specified must appear in this same word in the bit positions set aside for specifying coordinates to the CRT [illegible] (namely x $0 \leq x \leq 1023$) occupies bit positions 8 through 17 and y $0 \leq y \leq 1023$) occupies bit positions 26 through 35.* The special rule applying to the position of this number pair (72) in the word in which it is stored holds for this number pair and this number pair only.

When entry is made to this subroutine counters are set so that the first character in the message will be written at the upper left corner of the scope. Successive characters are written in order from left to right across the scope until a new line is initiated via 32 or 35 or until a change of origin is requested via 72.

Attempts to use number pairs listed as "not used" in the above dictionary (e.g. 36 and 37) will result in errors and therefore their use should be scrupulously avoided.

Space Required.

	UA SAP	MURASS
144 words program at	SCPS	A
7 words temporary at	COMMON	T

CODING INFORMATION

Timing

Time $(0.97 + 8.51N_1 + .70N_2 + 500N_3 + .48N_4 + .37N_5)$ milliseconds where

N_1 number of plotted characters and spaces

N_2 number of ten space, one line advance and ten line advance operations

N_3 number of film advances

N_4 number of scale change operations

N_5 number of origin changes.

Writing Space. To avoid overwriting, the following limits should be observed

number of characters on a line $< \frac{1024}{6(N+1)}$,

number of lines $< \frac{1024}{9(N+1)}$

*As an example suppose the new origin is to be $x = 100_{10}$ $y = 200_{10}$. The message word written as an octal number is 720144000310. It is to be noted that the message word for change of origin never contains any data other than the change of origin data. All other message words have the data, that is the octal number pairs, packed six to

