CB12

IDENTIFICATION

PRODUCT CODE:	MAINDEC 12-D1DA-D(D)
PRODUCT NAME:	PDP-12 CHECKERBOARD
DATE CREATED:	OCTOBER 20, 1969
MAINTAINER:	DIAGNOSTIC GROUP
AUTHOR:	HAROLD LONG

RSW = 0007 for 8K core
SMODE
START 200
RSW 4-1 for PAPER TAPE OUT. RIM & BIN

COPYRIGHT © 1969
DIGITAL EQUIPMENT CORPORATION

1. ABSTRACT

PDP-12 checkerboard is designed to test the operation of the PDP-12 memory, from 4 to 32K. It accomplishes this by using the L mode instructions LAM (link & AC added to memory, sum in AC and memory), ADM (AC added to memory, sum in AC and memory), and SAE (skip if accumulator is equal to designated memory register). The algorithim used for testing is to first set the memory cell under test to 5252; second, set the AC to 6525, and rotate it into the linc one place, resulting in the AC = (1) 5252 (the (1) indicating the link is set); third, a LAM is performed into the test cell and two comparisons made; once for the AC = 2525, and once for memory equal to the AC. Fourth, an ADM is performed; since the AC is now equal to 2525, and memory equal to 2525, the sum will be 5252. Another test of the AC and memory is made. If any of the comparisons fail, an error routine is entered; otherwise, the memory target address is incremented and testing continued.

This test will cycle throughout all available memory, as determined by the right switches.

2. REQUIREMENTS

2.1 Equipment

a) Any PDP-12 computer, (with or without EXT. memory)
b) An ASR-33 teletype or equivalent.

2.2 Preliminary Programs

a) Insure that the binary loader is operating properly.
b) If this test will not run as indicated, verify processor operation with CP Test 1 (INSTST). No other programs are necessary.

3. LOADING PROCEDURES

3.1 Method

This program must be loaded with the binary loader. If you are unfamiliar with the proper binary loading procedures refer to "Appendix A" of this program, otherwise procede with the following:

a) Set the teletype reader switch to FREE.
b) Open the teletype reader and insert the program tape so that the arrows on the tape are visible to and pointing toward the operator.
c) Close the reader and set the reader switch to START.
d) Set the teletype front panel switch to ON LINE
e) Set the LEFT switches to 7777.
f) Set the RIGHT switches to 4ØØØ.
g) Set the MODE switch to 8 mode.
h) Depress I/O preset.
i) Depress START LS.

j) When the program tape has been read the ACCUMULATOR must be ØØØØ if it is not, a read-in error has occured and one might try reloading the binary loader.
k) Remove the program tape from the reader.

4. STARTING PROCEDURES

a) Set the RIGHT Switches SR7 thru 11 to the amount of memory available, in 1K segments, within the range Ø to 37. (In a 4K machine this would be ØØØ3).
b) Set the MODE switch to 8 mode.
c) Depress I/O preset.
d) Depress START 20.
e) The program, when properly running, will cause the data field lights to appear to be counting up, and the teletype bell to ring at intervals dependent upon the amount of memory being tested.
f) Attempting to test non-existant memory may result in program destruction or false error printouts.

5. ERROR ROUTINE

5.1 Switch Settings

In general, SRØ-3 allows selection of the error mode. With all switches equal to zero, the sequence would be:

(HLT) - OPERATOR SELECTS ANY ADDITIONAL ERROR OPTIONS AND DEPRESSES THE CONTINUE SWITCH -
(ERROR PRINTOUT) - (NEXT CELL TESTED)

SRØØ = 1 SUPPRESS HALT
SRØ1 = 1 SUPPRESS PRINTOUT
SRØ2 = 1 SCOPE LOOP ON FAILING CELL
SRØ3 = 1 LOOP ON SELECTED FIELD

With SRØ3 = 1, the right switches Ø7-11 must contain the field you wish to test, within the range Ø to 37. The diagnostic will cycle within this field, stopping only in the event of an error.

SRØ4 = 1 DUMP PASS COUNTER

Setting this switch to a one causes a type out of the contents of the pass counter. A start 2Ø will set the counter to ØØØØ.

SRØ5 = 1 INHIBIT BELL RING AT END OF PASS.

5.2 Error Printout

The error printout has the following general form:

LINC FIELD	CHKB LOCN	CONT	ACUM
0007	0400	2524	2525
0007	0400	5202	5202

The message is interpreted as follows:

FIELD - The data field being tested, within the range 0 to 37.
LOCN - The 10 bit address within that field.
CONT - The contents of that location; this should equal the AC.
ACUM - The contents of the AC. This should equal either 2525 or 5252.

