IDENTIFICATION

PRODUCT CODE:	MAINDEC-8E-D1AB-D
PRODUCT NAME:	MM8E 4K MEMORY CHECKERBOARD
DATE CREATED:	JUNE 7, 1971
MAINTAINER:	DIAGNOSTIC GROUP
AUTHOR:	VERNON FREY

1. ABSTRACT

This program is designed to detect core failures on half-selected lines under worst case noise conditions. It's use is intended for the PDP-8E with a basic 4K memory system.

2. REQUIREMENTS

Equipment

A PDP-8E computer with 4K of memory.

Storage

Initially the program is in core locations 2ØØ-777 and in core locations 7ØØØ-7577.

3. LOADING PROCEDURE

Load the program with the binary loader (BIN).

4. OPERATING PROCEDURE

There are two entries to the program. These entries allow the user to start by testing upper core (1ØØØ-7777), or start by testing lower core (ØØØØ-6777). To start the program:

A. Load Address with desired entry address.

LOAD ADDRESS	Ø2ØØ	Test upper core (1ØØØ-7777).
LOAD ADDRESS	7ØØØ	Test lower core (ØØØØ-6777)

B. Set switch register to desired operation according to the following table.

SWITCH	Ø (down)	1 (up)
SRØØ	Continue testing	Halt after test
SRØ7	Relocate program	Inhibit relocation

C. Press key start.

NOTE 1: RIM and BIN are saved during this test and will not be lost if the program is halted using SRØØ.

NOTE 2: This program will alternate testing upper and lower core unless SRØ7 is set. During program relocation a comparison check is made to insure no program loss.

5. ERRORS

The contents of a given memory test location should always be ØØØØ or 7777, therefore anything other than ØØØØ or 7777 will result in a test error halt. A relocation error halt will occur if the relocation comparison check fails.

Test Error Halts

A test error halt is indicated by halt address Ø7XX or 75XX.

If the link is set, the error occurred on complemented data.

1st halt - The AC displays the contents of the location in error. Record the C(AC) and press key continue.

2nd halt - The AC displays the address of the location in error. Record the C(AC) and press key continue to resume testing with the next sequential memory address.

Relocation Error Halts

A relocation error halt is indicated by halt address Ø3XX or 71XX.

1st halt - The AC displays the contents of the location transferring from. Record the C(AC) and press key continue.

2nd halt - The AC displays the address of the location transferring from. Record the C(AC) and press key continue.

3rd halt - The AC displays the contents of the lcoation transferring to. Record the C(AC) and press key continue.

4th halt - The AC displays the address of the location transferring to. Record the C(AC) and C(MA). Manually correct bad core location if possible. Load Address = C(MA) and press key continue to continue relocation.

6. RESTRICTIONS

Starting Restrictions

The program may be restarted at Ø2ØØ if the program is in lower core, or at 7ØØØ if the program is in upper core. It can easily be determined where the program is by manually looking at a few core locations.

Operating Restrictions

None

7. EXECUTION TIME

The time to write and test the worst case pattern and its complement in upper and lower core is approximately 1 second.

During program execution a 5 will be typed on the TTY every 5 minutes of program run time. This allows the operator to determine approximate run time before a failure occurred.

8. SCOPE LOOPS

Two special scope loops have been provided in this program.

Before entering a scope loop run the checkerboard program with the halt switch up. This will write worst case pattern thru core.

Scope Loop 1

This scope loop reads the address in the switches 6 times before complementing.

A. LOAD ADDRESS Ø536 if program is in lower core
7336 if program is in upper core.

B. Set switches = address to be looped on.

C. Press key start.

Scope Loop 2

This scope loop executed a simple read, complement, write.

A. LOAD ADDRESS Ø561 if program is in lower core
7361 if program is in upper core.

B. Set switches = address to be looped on.

C. Press key start.

NOTE: The address being looped on can be changed simply by changing the switch settings. The previous address will be left with its original content.

9. PROGRAM DESCRIPTION

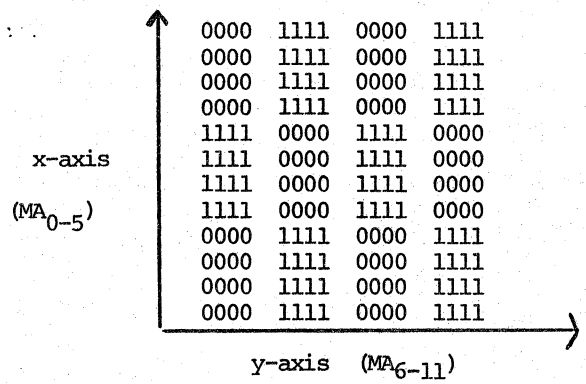
General

A given core is selected when the combined currents of the X- and Y- selection lines produce a magneto motive force which exceeds the threshold for reversing the flux direction of the core. This occurs at the intersection of the activated selection lines. All other cores which are threaded onto the activated lines will be slightly disturbed. Under marginal current conditions, such half-selected cores might also reverse polarity when their states are properly established by the pattern which the Checkerboard Test writes into memory.

When a selected core is in the 1 state, the read current will cause it to reverse polarity and become Ø. When the core is in the Ø state, the write current will cause it to become 1. Thus, the possibility of a reading error is greatest when all half-selected cores are in the 1 state; a writing error is most probable when all the half-selected cores are in the Ø state.

If a half-selected core changes polarity, the error will be detected when the memory location containing that core is tested by the program. For a reading error, the contents of that core will appear as a Ø in a field of 1's, and vice versa for a writing error.

The Checkerboard Test pattern consists of alternating 4 memory cells containing ØØØØ and 4 memory cells containing 7777. This pattern is reversed every 4ØØ octal locations. (This test pattern is generated according to the stringing of the stack and the wiring of the memory system. It is the same pattern for all 8E stacks).



The above array is interpreted as follows:

A. Positions on the y-axis represent consecutive octal locations in memory from ØØ thru 77.

B. Positions on the x-axis represent consecutive octal locations in memory from ØØ hundred thru 77 hundred.

Program Relocation

Program relocation is governed by the status of switch register bit 7. With this switch down (Ø pesition) program relocation occurs each time the test pattern and it's complement have been completely tested. During the relocation a comparison check is made to insure no program loss.

Test Procedure

The worst case pattern is written, then each location is treated as follows:

a. Read, Complement, Write the location.

B. Read and test the location.

C. Read, Complement, Write the location.

D. Read and test the location.

E. Go on to next location repeating A-D.

After the pattern is completely tested, the complement pattern is written and tested.

