PDP-15 CPU

5

IDENTIFICATION

Product Code:	MAINDEC-15-D0KA-D(D)
Product Name:	ISZ TEST
Date:	January 5, 1970
Maintainer:	Diagnostic Group
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25

1. ABSTRACT

The ISZ Test checks the operation of the ISZ instruction of the PDP-15. Various checks of the ISZ instruction are made, including ISZ of 777777_8 to 0_8 on all memory locations, and ISZ of random numbers stored in random memory locations from random memory locations. Errors are indicated to the operator via the teleprinter.

2. REQUIREMENTS

2.1 Equipment

Standard PDP-15 computer

2.2 Storage

The program uses all of 4K memory for the program or as a test area. When the program resides in upper 2K of memory, it occupies from locations 06440 to 07711. The random ISZ portion of the test tests all locations below 06440.

2.3 Preliminary Programs

Basic instruction tests

3. LOADING PROCEDURE

3.1 Method

a. Put HRI tape of program in reader (high speed, if available).

b. Set ADDRESS SWITCHES TO 00200; the BANK MODE switch on a 1.

c. Depress and release READ-IN key.

4. STARTING PROCEDURE

4.1 Control Switch Settings

The following is a table of ACCUMULATOR SWITCH settings and their action on the program:

AC Switch	Set As	Action
0	1	Halt on error
	0	Don't halt on error
1	1	Don't print on errors
	0	Print errors
2	1	Ring bell on error
	0	Ring bell after N passes
3	1	Loop on current conditions
	0	Don't loop on current conditions
4	1	Loop on current test
	0	Don't loop on current test
5	1	Save initial error conditions of random ISZ
	0	Don't save initial error conditions of random ISZ
6	1	Vary location of ISZ instruction
	0	Don't vary location of ISZ instruction
7	1	Vary location of number incremented
	0	Don't vary location of number incremented
8	1	Vary number incremented
	0	Don't vary number incremented

(Switches 6, 7, 8 operate in conjunction with 5; 3 supercedes 4)

N is an arbitrary number (initially 20000_8 for random (ISZ's) which is controlled by the LAW-N instruction in location 07052 and may be changed at the operator's discretion.

4.2 Starting Addresses

The starting address of the program is 00200. The restart addresses are 00200, 00244, 07000, 7052, and 7652 (see Section 5.3).

4.3 Program and/or Operator Action

a. Set ADDRESS SWITCHES to 00200

b. Set ACCUMULATOR SWITCHES to desired positions (see Section 4.1). Normal setting is 510000.

c. Depress I/O RESET

d. Depress START

5. OPERATING PROCEDURE

5.1 Operational Switch Settings

See Section 4.1.

5.2 Subroutine Abstracts

None

5.3 Program and/or Operator Action

a. To put the program in the 'scope mode, the ACCUMULATOR SWITCHES should be set to 270000, (don't halt, don't print, bell after N passes, loop on current number (location), loop on current test, save error conditions).

b. To start program initially so that upper memory may be checked, start at location 00200.

c. To start program initially so that lower memory may be checked without checking upper memory, start at location 00244.

d. To restart program to check upper memory after program has moved, restart at 07652.

e. To restart program to check lower memory after program has moved, restart at 07000.

f. To restart program to check random ISZ's after program has moved, restart at 07052.

6. ERRORS

Unless AC switch 1 is a 1, all errors will be printed on the Teletype.

6.1 Error Halts and Description

Location	Description
00442	ISZ on upper memory did not skip
00504	Location in upper memory did not ISZ to 0
07466	ISZ on lower memory did not skip
07530	Location in lower memory did not ISZ to 0
07601	Random ISZ add failure

6.2 Error Recovery

6.2.1 To Repeat Failure

If AC switch 0 is a 1, the computer will halt on an error. To recover and repeat the failure, reset AC switches 0 to 5 as necessary (see Section 4.1) and then depress CONTINUE key.

6.2.2 Recovery with Random ISZ

The random ISZ portion of this test has special recovery features. AC switch 3, as with the other tests, may be used to put the program in the 'scope mode (loop on current conditions). If, however, it is desired to save the conditions of an error and vary the parameters which make up the current conditions, AC switches 5 to 8 may be used. If switch 5 is a 1, and an error occurs, the exact conditions which caused the error will be saved (location of ISZ instruction, location of number ISZ'd, number ISZ'd). By setting switches 6, 7, and/or 8 to a 1, any one or all of these conditions may be changed. Returning 6, 7, and/or 8 to 0 causes the original error condition for that switch to be used again. Thus it is possible to determine which condition(s) is causing the error. Switches 5-8 have no effect, if an error does not occur.

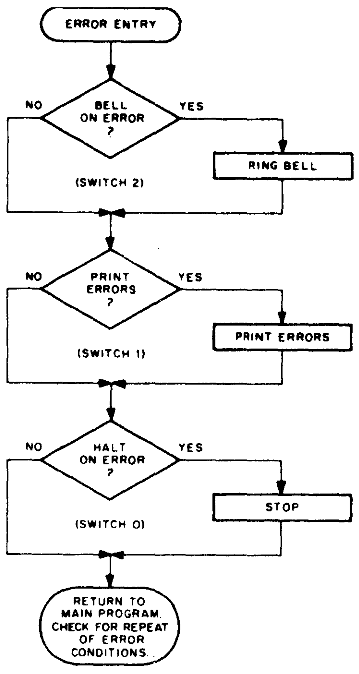
6.2.3 Test Special Conditions with Random ISZ

To test special conditions in the random ISZ test, store the location of the ISZ instruction in 07112 (SAVE1) and 07115 (RAND1), store the location of the number ISZ'd in 07113 (SAVE2) and 07116 (RAND2) and store the number to be ISZ'd in 07114 (SAVE3) and 07117 (RAND3). Restart the program at location 07067 (PROCED) with AC switches 3 and 5 to 1.

6.2.4 Test Particular Memory Location

To test a particular memory location in the ISZ to 0 tests, store the number of the location to be tested in 00252 (PNTR2) if program is in low memory and an upper memory location is to be tested (if program is not in low memory, move it there by restarting computer at 07652 (MOVEDN), or in 07046 (PNTR1) if program is in high memory and a lower memory location is to be tested (if program is not in high memory, move it there by restarting computer at 00244 (MOVEUP). Whether the program is in lower or upper memory can be determined by the program counter while the program is running (it may be easier to stop the computer before looking at the PC). If the PC contains a number above 04000, the program is in upper 2K of memory and conversely. Restart computer at 00206 (ISZHI+6) or 07005 (ISZLOW+5) (as appropriate) with AC switches 3 and 4 a 1.