5.3 Error Analysis

Compare the memory contents against the contents of the AC. In the first example, it is apparent that the AC is correct, indicating proper data acquisition, but that memory is bad, indicating poor write response in memory - this could be either inhibit current, memory timing, or bad cores.

In the second example, both memory and the AC are the same, but the data is bad, indicating poor read response. This could be marginal sense amps, memory timing, or bad cores.

These are examples only, and are not to be taken as a hard & fast rule.

```
0000                    *20
0001                    /PDP-12 CHECKERBOARD, MAINDEC 12-D1DA-L
0002                    /COPYRIGHT DIGITAL EQUIPMENT CORP., MAYNARD, MASS.
0003                    /
0004                    /AUTHOR: HAROLD LONG
0005                    /
0006                    /THIS TEST IS DESIGNED TO CHECK THE OPERATION
0007                    /OF THE PDP-12 INSTRUCTION "LAM".
0010                    /IT MAKES USE OF THE "READ -MODIFY -WRITE
0011                    /MEMORY CYCLE TO TEST MEMORY RELIABLILITY.
0012                    /THE PROGRAM OCCUPIES CELLS 0000 TO 0300
0013                    /IN BANK 0. IT WILL CHECK ALL OTHER MEMORY
0014                    /AVAILABLE.
0015                    /THE ALGORITHM USED FOR TESTING IS TO SET
0016                    /THE MEMORY CELL UNDER TEST TO 5252, AND THE AC TO 6525.
0017                    /THE AC IS ROTATED INTO THE LINC ONE PLACE
0020                    /AND A LAM TO THE TEST CELL EXECUTED
0021                    /A SAE IS EXECUTED FOR TESTING PURPOSES AND THE
0022                    /ROUTINE CONTINUED
0023                    /AN ERROR WILL CAUSE ENTRY INTO THE
0024                    /ERROR ROUTINE
0025                    /
0026                    /
0027                    /
0030                    /SWITCH SETTINGS:
0031                    /
0032                    /RSW 00=1, INHIBIT ERROR HALT
0033                    /RSW 01=1, INHIBIT ERROR TYPEOUT
0034                    /RSW 02=1, SCOPE LOOP ON FAILING CELL
0035                    /RSW 03=1, SCOPE LOOP ON SELECTED BANK
0036                    /RSW 04=1, DUMP PASS COUNTER
0037                    /RSW 05=1, INHIBIT BELL
0040                    /
0041                    /RSW 07 TO 11 ARE SET TO THE HIGHEST MEMORY BANK AVAILABLE,
0042                    /WITHIN THE RANGE 0 TO 37.  IN A 4K MACHINE, THIS WOULD BE
0043                    /0003;  WITH RSW 03=1, THE DESIRED BANK MUST BE IN THE SWITCHES.
0044                    /
0045                    /
0046                    /I/O PRESET TO 8 MODE, START 20
0047                    /
0050                            EJECT
```

```
0051                    /
0052                    /TAGS AND CONSTANTS
0053                    /
0054                            PMODE
0055                            *0001
0056        0001  0000  AUTO1,  0000
0057        0002  2351  AUTO2,  2351
0058        0003  0000  RSWB,   0000
0059        0004  0000  AUTO4,  0000
0060        0005  0000  AUTO5,  0000
0061        0006  0000  ERROR1, 0000
0062        0007  0252  MESSA,  K215-1
0063        0010  0000  AUTO10, 0000
0064        0011  0000  TEMP,   0000
0065        0012  1026  K1026,  1026
0066        0013  7774  K7774,  7774
0067        0014  0000  REGB,   0000
0068        0015  0003  MASK,   0003
0069        0016  0240  K0240,  0240
0070        0017  0000  BANK,   0000
0071                    /
0072                    EJECT
-
```

```
0077                    /
0100                    PMODE
0101                    /
0102                    /MAJOR START & MODE
0103                    /
0104                    *0020
0105    0020  6141  START,  LINC                    /GO TO LINC MODE
0106                  LMODE
0107    0021  3364          SET I    AUTO4         /RESET PASS COUNTER
0110    0022  0000          0000
0111    0023  0065          SET I    AUTO5         /RESET PASS MULTIPLIER
0112    0024  0000          0000
0113    0025  6112          JMP      RESET         /START WITH BANK 0
0114    0026  0516          RSW                    /READ THE SWITCHES
0115    0027  1560          BCL I                  /SAVE BITS 07-11
0116    0030  7740          7740
0117    0031  4003          STC      RSWB          /SAVE FOR ITERATION
0120    0032  0516          RSW                    /FIXED FIELD?
0121    0033  1560          BCL I