For further understanding of how the test is performed, refer to the listing.

```
                    /CHECKERBOARD 'WORST CASE NOISE' FO.. 4M8-E 4K MEMORY (VER  )
                    /COPYRIGHT 1971, DIGITAL EQUIPMENT CORPORATION, MAYNARD, MASS.
                    /PROGRAMMER, VERNON FREY
                    /
                    /SW0=1          HALT PROGRAM SAVING BIN
                    /SW7=1          INHIBIT PROGRAM RELOCATION
                    /
                    /
                    /PROGRAM STARTING ADDRESS
                    /0200           TEST UPPER CORE
                    /7000           TEST LOWER CORE
                    /
                    /
                    /
                    /
                    /

          0000      *0
0000      0000              0
0001      5001              JMP     1
0002      0002              2
0003      0003              3

          0200      *200
0200      7000              NOP                     /WILL = JMP LGOP2 FOR RESTART
0201      7600      K7600,  7600                    /CLA USED AS CONSTANT 7600
0202      1205      LCNT1,  TAD     .+3             /WILL = TRANSFER CONTROL COUNTER
0203      3200      LCNT2,  DCA     0200            /WILL = TRANSFER TO CONTROL
0204      4262      LCNT3,  JMS     LSAVBN          /WILL = TRANSFER FROM CONTROL
0205      5364      LINAD1, JMP     LGOP2           /WILL = INDIRECT ADDRESS
0206      5336              JMP     LPASS           /THIS INST MUST BE IN LOC 206
0207      4000      LSW0,   4000                    /SR BIT 0
0210      0020      LSW7,   0020                    /SR BIT 7
0211      0200      K0200,  0200
0212      7000      K7000,  7000
0213      7200      K7200,  7200

                    /
                    /CHECK HALT PROGRAM SWITCH
                    /
0214      7604      LSR00,  LAS
0215      0207              AND     LSW0
0216      7650              SNA CLA
0217      5223              JMP     LSR07           /HALT SW IS OFF
0220      4232              JMS     LHILO
0221      4272              JMS     LRESBN          /PROG IN LO - RESTORE BIN
0222      7402              HLT                     /PROG IN HI

                    /
                    /CHECK INHIBIT RELOCATION SWITCH
                    /
0223      7604      LSR07,  LAS
0224      0210              AND     LSW7
0225      7640              SZA CLA
0226      5364              JMP     LGOP2           /INHIBIT RELOCATION
```

```
0227  4232          JMS     LHILO
0230  5240          JMP     LRELOU          /PROG IN LO - MOVE UP
0231  5251          JMP     LRELOD          /PROG IN HI - MOVE DOWN

                    /
                    /CHECK FOR PROGRAM IN UPPER OR LOWER MEMORY
                    /
0232  0000    LHILO, 0
0233  1232          TAD     .-1             /0XXX OR 7XXX
0234  7004          RAL
0235  7630          SZL CLA                 /SKIP IF PROG IN LO
0236  2232          ISZ     LHILO           /PROG IN HI
0237  5632          JMP I   LHILO

                    /
                    /RELOCATE PROGRAM TO UPPER MEMORY
                    /
0240  4272    LRELOU, JMS     LRESBN          /RESTORE BIN INTO PAGE 31
0241  1213          TAD     K7200           /-600
0242  3202          DCA     LCNT1           /CONTROLS 600 TRANSFERS
0243  1211          TAD     K0200
0244  3204          DCA     LCNT3           /PAGE 1 CA
0245  1212          TAD     K7000
0246  3203          DCA     LCNT2           /PAGE 28 CA
0247  4302          JMS     LRELO           /RELOCATE PROGRAM
0250  5612          JMP I   K7000           /JMP TO PROG IN UPPER MEM

                    /
                    /RELOCATE PROGRAM TO LOWER MEMORY
                    /
0251  4262    LRELOD, JMS     LSAVBN          /SAVE BIN INTO PAGE 0
0252  1213          TAD     K7200           /-600
0253  3202          DCA     LCNT1           /CONTROLS 600 TRANSFERS
0254  1211          TAD     K0200
0255  3203          DCA     LCNT2           /PAGE 1 CA
0256  1212          TAD     K7000
0257  3204          DCA     LCNT3           /PAGE 28 CA
0260  4302          JMS     LRELO           /RELOCATE PROGRAM
0261  5611          JMP I   K0200           /JMP TO PROG IN LOWER MEM

                    /
                    /SAVE BIN AND RIM INTO PAGE 0
                    /
0262  0000    LSAVBN, 0
0263  1201          TAD     K7600           /-200
0264  3202          DCA     LCNT1           /CONTROLS 200 TRANSFERS
0265  3203          DCA     LCNT2           /PAGE 0 CA
0266  1201          TAD     K7600
0267  3204          DCA     LCNT3           /PAGE 31 CA
0270  4302          JMS     LRELO           /RELOCATE BIN INTO PAGE 0
0271  5662          JMP I   LSAVBN

                    /
                    /RESTORE BIN AND RIM INTO PAGE 31
                    /
```

```
0272  0000  LRESBN, 0
0273  1201        TAD     K7600           /-200
0274  3202        DCA     LCNT1           /CONTROLS 200 TRANSFERS
0275  3204        DCA     LCNT3           /PAGE 0 CA
0276  1201        TAD     K7600
0277  3203        DCA     LCNT2           /PAGE 31 CA
0300  4302        JMS     LRELO           /RELOCATE BIN INTO PAGE 31
0301  5672        JMP I   LRESBN


                  /
                  /RELOCATE SUBROUTINE
                  /
0302  0000  LRELO, 0
0303  1604        TAD I   LCNT3           /TRANSFER FROM
0304  3603        DCA I   LCNT2           /TRANSFER TO
0305  1604        TAD I   LCNT3           /CHECK TRANSFER
0306  7041        CIA
0307  1603        TAD I   LCNT2
0310  7640        SZA CLA
0311  4320        JMS     LXFERF          /TRANSFER FAILED
0312  2204        ISZ     LCNT3           /INCREMENT FROM ADDRESS
0313  2203        ISZ     LCNT2           /INCREMENT TO ADDRESS
0314  7000        NOP
0315  2202        ISZ     LCNT1           /INCREMENT TRANSFER CONTROL
0316  5303        JMP     LRELO+1
0317  5702        JMP I   LRELO           /TRANSFER COMPLETE

                  /
                  /RELOCATION FAILURE HALT ROUTINE
                  /
0320  0000  LXFERF, 0
0321  1604        TAD I   LCNT3
0322  7402        HLT                     /1ST HALT - FROM DATA
0323  7200        CLA
0324  1204        TAD     LCNT3
0325  7402        HLT                     /2ND HALT - FROM ADDRESS