6.3 Error Switch Hierarchy



6.4 Error Typeout Examples

6.4.1 Increment Memory from -1 to 0

6.4.1.1 No Skip

```
ISZ DID NOT SKIP, LOC 001234
```

The above example shows that the number in location 1234 (-1) when incremented, did not skip.

6.4.1.2 Bad Add

```
ISZ ADD
NUMBER AT   ORIGINAL   BAD

   001234      777777     777777
```

The above example shows that the number in location 1234 (-1) was not incremented.

6.4.2 Random ISZ Test

```
ISZ ADD

NUMBER AT   ORIGINAL  BAD     ISZ AT

001234      765435    765434  005763
```

The above example shows that a number in location 1234 (the number was 765435) was ISZ'd improperly producing a result of 765434 (carry from bit 17 to bit 16 was lost). The ISZ instruction was in location 5763.

7. MISCELLANEOUS

7.1 Execution Time

Not applicable

8. PROGRAM DESCRIPTION

There are three basic portions to the program, a portion which tests upper memory to be sure that all memory locations can be incremented to 0 (ISZHI), a portion which tests lower memory to be sure that all memory locations can be incremented to 0 (ISZLOW), and a portion which assures that random numbers stored in random memory locations can be ISZ'd from random memory location properly (RANISZ).

8.1 ISZHI

a. The first function performed is that of initializing the bell counter and setting up for header printing should an error occur.

b. Then a pointer is set to 04000 to allow the program to access the first location to be tested.

c. The number 777777_8 is stored in the memory location indicated in the pointer and it is then incremented to 0. Checks are made to assure that the computer skipped and the number went to 0.

d. A check is then made to see if the memory location should be tested again (switch 3). If so, c is repeated immediately. If not, then the address is incremented and then c is repeated.

e. Step d is repeated until location 07777_8 has been tested, at which time a check is made to determine if the sequence should be repeated (switch 4). If so, the program goes back to b. If not, the program is moved to upper memory and then control is transferred to the ISZLOW portion of the program.

8.2 ISZLOW

This portion is essentially the same as ISZHI except that location 0_8 to 3777_8 are tested and the program is not moved when ISZLOW is completed.

8.3 RANISZ

a. First the initialization of the loop counter and the header is set up.

b. Then three random numbers are generated for the location of the ISZ, location of the number, and the number respectively.

c. The number is stored in the appropriate memory location and an ISZ instruction is formed for that location and stored in its proper place.

d. The ISZ instruction is then executed and the result is checked with a synthesized ISZ for proper addition. If no errors occurred, a check is made to see if the test should be repeated (switch 3). If not then the program returns to step b. If it should be repeated, the program returns to step c.

e. If an error occurred, the conditions which caused it are indicated to the operator (unless they have been suppressed by AC switch 1) and then a check is made to see if the conditions should be saved (switch 5). If not, the program proceeds on as if no error occurred.

