

IDENTIFICATION

PRODUCT CODE: MAINDEC-14-D8AB-D
PRODUCT NAME: ABE-14
DATE CREATED: JUNE 18, 1970
MAINTAINER: DIAGNOSTIC GROUP
AUTHOR: EDWARD P. STEINBERGER



1. ABSTRACT

The purpose of ABE-14 (Accessory Box Test) is to test and diagnose the operation of the contents of an "Accessory Box" connected to a PDP-14 controller. The PDP-14 is in turn connected to a PDP-8I or 8L which contains the program that performs the tests. Among other tests, the Timers and Retentive Memories in the "A-Box" are timed to determine how long it takes for an output to "set" (turn on). This time is printed out to the operator via the PDP-8 teletype.

2. REQUIREMENTS

2.1 EQUIPMENT

PDP-8I or 8L
 PDP-14 to PDP 8I/L Interface Module (M745)
 PDP-14 Controller
 PDP-14 Accessory Box

2.2 STORAGE

The program occupies the first 3000 (octal) locations of PDP-8 memory.

2.3 PRELIMINARY PROGRAMS

TEST-14 should be run upon the PDP-14 successfully before this program is run.

3. LOADING PROCEDURE

3.1 METHOD

This program is loaded into PDP-8 memory using the "standard" PDP-8 Binary Loader technique.

4. STARTING PROCEDURE

4.1 CONTROL SWITCH SETTINGS

The following is a table of switch register settings and their operation upon the program:

SR	SET AS	ACTION
0	1	Loop on Current Test
	0	Don't Loop
1	1	Don't Halt on Error
	0	Halt on Error
2	1	Don't Print Errors
	0	Print Errors
3	1	Repeat Time Current Output (T0004 Only)
	0	Don't Repeat Time Current Output

4.2 STARTING ADDRESSES

Start the program at location $\emptyset 2\emptyset\emptyset$ if it is desired to interrogate the operator about the "A-Box" and its configuration.

Start the program at location $\emptyset 2\emptyset 1$ if the "A-Box" and its configuration has been previously defined to the program.

4.3 PROGRAM AND/OR OPERATOR ACTION

4.3.1 Connect the PDP-14 to be used for testing to the PDP-8L/I using the appropriate cables and revision of the M745 interface module. Install INPUT and OUTPUT and Register modules (four M746's).

4.3.2 Connect the PDP-14 A-Box to be tested to the appropriate Output slot in the PDP-14 (normally this is the slot which the user is going to use for the A-Box). Remember the "letter designation" of the Output slot (ref. page A2 of the "Users Guide").

4.3.3 Power up the PDP-8I/L and PDP-14 computers

4.3.4 Load the binary program into the 8I/L using the PDP-8 Binary Loader.

4.3.5 Start the program at location $\emptyset 2\emptyset\emptyset$. Set switch register per 4.1

4.3.6 Answer the questions asked by the program via the Teletype Keyboard [Answer A to S (only 1 letter) except I, O, or Q for "slot letter", answer T for Timer, M for Retentive memory for the contents of each address in the A-Box]

4.3.7 If the PDP-14 is not running, depress PDP-14 "START"

4.3.8 Program will now run to completion (assuming no errors) and will ring the bell on the Teletype Printer when 1 pass of the program has been completed.

5. OPERATING PROCEDURE

5.1 OPERATIONAL SWITCH SETTINGS (See 4.1 above)

5.2 SUBROUTINE ABSTRACTS

None

5.3 PROGRAM AND/OR OPERATOR ACTION

If Retentive Memories are being tested in the A-Box, it is necessary to simulate a power failure in the PDP-14 by powering down the PDP-14 so that the retentive ability

of the R.M.'s may be tested. Given below is the proper procedure to use:

- 5.3.1 After receiving the "Power-Down" printout, power-down the PDP-14 by turning the PDP-14 power switch "OFF"
- 5.3.2 Turn PDP-14 power switch "ON"
- 5.3.3. Depress PDP-8 "CONTINUE"

6. ERRORS

6.1 ERROR HALTS AND DESCRIPTION

Most of the error halts in the program are preceded by error type outs. However, if in doubt about the cause of the error halt, consult the program listing.

6.2 ERROR RECOVERY

To 'scope an error condition after an error halt, set the switch register per 4.1 and depress "CONTINUE"

6.3 ERROR MESSAGES

The error messages output by the program (with a very few exceptions) will contain an error designator (a 2 letter error number) followed by a description of the test being performed and/or a description of the failing error condition. If desired, the operator can use the 2 letter error designator to go directly to the module call list to see which module(s) should be replaced. Or, if he desires, he may set up a program 'scope loop and probe the A-Box (and maybe the PDP-14) to determine the failing condition, then replace the failing module.

6.4 ERROR IDENTIFIER - MODULE CALL

IDENTIFIER	MODULE TYPES
BL	K207, K161, K135
BN	See BL
BQ	See BL
BX	See BL
BY	See BL
CB	See BL
CF	K302
CG	K302
CH	K272, D302, K207, K161, K135

7. RESTRICTIONS

7.1 STARTING RESTRICTIONS

None

7.2 OPERATING RESTRICTIONS

INPUT and OUTPUT Register Modules (M746's) must be installed.

