IDENTIFICATION

PRODUCT CODE: MAINDEC-8E-D0GC-D

PRODUCT NAME: RANDOM DCA TEST

DATE CREATED: JUNE 11, 1971

MAINTAINER: DIAGNOSTIC GROUP

AUTHOR: BRUCE HANSEN

1. ABSTRACT

   THIS PROGRAM TESTS THE DCA INSTRUCTION OF THE PDP-8/E. THE
   DCA INSTRUCTION ADDRESS, OPERAND ADDRESS, AND OPERANDS ARE TAKEN
   FROM A RANDOM NUMBER GENERATOR.

2. REQUIREMENTS

2.1 EQUIPMENT

    PDP-8/E EQUIPPED WITH TELETYPE.

2.2 STORAGE

    THE DIAGNOSTIC PROGRAM IS STORED IN LOCATIONS 0000 THROUGH
    0407. THE PROGRAM USES 0410 THROUGH 7600 FOR A TEST AREA.
    THE BINARY LOADER MUST BE STORED IN THE LAST MEMORY PAGE.

2.3 PRELIMINARY PROGRAMS

    MAINDEC-8E-D0A(N), AND MAINDEC-8E-D0B(N)

3. LOADING PROCEDURE

3.1 METHOD

    THE STANDARD BINARY LOADER IS USED.

4. STARTING PROCEDURE

4.1 CONTROL SWITCH SETTINGS

    SR0 (0) HALT AFTER ERROR PRINTOUT.
    SR1 (1) BYPASS ERROR PRINTOUT
    SR2 HOLD "FROM" CONSTANT (1). SELECT RANDOM "FROM" (0).
    SR3 HOLD "OPERAND ADDRESS" CONSTANT (1). SELECT RANDOM "OPERAND
         ADDRESS" (0).
    SR4 HOLD "OPERAND" CONSTANT (1). SELECT RANDOM "OPERAND" (0).

4.2 STARTING ADDRESS

    0200

4.3   OPERATOR ACTION
       ----

       1. SET SR TO 0200.
       2. PRESS LOAD ADDRESS
       3. SET SR TO 0000
       4. PRESS CLEAR THEN CONTINUE

5.   OPERATING PROCEDURE

       SAME AS SECTION 4.

6.   ERRORS

6.1   ERROR PRINTOUTS

       F   XXXX   A   YYYY   O   NNNN

       L   RRRR   C   MMMM

       E

       FROM,   F   XXXX   WHERE XXXX = ADDRESS OF THE DCA
                                  INSTRUCTION

       ADDRESS,   A   YYYY   WHERE YYYY = ADDRESS WHERE DCA WILL
                                  DEPOSIT OPERAND

       OPERAND   O   NNNN   WHERE NNNN = THE OPERAND TO BE DEPOSITED.

       LOCATION,   L   RRRR   WHERE RRRR = A NONZERO LOCATION SOME-
                                  WHERE IN THE TEST FIELD.

       CONTENTS,   C   MMMM   WHERE MMMM = CONTENTS OF LOCATION RRRR.

       END,   E   THIS LETTER IS TYPED TO INFORM THAT THE
                                  ENTIRE TEST AREA HAS BEEN SEARCHED FOR
                                  NONZERO OPERANDS.

)   )   )

EXAMPLES

A. THE FOLLOWING IS A TYPICAL ERROR PRINTOUT:

```
F   4572   A   0205   O   2525
L   0205   C   2527
E
```

LINE 1 IS SIMPLY A STATEMENT OF THE PROBLEM. IT SAYS THAT A DCA INSTRUCTION LOCATED AT 4572 TRIED TO DEPOSIT THE OPERAND 2525 INTO LOCATION 0205.

LINE 2 SAYS THAT INSTEAD OF FINDING A 2525 IN LOCATION 0205, THE PROGRAM FOUND A 2527. BIT 10 WAS "PICKED UP." THE E SIGNIFIES THAT A SEARCH OF THE TEST AREA SHOWED ONLY THE ABOVE PRINTED LOCATIONS DIFFERING FROM WHAT THEY SHOULD BE.

B. THE FOLLOWING IS A TYPICAL ERROR PRINTOUT:

```
F   4572   A   0205   O   2525
L   0215   C   2525
E
```

LINE 1 IS A STATEMENT OF THE PROBLEM AS IN THE PREVIOUS EXAMPLE. LINE 2 SAYS THAT LOCATION 0215 CONTAINS 2525, AND THE E ON LINE 3 SAYS THAT NO OTHER LOCATIONS WERE DISTURBED. IT IS APPARENT THEN THAT THE DCA INSTRUCTION DEPOSITED ITS OPERAND NOT INTO LOCATION 0205, BUT INTO LOCATION 0215. BIT 8 WAS "PICKED UP".