f. If the error conditions should be saved, the program then determines which of the three variables should be changed, and repeats the test for the new variables and/or the old ones. The operator can always return to original error conditions by setting AC switch 6 7, and 8 to 0. By setting AC switch 5 to 0, the operator can continue on with testing independent of the error, if he so desires.

```
                                    .TITLE ISZ-15
                           /ISZ TEST
                                    .FULL
        00200                       .LOC 200
                           /ROUTINE TO ISZ UPPER 2K MEMORY FROM -1 TO 0 (OCCUPY LOW MEMORY)
                           /
        00200   760000     ISZHI    LAW
        00201   040251              DAC CNTR2           /SET LOOP COUNTER
        00202   200507              LAC CONST3          /SET UP TO PRINT HEADER
        00203   040455              DAC ERROR4+11
        00204   200256              LAC STRT
        00205   040252              DAC PNTR2           /SET POINTER TO 4000
        00206   754001              CLA!CLL!CMA         /SET AC TO -1
        00207   060252              DAC* PNTR2          /STORE IN MEMORY
        00210   460252              ISZ* PNTR2          /INDEX LOCATION TO 0
        00211   100421              JMS ERROR2          /ERROR, COMPUTER DID NOT SKIP
        00212   220252              LAC* PNTR2          /GET C(MEMORY)
        00213   740200              SZA                 /IS IT 0?
        00214   100444              JMS ERROR4                  /NO, ERROR
        00215   750004              LAS
        00216   500254              AND MASK12
        00217   740200              SZA                 /LOOP ON CURRENT NUMBER?
        00220   600206              JMP ISZHI+6         /YES
        00221   750004              LAS
        00222   742010              RTL
        00223   741100              SPA                 /RING BELL?
        00224   600232              JMP .+6             /NO
        00225   200251              LAC CNTR2
        00226   340253              TAD ONE2
        00227   040251              DAC CNTR2
        00230   741200              SNA
        00231   100316              JMS BELL2
        00232   200252              LAC PNTR2           /NO, GET C (PNTR2)
        00233   540257              SAD UPLIM2          /IS IT 7777
        00234   600240              JMP .+4             /YES
        00235   340253              TAD ONE2            /NO, INCREMENT FOR NEXT
        00236   040252              DAC PNTR2           /LOCATION
        00237   600206              JMP ISZHI+6
        00240   750004              LAS
        00241   500255              AND MASK22
        00242   750200              SZA!CLA             /LOOP ON THIS TEST?
        00243   600204              JMP ISZHI+4         /YES
        00244   776526     MOVEUP   LAW -A              /NO, GET READY TO
        00245   100260              JMS MOVE2           /MOVE PROGRAM
        00246   000200              ISZHI               /ORIGIN ADDRESS -LOWEST ADDRESS -LOW
        00247   006440              B                   /DESTINATION ADDRESS -LOWEST ADDRESS -HIGH
        00250   607000              JMP ISZLOW          /GO TO PROGRAM IN UPPER MEMORY
        00251   000000     CNTR2    0
        00252   000000     PNTR2    0
        00253   000001     ONE2     1
        00254   040000     MASK12   40000
        00255   020000     MASK22   20000
        00256   004000     STRT     4000
        00257   007777     UPLIM2   7777
                                    .EJECT
                                    /SUBROUTINE TO MOVE THE PROGRAM (OCCUPY LOW MEMORY)
        00260   000000              MOVE2       0
        00261   040313                          DAC TALLY2
        00262   220260                          LAC* MOVE2
        00263   040314                          DAC POINT3
        00264   200260                          LAC MOVE2
        00265   340253                          TAD ONE2
        00266   040260                          DAC MOVE2
        00267   220260                          LAC* MOVE2
        00270   040315                          DAC POINT4
        00271   220314              LOOP2       LAC* POINT3
        00272   260315                          DAC* POINT4
        00273   200314                          LAC POINT3
        00274   340253                          TAD ONE2
        00275   040314                          DAC POINT3
        00276   200315                          LAC POINT4
        00277   340253                          TAD ONE2
        00300   040315                          DAC POINT4
        00301   200313                          LAC TALLY2
        00302   340253                          TAD ONE2
        00303   040313                          DAC TALLY2
        00304   740200                          SZA
        00305   600271                          JMP LOOP2
        00306   200260                          LAC MOVE2
        00307   340253                          TAD ONE2
        00310   040260                          DAC MOVE2
        00311   754000                          CLA!CLL
        00312   620260                          JMP* MOVE2
        00313   000000              TALLY2      0
        00314   000000              POINT3      0
        00315   000000              POINT4      0
                                    /
                                    /ROUTINE TO RING BELL -LOW MEMORY
        00316   000000              BELL2       0
        00317   760207                          LAW 207
        00320   100531                          JMS TYPE2
        00321   400200                          XCT ISZHI
        00322   040251                          DAC CNTR2
        00323   620316                          JMP* BELL2
                                    /
                                    /ROUTINE TO ISSUE CR-LF  LOW MEMORY
        00324   000000              CRLF2       0
        00325   760215                          LAW 215
        00326   100531                          JMS TYPE2
        00327   760212                          LAW 212
        00330   100531                          JMS TYPE2
        00331   620324                          JMP* CRLF2
                                                .EJECT
```

```
                            /TYPE OUT THE CONTENTS OF THE AC IN OCTAL (LOW)
        00332   000000      TYPOLO      0
        00333   040355                  DAC TEMP2
        00334   777772                  LAW -6
        00335   040313                  DAC TALLY2
        00336   200355                  LAC TEMP2
        00337   740010                  RAL
        00340   740010                  RAL
        00341   742010                  RTL
        00342   040355                  DAC TEMP2
        00343   500356                  AND SEVEN2
        00344   240357                  XOR ASKII2
        00345   100531                  JMS TYPE2
        00346   200313                  LAC TALLY2
        00347   340253                  TAD ONE2
        00350   040313                  DAC TALLY2
        00351   741200                  SNA
        00352   620332                  JMP* TYPOLO
        00353   200355                  LAC TEMP2
        00354   600340                  JMP .-14
        00355   000000      TEMP2       0
        00356   000007      SEVEN2      7
        00357   000260      ASKII2      260
                            /
                            /
                            /ERROR MESSAGES (LOW MEMORY)
                            /
        00360   000361      MESS12      .+1
        00361   311323                  311323      /I,S
        00362   332240                  332240      /Z,SP
        00363   304311                  304311      /D,I
        00364   304240                  304240      /D,SP
        00365   316317                  316317      /N,O
        00366   324240                  324240      /T,SP
        00367   323313                  323313      /S,K
        00370   311320                  311320      /I,P
        00371   254240                  254240      /,,SP
        00372   314317                  314317      /L,O
        00373   303240                  303240      /C,SP
        00374   377000                  377000      /RO
                                        .EJECT
        00375   000376          MESS22     .+1
        00376   215212                     215212     /CR,LF
        00377   311323                     311323     /I,S
        00400   332240                     332240     /Z,SP
        00401   301304                     301304     /A,D
        00402   304215                     304215     /D,CR
        00403   212212                     212212     /LF,LF
        00404   316325                     316325     /N,U