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      REM SCP3-GENERAL ALPHANUMERIC CATHODE RAY DISPLAY                  MU   SCP3
SCP3  CLA SCP3+47          X                                            SCP3  0001
      STO COMMON           PLANT XZERO,YZERO                            SCP3  0002
      SXD SCP3+112,1       SAVE IR1                                     SCP3  0003
      SXD COMMON+4,2       SAVE IR2                                     SCP3  0004
      WTV                  SELECT SCOPE                                 SCP3  0005
      CAL 1,4              GET PROGRAM PARAMETER WORD                   SCP3  0006
      STA SCP3+15          PLANT CALL ADDRESS                           SCP3  0007
      ADD SCP3+46          DECREMENT PLUS 1=S                           SCP3  0008
      STD SCP3+109         PLANT SSUBX                                  SCP3  0009
      LRS 52               X                                            SCP3  0010
      STQ COMMON+1         PLANT SSUBY                                  SCP3  0011
      MPY SCP3+46          ((S)(2EXP-35))(2EXP-17+(7)(2EXP-35))         SCP3  0012
      STQ COMMON+2         SSUBX IN DECR.,7SSUBY IN ADDR.               SCP3  0013
      LXD SCP3+47,1        IR1=0                                        SCP3  0014
      LXA SCP3+109,2       IR2=36                                       SCP3  0015
      LDQ **,1             BCD WORD INTO MQ                             SCP3  0016
      LGL 42,2             BCD CHARACTER(AND JUNK)IN AC                 SCP3  0017
      ANA SCP3+110         EXTRACT CHARACTER                            SCP3  0018
      ADD SCP3+111         ADD BASE ADDRESS                             SCP3  0019
      STA SCP3+20          PLANT BINARY CALL ADDRESS                    SCP3  0020
      LDQ **               BINARY WORD INTO AC                          SCP3  0021
      STQ COMMON+3         TEMPORARY STORE BINARY WORD                  SCP3  0022
      TQP SCP3+24          TRANSFER IF CHARACTER                        SCP3  0023
      TRA COMMON+3         HERE IF OPERATOR                             SCP3  0024
      SXD COMMON+5,1       HERE IF CHARACTER TO BE GENERATED            SCP3  0025
      SXD COMMON+6,2       SAVE IR1 AND IR2                             SCP3  0026
      LXA SCP3+112,1       IR1=5                                        SCP3  0027
      LXD SCP3+73,2        IR2=7                                        SCP3  0028
      LDQ COMMON+3         BINARY WORD IN MQ                            SCP3  0029
      RQL 1                POSITION BIT FOR TEST                        SCP3  0030
      STQ COMMON+3         TEMPORARY STORE                              SCP3  0031
      TQP SCP3+33          TRANSFER IF NO POINT TO PLOT                 SCP3  0032
      CPY COMMON           PLOT POINT                                   SCP3  0033
      CLS COMMON+1         -SSUBY                                       SCP3  0034
      ADD COMMON           +(X,Y)                                       SCP3  0035
      STQ COMMON           (X,Y)INTO(X,Y-SSUBY)                         SCP3  0036
      TIX SCP3+28,2,1      LOOP, OUT AFTER 7 PASSES                     SCP3  0037
      ADD COMMON+2         +SSUBX+7SSUBY                                SCP3  0038
      STQ COMMON           (X,Y)INTO(X+SSUBX,Y+7SSUBY)                  SCP3  0039
      TIX SCP3+27,1,1      LOOP OUT AFTER 5 PASSES                      SCP3  0040
      ADD SCP3+109         (X,Y)INTO(X+SSUBX,Y)                         SCP3  0041
      STD COMMON           X                                            SCP3  0042
      LXD COMMON+5,1       RESTORE IR1                                  SCP3  0043
      LXD COMMON+6,2       RESTORE IR2                                  SCP3  0044
      TIX SCP3+15,2,6      LOOP, OUT AFTER 7 PASSES                     SCP3  0045
      TXI SCP3+14,1,-1     LOOP,DECREASE IR1 BY 1                       SCP3  0046
      OCT 000001000007     CONSTANT,(2EXP-17+7.2EXP-35)                 SCP3  0047
      OCT 000000001777     XZERO,YZERO                                  SCP3  0048
      OCT 175014060276     00-BCD CHARACTER,0-SYMBOL                    SCP3  0049
      OCT 000417740200     01,1                                         SCP3  0050
      OCT 103034262261     02,2                                         SCP3  0051
      OCT 105014462266     03,3                                         SCP3  0052
      OCT 030242236604     04,4                                         SCP3  0053
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OCT 005714462306     05,5                                   SCP3  0054
OCT 074514442206     06,6                                   SCP3  0055
OCT 201074424140     07,7                                   SCP3  0056
OCT 155114462266     10,8                                   SCP3  0057
OCT 141104462474     11,9                                   SCP3  0058
TNZ SCP3+113         12,10 SPACES TRANSFER                  SCP3  0059
OCT 044221104422     13,=                                   SCP3  0060
OCT 010040201004     14,-                                   SCP3  0061
LDQ SCP3+120           ,10 LINE FEED SWITCH ENTRY           SCP3  0062
STD COMMON             ,X                                   SCP3  0063
TRA SCP3+114           ,X                                   SCP3  0064
OCT 020103702010     20,+                                   SCP3  0065
OCT 076444211037     21,A                                   SCP3  0066