6.3   ERROR RECOVERY

TO ENTER A SCOPE MODE LOOP, SET SR0 TO A 0. WHEN A HALT OCCURS FOLLOWING AN ERROR, SET SWITCHES 1, 2, 3, AND 4 AND PUSH CONTINUE. A SCOPE MODE LOOP IS ENTERED USING THE CONDITIONS DESCRIBED BY THE LAST ERROR PRINTOUT.

IF IT IS DESIRED TO ENTER A SCOPE MODE LOOP USING A SPECIFIC SET OF CONDITIONS, STOP THE PROGRAM AND MAKE THE FOLLOWING ENTRIES:

A. ENTER DESIRED FROM ADDRESS INTO MEMORY LOCATION 0167.

B. ENTER DESIRED OPERAND ADDRESS INTO MEMORY LOCATION 0166.

C. ENTER DESIRED OPERAND INTO MEMORY LOCATION 0170.

RESTART THE PROGRAM USING A CONTROL SWITCH SETTING OF 3600.

7. RESTRICTIONS (NONE)
   ----

8. MISCELLANEOUS

8.1 EXECUTION TIME

    3904 RANDOM TESTS/PASS
    7 PASSES/BELL
    27,328 RANDOM TESTS/PASS

9. PROGRAM DESCRIPTION
   ------- -----------

   MEMORY LOCATIONS 0410 THROUGH 7600 ARE DESIGNATED AS TEST
   LOCATIONS, AND ZEROES ARE DEPOSITED INTO EACH AT THE BEGINNING
   OF THE PROGRAM. THE PROGRAM NOW SELECTS A LOCATION FOR THE DCA
   INSTRUCTION. THIS SELECTED LOCATION MAY BE SPECIFIED OR RANDOM,
   DEPENDING UPON THE SWITCH REGISTER SETTING. THE OPERAND AND
   OPERAND ADDRESS ARE SELECTED IN A SIMILAR MANNER. THE PROGRAM
   NOW JUMPS TO THE TEST DCA, PERFORMS THE INSTRUCTION, THEN JUMPS
   BACK TO A CHECKING ROUTINE. THE CHECKING ROUTINE VERIFIES THAT
   THE OPERAND WAS DEPOSITED CORRECTLY. IF AN ERROR IS DETECTED,
   THE ERROR ROUTINE SEARCHES THE TEST AREA AND PRINTS THE CONTENTS
   OF ANY NONZERO LOCATION EXCEPT FOR THE TEST DCA INSTRUCTION.
   UPON COMPLETION OF THIS SCAN THROUGH THE TEST AREA, AN E IS
   PRINTED AND A NEW TEST IS BEGUN.

   THE TELETYPE BELL RINGS AFTER 7 PASSES OF 3904 TEST/PASS.

