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QANDA

AN INTERACTIVE SUBROUTINE USING THE VR12 DISPLAY

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Specification for QANDA Subroutine.

ABSTRACT

QANDA is a PDP-12 subroutine written in LINC mode which allows a user to display textual information on the scope, ask questions of the viewer, allow editing of the input, and receive responses thereto.

PRELIMINARY REQUIREMENTS

QANDA will operate on a PDP-12 computer equipped with a VC12 LINCscope control and VR12 CRT display, and Teletype.

The subroutine is called by the following format:

```
.       JMP QAINIT
.+1     TXTSTR      /POINTER TO TEXT STRING (HALF WORD ADDRESS)
.+2     ANSWER      /POINTER TO ANSWER BUFFER (HALF WORD ADDRESS)
.+3     REFRESH return
.+4     DONE return
```

The calling sequence must be in LINC mode.

.	A JMP to QAINIT will initialize the subroutine and fill the answer buffer with the underline character (_). The subroutine must be initialized at least once. QAINIT is located at the relative address 0 with respect to the beginning of the routine.
.+1	Points to the first character of the textual information to be displayed on the scope.

Characters in the text string which have special meaning are:

Character	Code	Meaning
RETURN	43	End of a line of display. Place next character on next line.
<	74	Interpret the decimal number immediately following < as the number of characters in the question field (Range 1-9).
\	34	End of text string
F	06	Treated as a special character only if it appears at the beginning of a line. If present, the entire line will be displayed in full-size character format. F will not appear on the scope.

Character	Code	Meaning
H	10	Treated as a special character only if it appears at the beginning of a line. If present, the entire line will be displayed in half-size character format. H will not appear on the scope. If neither F nor H is present at the beginning of a line, half-size is assumed, and the first character of the line will appear on the scope. Intermixing of half and full-size characters between lines is legal.

The 6-bit character string must conform to the character set accepted by DIAL. (See Table I.)

The "TEXT" pseudo-op in DIAL may be used to create the text string. For example, to display the following message on the scope in full-size character format:

DATA AT BLOCK ___
UNIT _

the text string may be coded as:

```
TXTSTR, TEXT ␣ ZFDATA AT BLOCK <3
FUNIT <1 \Z
```

and would be assembled as:

```
TEXT,   0604
        0124
        0140
        0124
        4002
        1417
        0313
        7463
        4306
        2516
        1124
        7461
        3400
```

NOTE that the character "Z" before and after the text string is a delimiter for the assembler and does not appear in the assembled text string. (Any character not appearing in the text string may be used as a delimiter).

Note also that the character "TAB", if typed within the text string, will appear in the assembled string and will not be interpreted as a special character by DIAL. The use of "TAB" within the text string should, therefore, be avoided.

The subroutine will automatically place a space before all question fields on the scope. The text string will not be changed.

.+2

Points to the first character of the answer buffer. The answer buffer need not be set up in any special way; it must be in length at least the number of half words equal to the sum of the number of characters in each question field plus one for each question field plus one. In the example above, 7 half-words long: 4 for the total number of characters in all question fields plus 2 for the number of question fields ~~plus 2 for the number of question fields~~ plus 1 for the terminator.

Upon entry, QANDA will initialize the answer buffer as follows (see example above). All characters in each answer field are initialized to the underline character (00):

```
ANSWER,  7400
         0000
         7400
         3400
```

Code 74 precedes each answer field. Code 34 is the terminator. These codes are placed in the answer buffer by QANDA upon initialization.

Characters, as they are received by QANDA from the Teletype, replace code 00 from left to right in each answer field.

Conditions will always be such that the presence of a null value (00) in an answer field will guarantee that all remaining characters in that field will be set to 00. Note that an all-null field is possible.

If the typist responds to the questions with the block number 43 and the unit 1, when the "DONE" return is taken, the buffer will show:

```
ANSWER,  7464
         6300
         7461
         3400
```

If the responses to questions are dealt with as received, the same answer buffer may be used with various text strings in sundry calls to QANDA, since it will be initialized by QANDA upon each initialization entry; the area reserved must, of course, be of sufficient length to accommodate the requirement among the text strings.

.+3

QANDA will refresh the scope once and then will return to this address, provided a LINE FEED has not been typed. This return is provided so that the calling program may periodically check external conditions: e.g., a sense switch may be checked or; the program may display a message while awaiting completion of a tape instruction which it may check following each refresh. Examining a partial answer buffer, however, is not recommended, because the answer buffer can be edited at any time by the typist.

