IDENTIFICATION

PRODUCT CODE:	MAINDEC-14-D8AB-D
PRODUCT NAME:	ABE-14
DATE CREATED:	JUNE 18, 1970
MAINTAINER:	DIAGNOSTIC GROUP
AUTHOR:	EDWARD P. STEINBERGER

1. ABSTRACT

The purpose of ABE-14 (Accessory Box Test) is to test and diagnose the operation of the contents of an "Accessory Box" connected to a PDP-14 controller. The PDP-14 is in turn connected to a PDP-8I or 8L which contains the program that performs the tests. Among other tests, the Timers and Retentive Memories in the "A-Box" are timed to determine how long it takes for an output to "set" (turn on). This time is printed out to the operator via the PDP-8 teletype.

2. REQUIREMENTS

2.1 EQUIPMENT

PDP-8I or 8L
PDP-14 to PDP 8I/L Interface Module (M745)
PDP-14 Controller
PDP-14 Accessory Box

2.2 STORAGE

The program occupies the first 3ØØØ (octal) locations of PDP-8 memory.

2.3 PRELIMINARY PROGRAMS

TEST-14 should be run upon the PDP-14 successfully before this program is run.

3. LOADING PROCEDURE

3.1 METHOD

This program is loaded into PDP-8 memory using the "standard" PDP-8 Binary Loader technique.

4. STARTING PROCEDURE

4.1 CONTROL SWITCH SETTINGS

The following is a table of switch register settings and their operation upon the program:

SR	SET AS	ACTION
Ø	1	Loop on Current Test
	Ø	Don't Loop
1	1	Don't Halt on Error
	Ø	Halt on Error
2	1	Don't Print Errors
	Ø	Print Errors
3	1	Repeat Time Current Output (TØØØ4 Only)
	Ø	Don't Repeat Time Current Output

4.2 STARTING ADDRESSES

Start the program at location Ø2ØØ if it is desired to interrogate the operator about the "A-Box" and its configuration.

Start the program at location Ø2Ø1 if the "A-Box" and its configuration has been previously defined to the program.

4.3 PROGRAM AND/OR OPERATOR ACTION

4.3.1 Connect the PDP-14 to be used for testing to the PDP-8L/I using the appropriate cables and revision of the M745 interface module. Install INPUT and OUTPUT and Register modules (four M746's).

4.3.2 Connect the PDP-14 A-Box to be tested to the appropriate Output slot in the PDP-14 (normally this is the slot which the user is going to use for the A-Box). Remember the "letter designation" of the Output slot (ref. page A2 of the "Users Guide").

4.3.3 Power up the PDP-8I/L and PDP-14 computers

4.3.4 Load the binary program into the 8I/L using the PDP-8 Binary Loader.

4.3.5 Start the program at location Ø2ØØ. Set switch register per 4.1

4.3.6 Answer the questions asked by the program via the Teletype Keyboard [Answer A to S (only 1 letter) except I, O, or Q for "slot letter", answer T for Timer, M for Retentive memory for the contents of each address in the A-Box]

4.3.7 If the PDP-14 is not running, depress PDP-14 "START"

4.3.8 Program will now run to completion (assuming no errors) and will ring the bell on the Teletype Printer when 1 pass of the program has been completed.

5. OPERATING PROCEDURE

5.1 OPERATIONAL SWITCH SETTINGS (See 4.1 above)

5.2 SUBROUTINE ABSTRACTS

None

5.3 PROGRAM AND/OR OPERATOR ACTION

If Retentive Memories are being tested in the A-Box, it is necessary to simulate a power failure in the PDP-14 by powering down the PDP-14 so that the retentive ability

of the R.M.'s may be tested. Given below is the proper procedure to use:

5.3.1 After receiving the "Power-Down" printout, power-down the PDP-14 by turning the PDP-14 power switch "OFF"

5.3.2 Turn PDP-14 power switch "ON"

5.3.3. Depress PDP-8 "CONTINUE"

6. ERRORS

6.1 ERROR HALTS AND DESCRIPTION

Most of the error halts in the program are preceded by error type outs. However, if in doubt about the cause of the error halt, consult the program listing.

6.2 ERROR RECOVERY

To 'scope an error condition after an error halt, set the switch register per 4.1 and depress "CONTINUE"

6.3 ERROR MESSAGES

The error messages output by the program (with a very few exceptions) will contain an error designator (a 2 letter error number) followed by a description of the test being performed and/or a description of the failing error condition. If desired, the operator can use the 2 letter error designator to go directly to the module call list to see which module(s) should be replaced. Or, if he desires, he may set up a program 'scope loop and probe the A-Box (and maybe the PDP-14) to determine the failing condition, then replace the failing module.

6.4 ERROR IDENTIFIER - MODULE CALL

IDENTFIER	MODULE TYPES
BL	K2Ø7, K161, K135
BN	See BL
BQ	See BL
BX	See BL
BY	See BL
CB	See BL
CF	K3Ø2
CG	K3Ø2
CH	K272, D3Ø2, K2Ø7, K161, K135

7. RESTRICTIONS

7.1 STARTING RESTRICTIONS

None

7.2 OPERATING RESTRICTIONS

INPUT and OUTPUT Register Modules (M746's) must be installed.

8. MISCELLANEOUS

8.1 EXECUTION TIME

The execution time of the program is dependent upon the settings of the timer modules in the A-Box. The bell on the teletype printer will ring at program completion.

9. PROGRAM DESCRIPTION

9.1 Test 3 (SA = 0416)

Checks a TYD "N" status word with the "TEST" flop cleared and output off.

9.2 Test 4 (SA = 0600)

Turns on output "N", times it, and types out time to set it on teleprinter in milliseconds (time output will be within 10% of actual value - variation is due to Family-of-8 timing tolerances and response times). If SR3 = 1, program will loop, typing out the current output setting, so that timers may be adjusted to their approximate final settings.

9.3 Test 5 (SA = 1000)

Checks that with output "N" on, only TYN "N" sets the "TEST" flop.

9.4 Test 6 (SA = 1200)

Checks a TYD "N" status word with the "TEST" flop set and output on.

9.5 Test 7 (SA = 1400)

Checks that with output "N" on, only TYF "N" does not set the "TEST" flop

9.6 Test 8 (SA = 1600)

Checks that only SYF "N" clears output "N" and that SYF 377 clears output "N" only if "N" is a timer.

9.7 Test 10 (SA = 2000)

Checks Retentive Memory's ability to "remember" a 0 after power shut-down.