8. MISCELLANEOUS

8.1 EXECUTION TIME

The execution time of the program is dependent upon the settings of the timer modules in the A-Box. The bell on the teletype printer will ring at program completion.

9. PROGRAM DESCRIPTION

9.1 Test 3 (SA = 0416)

Checks a TYD "N" status word with the "TEST" flop cleared and output off.

9.2 Test 4 (SA = 0600)

Turns on output "N", times it, and types out time to set it on teleprinter in milliseconds (time output will be within 10% of actual value - variation is due to Family-of-8 timing tolerances and response times). If SR3 = 1, program will loop, typing out the current output setting, so that timers may be adjusted to their approximate final settings.

9.3 Test 5 (SA = 1000)

Checks that with output "N" on, only TYN "N" sets the "TEST" flop.

9.4 Test 6 (SA = 1200)

Checks a TYD "N" status word with the "TEST" flop set and output on.

9.5 Test 7 (SA = 1400)

Checks that with output "N" on, only TYF "N" does not set the "TEST" flop

9.6 Test 8 (SA = 1600)

Checks that only SYF "N" clears output "N" and that SYF 377 clears output "N" only if "N" is a timer.

9.7 Test 10 (SA = 2000)

Checks Retentive Memory's ability to "remember" a 0 after power shut-down.

9.8 Test 11 (SA = 2200)

Checks Retentive Memory's ability to "remember" a 1 after power shut-down.

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/ABE-14
/PROGRAM TO TEST ACCESSORY BOXES
/CONNECTED TO THE PDP-14 COMPUTER
/WHICH IS IN TURN CONNECTED TO A
/PDP-8L OR 8I

/COPYRIGHT 1969, DIGITAL EQUIPMENT CORP., MAYNARD, MASS.

/DEFINITION OF INTERFACE IOT'S
/
6161 SIDF=6161 /SKIP ON INSTRUCTION DONE FLAG
6162 LDIN=6162 /LOAD THE PDP-14 INPUT REGISTER FROM PDP-8 AC
6164 LDEX=6164 /LOAD AND EXECUTE INSTRUCTION IN PDP-14
6165 ILEX=6165 /INTERRUPT THE PDP-14, LOAD AND EXECUTE INSTRUCTION
6167 CIDF=6167 /CLEAR INSTRUCTION DONE FLAG
6171 SOTF=6171 /SKIP IF PDP-14 OUTPUT REGISTER LOADED
6172 COTF=6172 /CLEAR OUTPUT FLAG
6173 STFF=6173 /SKIP IF PDP-14 TEST FLOP SET
4174 CTFF=4174 /CLEAR TEST FLOP
6175 SCRF=6175 /SKIP IF PDP-14 IS RUNNING
6176 ROTR=6176 /CLEAR AC, READ OUTPUT REGISTER INTO PDP-8 AC

0040 *40
/CONSTANTS, VARIABLES, ETC.
0040 0000 BCNTR, 0 /POINTER TO CURRENT OUTPUT STATUS WORD
0041 0000 BPNTR, 0 /COUNTER TO COUNT STATUS WORDS
0042 0000 CNTR, 0
0043 0000 CHAR, 0
0044 0000 HEADER, 0 /HOLD HEADER TYPEOUT ADDRESS
0045 0000 INOW, 0 /CURRENT INSTRUCTION

0046 0017 K0017, 17
0047 0020 K0020, 20
0050 0240 K0240, 240
0051 0377 K0377, 377
0052 4252 K4252, 4252
0053 7400 K7400, 7400

0054 0000 LCNTR, 0 /TEST LOOP COUNTER
0055 0000 LTEMP, 0
0056 0000 LTEMP1, 0

0057 7771 M0007, -7
0060 7761 M0017, -17
0061 7760 M0020, -20
0062 7500 M0300, -300
0063 7467 M0311, -311
0064 7463 M0315, -315
0065 7461 M0317, -317
0066 7457 M0321, -321
0067 7454 M0324, -324
0070 0000 ONOW, 0 /CURRENT O-ADDRESS
0071 0000 PNTR, 0

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56 0072 0000
57 0073 0000
58

SLOT, 0
TSTNOW, 0

/SLOT USED FOR A-BOX
/CURRENT ADDRESS BEING TESTED

59				
60			/	
61	0074	1000	TYF,	1000
62	0075	1400	TYN,	1400
63	0076	3000	SYF,	3000
64	0077	3400	SYN,	3400
65	0100	5000	JFF,	5000
66	0101	7400	TYD,	7400
67			/	
68	0102	2445	PMESAG,	MESAG
69	0103	2512	PPRINT,	PRINT
70	0104	2400	PINTER,	INTER
71	0105	2537	TSTFLP,	FLPERR
72	0106	1203	TYDTST,	TSTTYD