0326  7200        CLA
0327  1603        TAD I   LCNT2
0330  7402        HLT                     /3RD HALT - TO DATA
0331  7200        CLA
0332  1203        TAD     LCNT2
0333  7402        HLT                     /4TH HALT - TO ADDRESS
0334  7300        CLA CLL
0335  5720        JMP I   LXFERF

                  /
                  /TYPEOUT A '5' EVERY 5 MINUTES OF RUN TIME
                  /
0336  2357  LPASS,  ISZ     LCNT
0337  5214        JMP     LSR00           /NOT 5 MINUTES YET
0340  1360        TAD     LM750
0341  3357        DCA     LCNT            /RESTORE COUNTER
0342  1361        TAD     K215
0343  4351        JMS     LTRANS          /CR
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0344  1362            TAD     K212
0345  4351            JMS     LTRANS          /LF
0346  1363            TAD     K265
0347  4351            JMS     LTRANS          /5
0350  5214            JMP     LSR00

0351  0000  LTRANS,   0
0352  6046            TLS                     /TRANSMIT CODE
0353  6041            TSF
0354  5353            JMP     .-1             /WAIT FOR FLAG
0355  7300            CLA CLL
0356  5751            JMP I   LTRANS

0357  6400  LCNT,     -1400                   /COUNT 5 MINUTES
0360  6400  LM750,    -1400
0361  0215  K215,     215                     /CR
0362  0212  K212,     212                     /LF
0363  0265  K265,     265                     /5

                      /
                      /GO TO PAGE 2 OR PAGE 29
                      /
0364  4365  LGOP2,    JMS     .+1
0365  0000            0                       /0XXX OR 7XXX
0366  7300            CLA CLL
0367  1365            TAD     .-2
0370  1211            TAD     K0200
0371  0201            AND     K7600
0372  3205            DCA     LINAD1
0373  5605            JMP I   LINAD1          /0400 OR 7200

      0400  *400
0400  5216            JMP     LWR             /WRITE PATTERN
0401  5225            JMP     LWRC            /WRITE COMPLEMENT
0402  7774  LM4,      -4
0403  7740  LM40,     -40
0404  0523  KLENDM,   LENDM                    /LO END MEM ROUTINE
0405  7330  KLAAA,    HAAA                    /HI END MEM ROUTINE
0406  0000  LEND1,    0                       /END MEM ROUTINE
0407  0000  LMADD,    0                       /START WRITE ADDRESS
0410  0000  LCNT4,    0                       /WRITE 2 PAGES
0411  0000  LCNT5,    0                       /WRITE 4 ADDRESSES
0412  0200  KK0200,   0200
0413  1000  K1000,    1000
0414  7600  KK7600,   7600
0415  0000  LINAD2,   0                       /INDIRECT ADDRESSING

                      /
                      /WRITE PATTERN INTO MEMORY
                      /
0416  4235  LWR,      JMS     LWCON           /CORRECT WRITE CONSTANTS
0417  4253            JMS     LWRMEM          /WRITE PATTERN
0420  1253            TAD     LWRMEM          /0XXX OR 7XXX
0421  1212            TAD     KK0200
0422  0214            AND     KK7600
```

```
0423  3215          DCA     LINAD2
0424  5615          JMP I   LINAD2          /0600 OR 7400

                    /
                    /WRITE COMPLEMENT PATTERN INTO MEMORY
                    /
0425  4235  LWRC,   JMS     LWCON           /CORRECT WRITE CONSTANTS
0426  4255          JMS     LWRMC           /WRITE COMPLEMENT PATTERN
0427  1253          TAD     LWRMEM          /0XXX OR 7XXX
0430  1212          TAD     KK0200
0431  0214          AND     KK7600
0432  7001          IAC
0433  3215          DCA     LINAD2
0434  5615          JMP I   LINAD2          /0601 OR 7401

                    /
                    /UPDATE WRITE CONSTANTS
                    /
0435  0000  LWCON,  0
0436  1235          TAD     .-1             /0XXX OR 7XXX
0437  7004          RAL
0440  7630          SZL CLA
0441  5247          JMP     LWCON1          /PROG IN UPPER MEM
0442  1213          TAD     K1000           /PROG IN LOWER MEM
0443  3207          DCA     LMADD           /START WRITE ADDRESS
0444  1204          TAD     KLENDM
0445  3206          DCA     LEND1           /END MEM ROUTINE
0446  5635          JMP I   LWCON

0447  1205  LWCON1, TAD     KLAAA
0450  3206          DCA     LEND1           /END MEM ROUTINE
0451  3207          DCA     LMADD           /START WRITE ADDRESS
0452  5635          JMP I   LWCON

                    /
                    /WRITE PATTERN OR WRITE PATTERN COMPLEMENT
                    /
0453  0000  LWRMEM, 0
0454  5261          JMP     LW1010          /WRITE PATTERN
0455  0000  LWRMC,  0
0456  1255          TAD     .-1
0457  3253          DCA     LWRMEM          /STORE RETURN ADDRESS
0460  5270          JMP     LW0101          /WRITE COMPLEMENT

0461  1203  LW1010, TAD     LM40            /-40
0462  3210          DCA     LCNT4           /WRITE 2 PAGES
0463  4311          JMS     LWONE           /WRITE 4 WORDS OF ONES
0464  4300          JMS     LWZERO          /WRITE 4 WORDS OF ZEROS
0465  2210          ISZ     LCNT4
0466  5263          JMP     LW1010+2
0467  4606          JMS I   LEND1           /END OF MEMORY?
0470  1203  LW0101, TAD     LM40            /-40
0471  3210          DCA     LCNT4           /WRITE 2 PAGES
0472  4300          JMS     LWZERO          /WRITE 4 WORDS OF ZEROS
0473  4311          JMS     LWONE           /WRITE 4 WORDS OF ONES
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```
0474  2210            ISZ     LCNT4
0475  5272            JMP     LW0101+2
0476  4606            JMS I   LEND1           /END OF MEMORY?
0477  5261            JMP     LW1010

0500  0000    LWZERO, 0
0501  1202            TAD     LM4             /-4
0502  3211            DCA     LCNT5           /WRITE 4 ZEROS
0503  3607            DCA I   LMADD
0504  2207            ISZ     LMADD           /INCREMENT MEMORY ADDRESS
0505  7000            NOP
0506  2211            ISZ     LCNT5
0507  5303            JMP     LWZERO+3
0510  5700            JMP I   LWZERO

0511  0000    LWONE,  0
0512  1202            TAD     LM4             /-4
0513  3211            DCA     LCNT5           /WRITE 4 ONES
0514  7240            STA
0515  3607            DCA I   LMADD
0516  2207            ISZ     LMADD           /INCREMENT MEMORY ADDRESS
0517  7000            NOP
0520  2211            ISZ     LCNT5