0122    0034  7377          7377                   /CHECK FOR SWITCH 03
0123    0035  0450          AZE                    /WAS IT THERE?
0124    0036  6133          JMP      FILD1         /SET FOR FIXED FIELD
0125    0037  0041          SET      AUTO1         /SET LOWER LIMIT
0126    0040  0002          AUTO2
0127    0041  0516          RSW                    /READ THE SWITCHES
0130    0042  1560          BCL I                  /SAVE SW 04
0131    0043  7577          7577
0132    0044  0450          AZE                    /IS IT SET?
0133    0045  6333          JMP      DUMP          /YES, TYPE PASS COUNTER
0134    0046  1020  GO,     LDA I                  /PICK UP LDF
0135    0047  0640          LDF
0136    0050  2017          ADD      BANK          /ADD NEW BANK NUMBER
0137    0051  1040          STA                    /RESET INTERNAL LDF
0140    0052  0200          CHANGE
0141    0053  1040          STA
0142    0054  0207          CHANG2
0143    0055  4056          STC      SETB          /STORE FOR EXECUTION
0144                  EJECT
-
```

```
0145                    /
0146                    /TEST MEMORY WITH LAM, ADM, AND SAE
0147                    /
0150        0056  0000  SETB,   0000                    /EXECUTE LDF
0151        0057  0011  BACK,   CLR                     /CLEAR LINK
0152        0060  1020          LDA I                   /PICK UP CONSTANT
0153        0061  6525          6525
0154        0062  0261          ROL I   1               /SET LINK, JUSTIFY
0155        0063  1041          STA     AUTO1           /INDIRECT TO DF
0156        0064  1221          LAM     AUTO1           /ADD (AC&N&LINK)=2525
0157        0065  1460          SAE I                   /AC OK?
0160        0066  2525          2525
0161        0067  6151          JMP     ERROR           /NO, GO TYPE MESSAGE
0162        0070  1441          SAE     AUTO1           /MEMORY OK?
0163        0071  6151          JMP     ERROR           /NO, GO TYPE MESSAGE
0164        0072  1141          ADM     AUTO1           /ADD THEM TOGETHER AGAIN
0165        0073  1460          SAE I                   /TEST
0166        0074  5252          5252
0167        0075  6151          JMP     ERROR
0170        0076  1441          SAE     AUTO1           /TEST MEMORY
0171        0077  6151          JMP     ERROR
0172        0100  0221  INCRN,  XSK I   AUTO1           /INCREMENT TARGET
0173        0101  6057          JMP     BACK            /TRY ANOTHER CELL
0174        0102  3237          XSK I   BANK            /WILL NEVER SKIP
0175        0103  1300          LDA                     /PICK UP BANK
0176        0104  0017          BANK
0177        0105  0017          COM                     /COMPLEMENT
0200        0106  2003          ADD     RSWB            /COMPARE WITH RSW
0201        0107  2252          ADD     K0001
0202        0110  0471          APO I                   /LAST BANK?
0203        0111  6046          JMP     GO              /NEW BANK
0204                            EJECT
-
```

```
0205    0112  0077  RESET,  SET I   BANK          /RESE, BANK
0206    0113  0000          0000                  /TO ZEROS
0207    0114  0225          XSK I   AUTO5         /PASS MULTIPLIER
0210    0115  0016          NOP                   /NO SKIP WANTED
0211    0116  0516          RSW                   /READ THE SWITCHES
0212    0117  1560          BCL I                 /SAVE SW 05
0213    0120  7677          7677
0214    0121  0450          AZE                   /IS IT SET?
0215    0122  6026          JMP     START+6       /YES, INHIBIT BELL
0216    0123  1020          LDA I                 /PICK UP CONSTANT
0217    0124  0207          0207                  /BELL CODE
0220    0125  0500          IOB
0221                  PMODE
0222    0126  6046          TLS                   /RING IT
0223                  LMODE
0224    0127  0500          IOB
0225                  PMODE
0226    0130  6041          TSF                   /WAIT
0227                  LMODE
0230    0131  6127          JMP     .-2
0231    0132  6026          JMP     START+6       /NEXT PASS
0232                  EJECT
-
```

```
0233    0133  0516  FILD1,  RSW                   /READ SWITCHES AGAIN
0234    0134  1560          BCL I
0235    0135  7740          7740                  /IN FIELD 0?
0236    0136  0061          SET I   AUTO1         /TRY FOR WHOLE FIELD
0237    0137  3777          3777
0240    0140  7470          AZE I                 /NOW SEE IF FIELD 0