To maintain the display on the scope, QANDA has another entry point, QARFSH, which will not reinitialize the answer buffer. QANDA must be entered at this point each time it is to be refreshed. It is located at the relative address QAINIT +53.

QANDA will always return to .+3 or .+4 following the instruction JMP QAINIT, regardless of the address of the instruction JMP QARFSH. A common situation is to place the instruction JMP QARFSH at .+3 following JMP QAINIT.

.+4

QANDA will return to this location only if either

1. LINE FEED is struck, or
2. RETURN is struck and no question fields exist.

A return to this address signals that the typist has completed his input.

INPUT

Input is received from the Teletype keyboard. Legal keyboard characters are converted to their 6-bit equivalent and displayed on the scope. Legal characters are shown in Table I. The following input characters are not displayed, but are treated as special characters.

Character	Code	Meaning
\	34	Ignored on input
ALT MODE	36	The scope display is reinitialized. All answer fields are reinitialized to the underline character (_).
RUBOUT	37	A cursor will always appear on the scope in front of the next character to be typed (unless there are no question fields).

Character	Code	Meaning
		Typing RUBOUT will delete the character preceding the cursor and will move all characters following the cursor one character to the left, unless the cursor is initially at the beginning of a question field.
RETURN	43	The cursor is moved to the beginning of the next question field. If the cursor is currently in the last field, it will be moved to the beginning of the first field when RETURN is typed. If there are no question fields, RETURN will have the same effect as LINE FEED.
LINE FEED	45	Causes QANDA to exit to the "DONE" return.
TAB	47	Ignored on input.
<	74	Moves the cursor left one position. Subsequent typing of another legal character will cause the present character on the scope to the right of the cursor to be replaced by the character just typed.
>	76	Moves the cursor right one position unless that character is the underline character (_).

OUTPUT

All output is to the scope, as described above.

USAGE

QANDA is written in LINC code. Along with the keyboard input subroutine, GETKBD, it occupies two blocks (512 words) of binary LINC tape. It may be assembled with the calling program by adding the source to the program. If this is done, remove *1000 at the beginning of the subroutine.

It may also be called by reading the binary of the program into LINC location 1000 (memory blocks 2 and 3) and executing an effective JMP 1000 and JMP 1053 to refresh. Two blocks of the binary must be read into core memory.

PROGRAMS CALLED

A LINC Teletype input subroutine, GETKBD, is called by QANDA and begins at location 121 of the second block of the binary.

It can be used independently of QANDA. GETKBD will accept ASCII input from the Teletype and convert it to 6-bit code as shown in Table I.

Its calling sequence is:

```
JMP GETKBD
RETURN address
```

GETKBD returns with the 6-bit code in the accumulator. If the accumulator equals zero, a key was not struck, and no input was received; or an illegal character was typed.

GETKBD uses the LINC instruction IOB followed by a PDP-8 Teletype IOT instruction to perform the Teletype input/output functions. The following instruction sequence is issued in the subroutine QATPE to echo a character:

```
QATPE,   IOB
         QATLS    /EQUATED TO PDP-8 IOT TLS
         LDA
         0
         STC   .+4/SAVE RETURN
         IOB
         QATSF    /WAIT FOR FLAG. PDP-8 IOT TSF
         JMP   .-2
         JMP      /EXIT
```

This routine prints the ASCII character in the accumulator then waits for the printer flag to rise. The routine can be made more efficient by first waiting for the flag, then printing the character by changing the above routine as shown below:

```
QATPE,   STC  QAACUM     /SAVE AC
         ADD  0
         STC  QARETR     /SAVE RETURN
         IOB
         QATSF           /WAIT FOR FLAG
         JMP  .-2
         LDA  I          /GET CHAR
QAACUM,  0
         IOB
```

```
        QATLS           /PRINT IT
        CLR
QARETR, JMP             /EXIT, AC=0
```

Subsequently, less flicker will appear on the scope while characters are being typed. However, the calling program must initially cause the Teletype flag to raise when the program is first started. This may be accomplished by the following instruction sequence at the beginning of the program:

```
        IOB
        6032            /PDP-8  IOT KCC
        IOB
        6046            /PDP-8  IOT TLS
         .
         .
         .
```

Whatever method is used, the calling program must, of course, also conform to the same convention throughout the program whenever it is driving the Teletype.

RESTRICTIONS

QANDA must reside in the same LINC lower memory segment as the calling sequence.