9.8 Test 11 (SA = 2200)

Checks Retentive Memory's ability to "remember" a 1 after power shut-down.

```
                                /ABE-14
                                /PROGRAM TO TEST ACCESSORY BOXES
                                /CONNECTED TO THE PDP-14 COMPUTER
                                /WHICH IS IN TURN CONNECTED TO A
                                /PDP-8L OR 8I

                                /COPYRIGHT 1969, DIGITAL EQUIPMENT CORP., MAYNARD, MASS.

                                /DEFINITION OF INTERFACE IOT'S
                                /
                    6161        SIDF=6161       /SKIP ON INSTRUCTION DONE FLAG
                    6162        LDIN=6162       /LOAD THE PDP-14 INPUT REGISTER FROM PDP-8 AC
                    6164        LDEX=6164       /LOAD AND EXECUTE INSTRUCTION IN PDP-14
                    6165        ILEX=6165       /INTERRUPT THE PDP-14, LOAD AND EXECUTE INSTRUCTIO
                    6167        CIDF=6167       /CLEAR INSTRUCTION DONE FLAG
                    6171        SOTF=6171       /SKIP IF PDP-14 OUTPUT REGISTER LOADED
                    6172        COTF=6172       /CLEAR OUTPUT FLAG
                    6173        STFF=6173       /SKIP IF PDP-14 TEST FLOP SET
                    4174        CTFF=4174       /CLEAR TEST FLOP
                    6175        SCRF=6175       /SKIP IF PDP-14 IS RUNNING
                    6176        ROTR=6176       /CLEAR AC, READ OUTPUT REGISTER INTO PDP-8 AC


                    0040        *40
                                /CONSTANTS, VARIABLES, ETC.
    0040    0000    BCNTR,  0       /POINTER TO CURRENT OUTPUT STATUS WORD
    0041    0000    BPNTR,  0       /COUNTER TO COUNT STATUS WORDS
    0042    0000    CNTR,   0
    0043    0000    CHAR,   0
    0044    0000    HEADER, 0       /HOLD HEADER TYPEOUT ADDRESS
    0045    0000    INOW,   0       /CURRENT INSTRUCTION

    0046    0017    K0017,  17
    0047    0020    K0020,  20
    0050    0240    K0240,  240
    0051    0377    K0377,  377
    0052    4252    K4252,  4252
    0053    7400    K7400,  7400

    0054    0000    LCNTR,  0       /TEST LOOP COUNTER
    0055    0000    LTEMP,  0
    0056    0000    LTEMP1, 0

    0057    7771    M0007,  -7
    0060    7761    M0017,  -17
    0061    7760    M0020,  -20
    0062    7500    M0300,  -300
    0063    7467    M0311,  -311
    0064    7463    M0315,  -315
    0065    7461    M0317,  -317
    0066    7457    M0321,  -321
    0067    7454    M0324,  -324
    0070    0000    ONOW,   0       /CURRENT 0-ADDRESS
    0071    0000    PNTR,   0
```

```
    56    0072  0000    SLOT,   0       /SLOT USED FOR A-BOX
    57    0073  0000    TSTNOW, 0       /CURRENT ADDRESS BEING TESTED
    58
```

```
59
60                              /
61      0074    1000    TYF,    1000
62      0075    1400    TYN,    1400
63      0076    3000    SYF,    3000
64      0077    3400    SYN,    3400
65      0100    5000    JFF,    5000
66      0101    7400    TYD,    7400
67                              /
68      0102    2445    PMESAG, MESAG
69      0103    2512    PPRINT, PRINT
70      0104    2400    PINTER, INTER
71      0105    2537    TSTFLP, FLPERR
72      0106    1203    TYDTST, TSTTYD
```

```
                                /CHECK PDP-14 RUNNING, THEN PUT 14 IN EXTERNAL MODE
                                
0107  0000    EXTERN, 0
0110  6175            SCRF            /WAIT FOR 14 TO RUN
0111  5110            JMP     .-1
0112  7200            CLA
0113  1116            TAD     K0600
0114  4504            JMS I   PINTER  /FORCE PDP-14 INTO EXTERNAL MODE
0115  5507            JMP I   EXTERN  /EXIT
0116  0600    K0600,  600

                                /TYPE SUBROUTINE

0117  0000    TYPE,   0
0120  6046            TLS
0121  6041            TSF
0122  5121            JMP     .-1
0123  7200            CLA
0124  5517            JMP I   TYPE

                                /CR-LF SUBROUTINE

0125  0000    CRLF,   0
0126  1133            TAD     K0215
0127  4117            JMS     TYPE
0130  1134            TAD     K0212
0131  4117            JMS     TYPE
0132  5525            JMP I   CRLF
0133  0215    K0215,  215
0134  0212    K0212,  212
0135  0007    K0007,  7
0136  0260    K0260,  260

0137  0000    GETCHR, 0
0140  6031            KSF
0141  5140            JMP     .-1
0142  6036            KRB
0143  3043            DCA     CHAR
0144  1043            TAD     CHAR
0145  4117            JMS     TYPE
0146  1043            TAD     CHAR
0147  5537            JMP I   GETCHR

              0174  *174
0174  0000            0
0175  1100            TAD     JFF
0176  4504            JMS I   PINTER
0177  5574            JMP I   174
```

```
                                *200
0200  7410  ABXTST, SKP                 /GO TO INTERROGATION ROUTINE
0201  5777'       JMP     STRTST
0202  4125        JMS     CRLF        /CR-LF
0203  1324  QUES1, TAD     PMES1
0204  4502        JMS I   PMESAG      /TYPE OUT FIRST QUESTION
0205  4137        JMS     GETCHR      /GET ANSWER
0206  3072        DCA     SLOT        /AND SAVE
0207  4125        JMS     CRLF        /CR-LF
0210  1072        TAD     SLOT        /CHECK FOR GOOD CHARACTER
0211  1062        TAD     M0300
0212  7710        SPA CLA             /IS IT >300?
0213  5203        JMP     QUES1       /NO
0214  1072        TAD     SLOT
0215  1063        TAD     M0311
0216  7650        SNA CLA             /IS IT I?
0217  5203        JMP     QUES1       /YES
0220  1072        TAD     SLOT
0221  1065        TAD     M0317
0222  7650        SNA CLA             /IS IT O?
0223  5203        JMP     QUES1       /YES
0224  1072        TAD     SLOT
0225  1066        TAD     M0321
0226  7650        SNA CLA             /IS IT Q?
0227  5203        JMP     QUES1       /YES
0230  1072        TAD     SLOT
0231  1067        TAD     M0324
0232  7700        SMA CLA             /IS IT <324?
0233  5203        JMP     QUES1       /NO
0234  1776'  QUES2, TAD     PMES2
0235  4502        JMS I   PMESAG      /MAKE SECOND STATEMENT
0236  4125        JMS     CRLF
0237  1775'       TAD     PMES2A
0240  4502        JMS I   PMESAG
0241  1061        TAD     M0020
0242  3042        DCA     CNTR
0243  1047        TAD     K0020
0244  3071        DCA     PNTR
0245  4125  QUESN, JMS     CRLF        /CR-LF
0246  1071        TAD     PNTR
0247  0046        AND     K0017
0250  4503        JMS I   PPRINT      /TYPE OUT ADDRESS
0251  1050        TAD     K0240
0252  4117        JMS     TYPE        /AND A SPACE
0253  4137        JMS     GETCHR
0254  1067        TAD     M0324
0255  7640        SZA CLA             /T?
0256  5261        JMP     .+3         /NO
0257  7001        IAC                 /SET AC TO 1
0260  5265        JMP     .+5
0261  1043        TAD     CHAR
0262  1064        TAD     M0315
0263  7650        SNA CLA             /M?
0264  7330        CLA CLL CML RAR /SET AC TO 4000
```

```
179   0265  3471          DCA I   PNTR
180   0266  2071          ISZ     PNTR
181   0267  2042          ISZ     CNTR    /DONE ALL ADDRESSES?
182   0270  5245          JMP     QUESN   /NO
183   0271  4125          JMS     CRLF    /YES
184   0272  5201          JMP     201
```

```
                        0301    *301
                                /TABLE TO CONVERT FROM SLOT LETTER TO ADDRESS
0301    0000                    0       /A
0302    0020                    20      /B
0303    0040                    40      /C
0304    0060                    60      /D
0305    0100                    100     /E
0306    0120                    120     /F
0307    0140                    140     /G
0310    0160                    160     /H
0311    0000                    0       /I
0312    0200                    200     /J
0313    0220                    220     /K
0314    0240                    240     /L
0315    0260                    260     /M
0316    0300                    300     /N
0317    0000                    0       /O
0320    0320                    320     /P
0321    0000                    0       /Q
0322    0340                    340     /R
0323    0360                    360     /S

0324    0325    PMES1,  .+1
0325    0155                    0155    /A,-
0326    0217                    0217    /B,0
0327    3040                    3040    /X,SP
0330    1123                    1123    /I,S
0331    4003                    4003    /SP,C
0332    1716                    1716    /O,N
0333    1605                    1605    /N,E
0334    0324                    0324    /C,T
0335    0504                    0504    /E,D
0336    4024                    4024    /SP,T
0337    1740                    1740    /O,SP
0340    2314                    2314    /S,L
0341    1724                    1724    /O,T
0342    4000                    4000    /SP,END
```

```

0375  2745
0376  2705
0377  0400
      0400          *400
                    /AFTER INTERROGATION, THE PROGRAM COMES HERE
                    /TO SET UP FOR TESTING

0400  7300          STRTST, CLA CLL
0401  4107                  JMS     EXTERN  /PUT 14 IN EXTERNAL MODE
0402  1472                  TAD I   SLOT    /DERIVE FIRST O-ADDRESS
0403  3070                  DCA     ONOW    /FROM SLOT USED FOR A-BOX
0404  1047                  TAD     K0020   /SET UP POINTER
0405  3041                  DCA     BPNTR