73
74
75
76 0107 0000
77 0110 6175
78 0111 5110
79 0112 7200
80 0113 1116
81 0114 4504
82 0115 5507
83 0116 0600
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85
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87
88 0117 0000
89 0120 6046
90 0121 6041
91 0122 5121
92 0123 7200
93 0124 5517
94
95
96
97
98 0125 0000
99 0126 1133
100 0127 4117
101 0130 1134
102 0131 4117
103 0132 5525
104 0133 0215
105 0134 0212
106 0135 0007
107 0136 0260
108
109 0137 0000
110 0140 6031
111 0141 5140
112 0142 6036
113 0143 3043
114 0144 1043
115 0145 4117
116 0146 1043
117 0147 5537
118
119 0174
120 0174 0000
121 0175 1100
122 0176 4504
123 0177 5574

/CHECK PDP-14 RUNNING, THEN PUT 14 IN EXTERNAL MODE

EXTERN, 0
SCRFB /WAIT FOR 14 TO RUN
JMP ,=1
CLA
TAD K0600
JMS I PINTER /FORCE PDP-14 INTO EXTERNAL MODE
JMP I EXTERN /EXIT
K0600, 600

/TYPE SUBROUTINE

TYPE, 0
TLS
TSF
JMP ,=1
CLA
JMP I TYPE

/CR=LF SUBROUTINE

CRLF, 0
TAD K0215
JMS TYPE
TAD K0212
JMS TYPE
JMP I CRLF
K0215, 215
K0212, 212
K0007, 7
K0260, 260

GETCHR, 0
KSF
JMP ,=1
KRB
DCA CHAR
TAD CHAR
JMS TYPE
TAD CHAR
JMP I GETCHR

*174

0
TAD JFF
JMS I PINTER
JMP I 174

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124
125      0200      0200      *200
126      0200      7410      ABXTST, SKP          /GO TO INTERROGATION ROUTINE
127      0201      5777      JMP          STRTST
128      0202      4125      JMS          CRLF          /CR-LF
129      0203      1324      QUES1, TAD          PMES1
130      0204      4502      JMS I       PMESAG        /TYPE OUT FIRST QUESTION
131      0205      4137      JMS          GETCHR        /GET ANSWER
132      0206      3072      DCA          SLOT          /AND SAVE
133      0207      4125      JMS          CRLF          /CR-LF
134      0210      1072      TAD          SLOT          /CHECK FOR GOOD CHARACTER
135      0211      1062      TAD          M0300
136      0212      7710      SPA CLA     /IS IT >300?
137      0213      5203      JMP          QUES1         /NO
138      0214      1072      TAD          SLOT
139      0215      1063      TAD          M0311
140      0216      7650      SNA CLA     /IS IT 1?
141      0217      5203      JMP          QUES1         /YES
142      0220      1072      TAD          SLOT
143      0221      1065      TAD          M0317
144      0222      7650      SNA CLA     /IS IT 0?
145      0223      5203      JMP          QUES1         /YES
146      0224      1072      TAD          SLOT
147      0225      1066      TAD          M0321
148      0226      7650      SNA CLA     /IS IT 0?
149      0227      5203      JMP          QUES1         /YES
150      0230      1072      TAD          SLOT
151      0231      1067      TAD          M0324
152      0232      7700      SMA CLA     /IS IT <324?
153      0233      5203      JMP          QUES1         /NO
154      0234      1776      QUES2, TAD          PMES2
155      0235      4502      JMS I       PMESAG        /MAKE SECOND STATEMENT
156      0236      4125      JMS          CRLF
157      0237      1775      TAD          PMES2A
158      0240      4502      JMS I       PMESAG
159      0241      1061      TAD          M0020
160      0242      3042      DCA          CNTR
161      0243      1047      TAD          K0020
162      0244      3071      DCA          PNTR
163      0245      4125      QUESN, JMS          CRLF          /CR-LF
164      0246      1071      TAD          PNTR
165      0247      0046      AND          K0017
166      0250      4503      JMS I       PPRINT        /TYPE OUT ADDRESS
167      0251      1050      TAD          K0240
168      0252      4117      JMS          TYPE          /AND A SPACE
169      0253      4137      JMS          GETCHR
170      0254      1067      TAD          M0324
171      0255      7640      SZA CLA     /T?
172      0256      5261      JMP          ,+3          /NO
173      0257      7001      IAC          /SET AC TO 1
174      0260      5265      JMP          ,+5
175      0261      1043      TAD          CHAR
176      0262      1064      TAD          M0315
177      0263      7650      SNA CLA     /M?
178      0264      7330      CLA CLL    CML RAR        /SET AC TO 4000

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179	0265	3471
180	0266	2071
181	0267	2042
182	0270	5245
183	0271	4125
184	0272	5201