It uses, without restoring, index registers 1, 2, 3, 4, 5, 6. Further, these registers cannot be used by the calling program between the refresh return and the next call to the refresh entry unless they are first saved and then restored.

The text string and answer buffer are separate from each other and from the calling sequence and may therefore be in upper memory. However, the text string may not start in the left half of LINC location 2000 (e.g. the left half of the first word of the upper memory segment) unless the pointer to the text string is coded as 2\2000, or 2\TAG, where TAG=2000.

QANDA will display a maximum of 44_{10} half-size characters horizontally on a line before scope "wrap-around" will occur. Likewise, a maximum of 22_{10} full-size characters per line may be displayed.

A maximum of 13_{10} lines of text (either half-size of full-size) may be displayed vertically on the scope without wraparound. The initial Y-coordinate setting is coded as 277_8 at location QARFSH+1. This initial Y-coordinate setting may be changed by incrementing or decrementing this number by a

number which is a multiple of 40_8. Thus, to raise the initial Y-coordinate one line and therefore increase the maximum number of lines to 14_{10}, the number 277_8 may be changed to 337_8 at location QARFSH+1.

Table I
PDP-12 Character Set

Character	6-bit Code	Comments
@	00	Illegal
A	01	
B	02	
C	03	
D	04	
E	05	
F	06	
G	07	
H	10	
I	11	
J	12	
K	13	
L	14	
M	15	
N	16	
O	17	
P	20	
Q	21	
R	22	
S	23	
T	24	
U	25	
V	26	
W	27	
X	30	
Y	31	
Z	32	
[	33	Shift/K
\	34	
]	35	Shift/M
ALT MODE	36	
RUBOUT	37	
SPACE	40	
!	41	
"	42	
RETURN	43	
$	44	Illegal
LINE FEED	45	
&	46	