        00405   315302                     315302     /M,B
        00406   305322                     305322     /E,R
        00407   240301                     240301     /SP,A
        00410   324240                     324240     /T,SP
        00411   317322                     317322     /O,R
        00412   311307                     311307     /I,G
        00413   311316                     311316     /I,N
        00414   301314                     301314     /A,L
        00415   240240                     240240     /SP,SP
        00416   302301                     302301     /B,A
        00417   304240                     304240     /D,SP
        00420   377000                     377000     /RO,
                                /
                                /ERROR REPORTING SUBROUTINE 2 (LOW MEMORY)
        00421   000000          ERROR2     0
        00422   750004                     LAS
        00423   742010                     RTL
        00424   741100                     SPA                   /BELL ON ERROR?
        00425   100316                     JMS BELL2
        00426   750004                     LAS
        00427   740010                     RAL
        00430   741100                     SPA                   /PRINT ERRORS?
        00431   600440                     JMP .+7               /NO
        00432   100324                     JMS CRLF2             /YES, CRLF
        00433   200360                     LAC MESS12
        00434   100510                     JMS TMESS2            /TYPE OUT "ISZ DID NOT SKIP, LOC"
        00435   200252                     LAC PNTR2
        00436   100332                     JMS TYPOLO            /TYPE OUT NUMBER OF LOCATION
        00437   100324                     JMS CRLF2             /CR-LF
        00440   750004                     LAS
        00441   741100                     SPA                   /HALT ON ERROR?
        00442   740040                     XX                    /YES
        00443   620421                     JMP* ERROR2           /EXIT
                                           .EJECT
```

```
                               /ERROR MESSAGE REPORTING SUBROUTINE 4 (LOW MEMORY)
00444   000000         ERROR4     0
00445   750004                    LAS
00446   742010                    RTL
00447   741100                    SPA                     /BELL ON ERROR?
00450   100316                    JMS BELL2               /YES
00451   750004                    LAS
00452   740010                    RAL
00453   741100                    SPA                     /PRINT ERRORS?
00454   600502                    JMP .+26                /NO
00455   200375                    LAC MESS22
00456   100510                    JMS TMESS2              /TYPE OUT HEADER
00457   100324                    JMS CRLF2
00460   200506                    LAC CONST2
00461   040455                    DAC .-4
00462   200252                    LAC PNTR2
00463   100332                    JMS TYPOLO              /TYPE OUT LOCATION OF NUMBER
00464   760240                    LAW 240
00465   100531                    JMS TYPE2               /TYPE 5 SPACES
00466   100531                    JMS TYPE2
00467   100531                    JMS TYPE2
00470   100531                    JMS TYPE2
00471   100531                    JMS TYPE2
00472   750001                    CLA!CMA
00473   100332                    JMS TYPOLO              /TYPE ORIGINAL NUMBER
00474   760240                    LAW 240
00475   100531                    JMS TYPE2
00476   100531                    JMS TYPE2
00477   220252                    LAC* PNTR2
00500   100332                    JMS TYPOLO              /TYPE BAD RESULT
00501   100324                    JMS CRLF2               /CR-LF
00502   750004                    LAS
00503   741100                    SPA                     /HALT ON ERROR?
00504   740040                    XX                      /YES
00505   620444                    JMP* ERROR4             /EXIT
00506   600462         CONST2     JMP ERROR4+16
00507   200375         CONST3     LAC MESS22
                                  .EJECT
```

```
                                 /MESSAGE TYPEOUT SUBROUTINE (LOW)
        00510   000000          TMESS2     0
        00511   040314                     DAC POINT3
        00512   220314                     LAC* POINT3
        00513   740020                     RAR
        00514   742020                     RTR
        00515   742020                     RTR
        00516   742020                     RTR
        00517   742020                     RTR
        00520   100531                     JMS TYPE2
        00521   540537                     SAD RUBOT2
        00522   620510                     JMP* TMESS2
        00523   220314                     LAC* POINT3
        00524   100531                     JMS TYPE2
        00525   440314                     ISZ POINT3
        00526   540537                     SAD RUBOT2
        00527   620510                     JMP* TMESS2
        00530   600512                     JMP TMESS2+2
        00531   000000          TYPE2      0
        00532   500537                     AND RUBOT2
        00533   700406                     TLS
        00534   700401                     TSF
        00535   600534                     JMP .-1
        00536   620531                     JMP* TYPE2
        00537   000377          RUBOT2     377
                                           .EJECT
```

```
Ø7ØØØ                         .LOC 7ØØØ
                    /ROUTINE TO ISZ LOWER 2K MEMORY FROM 777777 TO Ø (OCCUPY HIGH MEMORY)
Ø7ØØØ   76ØØØØ      ISZLOW    LAW
Ø7ØØ1   Ø47Ø45                DAC CNTR1
Ø7ØØ2   2Ø7533                LAC CONST5
Ø7ØØ3   Ø475Ø1                DAC ERROR3+11
Ø7ØØ4   147Ø46                DZM PNTR1             /ZERO POINTER
Ø7ØØ5   754ØØ1                CLA!CLL!CMA           /SET AC TO -1
Ø7ØØ6   Ø67Ø46                DAC* PNTR1            /STORE -1 IN MEMORY
Ø7ØØ7   467Ø46                ISZ* PNTR1            /INDEX LOCATION TO Ø
Ø7Ø1Ø   1Ø7445                JMS ERROR1            /GO TO ERROR SUBROUTINE
Ø7Ø11   227Ø46                LAC* PNTR1            /GET CONTENTS OF MEMORY
Ø7Ø12   74Ø2ØØ                SZA                   /IS IT Ø?
Ø7Ø13   1Ø747Ø                JMS ERROR3            /NO, ERROR
Ø7Ø14   75ØØØ4                LAS
Ø7Ø15   5Ø7Ø5Ø                AND MASK11
Ø7Ø16   74Ø2ØØ                SZA                   /LOOP ON CURRENT NUMBER?
Ø7Ø17   6Ø7ØØ5                JMP ISZLOW+5          /YES
Ø7Ø2Ø   75ØØØ4                LAS                   /GET C (ACS)
Ø7Ø21   742Ø1Ø                RTL                   /MOVE 2 LEFT
Ø7Ø22   7411ØØ                SPA                   /RING BELL?
Ø7Ø23   6Ø7Ø31                JMP .+6               /NO
Ø7Ø24   2Ø7Ø45                LAC CNTR1
Ø7Ø25   347Ø47                TAD ONE1
Ø7Ø26   Ø47Ø45                DAC CNTR1
Ø7Ø27   7412ØØ                SNA                   /IS CNTR Ø?
Ø7Ø3Ø   1Ø7276                JMS BELL1             /YES, RING BELL
Ø7Ø31   2Ø7Ø46                LAC PNTR1             /NO, GET C (PNTR)
Ø7Ø32   547Ø44                SAD UPLIM1            /IS IT 7777
Ø7Ø33   6Ø7Ø37                JMP .+4               /YES
Ø7Ø34   347Ø47                TAD ONE1
Ø7Ø35   Ø47Ø46                DAC PNTR1             /NO, INCREMENT FOR NEXT LOCATION
Ø7Ø36   6Ø7ØØ5                JMP ISZLOW+5
Ø7Ø37   75ØØØ4                LAS
Ø7Ø4Ø   5Ø7Ø51                AND MASK21
Ø7Ø41   75Ø2ØØ                SZA!CLA               /LOOP ON THIS TEST
Ø7Ø42   6Ø7ØØ4                JMP ISZLOW+4          /YES
Ø7Ø43   6Ø7Ø52                JMP RANISZ            /NO
Ø7Ø44   ØØ3777      UPLIM1    3777
Ø7Ø45   ØØØØØØ      CNTR1     Ø
Ø7Ø46   ØØØØØØ      PNTR1     Ø
Ø7Ø47   ØØØØØ1      ONE1      1
Ø7Ø5Ø   Ø4ØØØØ      MASK11    4ØØØØ
Ø7Ø51   Ø2ØØØØ      MASK21    2ØØØØ
                              .EJECT
```

```
                        /RANDOM ISZ TEST (OCCUPIES HIGH MEMORY)
07052   760000          RANISZ  LAW
07053   047045                  DAC CNTR1              /SET UP TO COUNT LOOPS
07054   207533                  LAC CONST5
07055   047545                  DAC ERROR5+11
07056   107312                  JMS GET1               /GET LOCATION OF ISZ
07057   047112                  DAC SAVE1
07060   107323                  JMS GET2               /GET LOCATION TO BE ISZ'D
07061   047113                  DAC SAVE2
07062   107334                  JMS COMPAR             /COMPARE RAND1 AND RAND2
07063   607060                  JMP .-3                /TO BE SURE THEY ARE DIFFERENT
07064   107224                  JMS GEN3               /GET NUMBER TO BE ISZ'D
07065   047117                  DAC RAND3
07066   047114                  DAC SAVE3
07067   107123          PROCED  JMS ISZTST             /PERFORM AND CHECK THE ISZ
