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IDENTIFICATION

PRODUCT CODE: MAINDEC-8E-D0GB-D

PRODUCT NAME: RANDOM DCA TEST

DATE CREATED: DECEMBER 10, 1970

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-8/E-D0AA, AND MAINDEC-8E-D0BA

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 SOMEWHERE 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.

6.2 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
```

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```
                        /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 FROMP
0124  1170            TAD OPER
0125  7000            NOP
0126  3567            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
                      $
```

```
0000  11111111  11111000  11111111  11111111  11111111  11111111  11111111  11111111
0100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

0200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

0400  11111111  00000000  00000000  00000000  00000000  00000000  00000000  00000000
0500  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

0600
0700


1000
1100

1200
1300

1400
1500

1600
1700


2000
2100

2200
2300

2400
2500

2600
2700


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
```

```
)       0371
R       0177
BACK    0130
BEL     0013
C       0373
CK1     0030
CK2     0052
CK3     0075
CK4     0104
CNT     0011
CNT2    0006
CR      0375
CTR     0360
DCA1    0171
E       0374
ER1     0233
ERR     0201
F       0367
FOUR    0357
FROM    0167
FROMP1  0173
GENRAN  0154
JMP1    0172
L       0372
LF      0376
LIMHI   0174
LIMLO   0175
LUP     0332
M7500   0012
MSK7    0361
O       0377
OPAD    0166
OPER    0170
PASS    0407
PHD     0265
PRINT   0351
PSUB    0007
RANUM   0165
SAVE    0363
SPACE   0370
START   0020
SUB     0400
THREE   0014
TW6     0362
TYPAC   0310
WORK    0010
WORK1   0176

ERRORS DETECTED: 0

LINKS GENERATED: 0

RUN-TIME:  3 SECONDS
```