Table I (Cont)
PDP-12 Character Set

Character	6-bit Code	Comments
TAB	47	Control/I
(	50	
)	51	
*	52	
+	53	
,	54	
-	55	
.	56	
/	57	
0	60	
1	61	
2	62	
3	63	
4	64	
5	65	
6	66	
7	67	
8	70	
9	71	
:	72	
;	73	
<	74	
=	75	
>	76	
?	77	

```
LI QANDA,1

0000                    *20
0001                    /QANDA SUBROUTINE FOR THE
0002                    /PDP-12
0003                    /REMOVE *1000 BELOW IF
0004                    /INSERTING SOURCE DIRECTLY
0005                    /INTO YOUR PROGRAM SOURCE
0006                    *1000 /REMOVE,IF DESIRED
0007                    /
0010                    /TO HERE TO INITIALIZE THE ROUTINE
0011                    /
0012        1000  1020  QAINIT, LDA I            /SAVE JMP RETURN
0013        1001  0002          2
0014        1002  2000          ADD 0
0015        1003  1060          STA I
0016        1004  0000  QAB,    0                /JMP    +3
0017        1005  3200          ADD QAL+3
0020        1006  4001          STC 1            /PTR TO FIRST PARAM
0021        1007  1001          LDA 1            /GET FIRST PARAM
0022        1010  3264          ADD QAO+1        /PTR TO HALFWORD-1
0023        1011  5057          STC QAG-3
0024        1012  1021          LDA I 1
0025        1013  5052          STC QARFSH-1
0026        1014  4006          STC 6            /XR6 USED AS A SWITCH. =0■
                  IELD, =1777 IF YES
0027        1015  0043  QACA,   SET 3   /XR3 TO PTR TO ANSWERS
0030        1016  1052          QARFSH-1
0031        1017  0044          SET 4            /XR4 TO PTR TO QUESTIONS
0032        1020  1057          QAG-3
0033                                             /TO HERE IF FIRST TIME TH■
                   CR
0034        1021  0041          SET 1
0035        1022  0004          4
0036        1023  7270          JMP QAT
0037        1024  0016          NOP              /F
0040        1025  1324          LDH I 4          /H. BUMP PTR IF H OR F
0041        1026  7231  QAD,     JMP QAO
0042        1027  7035          JMP .+6          /74
0043        1030  7050          JMP QAE          /34
0044        1031  1460          SAE I            /CR?
0045        1032  0043          43
0046        1033  7026          JMP QAD          /NO
0047        1034  7021          JMP QACA+4 /EXAMINE NEXT CHAR
0050                                             /INITIALIZE ANSWER BUFR
0051        1035  1343          STH 3            /74 TO ANSWERS
0052        1036  1324          LDH I 4          /NEXT HALFWORD
0053        1037  1120          ADA I
0054        1040  7717          -60
0055        1041  0017          COM
0056        1042  4006          STC 6
0057        1043  1363          STH I 3          /0 IN AC
0060        1044  0226          XSK I 6
0061        1045  7043          JMP .-2
0062        1046  1323          LDH I 3          /BUMP PTR TO ANSWERS
0063        1047  7026          JMP QAD
0064                                             /ANSWER BUFR IS INITIATED
0065        1050  1343  QAE,     STH 3
0066        1051  0064          SET I 4          /XR4 TO PTR TO LAST TYPED■
                   ER BUFR
0067        1052  0000          0
0070                                             /----RE-ENTER HERE TO REF■
0071        1053  1020  QARFSH, LDA I            /INITIAL Y POSITION
```

```
0072    1054  0277  277
0073    1055  5113        STC 0AH-1
0074    1056  0063        SET I 3          /XR3 TO PTR TO HALFWORD 0
0075    1057  0000        0
0076    1060  0045        SET 5            /XR5 TO PTR TO LAST DISPL
                SWER BUFR
0077    1061  1052        0ARFSH-1
0100    1062  0041  0AG,  SET 1
0101    1063  0003        3
0102    1064  7270        JMP 0AT
0103    1065  7074        JMP .+7          /F
0104    1066  1323        LDH I 3          /H. BUMP PTR
0105    1067  1020        LDA I            /NEITHER. ASSUME HALF SIZE
0106    1070  1560        BCL I
0107    1071  5103        STC 0AM+2        /SET INSTR TO CLEAR FF FO
0110    1072  3512        ADD 0AW          /NOP IN AC
0111    1073  7101        JMP 0AM
0112    1074  1323        LDH I 3          /BUMP PTR
0113    1075  1020        LDA I
0114    1076  1620        BSE I
0115    1077  5103        STC 0AM+2        /SET INSTR TO SET FF FOR
0116    1100  3513        ADD 0AW+1        /ADD 9U IN AC
0117    1101  5245  0AM,  STC 0AP+3
0120    1102  0024        MSC I 4          /EAD CONTROL REGISTER
0121    1103  1620        BSE I            /THIS INSTR CHANGES. EITH
                &
0122    1104  0200        200
0123    1105  0004        MSC 4            /AC TO CONTROL REGISTER
0124    1106  0061        SET I 1          /XR1 TO INITIAL X POSITION
0125    1107  0100        100
0126    1110  1020        LDA I            /Y COORDINATE MULTIPLE