0241    0141  6146          JMP     SET2          /IT WAS
0242    0142  1340          STA
0243    0143  0017          BANK                  /SET UP LIMIT
0244    0144  4003          STC     RSWB          /INTO BUFFER
0245    0145  6246          JMP     GO            /BACK TO MAINLINE
0246    0146  0041  SET2,   SET     AUTO1         /FIELD 0
0247    0147  0002          AUTO2
0250    0150  6003          JMP     0             /BACK TO FIELD
0251                        EJECT
-
```

```
0252  0151  4006  ERROR,  STC     ERROR1          /SAVE AC
0253  0152  0516          RSW                     /READ THE SWITCHES
0254  0153  0471          APO I                   /SWITCH 0 SET?
0255  0154  0000          HLT                     /NO, STOP
0256  0155  0241          ROL     1               /ROTATE
0257  0156  0471          APO I                   /SWITCH 1 SET?
0260  0157  6164          JMP     TYPE            /NO, TYPE ERROR
0261  0160  0241  CHECK,  ROL     1               /ROTATE
0262  0161  0471          APO I                   /SWITCH 2 SET?
0263  0162  6100          JMP     INCRN           /NO, TRY NEW CELL
0264  0163  6057          JMP     BACK            /YES, USE SAME CELL
0265  0164  1000  TYPE,   LDA                     /CHECK FOR HEADING
0266  0165  0010          AUTO10                  /MESSAGE POINTER
0267  0166  0470          AZE I                   /WAS IT TYPED?
0270  0167  6213          JMP     HEAD            /NO, GO TYPE IT
0271  0170  1000          LDA                     /GET BANK UNDER TEST
0272  0171  0017          BANK
0273  0172  6226          JMP     OUTYP           /TYPE IT
0274  0173  1000          LDA
0275  0174  0001          AUTO1
0276  0175  1560          BCL I
0277  0176  6000          6000                    /10 BIT ADDR
0300  0177  6226          JMP     OUTYP           /TYPE CELL LOCATION
0301  0200  0000  CHANGE, 0000                    /CHANGE DATA FIELD
0302  0201  1001          LDA     AUTO1           /GET CELL CONTENTS
0303  0202  6226          JMP     OUTYP           /TYPE IT
0304  0203  1000          LDA
0305  0204  0006          ERROR1
0306  0205  6226          JMP     OUTYP           /TYPE CONTENTS OF AC
0307  0206  6316          JMP     CRLF            /RETURN AND LINEFEED
0310  0207  0000  CHANG2, 0000                    /CHANGE DATA FIELD
0311  0210  0516          RSW                     /READ SWITCHES AGAIN
0312  0211  0241          ROL     1               /JUSTIFY
0313  0212  6160          JMP     CHECK           /CHECK WITH MONITOR
0314                /
0315                EJECT
-
```

```
0316                    /
0317                    /TYPEOUT ROUTINES
0320                    /
0321    0213    0002    HEAD,   PDP                     /GO TO PMODE
0322                    PMODE
0323    0214    6201            CDF     00              /DATA FIELD 1
0324    0215    1007            TAD     MESSA
0325    0216    3010            DCA     AUTO10          /SET UP HEADER
0326    0217    1410            TAD I   AUTO10          /GET FIRST CHARACTER
0327    0220    7450            SNA                     /DONE YET?
0330    0221    5224            JMP     .+3             /YES
0331    0222    4325            JMS     PRINT           /NO, PRINT CHARACTER
0332    0223    5217            JMP .-4                 /GET NEXT CHARACTER
0333    0224    6141            LINC                    /BACK TO LMODE
0334                    LMODE
0335    0225    6000            JMP     0               /RETURN
0336    0226    0002    OUTYP,  PDP                     /BACK TO PMODE
0337                    PMODE
0340    0227    3011            DCA     TEMP            /SAVE DATA
0341    0230    1013            TAD     K7774           /SET REGISTER
0342    0231    3014            DCA     REGB            /TO -4
0343    0232    1012    HERE,   TAD     K1026           /GET CONSTANT
0344    0233    3010    REDO,   DCA     AUTO10          /SAVE
0345    0234    1011            TAD     TEMP            /GET DATA
0346    0235    7004            RAL                     /ROTATE
0347    0236    3011            DCA     TEMP            /SAVE IT
0350    0237    1010            TAD     AUTO10          /GET CONSTANT
0351    0240    7004            RAL                     /ROTATE
0352    0241    7420            SNL                     /OK TO PRINT?
0353    0242    5233            JMP     REDO            /NO, ROTATE SOME MORE