0521  5314            JMP     LWONE+3
0522  5711            JMP I   LWONE

                /
                /CHECK FOR END OF MEMORY
                /
0523  0000    LENDM,  0
0524  1207            TAD     LMADD
0525  7640            SZA CLA
0526  5723            JMP I   LENDM
0527  5653            JMP I   LWRMEM
0530  0000    LAAA,   0
0531  1207            TAD     LMADD
0532  1213            TAD     K1000
0533  7640            SZA CLA
0534  5730            JMP I   LAAA
0535  5653            JMP I   LWRMEM

                /
                /TWO SPECIAL SCOPE LOOPS
                /
0536  7604    LSCOP1, LAS
0537  3372            DCA     LSWADD          /TEST ADDRESS
0540  1772            TAD I   LSWADD
0541  0772            AND I   LSWADD
0542  0772            AND I   LSWADD
0543  0772            AND I   LSWADD
0544  0772            AND I   LSWADD
0545  0772            AND I   LSWADD
0546  7040            CMA
0547  3772            DCA I   LSWADD
0550  1772            TAD I   LSWADD
```

```
0551  0772          AND I   LSWADD
0552  0772          AND I   LSWADD
0553  0772          AND I   LSWADD
0554  0772          AND I   LSWADD
0555  0772          AND I   LSWADD
0556  7040          CMA
0557  3772          DCA I   LSWADD
0560  5336          JMP     LSCOP1

0561  7604  LSCOP2, LAS
0562  3372          DCA     LSWADD          /TEST ADDRESS
0563  1772          TAD I   LSWADD
0564  7040          CMA
0565  3772          DCA I   LSWADD
0566  1772          TAD I   LSWADD
0567  7040          CMA
0570  3772          DCA I   LSWADD
0571  5361          JMP     LSCOP2

0572  0000  LSWADD, 0

      0600  #600
0600  5214          JMP     LTST            /READ AND TEST PATTERN
0601  5224          JMP     LTSTC           /READ AND TEST COMPLEMENT
0602  7774  LM04,   -4
0603  7700  LM100,  -100
0604  0763  KLENDT, LENDT                   /LO END TEST ROUTINE
0605  7570  KLBBB,  HBBB                    /HI END TEST ROUTINE
0606  0000  LEND2,  0                       /END TEST ROUTINE
0607  0000  LTSTAD, 0                       /START TEST ADDRESS
0610  0000  LCNT6,  0                       /TEST 2 PAGES
0611  0000  LCNT7,  0                       /TEST 4 ADDRESSES
0612  1000  KK1000, 1000
0613  7600  KC7600, 7600

                    /
                    /READ AND TEST PATTERN CONTROL
                    /
0614  4234  LTST,   JMS     LRCON           /CORRECT READ CONSTANTS
0615  4252          JMS     LRMEM           /READ AND TEST PATTERN
0616  1252          TAD     LRMEM           /0XXX OR 7XXX
0617  1213          TAD     KC7600          /-200
0620  0213          AND     KC7600
0621  7001          IAC
0622  3207          DCA     LTSTAD
0623  5607          JMP I   LTSTAD          /0401 OR 7201

                    /
                    /READ AND TEST COMPLEMENT PATTERN CONTROL
                    /
0624  4234  LTSTC,  JMS     LRCON           /CORRECT READ CONSTANTS
0625  4254          JMS     LRMEMC          /READ AND TEST COMPLEMENT PATTERN
0626  1254          TAD     LRMEMC          /0XXX OR 7XXX
0627  7006          7006                    /RTL - AND ADDRESS OF TAG HPASS
0630  7630          SZL CLA
```

```
0631  5627            JMP I   .-2              /PROG IN UPPER MEM
0632  5633            JMP I   .+1              /PROG IN LOWER MEM
0633  0206            0206                     /ADDRESS OF TAG LPASS

                      /
                      /UPDATE READ CONSTANTS
                      /
0634  0000    LRCON,  0
0635  1234            TAD     .-1              /0XXX OR 7XXX
0636  7004            RAL
0637  7630            SZL CLA
0640  5246            JMP     LRCON1           /PROG IN UPPER MEM
0641  1212            TAD     KK1000           /PROG IN LOWER MEM
0642  3207            DCA     LTSTAD           /START TEST ADDRESS
0643  1204            TAD     KLENDT
0644  3206            DCA     LEND2            /END MEM ROUTINE
0645  5634            JMP I   LRCON

0646  1205    LRCON1, TAD     KL8BB
0647  3206            DCA     LEND2            /END MEM ROUTINE
0650  3207            DCA     LTSTAD           /START TEST ADDRESS
0651  5634            JMP I   LRCON

                      /
                      /READ AND TEST PATTERN OR PATTERN COMPLEMENT
                      /
0652  0000    LRMEM,  0
0653  5260            JMP     LR1010           /READ AND TEST PATTERN
0654  0000    LRMEMC, 0
0655  1234            TAD     .-1
0656  3252            DCA     LRMEM            /STORE RETURN ADDRESS
0657  5311            JMP     LR0101           /READ AND TEST COMPLEMENT

0660  1203    LR1010, TAD     LM100            /-100
0661  3210            DCA     LCNT6            /READ AND TEST 2 PAGES
0662  1202    LONE,   TAD     LM04             /-4
0663  3211            DCA     LCNT7            /READ AND TEST 4 ADDRESSES
0664  1607    LONE1,  TAD I   LTSTAD
0665  7160            CMA STL
0666  3607            DCA I   LTSTAD
0667  1607            TAD I   LTSTAD
0670  7640            SZA CLA                  /TEST ONE COMPLEMENTED
0671  4352            JMS     LHALTC           /THIS LOC FAILED READ AND TEST
0672  1607            TAD I   LTSTAD
0673  7040            CMA
0674  3607            DCA I   LTSTAD
0675  1607            TAD I   LTSTAD
0676  7101            IAC CLL
0677  7640            SZA CLA                  /TEST ONE
0700  4342            JMS     LHALT            /THIS LOC FAILED READ AND TEST
0701  2207            ISZ     LTSTAD
0702  7000            NOP
0703  2211            ISZ     LCNT7
0704  5264            JMP     LONE+2
0705  2210            ISZ     LCNT6
```

```
0706  5313          JMP     LZERO
0707  4606          JMS I   LEND2           /END OF MEMORY?
0710  5260          JMP     LR1010          /NO

0711  1203  LR0101,  TAD     LM100           /-100
0712  3210          DCA     LCNT6           /READ AND TEST 2 PAGES
0713  1202  LZERO,   TAD     LM04            /-4
0714  3211          DCA     LCNT7           /READ AND TEST 4 ADDRESSES
0715  1607  LZERO1,  TAD I   LTSTAD
0716  7040          CMA
0717  3607          DCA I   LTSTAD
0720  1607          TAD I   LTSTAD
0721  7121          IAC STL
0722  7640          SZA CLA                 /TEST ZERO COMPLEMENTED