07070   107534                  JMS ERROR5             /ERROR, RETURN TO THIS INSTRUCTION
07071   750004                  LAS                    /NO ERROR, RETURN HERE
07072   507050                  AND MASK11
07073   740200                  SZA                    /LOOP ON CURRENT NUMBERS
07074   607067                  JMP PROCED             /YES
07075   750004                  LAS
07076   742010                  RTL
07077   741100                  SPA                    /RING BELL?
07100   607111                  JMP .+11               /NO
07101   207045                  LAC CNTR1              /YES
07102   347047                  TAD ONE1
07103   047045                  DAC CNTR1
07104   740200                  SZA
07105   607111                  JMP .+4
07106   107276                  JMS BELL1
07107   407052                  XCT RANISZ
07110   047045                  DAC CNTR1
07111   607056                  JMP RANISZ+4
07112   000000          SAVE1   0
07113   000000          SAVE2   0
07114   000000          SAVE3   0
07115   000000          RAND1   0
07116   000000          RAND2   0
07117   000000          RAND3   0
07120   771340          UPLIM3  -B                     /MINUS LOWER LIMIT OF UPPER PROGRAM
07121   440000          ISZCON  ISZ
07122   017777          CONST1  17777
                                .EJECT
```

```
                          /ISZ TEST SETUP AND EXECUTION SUBROUTINE
07123    000000           ISZTST    0
07124    207117                     LAC RAND3
07125    067116                     DAC* RAND2          /STORE NUMBER TO BE ISZ'D
07126    207121                     LAC ISZCON          /FORM ISZ
07127    347116                     TAD RAND2           /INSTRUCTION, AND
07130    067115                     DAC* RAND1          /STORE IT, THEN
07131    427115                     XCT* RAND1          /EXECUTE IT
07132    740000                     NOP                 /FILLER
07133    207117                     LAC RAND3           /SYNTHESIZE THE
07134    347047                     TAD ONE1            /ISZ AND CHECK
07135    567116                     SAD* RAND2          /TO SEE THAT THE
07136    741000                     SKP                 /ANSWERS AGREE
07137    627123                     JMP* ISZTST         /THEY DON'T, EXIT
07140    207123                     LAC ISZTST          /INCREMENT ISZTST
07141    347047                     TAD ONE1            /THE HARD WAY
07142    047123                     DAC ISZTST
07143    627123                     JMP* ISZTST
                          /
                          /SUBROUTINE TO MOVE THE PROGRAM (OCCUPY HIGH MEMORY)
07144    000000           MOVE1     0
07145    047177                     DAC TALLY1
07146    227144                     LAC* MOVE1
07147    047200                     DAC POINT1
07150    207144                     LAC MOVE1
07151    347047                     TAD ONE1
07152    047144                     DAC MOVE1
07153    227144                     LAC* MOVE1
07154    047201                     DAC POINT2
07155    227200           LOOP1     LAC* POINT1
07156    067201                     DAC* POINT2
07157    207200                     LAC POINT1
07160    347047                     TAD ONE1
07161    047200                     DAC POINT1
07162    207201                     LAC POINT2
07163    347047                     TAD ONE1
07164    047201                     DAC POINT2
07165    207177                     LAC TALLY1
07166    347047                     TAD ONE1
07167    047177                     DAC TALLY1
07170    740200                     SZA
07171    607155                     JMP LOOP1
07172    207144                     LAC MOVE1
07173    347047                     TAD ONE1
07174    047144                     DAC MOVE1
07175    754000                     CLA!CLL
07176    627144                     JMP* MOVE1
                          /
07177    000000           TALLY1    0
07200    000000           POINT1    0
07201    000000           POINT2    0
                                    .EJECT
```

```
                              /RANDOM NUMBER GENERATORS HIGH MEMORY
      07202   000000          GEN1      0
      07203   207211                    LAC R1
      07204   744010                    RAL!CLL
      07205   741400                    SZL
      07206   347212                    TAD R1+1
      07207   047211                    DAC R1
      07210   627202                    JMP* GEN1
      07211   000037          R1        000037
      07212   000003                    3
      07213   000000          GEN2      0
      07214   207222                    LAC R2
      07215   744010                    RAL!CLL
      07216   741400                    SZL
      07217   347223                    TAD R2+1
      07220   047222                    DAC R2
      07221   627213                    JMP* GEN2
      07222   000001          R2        000001
      07223   000003                    3
      07224   000000          GEN3      0
      07225   207252                    LAC R3
      07226   744010                    RAL!CLL
      07227   741400                    SZL
      07230   347253                    TAD R3+1
      07231   047252                    DAC R3
      07232   047254                    DAC R3+2
      07233   567255                    SAD* R3+3
      07234   741000                    SKP
      07235   627224                    JMP* GEN3
      07236   207255                    LAC R3+3
      07237   347047                    TAD ONE1
      07240   047255                    DAC R3+3
      07241   227255                    LAC* R3+3
      07242   047252                    DAC R3
      07243   741200                    SNA
      07244   607247                    JMP .+3
      07245   207254                    LAC R3+2
      07246   627224                    JMP* GEN3
      07247   207710                    LAC ADDRS
      07250   047255                    DAC R3+3
      07251   607245                    JMP .-4
                                        .EJECT
```

```
07252   000000      R3          000000
07253   000003                  3
07254   000000                  0
07255   007256                  R3+4
07256   000000                  000000
07257   777775                  777775
07260   056427                  056427
07261   000175                  000175
07262   000171                  000171
07263   000137                  000137
07264   000065                  000065
07265   000037                  000037
07266   000031                  000031
07267   000023                  000023
07270   000021                  000021
07271   000015                  000015
07272   000013                  000013
07273   000005                  000005
07274   000001                  000001
07275   000000                  000000
                    /
                    /ROUTINE TO RING BELL HIGH MEMORY
                    /
07276   000000      BELL1       0
07277   760207                  LAW 207
07300   107702                  JMS TYPE1
07301   407000                  XCT IS7LOW
07302   047045                  DAC CNTR1
07303   627276                  JMP* BELL1
                    /
                    /
                    /ROUTINE TO ISSUE CR-LF HIGH MEMORY
                    /
07304   000000      CRLF1       0
07305   760215                  LAW 215
07306   107702                  JMS TYPE1
07307   760212                  LAW 212
07310   107702                  JMS TYPE1
07311   627304                  JMP* CRLF1
                                .EJECT
```

```
                              /GET RANDOM NUMBER SUBROUTINES
07312   000000                GET1      0
07313   107202                          JMS GEN1               /GET RANDOM
07314   507122                          AND CONST1             /MASK
07315   047115                          DAC RAND1              /STORE
07316   347120                          TAD UPLIM3             /COMPARE TO SEE
07317   740100                          SMA                    /IF IT IS IN THE PROGRAM
07320   607313                          JMP .-5                /IT IS, GENERATE ANOTHER
07321   207115                          LAC RAND1              /NO, IT ISN'T, EXIT
07322   627312                          JMP* GET1              /WITH NUMBER IN AC
07323   000000                GET2      0
07324   107213                          JMS GEN2
07325   507122                          AND CONST1
07326   047116                          DAC RAND2
07327   347120                          TAD UPLIM3
07330   740100                          SMA
07331   607324                          JMP .-5
07332   207116                          LAC RAND2
07333   627323                          JMP* GET2
                              /
                              /COMPARE RAND1 AND RAND2 SUBROUTINE
07334   000000                COMPAR    0