0354    0243    4325            JMS     PRINT           /YES, TYPE IT
0355    0244    2014            ISZ     REGB            /DONE?
0356    0245    5232            JMP     HERE            /NO
0357    0246    1016            TAD     K0240           /PICK UP SPACE CODE
0360    0247    4325            JMS     PRINT           /TYPE IT
0361    0250    6141            LINC                    /BACK TO LMODE
0362                    LMODE
0363    0251    6000            JMP     0               /RETURN
0364                    PMODE
0365    0252    0001    K0001,  0001
0366                    EJECT
-
```

```
0367                    /
0370                    /MESSAGE TABLE
0371                    /
0372        0253  0215  K215,   0215
0373        0254  0212  K212,   0212
0374        0255  0314          0314                /LINC CHKB
0375        0256  0311          0311                /BANK LOCN CONT ACUM
0376        0257  0316          0316
0377        0260  0303          0303
0400        0261  0240          0240
0401        0262  0303          0303
0402        0263  0310          0310
0403        0264  0313          0313
0404        0265  0302          0302
0405        0266  0215          0215
0406        0267  0212          0212
0407        0270  0302          0302
0410        0271  0301          0301
0411        0272  0316          0316
0412        0273  0313          0313
0413        0274  0240          0240
0414        0275  0314          0314
0415        0276  0317          0317
0416        0277  0303          0303
0417        0300  0316          0316
0420        0301  0240          0240
0421        0302  0303          0303
0422        0303  0317          0317
0423        0304  0316          0316
0424        0305  0324          0324
0425        0306  0240          0240
0426        0307  0301          0301
0427        0310  0303          0303
0430        0311  0325          0325
0431        0312  0315          0315
0432        0313  0215          0215
0433        0314  0212          0212
0434        0315  0000          0000                /END
0435                    EJECT
-
```

```
0436                    /
0437                    /TYPE CARRIAGE RETURN AND LINE FEED
0440                    /
0441                    LMODE
0442    0316    0002    CRLF,   PDP                     /BACK TO PMODE
0443                    PMODE
0444    0317    1253            TAD     K215
0445    0320    4325            JMS     PRINT
0446    0321    1254            TAD     K212
0447    0322    4325            JMS     PRINT
0450    0323    6141            LINC
0451                    LMODE
0452    0324    6000            JMP     0               /RETURN
0453                    /
0454                    /SINGLE CHARACTER PRINT ROUTINE
0455                    /
0456                    PMODE
0457    0325    0000    PRINT,  0000
0460    0326    6046            TLS                     /PRINT CHARACTER
0461    0327    6041            TSF                     /WAIT
0462    0330    5327            JMP     .-1
0463    0331    7300            CLA CLL
0464    0332    5725            JMP I   PRINT
0465                    /
0466                    /PASS COUNTER DUMP ROUTINE
0467                    /
0470                    LMODE
0471    0333    0044    DUMP,   SET     AUTO4           /SAVE RETURN
0472    0334    0000            0
0473    0335    1000            LDA                     /GET PASS COUNTER
0474    0336    0005            AUTO5
0475    0337    6226            JMP     OUTYP           /GO TYPE PASS COUNTER
0476    0340    6316            JMP     CRLF            /GO CR-LF
0477    0341    0070            SET I   AUTO10          /CLEAR AUTO10 TO ALLOW HEADER TYPEOUT
0500    0342    0000            0000
0501    0343    6004            JMP     AUTO4           /RETURN TO MAINLINE
0502                    /
0503                    /LINCKBD MODEL C
0504                    /
```

0000 ERRORS

```
AUTO1   0001
AUTO10  0010
AUTO2   0002
AUTO4   0004
AUTO5   0005
BACK    0057
BANK    0017
CHANGE  0200
CHANG2  0207
CHECK   0160
CRLF    0316
DUMP    0333
ERROR   0151
ERROR1  0006
FILD1   0133
GO      0046
HEAD    0213
HERE    0232
INCRN   0100
K0001   0252
K0240   0016
-
```

```
K1026   0012
K212    0254
K215    0253
K7774   0013
MASK    0015
MESSA   0007
OUTYP   0226
PRINT   0325
REDU    0233
[illegible]
[illegible]
QRVA    9992
[illegible]
SET[illegible]  0196
START   0020
TEMP    0011
TYPE    0164
```