0723  4352          JMS     LHALTC          /THIS LOC FAILED READ AND TEST
0724  1607          TAD I   LTSTAD
0725  7140          CMA CLL
0726  3607          DCA I   LTSTAD
0727  1607          TAD I   LTSTAD
0730  7640          SZA CLA                 /TEST ZERO
0731  4342          JMS     LHALT           /THIS LOC FAILED READ AND TEST
0732  2207          ISZ     LTSTAD
0733  7000          NOP
0734  2211          ISZ     LCNT7
0735  5315          JMP     LZERO+2
0736  2210          ISZ     LCNT6
0737  5262          JMP     LONE
0740  4606          JMS I   LEND2           /END OF MEMORY?
0741  5311          JMP     LR0101          /NO

                    /
                    /ERROR HALT ROUTINE FOR DATA FAILURE
                    /
0742  0000  LHALT,  0
0743  1607          TAD I   LTSTAD
0744  7402          HLT                     /1ST HALT = BAD DATA
0745  7200          CLA
0746  1207          TAD     LTSTAD
0747  7402          HLT                     /2ND HALT = BAD LOCATION
0750  7200          CLA
0751  5742          JMP I   LHALT

                    /
                    /ERROR HALT ROUTINE FOR COMPLEMENT DATA FAILURE
                    /
0752  0000  LHALTC, 0
0753  1607          TAD I   LTSTAD
0754  7040          CMA
0755  7402          HLT                     /1ST HALT = BAD DATA
0756  7200          CLA
0757  1207          TAD     LTSTAD
0760  7402          HLT                     /2ND HALT = BAD LOCATION
0761  7300          CLA CLL
0762  5752          JMP I   LHALTC
```

```
                        /
                        /END OF MEMORY ROUTINE
                        /
0763  0000     LENDT,   0
0764  1207              TAD     LTSTAD
0765  7640              SZA CLA
0766  5763              JMP I   LENDT           /MORE MEMORY TO TEST
0767  5652              JMP I   LRMEM           /END OF TEST
0770  0000     LBBB,    0
0771  1207              TAD     LTSTAD
0772  1212              TAD     KK1000
0773  7640              SZA CLA
0774  5770              JMP I   LBBB            /MORE MEMORY TO TEST
0775  5652              JMP I   LRMEM           /END OF TEST

      7000     *7000
7000  7000              NOP                     /WILL = JMP HGOP2 FOR RESTART
7001  7600     C7600,   7600                    /CLA USED AS CONSTANT 7600
7002  1205     HCNT1,   TAD     .+3             /WILL = TRANSFER CONTROL COUNTER
7003  3200     HCNT2,   DCA     7000            /WILL = TRANSFER TO CONTROL
7004  7000     HCNT3,   NOP                     /WILL = TRANSFER FROM CONTROL
7005  5364     HINAD1,  JMP     HGOP2           /WILL = INDIRECT ADDRESS
7006  5336              JMP     HPASS           /THIS INST MUST BE IN LOC 7006
7007  4000     HSW0,    4000                    /SR BIT 0
7010  0020     HSW7,    0020                    /SR BIT 7
7011  0200     C0200,   0200
7012  7000     C7000,   7000
7013  7200     C7200,   7200

                        /
                        /CHECK HALT PROGRAM SWITCH
                        /
7014  7604     HSR00,   LAS
7015  0207              AND     HSW0
7016  7650              SNA CLA
7017  5223              JMP     HSR07           /HALT SW IS OFF
7020  4232              JMS     HHILO
7021  4272              JMS     HRESBN          /PROG IN LO - RESTORE BIN
7022  7402              HLT                     /PROG IN HI
                        /
                        /CHECK INHIBIT RELOCATION SWITCH
                        /
7023  7604     HSR07,   LAS
7024  0210              AND     HSW7
7025  7640              SZA CLA
7026  5364              JMP     HGOP2           /INHIBIT RELOCATION
7027  4232              JMS     HHILO
7030  5240              JMP     HRELOU          /PROG IN LO - MOVE UP
7031  5251              JMP     HRELOD          /PROG IN HI - MOVE DOWN

                        /
                        /CHECK FOR PROGRAM IN UPPER OR LOWER MEMORY
                        /
7032  0000     HHILO,   0
7033  1232              TAD     .-1             /0XXX OR 7XXX
```

```
7034  7004          RAL
7035  7630          SZL CLA                 /SKIP IF PROG IN LO
7036  2232          ISZ     HHILO           /PROG IN HI
7037  5632          JMP I   HHILO

                    /
                    /RELOCATE PROGRAM TO UPPER MEMORY
                    /
7040  4272    HRELOU, JMS     HRESBN        /RESTORE BIN INTO PAGE 31
7041  1213          TAD     C7200           /-600
7042  3202          DCA     HCNT1           /CONTROLS 600 TRANSFERS
7043  1211          TAD     C0200
7044  3204          DCA     HCNT3           /PAGE 1 CA
7045  1212          TAD     C7000
7046  3203          DCA     HCNT2           /PAGE 28 CA
7047  4302          JMS     HRELO           /RELOCATE PROGRAM
7050  5612          JMP I   C7000           /JMP TO PROG IN UPPER MEM

                    /
                    /RELOCATE PROGRAM TO LOWER MEMORY
                    /
7051  4262    HRELOD, JMS     HSAVBN        /SAVE BIN INTO PAGE 0
7052  1213          TAD     C7200           /-600
7053  3202          DCA     HCNT1           /CONTROLS 600 TRANSFERS
7054  1211          TAD     C0200
7055  3203          DCA     HCNT2           /PAGE 1 CA
7056  1212          TAD     C7000
7057  3204          DCA     HCNT3           /PAGE 28 CA
7060  4302          JMS     HRELO           /RELOCATE PROGRAM
7061  5611          JMP I   C0200           /JMP TO PROG IN LOWER MEM

                    /
                    /SAVE BIN AND RIM INTO PAGE 0
                    /
7062  0000    HSAVBN, 0
7063  1201          TAD     C7600           /-200
7064  3202          DCA     HCNT1           /CONTROLS 200 TRANSFERS
7065  3203          DCA     HCNT2           /PAGE 0 CA
7066  1201          TAD     C7600
7067  3204          DCA     HCNT3           /PAGE 31 CA
7070  4302          JMS     HRELO           /RELOCATE BIN INTO PAGE 0
7071  5662          JMP I   HSAVBN

                    /
                    /RESTORE BIN AND RIM INTO PAGE 31
                    /
7072  0000    HRESBN, 0
7073  1201          TAD     C7600           /-200
7074  3202          DCA     HCNT1           /CONTROLS 200 TRANSFERS
7075  3204          DCA     HCNT3           /PAGE 0 CA
7076  1201          TAD     C7600
7077  3203          DCA     HCNT2           /PAGE 31 CA