0406  1061                  TAD     M0020   /AND COUNTER FOR 20 OUTPUTS
0407  3040                  DCA     BCNTR
0410  1441          TSTLUP, TAD I   BPNTR   /PICK UP ADDRESS STATUS WORD
0411  7650                  SNA CLA         /TIMER OR RETENTIVE MEMORY?
0412  5777'                 JMP     INCADD  /NO
0413  4222                  JMS     CLROUT  /SET ALL OUTPUTS OFF
0414  4776'                 JMS     D120MS  /DELAY 120 MS
0415  4174                  CTFF            /CLEAR TEST FLOP



                    /NEXT ISSUE A TYO N AND CHECK THE STATUS WORD

0416  4506          T0003,  JMS I   TYOTST  /EXECUTE A TYO N
0417  0400                  0400            /MOST SIGNIFICANT BITS OF STATUS WORD
0420  5775'                 JMP     T0004
0421  4000                  4000
                    /SET ALL OUTPUTS OFF SUBROUTINE
0422  0000          CLROUT, 0
0423  7200                  CLA
0424  1053                  TAD     K7400
0425  3054                  DCA     LCNTR   /SET UP LOOP COUNT
0426  1076                  TAD     SYF
0427  3045                  DCA     INOW    /SET UP INSTRUCTION TO BE EXECUTED
0430  1045                  TAD     INOW
0431  4504                  JMS I   PINTER  /EXECUTE THE SYF
0432  2045                  ISZ     INOW    /INCREMENT THE SYF
0433  7000                  NOP
0434  2054                  ISZ     LCNTR   /DONE?
0435  5230                  JMP     .-5     /NO
0436  5622                  JMP I   CLROUT  /YES
```

```
        0575  0600
        0576  2557
        0577  1675
              0600     *600
                       /SET CURRENT OUTPUT ON, TIME HOW LONG IT TAKES
                       /TO THE NEAREST MILLISECOND (LOW)
                       /ALLOW A MAXIMUM OF 1 MINUTE (ACTUALLY 61.5 SECONDS)

        0600  7300     T0004,  CLA CLL
        0601  1070             TAD     ONOW
        0602  1077             TAD     SYN
        0603  4504             JMS I   PINTER  /EXECUTE SYN N
        0604  7604             LAS
        0605  7710             SPA CLA         /LOOP?
        0606  5200             JMP     T0004   /YES
        0607  4174             CTFF            /CLEAR TEST FLOP
        0610  1060             TAD     M0017   /SET UP FOR 1 MINUTE
        0611  3016             DCA     16
        0612  3017             DCA     17
        0613  4345     L0004,  JMS     TIMEIT
        0614  6173             STFF            /IS TEST FLOP SET?
        0615  5246             JMP     TIME    /NO
        0616  4125             JMS     CRLF    /YES TYPE OUT TIME
        0617  1275             TAD     PM4A
        0620  4502             JMS I   PMESAG  /TYPE "OUTPUT"
        0621  1070             TAD     ONOW
        0622  4503             JMS I   PPRINT  /TYPE OUTPUT NUMBER
        0623  1302             TAD     PM4B
        0624  4502             JMS I   PMESAG  /TYPE OUT REST OF MESSAGE
        0625  1016             TAD     16
        0626  1046             TAD     K0017
        0627  3016             DCA     16
        0630  4777'            JMS     UDPRNT  /TYPE OUT NUMBER OF MS
        0631  0016             16
        0632  1314             TAD     PM4C
        0633  4502             JMS I   PMESAG  /TYPE OUT "MILLISECONDS"
        0634  4125             JMS     CRLF
                       /THIS LOOP IS FOR SETTING TIMERS
                       /(TIMER SETTING WILL BE TYPED OUT
        0635  7604             LAS
        0636  0274             AND     K0400   /SR 3=1
        0637  7650             SNA CLA         /LOOP THIS OUTPUT?
        0640  5776'            JMP     T0005   /NO
        0641  1070             TAD     ONOW    /YES
        0642  1076             TAD     SYF
        0643  4504             JMS I   PINTER  /TURN OUTPUT OFF
        0644  4775'            JMS     D120MS  /DELAY 120 MS
        0645  5200             JMP     T0004   /LOOP
        0646  2017     TIME,   ISZ     17
        0647  5213             JMP     L0004
        0650  2016             ISZ     16
        0651  5213             JMP     L0004
        0652  7604             LAS             /HERE IF TIMED OUT
        0653  7006             RTL
```

```
  321  0654  7710          SPA CLA          /TYPE OUT ERRORS?
  322  0655  5264          JMP     E0004-3  /NO
  323  0656  4125          JMS     CRLF
  324  0657  1324          TAD     PM4D
  325  0660  4502          JMS I   PMESAG   /TYPE OUT ERROR MESSAGE
  326  0661  1070          TAD     ONOW
  327  0662  4503          JMS I   PPRINT   /TYPE OUT ADDRESSS
  328  0663  4125          JMS     CRLF
  329  0664  7604          LAS
  330  0665  7004          RAL
  331  0666  7700          SMA CLA          /HALT ON ERROR?
  332  0667  7402  E0004,  HLT              /YES
  333  0670  7604          LAS
  334  0671  7710          SPA CLA          /LOOP?
  335  0672  5200          JMP     T0004    /YES
  336  0673  5776'         JMP     T0005    /NO
  337  0674  0400  K0400,  400
```

```
                0675  0676    PM4A,   .+1
                0676  1725            1725            /O;U
                0677  2420            2420            /T;P
                0700  2524            2524            /U;T
                0701  4000            4000            /SP,END
                
                0702  0703    PM4B,   .+1
                0703  4023            4023            /SP,S
                0704  0524            0524            /E;T
                0705  4017            4017            /SP,O
                0706  1640            1640            /N;SP
                0707  1116            1116            /I;N
                0710  4001            4001            /SP,A
                0711  0217            0217            /B;O
                0712  2524            2524            /U;T
                0713  4000            4000            /SP,END
                
                0714  0715    PM4C,   .+1
                0715  4015            4015            /SP,M
                0716  1114            1114            /I;L
                0717  1411            1411            /L,I
                0720  2305            2305            /S;E
                0721  0317            0317            /C;O
                0722  1604            1604            /N;D
                0723  2300            2300            /S;END
                
                0724  0725    PM4D,   .+1
                0725  5252            5252            /*;*
                0726  0310            0310            /C;H
                0727  5252            5252            /*;*
                0730  4024            4024            /SP,T
                0731  1115            1115            /I;M
                0732  0540            0540            /E;SP
                0733  1725            1725            /O;U
                0734  2440            2440            /T;SP
                0735  0522            0522            /E;R
                0736  2217            2217            /R;U
                0737  2254            2254            /R;,
                0740  4017            4017            /SP,O
                0741  2524            2524            /U;T
                0742  2025            2025            /P;U
                0743  2440            2440            /T;SP
                0744  0000            0               /END
```

```
0745  0000  TIMEIT, 0                    /EXIT IN 1 MS OR WITH TEST FLOP SET
0746  7300          CLA CLL
0747  1070          TAD     ONOW
0750  1075          TAD     TYN
0751  4504          JMS I   PINTER  /EXECUTE TYN N
0752  1362          TAD     TIMCON
0753  3010          DCA     10
0754  6173          STFF
0755  7410          SKP
0756  5745          JMP I   TIMEIT
0757  2010          ISZ     10
0760  5354          JMP     .-4
0761  5745          JMP I   TIMEIT
0762  7640  TIMCON, -140
```

```
 396  0775  2557
 397  0776  1000
 398  0777  2600
       1000  *1000
 399         /ALL TYN INSTRUCTIONS WILL BE ISSUED
 400         /ONLY TYN N SHOULD SET THE TEST FLOP
 401
 402  1000  7300  T0005,  CLA CLL
 403  1001  1053          TAD     K7400
 404  1002  3054          DCA     LCNTR   /SET UP LOOP COUNTER
 405  1003  1075          TAD     TYN
 406  1004  3045          DCA     INOW    /SET UP TEST INSTRUCTION TO BE EXECUTED
 407  1005  4174  L0005,  CTFF            /CLEAR TEST FLOP
 408  1006  1045          TAD     INOW
 409  1007  0051          AND     K0377
 410  1010  3073          DCA     TSTNOW
 411  1011  1045          TAD     INOW
 412  1012  4504          JMS I   PINTER  /EXECUTE THE TYN
 413  1013  7604          LAS
 414  1014  7710          SPA CLA         /LOOP?
 415  1015  5205          JMP     L0005   /YES
 416  1016  1073          TAD     TSTNOW
 417  1017  7041          CIA
 418  1020  1070          TAD     ONOW
 419  1021  7640          SZA CLA         /ADDRESSING CURRENT OUTPUT?
 420  1022  5230          JMP     .+6     /NO
 421  1023  1247          TAD     PM5A
 422  1024  3044          DCA     HEADER
 423  1025  6173          STFF            /TEST FLOP SET?
 424  1026  4505          JMS I   TSTFLP  /NO, ERROR
 425  1027  5235          JMP     .+6
 426  1030  1271          TAD     PM5B
 427  1031  3044          DCA     HEADER
 428  1032  6173          STFF            /TEST FLOP SET?
 429  1033  7410          SKP             /NO
 430  1034  4505          JMS I   TSTFLP  /YES, ERROR