07335   207115                          LAC RAND1
07336   740001                          CMA
07337   347047                          TAD ONE1
07340   347116                          TAD RAND2
07341   741200                          SNA
07342   627334                          JMP* COMPAR
07343   207334                          LAC COMPAR
07344   347047                          TAD ONE1
07345   047334                          DAC COMPAR
07346   627334                          JMP* COMPAR
                                        .EJECT
```

```
                          /TYPE OUT THE CONTENTS OF THE AC IN OCTAL (HIGH)
07347   000000            TYPOHI    0
07350   047372                      DAC TEMP1
07351   777772                      LAW -6
07352   047177                      DAC TALLY1
07353   207372                      LAC TEMP1
07354   744010                      RAL!CLL
07355   740010                      RAL
07356   742010                      RTL
07357   047372                      DAC TEMP1
07360   507373                      AND SEVEN1
07361   247374                      XOR ASKII1
07362   107702                      JMS TYPE1
07363   207177                      LAC TALLY1
07364   347047                      TAD ONE1
07365   047177                      DAC TALLY1
07366   741200                      SNA
07367   627347                      JMP* TYPOHI
07370   207372                      LAC TEMP1
07371   607355                      JMP .-14
07372   000000            TEMP1     0
07373   000007            SEVEN1    7
07374   000260            ASKII1    260
                                    .EJECT
```

```
                              /ERROR MESSAGES (HIGH MEMORY)
07375   007376       MESS11     .+1
07376   311323                  311323     /I,S
07377   332240                  332240     /Z,SP
07400   304311                  304311     /D,I
07401   304240                  304240     /D,SP
07402   316317                  316317     /N,O
07403   324240                  324240     /T,SP
07404   323313                  323313     /S,K
07405   311320                  311320     /I,P
07406   254240                  254240     /,,SP
07407   314317                  314317     /L,O
07410   303240                  303240     /C,SP
07411   377000                  377000     /RO
07412   007413       MESS21     .+1
07413   215212                  215212     /CR,LF
07414   311323                  311323     /I,S
07415   332240                  332240     /Z,SP
07416   301304                  301304     /A,D
07417   304215                  304215     /D,CR
07420   212212                  212212     /LF,LF
07421   316325                  316325     /N,U
07422   315302                  315302     /M,B
07423   305322                  305322     /E,R
07424   240301                  240301     /SP,A
07425   324240                  324240     /T,SP
07426   317322                  317322     /O,R
07427   311307                  311307     /I,G
07430   311316                  311316     /I,N
07431   301314                  301314     /A,L
07432   240240                  240240     /SP SP
07433   302301                  302301     /B,A
07434   304240                  304240     /D,SP
07435   377000                  377000     /RO
07436   007437       MESS31     .+1
07437   240240                  240240     /SP SP
07440   311323                  311323     /I,S
07441   332240                  332240     /Z,SP
07442   301324                  301324     /A,T
07443   215212                  215212     /CR,LF
07444   377000                  377000     /RO
                                .EJECT
```

```
                                        /ERROR REPORTING SUBROUTINE 1 (HIGH MEMORY)
          07445    000000               ERROR1    0
          07446    750004                         LAS
          07447    742010                         RTL
          07450    741100                         SPA                     /BELL ON ERROR?
          07451    107276                         JMS BELL1               /YES
          07452    750004                         LAS
          07453    740010                         RAL
          07454    741100                         SPA                     /PRINT ERRORS
          07455    607464                         JMP .+7                 /NO
          07456    107304                         JMS CRLF1               /YES, CR-LF
          07457    207375                         LAC MESS11
          07460    107657                         JMS TMESS1              /TYPE OUT "ISZ DID NOT SKIP, LOC"
          07461    207046                         LAC PNTR1
          07462    107347                         JMS TYPOHI              /TYPE OUT NUMBER OF LOCATION
          07463    107304                         JMS CRLF1               /CR-LF
          07464    750004                         LAS
          07465    741100                         SPA                     /HALT ON ERROR
          07466    740040                         XX                      /YES
          07467    627445                         JMP* ERROR1             /EXIT
                                        /
                                        /ERROR MESSAGE REPORTING SUBROUTINE 3 (HIGH MEMORY)
          07470    000000               ERROR3    0
          07471    750004                         LAS
          07472    742010                         RTL
          07473    741100                         SPA                     /BELL ON ERROR
          07474    107276                         JMS BELL1               /YES
          07475    750004                         LAS
          07476    740010                         RAL
          07477    741100                         SPA                     /PRINT ERRORS?
          07500    607526                         JMP .+26                /NO
          07501    207412                         LAC MESS21
          07502    107657                         JMS TMESS1              /TYPE OUT HEADER
          07503    107304                         JMS CRLF1
          07504    207532                         LAC CONST4
          07505    047501                         DAC .-4
          07506    207046                         LAC PNTR1
          07507    107347                         JMS TYPOHI              /TYPE OUT LOCATION OF NUMBER
          07510    760240                         LAW 240
          07511    107702                         JMS TYPE1               /5 SPACES
          07512    107702                         JMS TYPE1
          07513    107702                         JMS TYPE1
          07514    107702                         JMS TYPE1
          07515    107702                         JMS TYPE1
                                                  .EJECT
```

```
        07516   750001            CLA!CMA
        07517   107347            JMS TYPOHI           /TYPE OUT ORIGINAL NUMBER
        07520   760240            LAW 240
        07521   107702            JMS TYPE1
        07522   107702            JMS TYPE1
        07523   227046            LAC* PNTR1
        07524   107347            JMS TYPOHI           /TYPE BAD RESULT
        07525   107304            JMS CRLF1            /CR-LF
        07526   750004            LAS
        07527   741100            SPA                  /HALT ON ERROR?
        07530   740040            XX                   /YES
        07531   627470            JMP* ERROR3          /EXIT
        07532   607506   CONST4   JMP ERROR3+16
        07533   207412   CONST5   LAC MESS21
                                  .EJECT
```

```
                                /ERROR REPORTING SUBROUTINE 5 (HIGH MEMORY)
     07534    040000            ERROR5    0
     07535    750004                      LAS
     07536    742010                      RTL
     07537    741100                      SPA                     /BELL ON ERROR
     07540    107276                      JMS BELL1               /YES
     07541    750004                      LAS
     07542    740010                      RAL
     07543    741100                      SPA                     /PRINT ERRORS?
     07544    607577                      JMP .+33                /NO
     07545    207412                      LAC MESS21
     07546    107657                      JMS TMESS1              /TYPE HEADER
     07547    207436                      LAC MESS31
     07550    107657                      JMS TMESS1              /TYPE "ISZ AT"
     07551    207651                      LAC CONST6
     07552    047545                      DAC .-5
     07553    207116                      LAC RAND2
     07554    107347                      JMS TYPOHI              /TYPE LOCATION OF NUMBER
     07555    760240                      LAW 240
     07556    107702                      JMS TYPE1               /5 SPACES