0127    1111  7737        -40
0130    1112  1160        ADM I            /Y COORDINATE
0131    1113  0000        0
0132    1114  1323  0AH,  LDH I 3
0133    1115  7232        JMP 0A0+1
0134    1116  7301        JMP 0AZ          /74 BUMP PTR TO NEXT CHAR
                C
0135    1117  7136        JMP 0AJ          /34
0136    1120  1420        SHD I            /NEITHER
0137    1121  4300        4300
0140    1122  7062        JMP 0AG          /CR. MOVE X AND Y COORDIN
0141    1123  7242        JMP 0AP          /ISPLAY CHAR
0142    1124  7114        JMP 0AH          /PICK UP NEXT CHAR
0143    1125  7242        JMP 0AP          /TO HERE IF DISPLAYING AN
0144    1126  1520        SRO I    /SWITCH TO DISPLAY CURSOR. EITHER0
                7777
0145    1127  0000        0                /IFXR4=XR5, THEN SWITCH=77
0146    1130  7516        JMP 0AF
0147                                       /QUESTION MODE
0150    1131  1325  0AI,  LDH I 5
0151    1132  7232        JMP 0A0+1
0152    1133  7114        JMP 0AH          /74
0153    1134  7114        JMP 0AH          /34
0154    1135  7125        JMP 0AI-4        /NEITHER. DISPLAY IT
0155    1136  7521  0AJ,  JMP GETKBD       /TO HERE IF DISPLAYED BUFR
0156    1137  0470        AZE I
 157    1140  7004        JMP 0AB /NOTHING TYPED . EXIT
0160    1141  7042        SET I 2
0161    1142  1412        0AY
0162    1143  1402        SHD 2            /LF?
0163    1144  7311        JMP 0AK+4        /YES. EXIT
0164    1145  1422        SHD I 2          /CR?
```

```
0165    1146  7223          JMP QAN
0166    1147  0206          SZK /                 /IS THERE AN ANSWER FIELD?
0167    1150  7053          JMP QARFSH
0170    1151  1422          SHD I 2               /<?
0171    1152  7175          JMP QAL
0172    1153  1422          SHD I 2               />?
0173    1154  7305          JMP QAK
0174    1155  1422          SHD I 2               /ALT?
0175    1156  7015          JMP QACA /REINITIALIZE
0176    1157  1422          SHD I 2               /BACK SLASH?
0177    1160  7053          JMP QARFSH            /IGNORE
0200    1161  1422          SHD I 2               /RUBOUT?
0201    1162  7175          JMP QAL               /IGNORE
0202    1163  1422          SHD I 2               /TAB?
0203    1164  7053          JMP QARFSH            /IGNORE
0204    1165  5172          STC .+5               /ACCEPTABLE CHAR
0205    1166  7231          JMP QAO               /TEST NEXT CHAR
0206    1167  7263          JMP QAQ               /74 BACK PTR UP BY 1
0207    1170  7263          JMP QAQ               /34 ↑
0210    1171  1020          LDA I                 /OK. STORE IT
0211    1172  0000          0
0212    1173  1344          STH 4
0213    1174  7053          JMP QARFSH            /REDISPLAY
0214    1175  1304  QAL,    LDH 4                 /TO HERE IF RUBBOUT OR <
0215    1176  7232          JMP QAO+1
0216    1177  7053          JMP QARFSH            /74 IGNORE
0217    1200  1775          -6002
0220    1201  1302          LDH 2                 /TEST THE CHAR
0221    1202  1460          SAE I                 /RUBOUT?
0222    1203  0037          37
0223    1204  7263          JMP QAQ               /NO. BACK PTR UP BY 1
0224    1205  0045          SET 5
0225    1206  0004          4
0226    1207  0043          SET 3
0227    1210  0004          4
0230    1211  7213          JMP .+2
0231    1212  1325          LDH I 5               /BUMP PTR
0232    1213  1323          LDH I 3               /GET NEXT CHAR
0233    1214  7232          JMP QAO+1
0234    1215  0016          NOP                   /IF 74 OR 34, REPLACE CUR
0235    1216  0011          CLR
0236    1217  1345          STH 5
0237    1220  0450          AZE                   /WAS IT 74 OR 34?
0240    1221  7212          JMP .-7               /NO. CONTINUE
0241    1222  7263          JMP QAQ               /BACK PTR UP BY 1
0242                                              /TO HERE IF CR
0243    1223  0206  QAN,     XSK 6
0244    1224  7311          JMP QAK+4             /EXIT ROUTINE IF NO ANSWE
0245    1225  7231          JMP QAO
0246    1226  7053          JMP QARFSH            /74 MOVE PTR TO NEXT QUES
0247    1227  7051          JMP QAE+1             /34 END OF BUFR. MOVE PTR
                  ESTION FIELD
0250    1230  7225          JMP QAN+2
0251
0252    1231  1324  QAO,     LDH I 4               /S\R
0253    1232  1420          SHD I                 /       +1 74 BEGIN FIELD
0254    1233  7400          7400                  /       +2 34 END BUFR
0255    1234  6000          JMP 0                 /       +3 NEITHER 74 NOR
0256    1235  1460          SAE I
0257    1236  0034          34
0260    1237  0220          XSK I 0
0261    1240  0220          XSK I 0