 431  1035  7604          LAS
 432  1036  7710          SPA CLA         /LOOP?
 433  1037  5205          JMP     L0005   /YES
 434  1040  2045          ISZ     INOW    /INCREMENT TO NEXT INSTRUCTION
 435  1041  2054          ISZ     LCNTR   /DONE ALL INSTRUCTIONS?
 436  1042  5205          JMP     L0005   /NO
 437  1043  1070          TAD     ONOW
 438  1044  1075          TAD     TYN
 439  1045  4504          JMS I   PINTER  /EXIT WITH TEST FLOP SET
 440  1046  5777!         JMP     T0006
```

```
                                /**BX** TEST FLOP NOT SET BY TYN
1047  1050  PM5A,    .+1
1050  5252            5252
1051  0230            0230
1052  5252            5252
1053  4024            4024
1054  0523            0523
1055  2440            2440
1056  0614            0614
1057  1720            1720
1060  4016            4016
1061  1724            1724
1062  4023            4023
1063  0524            0524
1064  4002            4002
1065  3140            3140
1066  2431            2431
1067  1640            1640
1070  0000            0
                      /**BQ** TEST FLOP SET BY TYN
1071  1072  PM5B,    .+1
1072  5252            5252
1073  0221            0221
1074  5252            5252
1075  4024            4024
1076  0523            0523
1077  2440            2440
1100  0614            0614
1101  1720            1720
1102  4023            4023
1103  0524            0524
1104  4002            4002
1105  3140            3140
1106  2431            2431
1107  1640            1640
1110  0000            0
```

```
 477    1177  1200
              1200  *1200
 478                /ISSUE ANOTHER TYD N AND CHECK THE STATUS WORD
 479
 480    1200  4506  T0006, JMS I   TYDTST  /EXECUTE A TYD N
 481    1201  6400        6400            /MOST SIGNIFICANT BITS OF STATUS WORD
 482    1202  5777'       JMP     T0007
 483                /TYD INSTRUCTION TEST SUBROUTINE
 484
 485    1203  0000  TSTTYD, 0
 486    1204  7200        CLA
 487    1205  1070  TYDLUP, TAD     ONOW
 488    1206  1101        TAD     TYD
 489    1207  4504        JMS I   PINTER  /EXECUTE A TYD N
 490    1210  7604        LAS
 491    1211  7710        SPA CLA         /LOOP?
 492    1212  5205        JMP     TYDLUP  /YES
 493    1213  6171        SOTF            /OUTPUT REGISTER FLAG SET?
 494    1214  7402        HLT             /NO
 495    1215  1070        TAD     ONOW
 496    1216  1603        TAD I   TSTTYD
 497    1217  3055        DCA     LTEMP   /FORM EXPECTED RESULT AND STORE
 498    1220  6176        ROTR            /READ OUTPUT REGISTER
 499    1221  3056        DCA     LTEMP1
 500    1222  1056        TAD     LTEMP1
 501    1223  7041        CIA
 502    1224  1055        TAD     LTEMP
 503    1225  7640        SZA CLA         /CORRECT STATUS WORD?
 504    1226  4234        JMS     TYDERR  /NO
 505    1227  7604        LAS
 506    1230  7710        SPA CLA         /LOOP?
 507    1231  5205        JMP     TYDLUP  /YES
 508    1232  2203        ISZ     TSTTYD  /NO
 509    1233  5603        JMP I   TSTTYD  /EXIT
```

```
                      /TYD ERROR SUBROUTINE

        1234  0000    TYDERR, 0
        1235  7604            LAS
        1236  7006            RTL
        1237  7710            SPA CLA           /TYPE OUT ERRORS?
        1240  5261            JMP     ERRTYD-3         /NO
        1241  4125            JMS     CRLF
        1242  1274            TAD     TYDMES
        1243  4502            JMS I   PMESAG  /TYPE OUT HEADING
        1244  1070            TAD     ONOW
        1245  4503            JMS I   PPRINT  /TYPE OUT ADDRESS
        1246  4125            JMS     CRLF
        1247  1266            TAD     PGDBD2
        1250  4502            JMS I   PMESAG  /TYPE OUT "GOOD BAD"
        1251  4125            JMS     CRLF
        1252  1055            TAD     LTEMP
        1253  4503            JMS I   PPRINT  /TYPE OUT GOOD DATA
        1254  1050            TAD     K0240
        1255  4117            JMS     TYPE    /1 SPACE
        1256  1056            TAD     LTEMP1
        1257  4503            JMS I   PPRINT  /TYPE OUT BAD DATA
        1260  4125            JMS     CRLF
        1261  7604            LAS
        1262  7004            RAL
        1263  7700            SMA CLA         /HALT ON ERROR?
        1264  7402    ERRTYD, HLT             /YES
        1265  5634            JMP I   TYDERR

        1266  1267    PGDBD2, .+1
        1267  0717            0717            /G,O
        1270  1704            1704            /O,D
        1271  4002            4002            /SP,B
        1272  0104            0104            /A,D
        1273  0000            0               /END
                      /**BN** STATUS ERROR, TYD
        1274  1275    TYDMES, .+1
        1275  5252            5252
        1276  0216            0216
        1277  5252            5252
        1300  4023            4023
        1301  2401            2401
        1302  2425            2425
        1303  2340            2340
        1304  0522            0522
        1305  2217            2217
        1306  2254            2254
        1307  4024            4024
        1310  3104            3104
        1311  4000            4000
```

```
                1377  1400
                      1400          *1400
                                    /TEST ALL TYF INSTRUCTIONS, ALL SHOULD SET TEST FLOP EXCEPT TYF N
                1400  7300  T0007,  CLA CLL
                1401  1053          TAD     K7400
                1402  3054          DCA     LCNTR   /SET UP LOOP COUNTER
                1403  1074          TAD     TYF
                1404  3045          DCA     INOW    /SET UP INSTRUCTION TO BE EXECUTED
                1405  4174  L0007,  CTFF            /CLEAR THE TEST FLOP
                1406  1045          TAD     INOW
                1407  0051          AND     K0377
                1410  3073          DCA     TSTNOW
                1411  1045          TAD     INOW
                1412  4504          JMS I   PINTER  /EXECUTE THE TYF
                1413  7604          LAS
                1414  7710          SPA CLA         /LOOP?
                1415  5205          JMP     L0007   /YES
                1416  1073          TAD     TSTNOW
                1417  7041          CIA
                1420  1070          TAD     ONOW
                1421  7650          SNA CLA         /ADDRESSING CURRENT OUTPUT?
                1422  5230          JMP     .+6     /YES
                1423  1244          TAD     PM7A
                1424  3044          DCA     HEADER
                1425  6173          STFF            /TEST FLOP SET?
                1426  4505          JMS I   TSTFLP  /NO, ERRROR
                1427  5235          JMP     .+6     /YES, OK
                1430  1266          TAD     PM7B
                1431  3044          DCA     HEADER
                1432  6173          STFF            /TEST FLOP SET?
                1433  7410          SKP             /NO
                1434  4505          JMS I   TSTFLP  /YES, ERROR
                1435  7604          LAS
                1436  7710          SPA CLA         /LOOP?
                1437  5205          JMP     L0007   /YES
                1440  2045          ISZ     INOW    /INCREMENT TO NEXT INSTRUCTION
                1441  2054          ISZ     LCNTR   /DONE ALL INSTRUCTIONS?
                1442  5205          JMP     L0007   /NO
                1443  5777,         JMP     T0008
```

```
 599                            /**BL** TEST FLOP NOT SET BY TYF
 600    1444  1445    PM7A,     ,*1
 601    1445  5252              5252
 602    1446  0214              0214
 603    1447  5252              5252
 604    1450  4024              4024
 605    1451  0523              0523
 606    1452  2440              2440
 607    1453  0614              0614
 608    1454  1720              1720
 609    1455  4016              4016
 610    1456  1724              1724
 611    1457  4023              4023
 612    1460  0524              0524
 613    1461  4002              4002
 614    1462  3140              3140
 615    1463  2431              2431
 616    1464  0640              0640
 617    1465  0000              0
 618
 619                            /**BY** TEST FLOP SET BY TYF
 620    1466  1467    PM7B,     ,*1
 621    1467  5252              5252
 622    1470  0231              0231
 623    1471  5252              5252
 624    1472  4024              4024
 625    1473  0523              0523
 626    1474  2440              2440
 627    1475  0614              0614
 628    1476  1720              1720
 629    1477  4023              4023
 630    1500  0524              0524
 631    1501  4002              4002
 632    1502  3140              3140
 633    1503  2431              2431
 634    1504  0640              0640
 635    1505  0000              0
```

```
                      /ONLY SYF "N" SHOULD CLEAR OUTPUT "N" IF "N" IS A TIMER,

                      /TAPE 2
      1577  1600
            1600      *1600
                      /TEST SYF 0 TO 377 (EXCEPT "N" AND 377) TO NOT AFFECT OUTPUT "N"
                      /SYF "N" AND SYF 377 SHOULD CLEAR OUTPUT "N" IF "N" IS A TIMER,
                      /ONLY SYF "N" SHOULD CLEAR OUTPUT "N" IF "N" IS A MEMORY

      1600  7300      T0008,  CLA CLL