DCA	I	PNTR
ISE		PNTR
ISE		CNTR
JMP		QUESN
JMS		CRLF
JMP		201

/DONE ALL ADDRESSES?
/NO
/YES

185
 186
 187
 188 0301 0000
 189 0302 0020
 190 0303 0040
 191 0304 0060
 192 0305 0100
 193 0306 0120
 194 0307 0140
 195 0310 0160
 196 0311 0000
 197 0312 0200
 198 0313 0220
 199 0314 0240
 200 0315 0260
 201 0316 0300
 202 0317 0000
 203 0320 0320
 204 0321 0000
 205 0322 0340
 206 0323 0360
 207
 208 0324 0325
 209 0325 0155
 210 0326 0217
 211 0327 3040
 212 0330 1123
 213 0331 4003
 214 0332 1716
 215 0333 1605
 216 0334 0324
 217 0335 0504
 218 0336 4024
 219 0337 1740
 220 0340 2314
 221 0341 1724
 222 0342 4000

*301
 /TABLE TO CONVERT FROM SLOT LETTER TO ADDRESS

0 /A
 20 /B
 40 /C
 60 /D
 100 /E
 120 /F
 140 /G
 160 /H
 0 /I
 200 /J
 220 /K
 240 /L
 260 /M
 300 /N
 0 /O
 320 /P
 0 /Q
 340 /R
 360 /S

 PMES1, ,+1
 0155 /A,-
 0217 /B,O
 3040 /X,SP
 1123 /I,S
 4003 /SP,C
 1716 /O,N
 1605 /N,E
 0324 /G,T
 0504 /E,D
 4024 /SP,T
 1740 /O,SP
 2314 /S,L
 1724 /O,T
 4000 /SP,END

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223
224 0375 2745
225 0376 2705
226 0377 0400
      0400
227
228 /AFTER INTERROGATION, THE PROGRAM COMES HERE
229 /TO SET UP FOR TESTING
230 0400 7300 STRTST, CLA CLL
231 0401 4107 JMS EXTERN /PUT 14 IN EXTERNAL MODE
232 0402 1472 TAD I SLOT /DERIVE FIRST O-ADDRESS
233 0403 3070 DCA ONOW /FROM SLOT USED FOR A-BOX
234 0404 1047 TAD K0020 /SET UP POINTER
235 0405 3041 DCA BPNTR
236 0406 1061 TAD M0020 /AND COUNTER FOR 20 OUTPUTS
237 0407 3040 DCA BCNTR
238 0410 1441 TSTLUP, TAD I BPNTR /PICK UP ADDRESS STATUS WORD
239 0411 7050 SNA CLA /TIMER OR RETENTIVE MEMORY?
240 0412 5777 JMP INCAOD /NO
241 0413 4222 JMS CLROUT /SET ALL OUTPUTS OFF
242 0414 4776 JMS D120MS /DELAY 120 MS
243 0415 4174 CTFP /CLEAR TEST FLOP
244
245
246
247 /NEXT ISSUE A TYD N AND CHECK THE STATUS WORD
248
249 0416 4506 T0003, JMS I TYDTST /EXECUTE A TYD N
250 0417 0400 0400 /MOST SIGNIFICANT BITS OF STATUS WORD
251 0420 5775 JMP T0004
252 0421 4000 4000
253 /SET ALL OUTPUTS OFF SUBROUTINE
254 0422 0000 CLROUT, 0
255 0423 7200 CLA
256 0424 1053 TAD K7400
257 0425 3054 DCA LCNTR /SET UP LOOP COUNT
258 0426 1076 TAD SYF
259 0427 3045 DCA INOW /SET UP INSTRUCTION TO BE EXECUTED
260 0430 1045 TAD INOW
261 0431 4504 JMS I PINTER /EXECUTE THE SYF
262 0432 2045 ISE INOW /INCREMENT THE SYF
263 0433 7000 NOP
264 0434 2054 ISE LCNTR /DONE?
265 0435 5230 JMP ,=5 /NO
266 0436 5022 JMP I CLROUT /YES

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267
 268 0575 0600
 269 0576 2557
 270 0577 1675
 0600

271
 272
 273
 274
 275 0600 7300
 276 0601 1070
 277 0602 1077
 278 0603 4504
 279 0604 7604
 280 0605 7710
 281 0606 5200
 282 0607 4174
 283 0610 1060
 284 0611 3016
 285 0612 3017
 286 0613 4345
 287 0614 6173
 288 0615 5246
 289 0616 4125
 290 0617 1275
 291 0620 4502
 292 0621 1070
 293 0622 4503
 294 0623 1302
 295 0624 4502
 296 0625 1016
 297 0626 1046
 298 0627 3016
 299 0630 4777
 300 0631 0016
 301 0632 1314
 302 0633 4502
 303 0634 4125

304
 305
 306 0635 7604
 307 0636 0274
 308 0637 7650
 309 0640 5776
 310 0641 1070
 311 0642 1076
 312 0643 4504
 313 0644 4775
 314 0645 5200
 315 0646 2017
 316 0647 5213
 317 0650 2016
 318 0651 5213
 319 0652 7604
 320 0653 7006

*600
 /SET CURRENT OUTPUT ON, TIME HOW LONG IT TAKES
 /TO THE NEAREST MILLISECOND (LOW)
 /ALLOW A MAXIMUM OF 1 MINUTE (ACTUALLY 61.5 SECONDS)