7100  4302          JMS     HRELO           /RELOCATE BIN INTO PAGE 31
7101  5672          JMP I   HRESBN
```

```
                        /
                        /RELOCATE SUBROUTINE
                        /
7102  0000    HRELO,    0
7103  1604              TAD I   HCNT3         /TRANSFER FROM
7104  3603              DCA I   HCNT2         /TRANSFER TO
7105  1604              TAD I   HCNT3         /CHECK TRANSFER
7106  7041              CIA
7107  1603              TAD I   HCNT2
7110  7640              SZA CLA
7111  4320              JMS     HXFERF        /TRANSFER FAILED
7112  2204              ISZ     HCNT3         /INCREMENT FROM ADDRESS
7113  2203              ISZ     HCNT2         /INCREMENT TO ADDRESS
7114  7000              NOP
7115  2202              ISZ     HCNT1         /INCREMENT TRANSFER CONTROL
7116  5303              JMP     HRELO+1
7117  5702              JMP I   HRELO         /TRANSFER COMPLETE

                        /
                        /RELOCATION FAILURE HALT ROUTINE
                        /
7120  0000    HXFERF,   0
7121  1604              TAD I   HCNT3
7122  7402              HLT                   /1ST HALT - FROM DATA
7123  7200              CLA
7124  1204              TAD     HCNT3
7125  7402              HLT                   /2ND HALT - FROM ADDRESS
7126  7200              CLA
7127  1603              TAD I   HCNT2
7130  7402              HLT                   /3RD HALT - TO DATA
7131  7200              CLA
7132  1203              TAD     HCNT2
7133  7402              HLT                   /4TH HALT - TO ADDRESS
7134  7300              CLA CLL
7135  5720              JMP I   HXFERF

                        /
                        /TYPEOUT A '5' EVERY 5 MINUTES OF RUN TIME
                        /
7136  2357    HPASS,    ISZ     HCNT
7137  5214              JMP     HSR00         /NOT 5 MINUTES YET
7140  1360              TAD     HM750
7141  3357              DCA     HCNT          /RESTORE COUNTER
7142  1361              TAD     C215
7143  4351              JMS     HTRANS        /CR
7144  1362              TAD     C212
7145  4351              JMS     HTRANS        /LF
7146  1363              TAD     C265
7147  4351              JMS     HTRANS        /5
7150  5214              JMP     HSR00

7151  0000    HTRANS,   0
7152  6046              TLS                   /TRANSMIT CODE
```

```
7153  6041          TSF
7154  5353          JMP     .-1             /WAIT FOR FLAG
7155  7300          CLA CLL
7156  5751          JMP I   HTRANS

7157  6400  HCNT,   -1400                   /COUNT 5 MINUTES
7160  6400  HM750,  -1400
7161  0215  C215,   215                     /CR
7162  0212  C212,   212                     /LF
7163  0265  C265,   265                     /5

                    /
                    /GO TO PAGE 2 OR PAGE 29
                    /
7164  4365  HGOP2,  JMS     .+1
7165  0000          0                       /0XXX OR 7XXX
7166  7300          CLA CLL
7167  1365          TAD     .-2
7170  1211          TAD     C0200
7171  0201          AND     C7600
7172  3205          DCA     HINAD1
7173  5605          JMP I   HINAD1          /0400 OR 7200

      7200    *7200
7200  5216          JMP     HWR             /WRITE PATTERN
7201  5225          JMP     HWRC            /WRITE COMPLEMENT
7202  7774  HM4,    -4
7203  7740  HM40,   -40
7204  0523  CHENDM, LENDM                   /LO END MEM ROUTINE
7205  7330  CHAAA,  HAAA                    /HI END MEM ROUTINE
7206  0000  HEND1,  0                       /END MEM ROUTINE
7207  0000  HMADD,  0                       /START WRITE ADDRESS
7210  0000  HCNT4,  0                       /WRITE 2 PAGES
7211  0000  HCNT5,  0                       /WRITE 4 ADDRESSES
7212  0200  CC0200, 0200
7213  1000  C1000,  1000
7214  7600  CC7600, 7600
7215  0000  HINAD2, 0                       /INDIRECT ADDRESSING

                    /
                    /WRITE PATTERN INTO MEMORY
                    /
7216  4235  HWR,    JMS     HWCON           /CORRECT WRITE CONSTANTS
7217  4253          JMS     HWRMEM          /WRITE PATTERN
7220  1253          TAD     HWRMEM          /0XXX OR 7XXX
7221  1212          TAD     CC0200
7222  0214          AND     CC7600
7223  3215          DCA     HINAD2
7224  5615          JMP I   HINAD2          /0600 OR 7400

                    /
                    /WRITE COMPLEMENT PATTERN INTO MEMORY
                    /
7225  4235  HWRC,   JMS     HWCON           /CORRECT WRITE CONSTANTS
7226  4255          JMS     HWRMC           /WRITE COMPLEMENT PATTERN
```

```
7227  1253            TAD     HWRMEM          /0XXX OR 7XXX
7230  1212            TAD     CC0200
7231  0214            AND     CC7600
7232  7001            IAC
7233  3215            DCA     HINAD2
7234  5615            JMP I   HINAD2          /0601 OR 7401

                /
                /UPDATE WRITE CONSTANTS
                /
7235  0000    HWCON,  0
7236  1235            TAD     .-1             /0XXX OR 7XXX
7237  7004            RAL
7240  7630            SZL CLA
7241  5247            JMP     HWCON1          /PROG IN UPPER MEM
7242  1213            TAD     C1000           /PROG IN LOWER MEM
7243  3207            DCA     HMADD           /START WRITE ADDRESS
7244  1204            TAD     CHENDM
7245  3206            DCA     HEND1           /END MEM ROUTINE
7246  5635            JMP I   HWCON

7247  1205    HWCON1, TAD     CHAAA
7250  3206            DCA     HEND1           /END MEM ROUTINE
7251  3207            DCA     HMADD           /START WRITE ADDRESS
7252  5635            JMP I   HWCON

                /
                /WRITE PATTERN OR WRITE PATTERN COMPLEMENT
                /
7253  0000    HWRMEM, 0
7254  5261            JMP     HW1010          /WRITE PATTERN
7255  0000    HWRMC,  0
7256  1255            TAD     .-1
7257  3253            DCA     HWRMEM          /STORE RETURN ADDRESS
7260  5270            JMP     HW0101          /WRITE COMPLEMENT

7261  1203    HW1010, TAD     HM40            /-40
7262  3210            DCA     HCNT4           /WRITE 2 PAGES
7263  4311            JMS     HWONE           /WRITE 4 WORDS OF ONES
7264  4300            JMS     HWZERO          /WRITE 4 WORDS OF ZEROES
7265  2210            ISZ     HCNT4