      1601  1053              TAD     K7400
      1602  3054              DCA     LCNTR   /SET UP LOOP COUNTER
      1603  1076              TAD     SYF
      1604  3045              DCA     INOW    /SET UP INSTRUCTION TO BE EXECUTED
      1605  4174      L0008,  CTFF            /CLEAR TEST FLOP
      1606  1070              TAD     ONOW
      1607  1075              TAD     TYN
      1610  4504              JMS I   PINTER  /EXECUTE TYN N
      1611  6173              STFF            /IS OUTPUT "N" ON?
      1612  7410              SKP             / NO
      1613  5224              JMP     .+11    /YES
      1614  1070              TAD     ONOW
      1615  1077              TAD     SYN
      1616  4504              JMS I   PINTER  /SET OUTPUT "N"
      1617  1070              TAD     ONOW    /WAIT
      1620  1075              TAD     TYN     /FOR
      1621  4504              JMS I   PINTER  /OUTPUT
      1622  6173              STFF            /TO TURN
      1623  5217              JMP     .-4     /ON
      1624  1045              TAD     INOW
      1625  4504              JMS I   PINTER  /TURN OFF OUTPUT "Y"
      1626  4777'             JMS     D120MS  /DELAY 120 MS
      1627  7604              LAS
      1630  7710              SPA CLA         /LOOP?
      1631  5205              JMP     L0008   /YES
      1632  4174              CTFF            /CLEAR TEST FLOP
      1633  1070              TAD     ONOW
      1634  1074              TAD     TYF
      1635  4504              JMS I   PINTER  /EXECUTE TYF "N"
      1636  1045              TAD     INOW
      1637  0051              AND     K0377
      1640  7041              CIA
      1641  1070              TAD     ONOW
      1642  7650              SNA CLA         /CURRENT OUTPUT?
      1643  5263              JMP     OUTCLR  /YES
      1644  1045              TAD     INOW
      1645  0051              AND     K0377
      1646  7041              CIA
      1647  1051              TAD     K0377
      1650  7640              SZA CLA         /OUTPUT 377?
      1651  5255              JMP     OUTSET  /NO
      1652  1441              TAD I   BPNTR   /YES
      1653  7700              SMA CLA         /R.M.?
      1654  5263              JMP     OUTCLR  /NO
```

```
1655  1367   OUTSET, TAD    PM8A
1656  3044           DCA    HEADER
1657  6173           STFF           /TEST FLOP SET?
1660  7410           SKP            /NO, OK
1661  4314           JMS    ERR8    /YES, ERROR
1662  5267           JMP    I0008-3
1663  1341   OUTCLR, TAD    PM8B
1664  3044           DCA    HEADER
1665  6173           STFF           /TEST FLOP SET?
1666  4314           JMS    ERR8    /NO,ERROR
1667  7604           LAS            /YES, OK
1670  7710           SPA CLA        /LOOP?
1671  5205           JMP    L0008   /YES
1672  2045   I0008,  ISZ    INOW    /INCREMENT INSTRUCTION TO BE EXECUTED
1673  2054           ISZ    LCNTR   /DONE ALL INSTRUCTIONS?
1674  5205           JMP    L0008   /NO

             /PROGRAM COMES HERE TO INCREMENT TO NEXT OUTPUT ADDRESS
1675  2070   INCADD, ISZ    ONOW    /INCREMENT OUTPUT ADDRESS
1676  2041           ISZ    BPNTR   /INCREMENT STATUS WORD POINTER
1677  2040           ISZ    BCNTR   /DONE ALL OUTPUTS
1700  5776'          JMP    TSTLUP  /NO

             /AFTER TESTING ALL OUTPUTS, CHECK TO SEE
             /IF THE RETENTIVE MEMORY POWER TESTS SHOULD BE RUN
1701  1047           TAD    K0020   /SET UP
1702  3041           DCA    BPNTR   /SCAN POINTER
1703  1061           TAD    M0020
1704  3040           DCA    BCNTR   /AND COUNTER
1705  1441           TAD I  BPNTR   /GET OUTPUT STATUS
1706  7710           SPA CLA        /R.M.?
1707  5775'          JMP    T0010   /YES
1710  2041           ISZ    BPNTR   /NO
1711  2040           ISZ    BCNTR
1712  5305           JMP    .-5     /TRY NEXT OUTPUT
1713  5774'          JMP    I0011+4 /NO R.M.'S CONNECTTED
```

```
                                /SUBROUTINE TO HANDLE CLEAR OUTPUT CROSSTALK ERRORS

1714  0000  ERR8,   0
1715  7604          LAS
1716  7006          RTL
1717  7710          SPA CLA           /TYPE OUT ERRORS?
1720  5334          JMP     E0008-3   /NO
1721  4125          JMS     CRLF      /YES
1722  1356          TAD     PM8C
1723  4502          JMS I   PMESAG    /TYPE OUT ERROR CODE AND "OUTPUT"
1724  1070          TAD     ONOW
1725  4503          JMS I   PPRINT    /TYPE OUTPUT NUMBER
1726  1044          TAD     HEADER
1727  4502          JMS I   PMESAG    /TYPE REST OF MESSAGE
1730  1045          TAD     INOW
1731  0051          AND     K0377
1732  4503          JMS I   PPRINT    /TYPE OUT OTHER NUMBER
1733  4125          JMS     CRLF
1734  7604          LAS
1735  7004          RAL
1736  7700          SMA CLA           /HALT ON ERROR?
1737  7402  E0008,  HLT               /YES
1740  5714          JMP I   ERR8

                                /NOT TURNED OFF BY SYF
1741  1742  PM8B,   .+1
1742  4016          4016
1743  1724          1724
1744  4024          4024
1745  2522          2522
1746  1605          1605
1747  0440          0440
1750  1706          1706
1751  0640          0640
1752  0231          0231
1753  4023          4023
1754  3106          3106
1755  4000          4000
                    /**CB** OUTPUT
1756  1757  PM8C,   .+1
1757  5252          5252
1760  0302          0302
1761  5252          5252
1762  4017          4017
1763  2524          2524
1764  2025          2025
1765  2440          2440
1766  0000          0
1767  1744  PM8A,   PM8B+3
```

```
                                *2000
                                /NOW TO GET TO THE TESTS WHICH ARE PARTICULAR TO
                                /THE RETENTIVE MEMORIES..
                                /
                                /FIRST, ALL RETENTIVE MEMORIES WILL BE SET TO 0
                                /THEN THE OPERATOR WILL POWER DOWN THE PDP-14
                                /THEN HE WILL POWER IT BACK UP AGAIN

2000  7200  T0010,  CLA
2001  1261          TAD     PM10
2002  3044          DCA     HEADER
2003  4777'         JMS     CLROUT  /CLEAR ALL OUTPUTS
2004  4125          JMS     CRLF
2005  1776'         TAD     PMES3
2006  4502          JMS I   PMESAG  /TYPE OUT POWER DOWN MESSAGE
2007  4125          JMS     CRLF
2010  6175          SCRF            /WAIT FOR PDP-14 POWER DOWN
2011  7412          SKP HLT
2012  5210          JMP     .-2
2013  4107          JMS     EXTERN  /PUT THE 14 IN EXTERNAL MODE WHEN POWER RETURNS
2014  1472          TAD I   SLOT
2015  3070          DCA     ONOW
2016  1047          TAD     K0020
2017  3041          DCA     BPNTR
2020  1061          TAD     M0020
2021  3040          DCA     BCNTR
2022  7300  L0010,  CLA CLL
2023  1441          TAD I   BPNTR
2024  7700          SMA CLA         /RETENTIVE MEMORY?
2025  5234          JMP     I0010   /NO
2026  4174          CTFF            /CLEAR TEST FLOP
2027  1070          TAD     ONOW
2030  1074          TAD     TYF
2031  4504          JMS I   PINTER  /EXCUTE A TYF N
2032  6173          STFF            /TEST FLOP SET?
2033  4241          JMS     ERR10   /NO, ERROR
2034  2070  I0010,  ISZ     ONOW    /INCREMENT OUTPUT ADDRESS
2035  2041          ISZ     BPNTR   /INCREMENT STATUS WORD POINTER
2036  2040          ISZ     BCNTR   /INCREMENT COUNTER
2037  5222          JMP     L0010   /NOT DONE
2040  5775'         JMP     T0011
```

```
821     2041  0000    ERR10,  0
822     2042  7604            LAS
823     2043  7006            RTL
824     2044  7710            SPA CLA             /TYPE OUT ERRORS?
825     2045  5254            JMP     E0010-3     /NO
826     2046  4125            JMS     CRLF
827     2047  1044            TAD     HEADER
828     2050  4502            JMS I   PMESAG      /TYPE OUT ERROR
829     2051  1070            TAD     ONOW
830     2052  4503            JMS I   PPRINT      /TYPE OUT ADDRESS
831     2053  4125            JMS     CRLF
832     2054  7604            LAS
833     2055  7004            RAL
834     2056  7700            SMA CLA             /HALT ON ERROR?
835     2057  7402    E0010,  HLT                 /YES
836     2060  5641            JMP I   ERR10
837
838     2061  2062    PM10,   .+1
839     2062  5252            5252                /*,*
840     2063  0306            0306                /C;F
841     2064  5252            5252                /*,*
842     2065  4032            4032                /SP,E
843     2066  0522            0522                /E;R
844     2067  1740            1740                /O;SP
845     2070  1417            1417                /L;0
846     2071  2324            2324                /S;T
847     2072  4011            4011                /SP,I
848     2073  1640            1640                /N;SP
849     2074  2017            2017                /P;O
850     2075  2705            2705                /W;E
851     2076  2240            2240                /R;SP
852     2077  2310            2310                /S;H
853     2100  2524            2524                /U;T
854     2101  5504            5504                /-;D
855     2102  1727            1727                /O;W
856     2103  1640            1640                /N;SP
857     2104  0231            0231                /B;Y
858     2105  4022            4022                /SP,R
859     2106  1540            1540                /M;SP
