

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 2K runs

SMODE

START 20

RSW 4-1 for miss count

WIPED OUT RIM & BIN

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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 algorithm 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 link 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 4000.
- 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 0000 if it is not, a read-in error has occurred 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 0 to 37. (In a 4K machine this would be 0003).
- 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-existent memory may result in program destruction or false error printouts.

5. ERROR ROUTINE

5.1 Switch Settings

In general, SR0-3 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)

SR0 = 1 SUPPRESS HALT  
SR1 = 1 SUPPRESS PRINTOUT  
SR2 = 1 SCOPE LOOP ON FAILING CELL  
SR3 = 1 LOOP ON SELECTED FIELD

With SR3 = 1, the right switches 07-11 must contain the field you wish to test, within the range 0 to 37. The diagnostic will cycle within this field, stopping only in the event of an error.

SR4 = 1 DUMP PASS COUNTER

Setting this switch to a one causes a type out of the contents of the pass counter. A start 20 will set the counter to 0000.

SR5 = 1 INHIBIT BELL RING AT END OF PASS.

5.2 Error Printout

The error printout has the following general form:

```
LINC  CHKB
FIELD  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 RELIABILITY.  
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

OK  
LA

```

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 0008 0000 AUTO10, 0000
0064 0009 0000 TEMP, 0000
0065 0010 1026 K1026, 1026
0066 0011 7774 K7774, 7774
0067 0012 0000 REGB, 0000
0068 0013 0003 MASK, 0003
0069 0014 0240 K0240, 0240
0070 0015 0000 BANK, 0000
0071 /
0072 EJECT
0073
0074
0075
0076

```



0077			/			
0100			P	MODE		
0101			/			
0102			/	MAJOR START 8	MODE	
0103			/			
0104			*	0020		
0105	0020	6141	S	T	A	R
0106			L	M	O	D
0107	0021	0064	S	E	T	I
0110	0022	0000				
0111	0023	0065	S	E	T	I
0112	0024	0000				
0113	0025	6112	J	M	P	
0114	0026	0516	R	S	W	
0115	0027	1560	B	C	L	I
0116	0030	7740				
0117	0031	4003	S	T	C	
0120	0032	0516	R	S	W	
0121	0033	1560	B	C	L	I
0122	0034	7377				
0123	0035	0450	A	Z	E	
0124	0036	6133	J	M	P	
0125	0037	0041	S	E	T	
0126	0040	0002	A	U	T	O
0127	0041	0516	R	S	W	
0130	0042	1560	B	C	L	I
0131	0043	7577				
0132	0044	0450	A	Z	E	
0133	0045	6333	J	M	P	
0134	0046	1020	L	D	A	
0135	0047	0540	L	D	F	
0136	0050	2017	A	D	D	
0137	0051	1040	S	T	A	
0140	0052	0200	C	H	A	N
0141	0053	1040	S	T	A	
0142	0054	0207	C	H	A	N
0143	0055	4056	S	T	C	
0144			E	J	E	C

/GO TO LINC MODE

/RESET PASS COUNTER

/RESET PASS MULTIPLIER

/START WITH BANK 0

/READ THE SWITCHES

/SAVE BITS 07-11

/SAVE FOR ITERATION

/FIXED FIELD?

/CHECK FOR SWITCH 03

/WAS IT THERE?

/SET FOR FIXED FIELD

/SET LOWER LIMIT

/READ THE SWITCHES

/SAVE SW 04

/IS IT SET?

/YES, TYPE PASS COUNTER

/PICK UP LDF

/ADD NEW BANK NUMBER

/RESET INTERNAL LDF

/STORE FOR EXECUTION

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
0155	0063	1041		STA	AUTO1
0156	0064	1221		LAM	AUTO1
0157	0065	1460		SAE I	
0160	0066	2525		2525	
0161	0067	6151		JMP	ERROR
0162	0070	1441		SAE	AUTO1
0163	0071	6151		JMP	ERROR
0164	0072	1141		ADM	AUTO1
0165	0073	1460		SAE I	
0166	0074	5252		5252	
0167	0075	6151		JMP	ERROR
0170	0076	1441		SAE	AUTO1
0171	0077	6151		JMP	ERROR
0172	0100	0221	INCRN,	XSK I	AUTO1
0173	0101	6057		JMP	BACK
0174	0102	3237		XSK I	BANK
0175	0103	1300		LDA	
0176	0104	0017		BANK	
0177	0105	0017		COM	
0200	0106	2003		ADD	RSWB
0201	0107	2252		ADD	K0001
0202	0110	0471		AP0 I	
0203	0111	6046		JMP	GO
0204				EJECT	

0205	0112	0077	RESET,	SET I	BANK	/RESET 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	0261		SET I	AUTO1	/TRY FOR WHOLE FIELD
0237	0137	3777		3777		
0240	0140	2470		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	5246		JMP	GO	/BACK TO MAINLINE
0246	0146	0041	SET2.	SET	AUTO1	/FIELD 0
0247	0147	0022		AUTO2		
0250	0150	6000		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		AP0 I		/SWITCH 0 SET?
0255	0154	0000		HLT		/NO, STOP
0256	0155	0241		ROL	1	/ROTATE
0257	0156	0471		AP0 I		/SWITCH 1 SET?
0260	0157	6164		JMP	TYPE	/NO, TYPE ERROR
0261	0160	0241	CHECK,	ROL	1	/ROTATE
0262	0161	0471		AP0 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
0375	0256	0311		0311
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
0435			EJECT	

/LINC CHKB  
/BANK LOCN CONT ACUM

/END

```

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 AUT05
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
CHANGE2	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	012
K212	0254
K215	0253
K7774	0013
MASK	0015
MESSA	0007
OUTYP	0226
PRINT	0325
REDU	0233
REGB	0014
RESC	0002
RRDNC	0001
QRVA	0902
RD SA	0940
SET4	0116
START	0020
TEMP	0011
TYPE	0164