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T0004: CLA CLL
      TAD ONOW
      TAD SYN
      JMS I PINTER /EXECUTE SYN N
      LAS
      SPA CLA /LOOP?
      JMP T0004 /YES
      CTF: /CLEAR TEST FLOP
      TAD M0017 /SET UP FOR 1 MINUTE
      DCA 16
      DCA 17
L0004: JMS TIMEIT
      STFF /IS TEST FLOP SET?
      JMP TIME /NO
      JMS CRLF /YES TYPE OUT TIME
      TAD PM4A
      JMS I PMESAG /TYPE "OUTPUT"
      TAD ONOW
      JMS I PPRINT /TYPE OUTPUT NUMBER
      TAD PM4B
      JMS I PMESAG /TYPE OUT REST OF MESSAGE
      TAD 16
      TAD K0017
      DCA 16
      JMS UDPRNT /TYPE OUT NUMBER OF MS
      16
      TAD PM4C
      JMS I PMESAG /TYPE OUT "MILLISECONDS"
      JMS CRLF
/THIS LOOP IS FOR SETTING TIMERS
/(TIMER SETTING WILL BE TYPED OUT
      LAS
      AND K0400 /SR 3=1
      SNA CLA /LOOP THIS OUTPUT?
      JMP T0005 /NO
      TAD ONOW /YES
      TAD SYF
      JMS I PINTER /TURN OUTPUT OFF
      JMS D120MS /DELAY 120 MS
      JMP T0004 /LOOP
TIME, ISZ 17
      JMP L0004
      ISZ 16
      JMP L0004
      LAS /HERE IF TIMED OUT
      RTL
  
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321	0654	7710	SPA	CLA	/TYPE OUT ERRORS?
322	0655	5264	JMP	E0004-3	/NO
323	0656	4125	JMS	CRLF	
324	0657	1324	TAD	PM40	
325	0660	4902	JMS I	PMESAG	/TYPE OUT ERROR MESSAGE
326	0661	1070	TAD	ONOW	
327	0662	4503	JMS I	PPRINT	/TYPE OUT ADDRESS
328	0663	4125	JMS	CRLF	
329	0664	7604	LAS		
330	0665	7004	RAL		
331	0666	7700	SMA	CLA	/HALT ON ERROR?
332	0667	7402	E0004, HLT		/YES
333	0670	7604	LAS		
334	0671	7710	SPA	CLA	/LOOP?
335	0672	5200	JMP	T0004	/YES
336	0673	5776	JMP	T0005	/NO
337	0674	0400	K0400, 400		

338	0675	0676	PM4A,	.*1	
339	0676	1725		1725	/O,U
340	0677	2420		2420	/T,P
341	0700	2524		2524	/U,T
342	0701	4000		4000	/SP,END
343					
344	0702	0703	PM4B,	.*1	
345	0703	4023		4023	/SP,S
346	0704	0524		0524	/E,T
347	0705	4017		4017	/SP,O
348	0706	1640		1640	/N,SP
349	0707	1116		1116	/I,N
350	0710	4001		4001	/SP,A
351	0711	0217		0217	/B,O
352	0712	2524		2524	/U,T
353	0713	4000		4000	/SP,END
354					
355	0714	0715	PM4C,	.*1	
356	0715	4015		4015	/SP,M
357	0716	1114		1114	/I,L
358	0717	1411		1411	/L,I
359	0720	2305		2305	/S,E
360	0721	0317		0317	/C,O
361	0722	1604		1604	/N,D
362	0723	2300		2300	/S,END
363					
364	0724	0725	PM4D,	.*1	
365	0725	5252		5252	/*,*
366	0726	0310		0310	/C,H
367	0727	5252		5252	/*,*
368	0730	4024		4024	/SP,T
369	0731	1115		1115	/I,M
370	0732	0540		0540	/E,SP
371	0733	1725		1725	/O,U
372	0734	2440		2440	/T,SP
373	0735	0522		0522	/E,R
374	0736	2217		2217	/R,U
375	0737	2254		2254	/R,.
376	0740	4017		4017	/SP,O
377	0741	2524		2524	/U,T
378	0742	2025		2025	/P,U
379	0743	2440		2440	/T,SP
380	0744	0000		0	/END

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381 0745 0000
382 0746 7300
383 0747 1070
384 0750 1075
385 0751 4504
386 0752 1362
387 0753 3010
388 0754 6173
389 0755 7410
390
391 0756 5745
392 0757 2010
393 0760 5354
394 0761 5745
395 0762 7640