860     2107  0000            0                   /END
```

```
 861    2175  2200
 862    2176  2314
 863    2177  0422
               2200          *2200
 864                         /NOW ALL RETENTIVE MEMORIES WILL BE SET TO 1
 865                         /THEN THE OPERATOR WILL POWER DOWN THE PDP-14
 866                         /THEN HE WILL POWER IT BACK UP AGAIN
 867
 868    2200  7200    T0011, CLA
 869    2201  1266           TAD     PM11
 870    2202  3044           DCA     HEADER
 871    2203  1472           TAD I   SLOT     /SET UP LOCATIONS
 872    2204  3070           DCA     ONOW
 873    2205  1047           TAD     K0020    /TO ENABLE SETTING
 874    2206  3041           DCA     BPNTR
 875    2207  1061           TAD     M0020    /OF ALL R,M,'S
 876    2210  3040           DCA     BCNTR
 877    2211  7300    L0011A, CLA CLL
 878    2212  1441           TAD I   BPNTR
 879    2213  7700           SMA CLA          /RETENTIVE MEMORY?
 880    2214  5220           JMP     .+4      /NO
 881    2215  1070           TAD     ONOW
 882    2216  1077           TAD     SYN
 883    2217  4504           JMS I   PINTER   /EXECUTE A SYN "N"
 884    2220  2070           ISZ     ONOW
 885    2221  2041           ISZ     BPNTR
 886    2222  2040           ISZ     BCNTR    /TURNED ON ALL R,M,'S
 887    2223  5211           JMP     L0011A   /NO
 888    2224  4125           JMS     CRLF
 889    2225  1314           TAD     PMES3
 890    2226  4502           JMS I   PMESAG   /TYPE OUT POWER DOWN MESSAGE
 891    2227  4125           JMS     CRLF
 892    2230  6175           SCRF             /WAIT FOR PDP-14 POWER DOWN
 893    2231  7412           SKP HLT
 894    2232  5230           JMP     .-2
 895    2233  4107           JMS     EXTERN
 896    2234  1472           TAD I   SLOT
 897    2235  3070           DCA     ONOW
 898    2236  1047           TAD     K0020
 899    2237  3041           DCA     BPNTR
 900    2240  1061           TAD     M0020
 901    2241  3040           DCA     BCNTR
 902    2242  7300    L0011B, CLA CLL
 903    2243  1441           TAD I   BPNTR
 904    2244  7700           SMA CLA          /RETENTIVE MEMORY?
 905    2245  5254           JMP     I0011    /NO
 906    2246  4174           CTFF             /CLEAR TEST FLOP
 907    2247  1070           TAD     ONOW
 908    2250  1075           TAD     TYN
 909    2251  4504           JMS I   PINTER   /EXECUTE A TYP N
 910    2252  6173           STFF             /TEST FLOP SET?
 911    2253  4777'          JMS     ERR10    /NO, ERROR
```

```
912  2254  2070   I0011,  ISZ     ONOW    /INCREMENT OUTPUT ADDRESS
913  2255  2041           ISZ     BPNTR   /INCREMENT STATUS WORD POINTER
914  2256  2040           ISZ     BCNTR   /INCREMENT COUNTER
915  2257  5242           JMP     L0011B  /NO DONE
916                 /PROGRAM HAS COMPLETED 1 PASS
917  2260  7200           CLA
918  2261  1265           TAD     K0207
919  2262  4117           JMS     TYPE            /RING BELL
920  2263  7402           HLT
921  2264  5776'          JMP     STRTST
922
923  2265  0207   K0207,  207
924  2266  2267   PM11,   .+1
925  2267  5252           5252            /*,*
926  2270  0307           0307            /C,G
927  2271  5252           5252            /*,*
928  2272  4017           4017            /SP,O
929  2273  1605           1605            /N,E
930  2274  4014           4014            /SP,L
931  2275  1723           1723            /O,S
932  2276  2440           2440            /T,SP
933  2277  1116           1116            /I,N
934  2300  4020           4020            /SP,P
935  2301  1727           1727            /O,W
936  2302  0522           0522            /E,R
937  2303  4023           4023            /SP,S
938  2304  1025           1025            /H,U
939  2305  2455           2455            /T,-
940  2306  0417           0417            /D,O
941  2307  2716           2716            /W,N
942  2310  4002           4002            /SP,B
943  2311  3140           3140            /Y,SP
944  2312  2215           2215            /R,M
945  2313  4000           4000            /SP,END
946
```

```
947     2314    2315    PMES3,  .+1
948     2315    2017            2017            /P;O
949     2316    2705            2705            /W;E
950     2317    2255            2255            /R;-
951     2320    0417            0417            /D;O
952     2321    2716            2716            /W;N
953     2322    4024            4024            /SP,T
954     2323    1005            1005            /H;E
955     2324    4020            4020            /SP,P
956     2325    0420            0420            /D;P
957     2326    5561            5561            /-;1
958     2327    6454            6454            /4;,
959     2330    4024            4024            /SP,T
960     2331    1005            1005            /H;E
961     2332    1640            1640            /N;SP
962     2333    2017            2017            /P;O
963     2334    2705            2705            /W;E
964     2335    2240            2240            /R;SP
965     2336    1124            1124            /I;T
966     2337    4025            4025            /SP,U
967     2340    2040            2040            /P;SP
968     2341    0107            0107            /A;G
969     2342    0111            0111            /A;I
970     2343    1654            1654            /N;,
971     2344    4004            4004            /SP,D
972     2345    0520            0520            /E;P
973     2346    2205            2205            /R;E
974     2347    2323            2323            /S;S
975     2350    4020            4020            /SP,P
976     2351    0420            0420            /D;P
977     2352    5570            5570            /-;8
978     2353    4003            4003            /SP,C
979     2354    1716            1716            /O;N
980     2355    2411            2411            /T;I
981     2356    1625            1625            /N;U
982     2357    0500            0500            /E;END
```

```
                                /INTERRUPT THE PDP-14 AND EXECUTE 1 INSTRUCTION (IN AC)
2400 0000 INTER, 0
2401 6165        ILEX           /INTERRUPT AND EXECUTE
2402 4203        JMS    .+1
2403 0000        0
2404 6175        SCRF
2405 5222        JMP    NORUN
2406 6161        SIDF
2407 7410        SKP
2410 5220        JMP    EXIT1
2411 2203        ISZ    INTER+3
2412 5204        JMP    INTER+4
2413 4125        JMS    CRLF
2414 1225        TAD    PHUNG
2415 4502        JMS I  PMESAG
2416 4125        JMS    CRLF
2417 7402 INSTER, HLT
2420 7200 EXIT1, CLA
2421 5600        JMP I  INTER
2422 4125 NORUN, JMS    CRLF
2423 1234        TAD    PNORUN
2424 5215        JMP    INSTER+2

                                /PDP-14 HUNG
2425 2426 PHUNG, .+1
2426 2004        2004
2427 2055        2055
2430 6164        6164
2431 4010        4010
2432 2516        2516
2433 0700        0700

                                /PDP-14 STOPPED
2434 2435 PNORUN, .+1
2435 2004        2004
2436 2055        2055
2437 6164        6164
2440 4023        4023
2441 2417        2417
2442 2020        2020
2443 0504        0504
2444 0000        0
```

```
1029
1030                    /MESSAGE PRINT SUBROUTINE
1031                    /ENTER WITH MESSAGE ADDRESS IN AC
1032
1033    2445  0000      MESAG,  0
1034    2446  3304              DCA     MPNTR
1035    2447  1704              TAD I   MPNTR
1036    2450  0306              AND     K7700
1037    2451  7450              SNA
1038    2452  5645              JMP I   MESAG
1039    2453  7112              RTR CLL
1040    2454  7012              RTR
1041    2455  7012              RTR
1042    2456  3043              DCA     CHAR
1043    2457  1043              TAD     CHAR
1044    2460  1311              TAD     M0040
1045    2461  7710              SPA CLA
1046    2462  1307              TAD     K0100
1047    2463  1310              TAD     K0200
1048    2464  1043              TAD     CHAR
1049    2465  4117              JMS     TYPE
1050    2466  1704              TAD I   MPNTR
1051    2467  0305              AND     K0077
1052    2470  7450              SNA
1053    2471  5645              JMP I   MESAG
1054    2472  3043              DCA     CHAR
1055    2473  1043              TAD     CHAR
1056    2474  1311              TAD     M0040
1057    2475  7710              SPA CLA
1058    2476  1307              TAD     K0100
1059    2477  1310              TAD     K0200
1060    2500  1043              TAD     CHAR
1061    2501  4117              JMS     TYPE
1062    2502  2304              ISZ     MPNTR
1063    2503  5247              JMP     MESAG+2
1064    2504  0000      MPNTR,  0
1065    2505  0077      K0077,  77
1066    2506  7700      K7700,  7700
1067    2507  0100      K0100,  100
1068    2510  0200      K0200,  200
1069    2511  7740      M0040,  -40
1070
1071                    /TYPE OUT THE CONTENTS OF THE AC IN OCTAL
1072
1073    2512  0000      PRINT,  0
1074    2513  3334              DCA     NUMBER
1075    2514  1336              TAD     M0004
1076    2515  3335              DCA     PCNTR
1077    2516  1334              TAD     NUMBER
1078    2517  7104              RAL CLL
1079    2520  7004              RAL
1080    2521  7006              RTL