OCT 203774462266     22,B                                   SCP3  0067
OCT 175014060242     23,C                                   SCP3  0068
OCT 203774060276     24,D                                   SCP3  0069
OCT 377114460301     25,E                                   SCP3  0070
OCT 377104420100     26,F                                   SCP3  0071
OCT 175014062317     27,G                                   SCP3  0072
OCT 376100402177     30,H                                   SCP3  0073
OCT 000007740000     31,I                                   SCP3  0074
TNZ SCP3+61          32,10 LINE FEED TRANSFER               SCP3  0075
OCT 000030140000     33,.                                   SCP3  0076
OCT 000000020276     34,)                                   SCP3  0077
TNZ SCP3+78          35,1 LINE FEED TRANSFER                SCP3  0078
LDQ SCP3+121           ,X                                   SCP3  0079
TRA SCP3+62            ,X                                   SCP3  0080
OCT 010040201004     40,-                                   SCP3  0081
OCT 004010040376     41,J                                   SCP3  0082
OCT 376101210501     42,K                                   SCP3  0083
OCT 376010040201     43,L                                   SCP3  0084
OCT 376401410177     44,M                                   SCP3  0085
OCT 376401002177     45,N                                   SCP3  0086
OCT 175014060276     46,O                                   SCP3  0087
OCT 377104422060     47,P                                   SCP3  0088
OCT 175014260475     50,Q                                   SCP3  0089
OCT 377104622461     51,R                                   SCP3  0090
TNZ SCP3+122         52, END TRANSFER                       SCP3  0091
OCT 044526552444     53,$                                   SCP3  0092
OCT 250707616124     54,*                                   SCP3  0093
TNZ SCP3+125         55, ADVANCE FILM FRAME TRANSFER        SCP3  0094
TNZ SCP3+128         56, S INTO S-1 TRANSFER                SCP3  0095
TNZ SCP3+135         57, S INTO S+1 TRANSFER                SCP3  0096
OCT 000000000000     60, BLANK                              SCP3  0097
OCT 004040404040     61,/                                   SCP3  0098
OCT 105214461242     62,S                                   SCP3  0099
OCT 201007760100     63,T                                   SCP3  0100
OCT 374010040376     64,U                                   SCP3  0101
OCT 340140143160     65,V                                   SCP3  0102
OCT 376020200577     66,W                                   SCP3  0103
OCT 306240405143     67,X                                   SCP3  0104
OCT 300200744140     70,Y                                   SCP3  0105
OCT 207054464341     71,Z                                   SCP3  0106
TNZ SCP3+137         72,(X,Y)INTO(X*,Y*)TRANSFER            SCP3  0107
OCT 000000000000     73, BLANK                              SCP3  0108
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OCT 175010000000     74,(                                SCP3  0109
HTR 36               CONSTANTS                           SCP3  0110
OCT 000000000077     EXTRACTOR                           SCP3  0111
HTR SCP3+48          BASE ADDRESS                        SCP3  0112
HTR 5                CONSTANT                            SCP3  0113
LDQ SCP3+119         10 SPACES SWITCH ENTRY              SCP3  0114
MPY COMMON+1         X                                   SCP3  0115
LLS 35               X                                   SCP3  0116
ADD COMMON           +(X,Y)                              SCP3  0117
STO COMMON           (X,Y)INTO(X+60S,Y),OR               SCP3  0118
TRA SCP3+44          (0,Y+90S),OR(0,Y+9S)                SCP3  0119
OCT 000074000000     CONSTANTS                           SCP3  0120
OCT 400000000132     X                                   SCP3  0121
OCT 400000000011     X                                   SCP3  0122
LXD SCP3+112,1       END ENTRY                           SCP3  0123
LXD COMMON+4,2       X                                   SCP3  0124
TRA 2,4              EXIT                                SCP3  0125
CFF                  ADVANCE FILM FRAME                  SCP3  0126
CLA SCP3+47          GET XZERO,YZERO                     SCP3  0127
TRA SCP3+117         X                                   SCP3  0128
CLS SCP3+46          S INTO S-1 ENTRY                    SCP3  0129
ADD COMMON+2         X                                   SCP3  0130
STO COMMON+2         X                                   SCP3  0131
STD SCP3+109         X                                   SCP3  0132
ARS 18               X                                   SCP3  0133
STA COMMON+1         X                                   SCP3  0134
TRA SCP3+44          X                                   SCP3  0135
CLA SCP3+46          S INTO S+1 ENTRY                    SCP3  0136
TRA SCP3+129         X                                   SCP3  0137
CLA SCP3+15          (X,Y)INTO(X*,Y*) ENTRY              SCP3  0138
STA SCP3+139         X                                   SCP3  0139
CLA **,1             X                                   SCP3  0140
ANA SCP3+143         X                                   SCP3  0141
STO COMMON           X                                   SCP3  0142
TRA SCP3+45          X                                   SCP3  0143
OCT 001777001777     CONSTANT                            SCP3  0144
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