0262    1241  6000          JMP 0
```

```
0263                                                    /S\R TO DISP LINC CHAR IN@
0264      1242  0241  OAP,    ROL 1                   /MULT BY 2 FOR INDEX TO A@
                      ABLE
0265      1243  3430          ADD OAX+4
0266      1244  4002          STC 2                   /ADDRESS OF CHAR TO DISP @
0267      1245  3506          ADD OAU                 /THIS INSTR CHANGES. EITH@
                      9U
0270      1246  3506          ADD OAU
0271      1247  2001          ADD 1                   /ADD 4 TO XR1 TO SPACE CHR
0272      1250  4001          STC 1
0273      1251  2005          ADD 5                   /GET ADDRESS OF ANSWER BUR
0274      1252  0017          COM
0275      1253  2004          ADD 4
0276      1254  0450          AZE
0277      1255  0011          CLR
0300      1256  5127          STC OAI-2               /SWITCH=0 OR 7777
0301      1257  3113          ADD OAH-1               /Y COORDINATE IN AC
0302      1260  1742          DSC 2
0303      1261  1762          DSC I 2                 /DISPLAY CHAR
0304      1262  6000          JMP 0
0305      1263  1020  OAQ,    LDA I                   /BACK UP PTR BY 1
0306      1264  3777          -4000
0307      1265  1140          ADM
0310      1266  0004          4
0311      1267  7053          JMP OAREFSH             /REDISPLAY
0312                                                  /
0313      1270  1321  OAT,    LDH I 1                 /S\R
0314      1271  1420          SHD I                   /       +1 F
0315      1272  0600          0600                    /       +2 H
0316      1273  6000          JMP 0                   /       +3 NEITHER
0317      1274  1460          SAE I
0320      1275  0010          10
0321      1276  0220          XSK I 0
0322      1277  0220          XSK I 0
0323      1300  6000          JMP 0
0324                                                  /
0325      1301  1323  OAZ,    LDH I 3
0326      1302  1020          LDA I
0327      1303  0040          40
0330      1304  7125          JMP OAI-4
0331                                                  /TO HERE IF >
0332      1305  1324  OAK,    LDH I 4
0333      1306  0470          AZE I                   /IS CURRENT CHAR BLANK?
0334      1307  7263          JMP OAQ                 /YES. IGNORE
0335      1310  7424          JMP OAX                 /MOVE DOT FORWARD
0336                                                  /TO HERE TO EXIT WITH SKIP
0337      1311  1020          LDA I
0340      1312  0001          1
0341      1313  1140          ADM
0342      1314  1004          OAB
0343      1315  7004          JMP OAB
0344                                                  /CHARACTER PATTERNS
0345      1316  0101  OAV,    0101                    /KBD 0, ILLEGAL. USED AS @
0346      1317  0101          0101
0347      1320  4477          4477                    /1:A
0350      1321  7744          7744
0351      1322  5177          5177                    /2:B
0352      1323  2651          2651
0353      1324  4136          4136                    /3:C
0354      1325  2241          2241
0355      1326  4177          4177                    /4:D
0356      1327  3641          3641
0357      1330  4577          4577                    /5:E
```

```
0360    1331  4145          4145
0361    1332  4477          4477          /6:F
0362    1333  4044          4044
0363    1334  4136          4136          /7:G
0364    1335  2645          2645
0365    1336  1077          1077          /10:H
0366    1337  7710          7710
0367    1340  7741          7741          /11:I
0370    1341  0041          0041
0371    1342  4142          4142          /12:J
0372    1343  4076          4076
0373    1344  1077          1077          /13:K
0374    1345  4324          4324
0375    1346  0177          0177          /14:L
0376    1347  0301          0301
0377    1350  3077          3077          /15:M
0400    1351  7730          7730
0401    1352  3077          3077          /16:N
0402    1353  7706          7706
0403    1354  4177          4177          /17:O
0404    1355  7741          7741
0405    1356  4477          4477          /20:P
0406    1357  3044          3044
0407    1360  4276          4276          /21:Q
0410    1361  0376          0376
0411    1362  4477          4477          /22:R
0412    1363  3146          3146
0413    1364  5121          5121          /23:S
0414    1365  4651          4651
0415    1366  4040          4040          /24:T
0416    1367  4077          4077
0417    1370  0177          0177          /25:U
0420    1371  7701          7701
0421    1372  0176          0176          /26:V
0422    1373  7402          7402
0423    1374  0677          0677          /27:W