1081    2522  3334              DCA     NUMBER
1082    2523  1334              TAD     NUMBER
1083    2524  0135              AND     K0007
```

```
1084    2525  1136            TAD     K0260
1085    2526  4117            JMS     TYPE
1086    2527  1334            TAD     NUMBER
1087    2530  2335            ISZ     PCNTR
1088    2531  5320            JMP     .-11
1089    2532  7200            CLA
1090    2533  5712            JMP I   PRINT
1091    2534  0000    NUMBER, 0
1092    2535  0000    PCNTR,  0
1093    2536  7774    M0004,  -4
```

```
1094
1095                    /TEST FLOP ERROR ROUTINE
1096
1097    2537  0000      FLPERR, 0
1098    2540  7604              LAS
1099    2541  7006              RTL
1100    2542  7710              SPA CLA           /TYPE OUT ERRORS
1101    2543  5352              JMP     EFLOP-3   /NO
1102    2544  4125              JMS     CRLF      /YES
1103    2545  1044              TAD     HEADER
1104    2546  4502              JMS I   PMESAG    /TYPE OUT HEADER
1105    2547  1073              TAD     TSTNOW
1106    2550  4503              JMS I   PPRINT    /TYPE OUT INSTRUCTION ADDRESS
1107    2551  4125              JMS     CRLF
1108    2552  7604              LAS
1109    2553  7004              RAL
1110    2554  7700              SMA CLA           /HALT ON ERROR?
1111    2555  7402      EFLOP,  HLT               /YES
1112    2556  5737              JMP I   FLPERR
1113
1114
1115                    /DELAY SUBROUTINES
1116
1117    2557  0000      D120MS, 0                 /120 MS (ACTUALLY 128.8MS)
1118    2560  7300              CLA CLL
1119    2561  1057              TAD     M0007
1120    2562  3010              DCA     10
1121    2563  3011              DCA     11
1122    2564  2011              ISZ     11
1123    2565  5364              JMP     .-1
1124    2566  2010              ISZ     10
1125    2567  5364              JMP     .-3
1126    2570  5757              JMP I   D120MS
1127
1128    2571  0000      D10MS,  0                 /10 MS
1129    2572  7300              CLA CLL
1130    2573  1052              TAD     K4252
1131    2574  3010              DCA     10
1132    2575  2010              ISZ     10
1133    2576  5375              JMP     .-1
1134    2577  5771              JMP I   D10MS
```

```
1135
1136            2600    *2600
1137                    /DOUBLE PRECISION UNSIGNED DECIMAL TYPEOUT SUBROUTINE
1138
1139    2600    0000    UDPRNT, 0
1140    2601    7300            CLA CLL
1141    2602    1600            TAD I   UDPRNT
1142    2603    3263            DCA     UDGET
1143    2604    1663            TAD I   UDGET
1144    2605    3255            DCA     UDHIGH
1145    2606    2263            ISZ     UDGET
1146    2607    1663            TAD I   UDGET
1147    2610    3256            DCA     UDLOW
1148    2611    1252            TAD     UDLOOP
1149    2612    3254            DCA     UDCNT
1150    2613    1253            TAD     UDADDR
1151    2614    3264            DCA     UDPTR
1152    2615    2200            ISZ     UDPRNT
1153    2616    1664    UDARND, TAD I   UDPTR
1154    2617    2264            ISZ     UDPTR
1155    2620    3257            DCA     UDHSUB
1156    2621    1664            TAD I   UDPTR
1157    2622    2264            ISZ     UDPTR
1158    2623    3260            DCA     UDLSUB
1159    2624    7100    UDDO,   CLL
1160    2625    1260            TAD     UDLSUB
1161    2626    1256            TAD     UDLOW
1162    2627    3262            DCA     UDTEML
1163    2630    7004            RAL
1164    2631    1257            TAD     UDHSUB
1165    2632    1255            TAD     UDHIGH
1166    2633    7420            SNL
1167    2634    5242            JMP     UDOUT
1168    2635    2261            ISZ     UDBOX
1169    2636    3255            DCA     UDHIGH
1170    2637    1262            TAD     UDTEML
1171    2640    3256            DCA     UDLOW
1172    2641    5224            JMP     UDDO
1173    2642    7200    UDOUT,  CLA
1174    2643    1261            TAD     UDBOX
1175    2644    1136            TAD     K0260
1176    2645    4117            JMS     TYPE
1177    2646    3261            DCA     UDBOX
1178    2647    2254            ISZ     UDCNT
1179    2650    5216            JMP     UDARND
1180    2651    5600            JMP I   UDPRNT
1181    2652    7770    UDLOOP, -10
1182    2653    2665    UDADDR, UDCON1
```

```
1183    2654  0000    UDCNT:  0
1184    2655  0000    UDHIGH, 0
1185    2656  0000    UDLOW:  0
1186    2657  0000    UDHSUB, 0
1187    2660  0000    UDLSUB, 0
1188    2661  0000    UDBOX:  0
1189    2662  0000    UDTEML, 0
1190    2663  0000    UDGET:  0
1191    2664  0000    UDPTR:  0
1192    2665  3166    UDCON1, 3166
1193    2666  4600            4600
1194    2667  7413            7413
1195    2670  6700            6700
1196    2671  7747            7747
1197    2672  4540            4540
1198    2673  7775            7775
1199    2674  4360            4360
1200    2675  7777            7777
1201    2676  6030            6030
1202    2677  7777            7777
1203    2700  7634            7634
1204    2701  7777            7777
1205    2702  7766            7766
1206    2703  7777            7777
1207    2704  7777            7777
1208
1209
1210    2705  2706    PMES2,  .+1
1211    2706  1104            1104    /I,D
1212    2707  0516            0516    /E,N
1213    2710  2411            2411    /T,I
1214    2711  0631            0631    /F,Y
1215    2712  4024            4024    /SP,T
1216    2713  1005            1005    /H,E
1217    2714  4010            4010    /SP,H
1218    2715  0122            0122    /A,R
1219    2716  0427            0427    /D,W
1220    2717  0122            0122    /A,R
1221    2720  0540            0540    /E,SP
1222    2721  0123            0123    /A,S
1223    2722  2317            2317    /S,O
1224    2723  0311            0311    /C,I
1225    2724  0124            0124    /A,T
1226    2725  0504            0504    /E,D
1227    2726  4027            4027    /SP,W
1228    2727  1124            1124    /I,T
1229    2730  1040            1040    /H,SP
1230    2731  0501            0501    /E,A
1231    2732  0310            0310    /C,H
1232    2733  4001            4001    /SP,A
1233    2734  0404            0404    /D,D
1234    2735  2205            2205    /R,E
1235    2736  2323            2323    /S,S
1236    2737  4002            4002    /SP,B
1237    2740  3140            3140    /Y,SP
```

```
1238    2741  2431          2431    /T,Y
1239    2742  2011          2011    /P,I
1240    2743  1607          1607    /N,G
1241    2744  7200          7200    /I,END
1242    2745  2746    PMES2A, .+1
1243    2746  2440          2440    /T,SP
1244    2747  0617          0617    /F,O
1245    2750  2240          2240    /R,SP
1246    2751  2411          2411    /T,I
1247    2752  1505          1505    /M,E
1248    2753  2254          2254    /R,,
1249    2754  4015          4015    /SP,M
1250    2755  4006          4006    /SP,F
1251    2756  1722          1722    /O,R
1252    2757  4022          4022    /SP,R
1253    2760  0524          0524    /E,T
1254    2761  0516          0516    /E,N
1255    2762  2411          2411    /T,I
1256    2763  2605          2605    /V,E
1257    2764  4015          4015    /SP,M
1258    2765  0515          0515    /E,M
1259    2766  1722          1722    /O,R
1260    2767  3154          3154    /Y,,
1261    2770  4001          4001    /SP,A
1262    2771  1414          1414    /L,L
1263    2772  4005          4005    /SP,E
1264    2773  1423          1423    /L,S
1265    2774  0540          0540    /E,SP
1266    2775  0515          0515    /E,M
1267    2776  2024          2024    /P,T
1268    2777  3100          3100    /Y,END
1269
1270                  $
```

```
0000  00000000  00000000  00000000  00000000  11111111  11111111  11111111  11111111
0100  11111111  11111111  11111111  11111111  11111111  00000000  00000000  00001111

0200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11100000
0300  01111111  11111111  11111111  11111111  11100000  00000000  00000000  00000111

0400  11111111  11111111  11111111  11111110  00000000  00000000  00000000  00000000
0500  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000111

0600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0700  11111111  11111111  11111111  11111111  11111111  11111111  11100000  00000111

1000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1100  11111111  10000000  00000000  00000000  00000000  00000000  00000000  00000001

1200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1300  11111111  11000000  00000000  00000000  00000000  00000000  00000000  00000001

1400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1500  11111100  00000000  00000000  00000000  00000000  00000000  00000000  00000001

1600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  00001111

2000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2100  11111111  00000000  00000000  00000000  00000000  00000000  00000000  00000111

2200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2300  11111111  11111111  11111111  11111111  11111111  11111111  00000000  00000011

2400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

2600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

3000
3100

3200
3300

3400
3500

3600
3700
```