)   )   )

```
                        /RANDOM DCA TEST
                        /SR0(0)=HALT ON ERROR
                        /SR1(1)=NO PRINTOUTS
                        /SR2(1)=CONSTANT FROM
                        /SR3(1)=CONSTANT OPERAND ADDRESS
                        /SR4(1)=CONSTANT OPERAND
                0000    *0
        0000    0000            0
        0001    5001            JMP 1
        0002    0002            2
        0003    0003            3
        0004    0000            0
        0005    0000            0
        0006    7771    CNT2,   7771
        0007    0400    PSUB,   SUB
        0010    0000    WORK,   0
        0011    0000    CNT,    0
        0012    0300    M7500,  -7500
        0013    0207    BEL,    207
        0014    0003    THREE,  3

                        /CLEAR MEMORY
                0020    *20
        0020    1175    START,  TAD LIMLO
        0021    3010            DCA WORK
        0022    3410            DCA I WORK
        0023    1010            TAD WORK
        0024    7041            CIA
        0025    1174            TAD LIMHI
        0026    7640            SZA CLA
        0027    5022            JMP START+2

                        /CHECK FOR CONSTANT FROM
        0030    7604    CK1,    LAS
        0031    7006            RTL
        0032    7510            SPA
        0033    5052            JMP CK2

                        /GET FROM ADDRESS
        0034    4154            JMS GENRAN
        0035    3167            DCA FROM

        0036    1167            TAD FROM
        0037    7510            SPA
        0040    5046            JMP .+6
        0041    7041            CIA
        0042    1175            TAD LIMLO
        0043    7710            SPA CLA
        0044    5052            JMP CK2
        0045    5034            JMP CK1+4
        0046    7041            CIA
        0047    1174            TAD LIMHI
        0050    7710            SPA CLA
        0051    5034            JMP CK1+4
```

```
                    /CHECK FOR CONSTANT OPERAND ADDRESS
0052  7604    CK2,    LAS
0053  7006            RTL
0054  7004            RAL
0055  7510            SPA
0056  5075            JMP CK3

                    /GET OPERAND ADDRESS
0057  4154            JMS GENRAN
0060  3166            DCA OPAD

0061  1166            TAD OPAD
0062  7510            SPA
0063  5071            JMP .+6
0064  7041            CIA
0065  1175            TAD LIMLO
0066  7710            SPA CLA
0067  5075            JMP CK3
0070  5057            JMP CK2+5
0071  7041            CIA
0072  1174            TAD LIMHI
0073  7710            SPA CLA
0074  5057            JMP CK2+5
                    /CHECK FOR CONSTANT OPERAND
0075  7604    CK3,    LAS
0076  7006            RTL
0077  7006            RTL
0100  7710            SPA CLA
0101  5104            JMP CK4

                    /GET OPERAND
0102  4154            JMS GENRAN
0103  3170            DCA OPER


                    /CHECK FOR FROM+1=OPERAND ADDRESS
                    /CHECK FOR FROM=OPERAND ADDRESS
0104  1167    CK4,    TAD FROM
0105  7041            CIA
0106  1166            TAD OPAD
0107  7450            SNA
0110  5030            JMP CK1
0111  7041            CIA
0112  7040            CMA
0113  7650            SNA CLA
0114  5030            JMP CK1

                    /PLACE THE INSTRUCTIONS
0115  1171            TAD DCA1
0116  3567            DCA I FROM
0117  1167            TAD FROM
0120  7001            IAC
0121  3173            DCA FROMP1
0122  1172            TAD JMP1
```

```
        0123  3573              DCA I FROMP1
        0124  1170              TAD OPER
        0125  7000              NOP
        0126  5567              JMP I FROM          /GO OUT TO TEST
        0127  7402              HLT                 /JMP FAILURE

                                /RETURN FROM TEST
        0130  1566      BACK,   TAD I OPAD
        0131  7041              CIA
        0132  1170              TAD OPER
        0133  7640              SZA CLA
        0134  4577              JMS I AERR
        0135  3566              DCA I OPAD
        0136  3567              DCA I FROM
        0137  3573              DCA I FROMP1

                                /RING BELL AFTER 7 PASSES OF 3904 TEST PER PASS
        0140  1011              TAD CNT
        0141  7001              IAC
        0142  3011              DCA CNT
        0143  1011              TAD CNT
        0144  1012              TAD M7500
        0145  7640              SZA CLA
        0146  5030              JMP CK1
        0147  3011              DCA CNT
        0150  2006              ISZ CNT2
        0151  5030              JMP CK1
        0152  4407              JMS I PSUB
        0153  5030              JMP CK1

                                /RANDOM NUMBER GENERATOR
        0154  0000      GENRAN, 0
        0155  7200              CLA
        0156  1165              TAD RANUM
        0157  7104              RAL CLL
        0160  7430              SZL
        0161  1014              TAD THREE
        0162  3165              DCA RANUM
        0163  1165              TAD RANUM
        0164  5554              JMP I GENRAN
        0165  2525      RANUM,  2525


                                /CONSTANTS AND VARIABLES

        0166  3000      OPAD,   3000
        0167  3001      FROM,   3001
        0170  2525      OPER,   2525
        0171  3566      DCA1,   DCA I OPAD
        0172  5130      JMP1,   JMP BACK
        0173  3002      FROMP1, 3002
        0174  7600      LIMHI,  7600
        0175  0410      LIMLO,  410
        0176  0000      WORK1,  0
        0177  0201      AERR,   ERR
```

```
          0200          *200
                        /DCA ERROR, CHECK ALL MEMORY
0200   5020             JMP START
0201   0000    ERR,     0
0202   7604             LAS
0203   7004             RAL
0204   7710             SPA CLA
0205   5601             JMP I ERR
0206   4265             JMS PHD
0207   1175             TAD LIMLO
0210   3010             DCA WORK
0211   1410             TAD I WORK
0212   7640             SZA CLA
0213   4233             JMS ER1
0214   1010             TAD WORK
0215   7041             CIA
0216   1174             TAD LIMHI
0217   7640             SZA CLA
0220   5211             JMP .-7
0221   1374             TAD E
0222   4351             JMS PRINT
0223   1375             TAD CR
0224   4351             JMS PRINT
0225   1376             TAD LF
0226   4351             JMS PRINT
0227   7604             LAS
0230   7700             SMA CLA
0231   7402             HLT            /HALT ON ERROR
0232   5601             JMP I ERR

                        /MEMORY LOCATION WRONG (MAYBE)
0233   0000    ER1,     0
0234   1010             TAD WORK
0235   7041             CIA
0236   1167             TAD FROM
0237   7650             SNA CLA
0240   5633             JMP I ER1                      /FORGET IT. THIS IS LOC FROM
0241   1010             TAD WORK
0242   7041             CIA
0243   1173             TAD FROMP1
0244   7650             SNA CLA
0245   5633             JMP I ER1                      /FORGET IT. THIS IS LOC FROM+1
0246   1372             TAD L
0247   4351             JMS PRINT
0250   1010             TAD WORK
0251   4310             JMS TYPAC
0252   1010             TAD WORK
0253   3176             DCA WORK1
0254   1373             TAD C
0255   4351             JMS PRINT
0256   1576             TAD I WORK1
0257   4310             JMS TYPAC
```