0424    1375  7701          7701
0425    1376  1463          1463          /30:X
0426    1377  6314          6314
0427    1400  0770          0770          /31:Y
0430    1401  7007          7007
0431    1402  4543          4543          /32:Z
0432    1403  6151          6151
0433    1404  4177          4177          /33:/
0434    1405  0000          0000
0435                                      /34:BACKSLASH IGNORED ON
0436    1406  0000          0             /NOT USED
0437    1407  0000          0             /NOT USED
0440    1410  0000          0000          /35:]
0441    1411  7741          7741
0442                                      /CODES 36:ALT, 37:RUBOUT
0443    1412  4543  QAY,    4543          /LF,CR
0444    1413  7476          7476          /<,>
0445    1414  3634          3634          /ALT, BACKSLASH
0446    1415  3747          3747          /RUBOUT, TAB
0447    1416  0000          0000          /40:SPACE
0450    1417  0000          0000
0451    1420  7500          7500          /41:X!
0452    1421  0000          0000
0453    1422  7000          7000          /42:"
0454    1423  0070          0070
0455                                      /CODES 43:, 44:, 45:LF NO
0456    1424  7232  QAX,    JMP QAO+1
```

```
0457    1425  7263          JMP QAQ
0460    1426  7263          JMP QAQ
0461    1427  7053          JMP QARFSH
0462    1430  1316          QAV
0463    1431  0000          0                 /NOT USED
0464    1432  5166          5166              /46: &
0465    1433  0526          0526
0466                                          /CODE 47:TAB NOT DISPLAYED
0467    1434  0000          0                 /NOT USED
0470    1435  0000          0                 /NOT USED
0471    1436  3600          3600              /50:(
0472    1437  0041          0041
0473    1440  4100          4100              /51:)
0474    1441  0036          0036
0475    1442  2050          2050              /52:*
0476    1443  0050          0050
0477    1444  0404          0404              /53:+
0500    1445  0437          0437
0501    1446  0500          0500              /54:,
0502    1447  0006          0006
0503    1450  0404          0404              /55:-
0504    1451  0404          0404
0505    1452  0001          0001              /56:.
0506    1453  0000          0000
0507    1454  0601          0601              /57:\
0510    1455  4030          4030
0511    1456  4536          4536    /60:0
0512    1457  3651          3651
0513    1460  2101          2101              /61:1
0514    1461  0177          0177
0515    1462  4523          4523              /62:2
0516    1463  2151          2151
0517    1464  4122          4122              /63:3
0520    1465  2651          2651
0521    1466  2414          2414              /64:4
0522    1467  0477          0477
0523    1470  5172          5172              /65:5
0524    1471  0651          0651
0525    1472  1506          1506              /66:6
0526    1473  4225          4225
0527    1474  4443          4443              /67:7
0530    1475  6050          6050
0531    1476  5126          5126    /70:8
0532    1477  2651          2651
0533    1500  5122          5122              /71:9
0534    1501  3651          3651
0535    1502  2200          2200              /72::
0536    1503  0000          0000
0537    1504  4601          4601              /73:;
0540    1505  0000          0000
0541                                          /CODE 74:<NOT DISPLAYED
0542    1506  0002  QAU,     2                 /CONSTANT
0543    1507  0000          0       /NOT USED
0544    1510  1212          1212              /75:=
0545    1511  1212          1212
0546                                          /CODE 76:> NOT DISPLAYED
0547    1512  0016  QAW,     NOP
0550    1513  3506          ADD QAU
0551    1514  4020          4020              /77:?
0552    1515  2055          2055
0553                /
0554    1516  1760  QAF,     DSC I
0555    1517  6000          6000
```

```
0556    1520  7131          JMP QAI
0557                /
0560                                        /END 0+A
0561                /
0562                /
0563                /
0564                /
0565                /KEYBOARD INPUT ROUTINE
0566                /
0567                QAKRB=6036      /PDP-8 IOT KBD
0570                QATSF=6041      /TSF
0571                QATLS=6046      /TLS
0572                /
0573    1521  1000  GETKBD, LDA
0574    1522  0000          0
0575    1523  5643          STC QAEXIT+6    /SAVE RETURN
0576    1524  2001          ADD 1           /SAVE XRS 1 AND 2
0577    1525  5640          STC QAEXIT+3
0600    1526  2002          ADD 2
0601    1527  5642          STC QAEXIT+5
0602    1530  5636          STC QAEXIT+1