4000
4100

4200
4300

4400
4500

4600
4700

5000
5100

5200
5300

5400
5500

5600
5700

6000
6100

6200
6300

6400
6500

6600
6700

7000
7100

7200
7300

7400
7500

7600
7700

```
ABXTST  0200        L0007   1405        PPRINT  0103        UDTEML  2662
BCNTR   0040        L0008   1605        PRINT   2512
BPNTR   0041        L0010   2022        QUES1   0203
CHAR    0043        L0011A  2211        QUES2   0234
CIDF    6167        L0011B  2242        QUESN   0245
CLROUT  0422        LCNTR   0054        ROTR    6176
CNTR    0042        LDEX    6164        SCRF    6175
COTF    6172        LDIN    6162        SIDF    6161
CRLF    0125        LTEMP   0055        SLOT    0072
CTFF    4174        LTEMP1  0056        SOTF    6171
D10MS   2571        M0004   2536        STFF    6173
D120MS  2537        M0007   0057        STRTST  0400
E0004   0667        M0017   0060        SYF     0076
E0008   1737        M0020   0061        SYN     0077
E0010   2057        M0040   2511        T0003   0416
EFLOP   2555        M0300   0062        T0004   0600
ERR10   2041        M0311   0063        T0005   1000
ERR8    1714        M0315   0064        T0006   1200
ERRTYD  1264        M0317   0065        T0007   1400
EXIT1   2420        M0321   0066        T0008   1600
EXTERN  0107        M0324   0067        T0010   2000
FLPERR  2537        MESAG   2445        T0011   2200
GETCHR  0137        MPNTR   2504        TIMCON  0762
HEADER  0044        NORUN   2422        TIME    0646
I0008   1672        NUMBER  2534        TIMEIT  0745
I0010   2034        ONOW    0070        TSTFLP  0105
I0011   2254        OUTCLR  1663        TSTLUP  0410
ILEX    6165        OUTSET  1655        TSTNOW  0073
INCADD  1675        PCNTR   2535        TSTTYD  1203
INOW    0045        PGDBD2  1266        TYD     0101
INSTER  2417        PHUNG   2425        TYDERR  1234
INTER   2400        PINTER  0104        TYDLUP  1205
JFF     0100        PM10    2061        TYDMES  1274
K0007   0135        PM11    2266        TYDTST  0106
K0017   0046        PM4A    0675        TYF     0074
K0020   0047        PM4B    0702        TYN     0075
K0077   2505        PM4C    0714        TYPE    0117
K0100   2507        PM4D    0724        UDADDR  2653
K0200   2510        PM5A    1047        UDARND  2616
K0207   2265        PM5B    1071        UDBOX   2661
K0212   0134        PM7A    1444        UDCNT   2654
K0215   0133        PM7B    1466        UDCON1  2665
K0240   0050        PM8A    1767        UDDO    2624
K0260   0136        PM8B    1741        UDGET   2663
K0377   0051        PM8C    1756        UDHIGH  2655
K0400   0674        PMES1   0324        UDHSUB  2657
K0600   0116        PMES2   2705        UDLOOP  2652
K4252   0052        PMES2A  2745        UDLOW   2656
K7400   0053        PMES3   2314        UDLSUB  2660
K7700   2506        PMESAG  0102        UDOUT   2642
L0004   0613        PNORUN  2434        UDPRNT  2600
L0005   1005        PNTR    0071        UDPTR   2664
```

```
ERRORS DETECTED: 0
LINKS GENERATED: 22
RUN-TIME:  10 SECONDS
3K CORE USED
```

```
UDLSUB    1158    1160    1187#
UDOUT     1167    1173#
UDPRNT     299    1139#   1141    1152    1180
UDPTR     1151    1153    1154    1156    1157    1191#
UDTEML    1162    1170    1189#
.L0375     157     224#
.L0376     154     225#
.L0377     127     226#
.L0575     251     268#
.L0576     242     269#
.L0577     240     270#
.L0775     313     396#
.L0776     309     336     397#
.L0777     299     398#
.L1177     440     477#
.L1377     482     560#
.L1577     598     639#
.L1774     725     777#
.L1775     721     778#
.L1776     711     779#
.L1777     666     780#
.L2175     820     861#
.L2176     793     862#
.L2177     791     863#
.L2376     921     984#
.L2377     911     985#
```