)   )   )

```
0260  1375              TAD CR
0261  4351              JMS PRINT
0262  1376              TAD LF
0263  4351              JMS PRINT
0264  5633              JMP I ER1
```

                        /PRINT FIRST LINE OF ERROR

```
0265  0000      PHD,    0
0266  7200              CLA
0267  1367              TAD F
0270  4351              JMS PRINT
0271  1167              TAD FROM
0272  4310              JMS TYPAC
0273  1371              TAD A
0274  4351              JMS PRINT
0275  1166              TAD OPAD
0276  4310              JMS TYPAC
0277  1377              TAD O
0300  4351              JMS PRINT
0301  1170              TAD OPER
0302  4310              JMS TYPAC
0303  1375              TAD CR
0304  4351              JMS PRINT
0305  1376              TAD LF
0306  4351              JMS PRINT
0307  5665              JMP I PHD
```

                        /TYPE AC CONTENTS IN OCTAL

```
0310  5310      TYPAC,  JMP .
0311  3366              DCA SAVE+3
0312  1366              TAD SAVE+3
0313  7012              RTR
0314  7010              RAR
0315  3365              DCA SAVE+2
0316  1365              TAD SAVE+2
0317  7012              RTR
0320  7010              RAR
0321  3364              DCA SAVE+1
0322  1364              TAD SAVE+1
0323  7012              RTR
0324  7010              RAR
0325  3363              DCA SAVE
0326  1370              TAD SPACE
0327  4351              JMS PRINT
0330  1357              TAD FOUR
0331  3360              DCA CTR
```

```
0332  1363      LUP,    TAD SAVE
0333  0361              AND MSK7
0334  1362              TAD TW6
```

```
0335  4351          JMS PRINT
0336  1364          TAD SAVE+1
0337  3363          DCA SAVE
0340  1365          TAD SAVE+2
0341  3364          DCA SAVE+1
0342  1366          TAD SAVE+3
0343  3365          DCA SAVE+2
0344  2360          ISZ CTR
0345  5332          JMP LUP
0346  1370          TAD SPACE
0347  4351          JMS PRINT
0350  5710          JMP I TYPAC
0351  0000   PRINT,  0
0352  6046          TLS
0353  6041          TSF
0354  5353          JMP .-1
0355  7200          CLA
0356  5751          JMP I PRINT

             /CONSTANTS

0357  7774   FOUR,   -4
0360  0000   CTR,    0
0361  0007   MSK7,   7
0362  0260   TW6,    0260
0363  0000   SAVE,   0
0364  0000           0
0365  0000           0
0366  0000           0
0367  0306   F,      306
0370  0240   SPACE,  240
0371  0301   A,      301
0372  0314   L,      314
0373  0303   C,      303
0374  0305   E,      305
0375  0215   CR,     215
0376  0212   LF,     212
0377  0317   O,      317

      0400           *400
0400  0000   SUB,    0
0401  1207          TAD PASS
0402  3006          DCA CNT2
0403  1013          TAD BEL
0404  6046          TLS
0405  7200          CLA
0406  5600          JMP I SUB
0407  7771   PASS,   7771
             S
```