0603    1531  0415          KST     /WAS SOMETHING TYPED?
0604    1532  6000          JMP 0           /NO: EXIT
0605    1533  0500          IOB
0606    1534  6036          QAKRB   /GET TTY CHAR, CLEAR FLAG
0607    1535  1060          STA I           /SAVE IT
0610    1536  0000  QATY,    0
0611    1537  1120          ADA I
0612    1540  7540          -237
0613    1541  0451          APO             /BETWEEN 200 AND 237?
0614    1542  7604          JMP QACNTR      /CONTROL CHAR. CHECK FOR
0615                /
0616    1543  0061          SET I 1         /NO
0617    1544  1654          QACHAR-1
0620    1545  0062          SET I 2
0621    1546  7770          -7
0622    1547  1000          LDA
0623    1550  1536          QATY
0624    1551  1461          SAE I 1
0625    1552  7554          JMP .+2
0626    1553  7635          JMP QAEXIT      /ILLEGAL CHAR. DONT ECHO
0627    1554  0222          XSK I 2 /CHECKED THEM ALL?
0630    1555  7551          JMP .-4
0631                /
0632    1556  1120          ADA I
0633    1557  7440          -337
0634    1560  0451          APO             /BETWEEN 240 AND 337?
0635    1561  7575          JMP QALEGL      /YES. LEGAL CHAR
0636                /
0637    1562  1461          SAE I 1         /NO. CHECK FURTHER.
0640    1563  7572          JMP .+7
0641    1564  1020          LDA I           /RUBOUT
0642    1565  0334          334
0643    1566  7644          JMP QATPE       /ECHO BACKSLASH
0644    1567  1020          LDA I
0645    1570  0037          37
0646    1571  7637          JMP QAEXIT+2    /LEGAL EXIT
0647                /
0650    1572  1461          SAE I 1
0651    1573  7635          JMP QAEXIT      /ILLEGAL
0652                                        /ALT
0653    1574  7637          JMP QAEXIT+2    /EXIT, DONT ECHO
0654                /
```

```
0655    1575  1000  0ALEGL, LDA
0656    1576  1536        0ATY
0657    1577  7644        JMP 0ATPE       /ECHO CHAR
0660    1600  3536        ADD 0ATY
0661    1601  1560        BCL I           /STRIP IT TO 6-BIT
0662    1602  7700        7700
0663    1603  7637        JMP 0AEXIT+2
0664                /TO HERE IF CONTROL CHAR
0665    1604  1460  0ACNTR, SAE I
0666    1605  7755        7755
0667    1606  7621        JMP 0ACKLF
0670    1607  1020        LDA I           /CR
0671    1610  0043        43
0672    1611  5636        STC 0AEXIT+1
0673    1612  1020        LDA I
0674    1613  0215        215
0675    1614  7644        JMP 0ATPE
0676    1615  1020        LDA I
0677    1616  0212        212
0700    1617  7644        JMP 0ATPE
0701    1620  7635        JMP 0AEXIT
0702                /
0703    1621  1460  0ACKLF, SAE I
0704    1622  7752        7752
0705    1623  7627        JMP .+4
0706    1624  1020        LDA I           /LF
0707    1625  0045        45
0710    1626  7611        JMP 0ACNTR+5
0711    1627  1460        SAE I
0712    1630  7751        7751
0713    1631  7635        JMP 0AEXIT      /ILLEGAL
0714    1632  1020        LDA I
0715    1633  0047        47
0716    1634  7637        JMP 0AEXIT+2    /EXIT, DONT ECHO
0717                /
0720    1635  1020  0AEXIT, LDA I   /GET 6-BIT ASCII
0721    1636  0000        0
0722    1637  0061        SET I 1         /RESTORE XRS
0723    1640  0000        0
0724    1641  0062        SET I 2
0725    1642  0000        0
0726    1643  6000        JMP             /EXIR S\R GETKBD
0727                /S\R TO PRINT C(AC)
0730    1644  0500  0ATPE, IOB
0731    1645  6046        0ATLS   /PDP-8 IOT TLS
0732    1646  1000        LDA
0733    1647  0000        0
0734    1650  5654        STC .+4 /SAVE RETURN
0735    1651  0500        IOB
0736    1652  6041        0ATSF   /WAIT FOR FLAG
0737    1653  7651        JMP .-2
0740    1654  6000        JMP     /EXIT
0741                /
0742    1655  0243  0ACHAR, 243     /HASH
0743    1656  0244        244     /DOLLAR SIGN
0744    1657  0245        245     /PER CENT
0745    1660  0247        247     /APOSTROPHE
0746    1661  0300        300     /AT SIGN
0747    1662  0336        336     /UP ARROW
0750    1663  0337        337     /BACK ARROW
0751    1664  0040        40      /RUBOUT
0752    1665  0036        36      /ALT
0753                /END OF S\R GETKBD
```

```
                    0000  ERRORS

GETKPD  5521
0AB     5004
0ACA    5015
0ACHAR  5655
0ACKLF  5621
0ACNTR  5604
0AD     5026
0AF     5050
0AFXIT  5635
0AF     5516
0AG     5062
0AH     5114
0AI     5131
0AINIT  5000
0AJ     5136
0AK     5305
0AKRB   6036
0AL     5175
0ALEGL  5575
0AM     5101
0AN     5223
0AO     5231
0AP     5242
0AQ     5263
0ARFSH  5053
0AT     5270
0ATLS   6046
0ATPE   5644
0ATSE   6041
0ATY    5536
0AU     5506
0AV     5316
0AW     5512
0AX     5424
0AY     5412
0AZ     5301
```