TIMEIT, 0

/EXIT IN 1 MS OR WITH TEST FLOP SET

CLA CLL

TAD ONOW

TAD TYN

JMS I PINTER /EXECUTE TYN N

TAD TIMCON

DCA 10

STFF

SKP

JMP I TIMEIT

ISE 10

JMP I 4

JMP I TIMEIT

TIMCON, -140

396 0775 2557
 397 0776 1000
 398 0777 2600
 1000

*1000
 /ALL TYN INSTRUCTIONS WILL BE ISSUED
 /ONLY TYN N SHOULD SET THE TEST FLOP

399
 400
 401
 402 1000 7300
 403 1001 1053
 404 1002 3054
 405 1003 1075
 406 1004 3045
 407 1005 4174
 408 1006 1045
 409 1007 0051
 410 1010 3073
 411 1011 1045
 412 1012 4504
 413 1013 7604
 414 1014 7710
 415 1015 5205
 416 1016 1073
 417 1017 7041
 418 1020 1070
 419 1021 7640
 420 1022 5230
 421 1023 1247
 422 1024 3044
 423 1025 6173
 424 1026 4505
 425 1027 5235
 426 1030 1271
 427 1031 3044
 428 1032 6173
 429 1033 7410
 430 1034 4505
 431 1035 7604
 432 1036 7710
 433 1037 5205
 434 1040 2045
 435 1041 2054
 436 1042 5205
 437 1043 1070
 438 1044 1075
 439 1045 4504
 440 1046 5777

T0005, CLA CLL
 TAD K7400
 DCA LCNTR /SET UP LOOP COUNTER
 TAD TYN
 DCA INOW /SET UP TEST INSTRUCTION TO BE EXECUTED
 L0005, CTFF /CLEAR TEST FLOP
 TAD INOW
 AND K0377
 DCA TSTNOW
 TAD INOW
 JMS I PINTER /EXECUTE THE TYN
 LAS
 SPA CLA /LOOP?
 JMP L0005 /YES
 TAD TSTNOW
 CIA
 TAD ONOW
 SEA CLA /ADDRESSING CURRENT OUTPUT?
 JMP ,+6 /NO
 TAD PMSA
 DCA HEADER
 STFF /TEST FLOP SET?
 JMS I TSTFLP /NO, ERROR
 JMP ,+6
 TAD PMSB
 DCA HEADER
 STFF /TEST FLOP SET?
 SKP /NO
 JMS I TSTFLP /YES, ERROR
 LAS
 SPA CLA /LOOP?
 JMP L0005 /YES
 ISE INOW /INCREMENT TO NEXT INSTRUCTION
 ISE LCNTR /DONE ALL INSTRUCTIONS?
 JMP L0005 /NO
 TAD ONOW
 TAD TYN
 JMS I PINTER /EXIT WITH TEST FLOP SET
 JMP T0006

441
442 1047 1050
443 1050 5252
444 1051 0230
445 1052 5252
446 1053 4024
447 1054 0523
448 1055 2440
449 1056 0614
450 1057 1720
451 1060 4016
452 1061 1724
453 1062 4023
454 1063 0524
455 1064 4002
456 1065 3140
457 1066 2431
458 1067 1640
459 1070 0000
460
461 1071 1072
462 1072 5252
463 1073 0221
464 1074 5252
465 1075 4024
466 1076 0523
467 1077 2440
468 1100 0614
469 1101 1720
470 1102 4023
471 1103 0524
472 1104 4002
473 1105 3140
474 1106 2431
475 1107 1640
476 1110 0000