7266  5263            JMP     HW1010+2
7267  4606            JMS I   HEND1           /END OF MEMORY?
7270  1203    HW0101, TAD     HM40            /-40
7271  3210            DCA     HCNT4           /WRITE 2 PAGES
7272  4300            JMS     HWZERO          /WRITE 4 WORDS OF ZEROS
7273  4311            JMS     HWONE           /WRITE 4 WORDS OF ONES
7274  2210            ISZ     HCNT4
7275  5272            JMP     HW0101+2
7276  4606            JMS I   HEND1           /END OF MEMORY?
7277  5261            JMP     HW1010

7300  0000    HWZERO, 0
7301  1202            TAD     HM4             /-4
7302  3211            DCA     HCNT5           /WRITE 4 ZEROES
```

```
7303  3607          DCA I   HMADD
7304  2207          ISZ     HMADD           /INCREMENT MEMORY ADDRESS
7305  7000          NOP
7306  2211          ISZ     HCNT5
7307  5303          JMP     HWZERO+3
7310  5700          JMP I   HWZERO

7311  0000  HWONE,  0
7312  1202          TAD     HM4             /-4
7313  3211          DCA     HCNT5           /WRITE 4 ONES
7314  7240          STA
7315  3607          DCA I   HMADD
7316  2207          ISZ     HMADD           /INCREMENT MEMORY ADDRESS
7317  7000          NOP
7320  2211          ISZ     HCNT5
7321  5314          JMP     HWONE+3
7322  5711          JMP I   HWONE


                    /
                    /CHECK FOR END OF MEMORY
                    /
7323  0000  HENDM,  0
7324  1207          TAD     HMADD
7325  7640          SZA CLA
7326  5723          JMP I   HENDM
7327  5653          JMP I   HWRMEM
7330  0000  HAAA,   0
7331  1207          TAD     HMADD
7332  1213          TAD     C1000
7333  7640          SZA CLA
7334  5730          JMP I   HAAA
7335  5653          JMP I   HWRMEM

                    /
                    /TWO SPECIAL SCOPE LOOPS
                    /
7336  7604  HSCOP1, LAS
7337  3372          DCA     HSWADD          /TEST ADDRESS
7340  1772          TAD I   HSWADD
7341  0772          AND I   HSWADD
7342  0772          AND I   HSWADD
7343  0772          AND I   HSWADD
7344  0772          AND I   HSWADD
7345  0772          AND I   HSWADD
7346  7040          CMA
7347  3772          DCA I   HSWADD
7350  1772          TAD I   HSWADD
7351  0772          AND I   HSWADD
7352  0772          AND I   HSWADD
7353  0772          AND I   HSWADD
7354  0772          AND I   HSWADD
7355  0772          AND I   HSWADD
7356  7040          CMA
7357  3772          DCA I   HSWADD
```

```
7360  5336          JMP     HSCOP1

7361  7604  HSCOP2, LAS
7362  3372          DCA     HSWADD          /TEST ADDRESS
7363  1772          TAD I   HSWADD
7364  7040          CMA
7365  3772          DCA I   HSWADD
7366  1772          TAD I   HSWADD
7367  7040          CMA
7370  3772          DCA I   HSWADD
7371  5361          JMP     HSCOP2

7372  0000  HSWADD, 0

      7400  *7400
7400  5214          JMP     HTST            /READ AND TEST PATTERN
7401  5224          JMP     HTSTC           /READ AND TEST COMPLEMENT
7402  7774  HM04,   -4
7403  7700  HM100,  -100
7404  0763  CHENDT, LENDT                    /LO END TEST ROUTINE
7405  7570  CHBBB,  HBBB                     /HI END TEST ROUTINE
7406  0000  HEND2,  0                       /END TEST ROUTINE
7407  0000  HTSTAD, 0                       /START TEST ADDRESS
7410  0000  HCNT6,  0                       /TEST 2 PAGES
7411  0000  HCNT7,  0                       /TEST 4 ADDRESSES
7412  1000  CC1000, 1000
7413  7600  CK7600, 7600

                    /
                    /READ AND TEST PATTERN CONTROL
                    /
7414  4234  HTST,   JMS     HRCON           /CORRECT READ CONSTANTS
7415  4252          JMS     HRMEM           /READ AND TEST PATTERN
7416  1252          TAD     HRMEM           /0XXX OR 7XXX
7417  1213          TAD     CK7600          /-200
7420  0213          AND     CK7600
7421  7001          IAC
7422  3207          DCA     HTSTAD
7423  5607          JMP I   HTSTAD          /0401 OR 7201

                    /
                    /READ AND TEST COMPLEMENT PATTERN CONTROL
                    /
7424  4234  HTSTC,  JMS     HRCON           /CORRECT READ CONSTANTS
7425  4254          JMS     HRMEMC          /READ AND TEST COMPLEMENT PATTERN
7426  1254          TAD     HRMEMC          /0XXX OR 7XXX
7427  7006          7006                    /RTL - AND ADDRESS OF TAG HPASS
7430  7630          SZL CLA
7431  5627          JMP I   .-2             /PROG IN UPPER MEM
7432  5633          JMP I   .+1             /PROG IN LOWER MEM
7433  0206          0206                    /ADDRESS OF TAG LPASS

                    /
                    /UPDATE READ CONSTANTS
                    /
```

```
7434  0000  HRCON,  0
7435  1234          TAD     .-1             /0XXX OR 7XXX
7436  7004          RAL
7437  7630          SZL CLA
7440  5246          JMP     HRCON1          /PROG IN UPPER MEM
7441  1212          TAD     CC1000          /PROG IN LOWER MEM
7442  3207          DCA     HTSTAD          /START TEST ADDRESS
7443  1204          TAD     CHENDT
7444  3206          DCA     HEND2           /END MEM ROUTINE
7445  5634          JMP I   HRCON

7446  1205  HRCON1, TAD     CHBBB
7447  3206          DCA     HEND2           /END MEM ROUTINE
7450  3207          DCA     HTSTAD          /START TEST ADDRESS
7451  5634          JMP I   HRCON

                    /
                    /READ AND TEST PATTERN OR PATTERN COMPLEMENT
                    /
7452  0000  HRMEM,  0
7453  5260          JMP     HR1010          /READ AND TEST PATTERN
7454  0000  HRMEMC, 0
7455  1254          TAD     .+1
7456  3252          DCA     HRMEM           /STORE RETURN ADDRESS
7457  5311          JMP     HR0101          /READ AND TEST COMPLEMENT

7460  1203  HR1010, TAD     HM100           /-100
7461  3210          DCA     HCNT6           /READ AND TEST 2 PAGES
7462  1202  HONE,   TAD     HM04            /-4
7463  3211          DCA     HCNT7           /READ AND TEST 4 ADDRESSES
7464  1607  HONE1,  TAD I   HTSTAD
7465  7160          CMA STL
7466  3607          DCA I   HTSTAD
7467  1607          TAD I   HTSTAD
7470  7640          SZA CLA                 /TEST ONE COMPLEMENTED
7471  4342          JMS     HHALTC          /THIS LOC FAILED READ AND TEST
7472  1607          TAD I   HTSTAD