     07557    107702                      JMS TYPE1
     07560    107702                      JMS TYPE1
     07561    107702                      JMS TYPE1
     07562    107702                      JMS TYPE1
     07563    207117                      LAC RAND3
     07564    107347                      JMS TYPOHI              /TYPE ORIGINAL NUMBER
     07565    760240                      LAW 240
     07566    107702                      JMS TYPE1
     07567    107702                      JMS TYPE1
     07570    227116                      LAC* RAND2
     07571    107347                      JMS TYPOHI              /TYPE BAD NUMBER
     07572    760240                      LAW 240
     07573    107702                      JMS TYPE1
     07574    207115                      LAC RAND1
     07575    107347                      JMS TYPOHI              /TYPE LOCATION OF ISZ
     07576    107304                      JMS CRLF1
     07577    750004                      LAS
     07600    741100                      SPA                     /HALT ON ERROR?
     07601    740040                      XX                      /YES
     07602    750004            BACK      LAS
     07603    507645                      AND MASK31
     07604    741200                      SNA                     /SAVE ERROR CONDITIONS?
     07605    627534                      JMP* ERROR5             /NO
                                          .EJECT
```

```
07606   750004   ISZLOC   LAS
07607   507646            AND MASK41
07610   741200            SNA                 /VARY LOCATION OF ISZ?
07611   607616            JMP .+5             /NO
07612   107312            JMS GET1            /YES, GET ANOTHER ADDRESS
07613   107334            JMS COMPAR          /IS RAND1=RAND2
07614   607612            JMP .-2             /YES. TRY AGAIN
07615   607620            JMP OPLOC           /ALL OK, GO ON
07616   207112            LAC SAVE1           /TRANSFER C(SAVE1)
07617   047115            DAC RAND1           /TO RAND1
07620   750004   OPLOC    LAS
07621   507647            AND MASK51
07622   741200            SNA                 /VARY LOCATION OF OPERAND?
07623   607630            JMP .+5             /NO
07624   107323            JMS GET2            /YES, GET OP ADDRESS
07625   107334            JMS COMPAR          /IS RAND1=RAND2?
07626   607624            JMP .-2             /YES, TRY AGAIN
07627   607632            JMP OPNUM           /ALL OK, GO ON
07630   207113            LAC SAVE2           /TRANSFER C(SAVE2)
07631   047116            DAC RAND2           /TO RAND2
07632   750004   OPNUM    LAS
07633   507650            AND MASK61
07634   741200            SNA                 /VARY OPERAND?
07635   607640            JMP .+3             /NO
07636   107224            JMS GEN3            /YES
07637   607641            JMP .+2
07640   207114            LAC SAVE3
07641   047117            DAC RAND3
07642   107123   TRYDIF   JMS ISZTST          /PERFORM AND CHECK THE ISZ
07643   607535            JMP ERROR5+1        /ERROR RETURNS HERE
07644   607602            JMP BACK            /NO ERROR RETURNS HERE
07645   010000   MASK31   10000
07646   004000   MASK41   4000
07647   002000   MASK51   2000
07650   001000   MASK61   1000
07651   607553   CONST6   JMP ERROR5+17
                          .EJECT
```

```
                        /ROUTINE TO MOVE PROGRAM TO LOWER MEMORY AND START ISZHI
07652   776526          MOVEON    LAW -A              /GET READY TO
07653   107144                    JMS MOVE1           /MOVE A WORDS
07654   006440                    B                   /FROM HIGH TO
07655   000200                    ISZHI               /LOW MEMORY
07656   600200                    JMP ISZHI           /THEN TRANSFER CONTROL TO ISZHI
                        /
                        /MESSAGE TYPEOUT SUBROUTINE (HIGH)
07657   000000          TMESS1    0
07660   047200                    DAC POINT1
07661   227200                    LAC* POINT1
07662   740020                    RAR
07663   742020                    RTR
07664   742020                    RTR
07665   742020                    RTR
07666   742020                    RTR
07667   107702                    JMS TYPE1
07670   547711                    SAD RUBOT1
07671   627657                    JMP* TMESS1
07672   227200                    LAC* POINT1
07673   107702                    JMS TYPE1
07674   547711                    SAD RUBOT1
07675   627657                    JMP* TMESS1
07676   207200                    LAC POINT1
07677   347047                    TAD ONE1
07700   047200                    DAC POINT1
07701   607661                    JMP TMESS1+2
07702   000000          TYPE1     0
07703   507711                    AND RUBOT1
07704   700406                    TLS
07705   700401                    TSF
07706   607705                    JMP .-1
07707   627702                    JMP* TYPE1
07710   007256          ADDRS     P3+4
07711   000377          RUBOT1    377
        001252          A=RUBOT2-ISZHI+1+RUBOT1-ISZLOW+1
        006440          B=ISZLOW-RUBOT2+ISZHI-1
        000000                    .END
                                  NO ERROR LINES
```

```
PAGE 20      ISZ-15

A          001252
ADDRS       07710
ASKII1      07374
ASKII2      00357
B          006440
BACK        07602
BELL1       07276
BELL2       00316
CLOF       700004
CLON       700044
CLSF       700001
CNTR1       07045
CNTR2       00251
COMPAR      07334
CONST1      07122
CONST2      00506
CONST3      00507
CONST4      07532
CONST5      07533
CONST6      07651
CRLF1       07304
CRLF2       00324
ERROR1      07445
ERROR2      00421
ERROR3      07470
ERROR4      00444
ERROR5      07534
GEN1        07202
GEN2        07213
GEN3        07224
GET1        07312
GET2        07323
ISZCON      07121
ISZHI       00200
ISZLOC      07606
ISZLOW      07000
ISZTST      07123
KRB        700312
KSF        700301
LOOP1       07155
LOOP2       00271
MASK11      07050
MASK12      00254
MASK21      07051
MASK22      00255
MASK31      07645
MASK41      07646
MASK51      07647
MASK61      07650
MESS11      07375
MESS12      00360
MESS21      07412
MESS22      00375
MESS31      07436
MOVEDN      07652
```

```
MOVEUP    00244
MOVE1     07144
MOVE2     00260
ONE1      07047
ONE2      00253
OPLOC     07620
OPNUM     07632
PCF      700202
PNTR1     07046
PNTR2     00252
POINT1    07200
POINT2    07201
POINT3    00314
POINT4    00315
PROCED    07067
PSA      700204
PSB      700244
PSF      700201
RAND1     07115
RAND2     07116
RAND3     07117
RANISZ    07052
RCF      700102
RRB      700112
RSA      700104
RSB      700144
RSF      700101
RUBOT1    07711
RUBOT2    00537
R1        07211
R2        07222
R3        07252
SAVE1     07112
SAVE2     07113
SAVE3     07114
SEVEN1    07373
SEVEN2    00356
STRT      00256
TALLY1    07177
TALLY2    00313
TCF      700402
TEMP1     07372
TEMP2     00355
TLS      700406
TMESS1    07657
TMESS2    00510
TRYDIF    07642
TSF      700401
TYPE1     07702
TYPE2     00531
TYPOHI    07347
TYPOLO    00332
UPLIM1    07044
UPLIM2    00257
UPLIM3    07120
```

```
ISZHI     00200
MOVEUP    00244
CNTR2     00251
PNTR2     00252
ONE2      00253
MASK12    00254
MASK22    00255
STRT      00256
UPLIM2    00257
MOVE2     00260
LOOP2     00271
TALLY2    00313
POINT3    00314
POINT4    00315
BELL2     00316
CRLF2     00324
TYPOLO    00332
TEMP2     00355
SEVEN2    00356
ASKII2    00357
MESS12    00360
MESS22    00375
ERROR2    00421
ERROR4    00444
CONST2    00506
CONST3    00507
TMESS2    00510
TYPE2     00531
RUBOT2    00537
A        001252
B        006440
ISZLOW    07000
UPLIM1    07044
CNTR1     07045
PNTR1     07046
ONE1      07047
MASK11    07050
MASK21    07051
RANISZ    07052
PROCED    07067
SAVE1     07112
SAVE2     07113
SAVE3     07114
RAND1     07115
RAND2     07116
RAND3     07117
UPLIM3    07120
ISZCON    07121
CONST1    07122
ISZTST    07123
MOVE1     07144
LOOP1     07155
TALLY1    07177
POINT1    07200
POINT2    07201
```

```
GEN1      07202
R1        07211
GEN2      07213
R2        07222
GEN3      07224
R3        07252
BELL1     07276
CRLF1     07304
GET1      07312
GET2      07323
COMPAR    07334
TYPOHI    07347
TEMP1     07372
SEVEN1    07373
ASKII1    07374
MESS11    07375
MESS21    07412
MESS31    07436
ERROR1    07445
ERROR3    07470
CONST4    07532
CONST5    07533
ERROR5    07534
BACK      07602
IS7LOC    07606
OPLOC     07620
OPNUM     07632
TRYDIF    07642
MASK31    07645
MASK41    07646
MASK51    07647
MASK61    07650
CONST6    07651
MOVEON    07652
TMESS1    07657
TYPE1     07702
ADDRS     07710
RUBOT1    07711
CLSF     700001
CLOF     700004
CLON     700044
RSF      700101
RCF      700102
RSA      700104
RRB      700112
RSB      700144
PSF      700201
PCF      700202
PSA      700204
PSB      700244
KSF      700301
KRB      700312
TSF      700401
TCF      700402
TLS      700406
```