/**BX** TEST FLOP NOT SET BY TYN

PM5A, +1
5252
0230
5252
4024
0523
2440
0614
1720
4016
1724
4023
0524
4002
3140
2431
1640
0

/**BQ** TEST FLOP SET BY TYN

PM5B, +1
5252
0221
5252
4024
0523
2440
0614
1720
4023
0524
4002
3140
2431
1640
0

477 1177 1200
 478 1200 1200
 479
 480 1200 4506
 481 1201 6400
 482 1202 5777
 483
 484
 485 1203 0000
 486 1204 7200
 487 1205 1070
 488 1206 1101
 489 1207 4904
 490 1210 7604
 491 1211 7710
 492 1212 5205
 493 1213 6171
 494 1214 7402
 495 1215 1070
 496 1216 1603
 497 1217 3055
 498 1220 6176
 499 1221 3056
 500 1222 1056
 501 1223 7041
 502 1224 1055
 503 1225 7640
 504 1226 4234
 505 1227 7604
 506 1230 7710
 507 1231 5205
 508 1232 2203
 509 1233 5603

```

*1200
/ISSUE ANOTHER TYD N AND CHECK THE STATUS WORD
T0006, JMS I TYDTST /EXECUTE A TYD N
        6400 /MOST SIGNIFICANT BITS OF STATUS WORD
        JMP T0007
/TYD INSTRUCTION TEST SUBROUTINE
TSTTYD, 0
        CLA
TYDLUP, TAD ONOW
        TAD TYD
        JMS I PINTER /EXECUTE A TYD N
        LAS
        SPA CLA /LOOP?
        JMP TYDLUP /YES
        SOTF /OUTPUT REGISTER FLAG SET?
        HLT /NO
        TAD ONOW
        TAD I TSTTYD
        DCA LTEMP /FORM EXPECTED RESULT AND STORE
        ROTR /READ OUTPUT REGISTER
        DCA LTEMP1
        TAD LTEMP1
        CIA
        TAD LTEMP
        SZA CLA /CORRECT STATUS WORD?
        JMS TYDERR /NO
        LAS
        SPA CLA /LOOP?
        JMP TYDLUP /YES
        ISZ TSTTYD /NO
        JMP I TSTTYD /EXIT
    
```

```

510
511
512 1234 0000
513 1235 7604
514 1236 7006
515 1237 7710
516 1240 5261
517 1241 4125
518 1242 1274
519 1243 4502
520 1244 1070
521 1245 4503
522 1246 4125
523 1247 1266
524 1250 4502
525 1251 4125
526 1252 1055
527 1253 4503
528 1254 1050
529 1255 4117
530 1256 1056
531 1257 4503
532 1260 4125
533 1261 7604
534 1262 7004
535 1263 7700
536 1264 7402
537 1265 5634
538
539 1266 1267
540 1267 0717
541 1270 1704
542 1271 4002
543 1272 0104
544 1273 0000
545
546 1274 1275
547 1275 5252
548 1276 0216
549 1277 5252
550 1300 4023
551 1301 2401
552 1302 2425
553 1303 2340
554 1304 0522
555 1305 2217
556 1306 2254
557 1307 4024
558 1310 3104
559 1311 4000

TYDERR, 0
LAS
RTL
SPA CLA /TYPE OUT ERRORS?
JMP ERRTYD=3 /NO
JMS CRLF
TAD TYDMES
JMS I PMESAG /TYPE OUT HEADING
TAD ONOH
JMS I PPRINT /TYPE OUT ADDRESS
JMS CRLF
TAD PGDBD2
JMS I PMESAG /TYPE OUT "GOOD BAD"
JMS CRLF
TAD LTEMP
JMS I PPRINT /TYPE OUT GOOD DATA
TAD K0240
JMS TYPE /1 SPACE
TAD LTEMP1
JMS I PPRINT /TYPE OUT BAD DATA
JMS CRLF
LAS
RAL
SMA CLA /HALT ON ERROR?
ERRTYD, HLT /YES
JMP I TYDERR

PGDBD2, +1
0717 /G,0
1704 /O,0
4002 /SP,B
0104 /A,0
0 /END

/**BN** STATUS ERROR, TYD
TYDMES, +1
5252
0216
5252
4023
2401
2425
2340
0522
2217
2254
4024
3104
4000

```

560 1377 1400
 562 1400

*1400
 /TEST ALL TYF INSTRUCTIONS; ALL SHOULD SET TEST FLOP EXCEPT TYE N

561
 563 1400 7300
 564 1401 1053
 565 1402 3054
 566 1403 1074
 567 1404 3045
 568 1405 4174
 569 1406 1045
 570 1407 0051
 571 1410 3073
 572 1411 1045
 573 1412 4504
 574 1413 7604
 575 1414 7710
 576 1415 5205
 577 1416 1073
 578 1417 7041
 579 1420 1070
 580 1421 7650
 581 1422 5230
 582 1423 1244
 583 1424 3044
 584 1425 6173
 585 1426 4505
 586 1427 5235
 587 1430 1266
 588 1431 3044
 589 1432 6173
 590 1433 7410
 591 1434 4505
 592 1435 7604
 593 1436 7710
 594 1437 5205
 595 1440 2045
 596 1441 2054
 597 1442 5205
 598 1443 5777

T0007, CLA CLL
 TAD K7400
 DCA LCNTR /SET UP LOOP COUNTER
 TAD TYF
 DCA INOW /SET UP INSTRUCTION TO BE EXECUTED
 L0007, CTFF /CLEAR THE TEST FLOP
 TAD INOW
 AND K0377
 DCA TSTNOW
 TAD INOW
 JMS I PINTER /EXECUTE THE TYF
 LAS
 SPA CLA /LOOP?
 JMP L0007 /YES
 TAD TSTNOW
 CIA
 TAD ONOW
 SNA CLA /ADDRESSING CURRENT OUTPUT?
 JMP ,+6 /YES
 TAD PM7A
 DCA HEADER
 STFF /TEST FLOP SET?
 JMS I TSTFLP /NO, ERROR
 JMP ,+6 /YES, OK
 TAD PM7B
 DCA HEADER
 STFF /TEST FLOP SET?
 SKP /NO
 JMS I TSTFLP /YES, ERROR
 LAS
 SPA CLA /LOOP?
 JMP L0007 /YES
 ISZ INOW /INCREMENT TO NEXT INSTRUCTION
 ISZ LCNTR /DONE ALL INSTRUCTIONS?
 JMP L0007 /NO
 T0008

599		
600	1444	1445
601	1445	5252
602	1446	0214
603	1447	5252
604	1450	4024
605	1451	0523
606	1452	2440
607	1453	0614
608	1454	1720
609	1455	4016
610	1456	1724
611	1457	4023
612	1460	0524
613	1461	4002
614	1462	3140
615	1463	2431
616	1464	0640
617	1465	0000
618		
619		
620	1466	1467
621	1467	5252
622	1470	0231
623	1471	5252
624	1472	4024
625	1473	0523
626	1474	2440
627	1475	0614
628	1476	1720
629	1477	4023
630	1500	0524
631	1501	4002
632	1502	3140
633	1503	2431
634	1504	0640
635	1505	0000