7473  7040          CMA
7474  3607          DCA I   HTSTAD
7475  1607          TAD I   HTSTAD
7476  7101          IAC CLL
7477  7640          SZA CLA                 /TEST ONE
7500  4342          JMS     HHALT           /THIS LOCATION FAILED READ AND TEST
7501  2207          ISZ     HTSTAD
7502  7000          NOP
7503  2211          ISZ     HCNT7
7504  5264          JMP     HONE+2
7505  2210          ISZ     HCNT6
7506  5313          JMP     HZERO
7507  4606          JMS I   HEND2           /END OF MEMORY?
7510  5260          JMP     HR1010          /NO

7511  1203  HR0101, TAD     HM100           /-100
7512  3210          DCA     HCNT6           /READ AND TEST 2 PAGES
7513  1202  HZERO,  TAD     HM04            /-4
```

```
7514  3211            DCA     HCNT7           /READ AND TEST 4 ADDRESSES
7515  1607  HZERO1,   TAD I   HTSTAD
7516  7040            CMA
7517  3607            DCA I   HTSTAD
7520  1607            TAD I   HTSTAD
7521  7121            IAC STL
7522  7640            SZA CLA                 /TEST ZERO COMPLEMENTED
7523  4352            JMS     HHALTC          /THIS LOC FAILED READ AND TEST
7524  1607            TAD I   HTSTAD
7525  7140            CMA CLL
7526  3607            DCA I   HTSTAD
7527  1607            TAD I   HTSTAD
7530  7640            SZA CLA                 /TEST ZERO
7531  4342            JMS     HHALT           /THIS LOC FAILED READ AND TEST
7532  2207            ISZ     HTSTAD
7533  7000            NOP
7534  2211            ISZ     HCNT7
7535  5315            JMP     HZERO+2
7536  2210            ISZ     HCNT6
7537  5262            JMP     HONE
7540  4606            JMS I   HEND2           /END OF MEMORY?
7541  5311            JMP     HR0101          /NO

                      /
                      /ERROR HALT ROUTINE FOR DATA FAILURE
                      /
7542  0000  HHALT,     0
7543  1607            TAD I   HTSTAD
7544  7402            HLT                     /1ST HALT = BAD DATA
7545  7200            CLA
7546  1207            TAD     HTSTAD
7547  7402            HLT                     /2ND HALT = BAD LOCATION
7550  7200            CLA
7551  5742            JMP I   HHALT

                      /
                      /ERROR HALT ROUTINE FOR COMPLEMENT DATA FAILURE
                      /
7552  0000  HHALTC,    0
7553  1607            TAD I   HTSTAD
7554  7040            CMA
7555  7402            HLT                     /1ST HALT = BAD DATA
7556  7200            CLA
7557  1207            TAD     HTSTAD
7560  7402            HLT                     /2ND HALT = BAD LOCATION
7561  7300            CLA CLL
7562  5752            JMP I   HHALTC

                      /
                      /END OF MEMORY ROUTINE
                      /
7563  0000  HENDT,     0
7564  1207            TAD     HTSTAD
7565  7640            SZA CLA
7566  5763            JMP I   HENDT           /MORE MEMORY TO TEST
```

```
7567  5652              JMP I   HRMEM           /END OF TEST
7570  0000    HBBB,     0
7571  1207              TAD     HTSTAD
7572  1212              TAD     CC1000
7573  7640              SZA CLA
7574  5770              JMP I   HBBB            /MORE MEMORY TO TEST
7575  5652              JMP I   HRMEM           /END OF TEST
                        $
```

```
0000  11110000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
0100  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

0200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11110000

0400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11100000

0600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111100


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  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
7100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11110000

7200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
7300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11100000

7400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
7500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111100

7600
7700
```

```
C0200   7011
C1000   7213
C212    7162
C215    7161
C265    7163
C7000   7012
C7200   7013
C7600   7001
CC0200  7212
CC1000  7412
CC7600  7214
CHAAA   7205
CHBBB   7405
CHENDM  7204
CHENDT  7404
CK7600  7413
HAAA    7330
HBBB    7570
HCNT    7157
HCNT1   7002
HCNT2   7003
HCNT3   7004
HCNT4   7210
HCNT5   7211
HCNT6   7410
HCNT7   7411
HEND1   7206
HEND2   7406
HENDM   7323
HENDT   7563
HGOP2   7164
HHALT   7542
HHALTC  7552
HHILO   7032
HINAD1  7005
HINAD2  7215
HM04    7402
HM100   7403
HM4     7202
HM40    7203
HM750   7160
HMADD   7207
HONE    7462
HONE1   7464
HPASS   7136
HR0101  7511
HR1010  7460
HRCON   7434
HRCON1  7446
HRELO   7102
HRELOD  7051
HRELOU  7040
HRESBN  7072
HRMEM   7452
HRMEMC  7454
HSAVBN  7062
HSCOP1  7336
HSCOP2  7361
HSR00   7014
HSR07   7023
HSW0    7007
HSW7    7010
HSWADD  7372
HTRANS  7151
HTST    7414
HTSTAD  7407
HTSTC   7424
HW0101  7270
HW1010  7261
HWCON   7235
HWCON1  7247
HWONE   7311
HWR     7216
HWRC    7225
HWRMC   7255
HWRMEM  7253
HWZERO  7300
HXFERF  7120
HZERO   7513
HZERO1  7515
K0200   0211
K1000   0413
K212    0362
K215    0361
K265    0363
K7000   0212
K7200   0213
K7600   0201
KC7600  0613
KK0200  0412
KK1000  0612
KK7600  0414
KLAAA   0405
KLBBB   0605
KLENDM  0404
KLENDT  0604
LAAA    0530
LBBB    0770
LCNT    0357
LCNT1   0202
LCNT2   0203
LCNT3   0204
LCNT4   0410
LCNT5   0411
LCNT6   0610
LCNT7   0611
LEND1   0406
LEND2   0606
LENDM   0523
LENDT   0763
LGOP2   0364
LHALT   0742
LHALTC  0752
LHILO   0232
LINAD1  0205
LINAD2  0415
LM04    0602
LM100   0603
LM4     0402
LM40    0403
LM750   0360
LMADD   0407
LONE    0662
LONE1   0664
LPASS   0336
LR0101  0711
LR1010  0660
LRCON   0634
LRCON1  0646
LRELO   0302
LRELOD  0251
LRELOU  0240
LRESBN  0272
LRMEM   0652
LRMEMC  0654
LSAVBN  0262
LSCOP1  0536
LSCOP2  0561
LSR00   0214
LSR07   0223
LSW0    0207
LSW7    0210
LSWADD  0572
LTRANS  0351
LTST    0614
LTSTAD  0607
LTSTC   0624
LW0101  0470
LW1010  0461
LWCON   0435
LWCON1  0447
LWONE   0511
LWR     0416
LWRC    0425
LWRMC   0455
LWRMEM  0453
LWZERO  0500
LXFERF  0320
LZERO   0713
LZERO1  0715
```

ERRORS DETECTED: 0

LINKS GENERATED: 0

RUN-TIME: 9 SECONDS

3K CORE USED