MAINDEC EVALUATION REQUEST

After sufficient familiarization with the operation and documentation of this MAINDEC, please indicate your assessment of the following areas and return this form to Digital Equipment Corporation.

IDENTIFICATION: MAINDEC NO.__________ Program Title__________

USAGE: Used by: Field Service ☐ Production ☐ Other__________ ☐

Frequency of Usage: Daily ☐ Weekly ☐ Monthly ☐

SUGGESTIONS FOR IMPROVEMENT

1. Are the program loading and operating instructions: clear ? ☐, incomplete ? ☐, difficult to follow ? ☐

2. Do the error reports and program documentation provide sufficient diagnostic information. in all cases ? ☐, in most cases ? ☐, in very few cases ? ☐. Suggestions for improvement:

____

____

____

3. Is the program effective in isolating malfunctions: in all cases ? ☐, in most cases ? ☐, in very few cases ? ☐. Would additional Scope loops or Switch Register control be helpful ?_____ Suggestions for improvement:

____

____

____

4. Does the program ever fail to detect malfunctions exposed by other software ?_____ Were Margins used ?_____ Please describe malfunction in detail:

____

____

____

5. Does the program ever report non-existant malfunctions ?_____ Please indicate erroneous report and any pertinent operating conditions:

____

6. Does this MAINDEC ever expose malfunctions in the Central Processor or other peripheral units not detected by the appropriate MAINDEC ?_____ Please describe malfunction and MAINDEC(S) used:

____

7. Does the document provide a general understanding of the functional programming requirements of the system ? Good ☐, Fair ☐, None ☐. Would a general description of programming requirements increase the effectiveness of this MAINDEC ?_____

Remarks:

____

____

____

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