/**BL** TEST FLOP NOT SET BY TYF
PM7A,

.+1
5252
0214
5252
4024
0523
2440
0614
1720
4016
1724
4023
0524
4002
3140
2431
0640
0

/**BY** TEST FLOP SET BY TYF
PM7B,

.+1
5252
0231
5252
4024
0523
2440
0614
1720
4023
0524
4002
3140
2431
0640
0

```

636 /ONLY SYF "N" SHOULD CLEAR OUTPUT "N" IF "N" IS A TIMER,
637
638 /TAPE 2
639 1577 1600
        1600
640 *1600
641 /TEST SYF 0 TO 377 (EXCEPT "N" AND 377) TO NOT AFFECT OUTPUT "N"
642 /SYF "N" AND SYF 377 SHOULD CLEAR OUTPUT "N" IF "N" IS A TIMER,
643 /ONLY SYF "N" SHOULD CLEAR OUTPUT "N" IF "N" IS A MEMORY
644 1600 7300
645 1601 1053
646 1602 3034
647 1603 1076
648 1604 3045
649 1605 4174
650 1606 1070
651 1607 1075
652 1610 4504
653 1611 6173
654 1612 7410
655 1613 5224
656 1614 1070
657 1615 1077
658 1616 4504
659 1617 1070
660 1620 1075
661 1621 4504
662 1622 6173
663 1623 5217
664 1624 1045
665 1625 4504
666 1626 4777
667 1627 7604
668 1630 7710
669 1631 5205
670 1632 4174
671 1633 1070
672 1634 1074
673 1635 4504
674 1636 1045
675 1637 0051
676 1640 7041
677 1641 1070
678 1642 7650
679 1643 5263
680 1644 1045
681 1645 0051
682 1646 7041
683 1647 1051
684 1650 7640
685 1651 5255
686 1652 1441
687 1653 7700
688 1654 5263

```

```

T0008, CLA CLL
        TAD K7400
        DCA LCNTR /SET UP LOOP COUNTER
        TAD SYF
        DCA INOW /SET UP INSTRUCTION TO BE EXECUTED
L0008, CTFF /CLEAR TEST FLOP
        TAD ONOW
        TAD TYN
        JMS I PINTER /EXECUTE TYN N
        STFF /IS OUTPUT "N" ON?
        SKP / NO
        JMP ,+11 /YES
        TAD ONOW
        TAD SYN
        JMS I PINTER /SET OUTPUT "N"
        TAD ONOW /WAIT
        TAD TYN /FOR
        JMS I PINTER /OUTPUT
        STFF /TO TURN
        JMP ,+4 /ON
        TAD INOW
        JMS I PINTER /TURN OFF OUTPUT "Y"
        JMS D120MS /DELAY 120 MS
        LAS
        SPA CLA /LOOP?
        JMP L0008 /YES
        CTFF /CLEAR TEST FLOP
        TAD ONOW
        TAD TYF
        JMS I PINTER /EXECUTE TYF "N"
        TAD INOW
        AND K0377
        CIA
        TAD ONOW
        SNA CLA /CURRENT OUTPUT?
        JMP OUTCLR /YES
        TAD INOW
        AND K0377
        CIA
        TAD K0377
        SZA CLA /OUTPUT 377?
        JMP OUTSET /NO
        TAD I BPNTR /YES
        SNA CLA /R.M.?
        JMP OUTCLR /NO

```

689					
690	1655	1367	OUTSET, TAD	PM8A	
691	1656	3044	DCA	HEADER	
692	1657	6173	STFF		/TEST FLOP SET?
693	1660	7410	SKP		/NO, OK
694	1661	4314	JMS	ERR8	/YES, ERROR
695	1662	5267	JMP	10008-3	
696	1663	1341	OUTCLR, TAD	PM8B	
697	1664	3044	DCA	HEADER	
698	1665	6173	STFF		/TEST FLOP SET?
699	1666	4314	JMS	ERR8	/NO, ERROR
700	1667	7604	LAS		/YES, OK
701	1670	7710	SPA CLA		/LOOP?
702	1671	5205	JMP	L0008	/YES
703	1672	2045	10008, ISE	IN0W	/INCREMENT INSTRUCTION TO BE EXECUTED
704	1673	2054	ISE	LCNTR	/DONE ALL INSTRUCTIONS?
705	1674	5205	JMP	L0008	/NO
706					
707			/PROGRAM COMES HERE TO INCREMENT TO NEXT OUTPUT ADDRESS		
708	1675	2070	INCADD, ISE	ON0W	/INCREMENT OUTPUT ADDRESS
709	1676	2041	ISE	BPNTR	/INCREMENT STATUS WORD POINTER
710	1677	2040	ISE	BCNTR	/DONE ALL OUTPUTS
711	1700	5776	JMP	TSTLUP	/NO
712					
713			/AFTER TESTING ALL OUTPUTS, CHECK TO SEE		
714			/IF THE RETENTIVE MEMORY POWER TESTS SHOULD BE RUN		
715	1701	1047	TAD	K0020	/SET UP
716	1702	3041	DCA	BPNTR	/SCAN POINTER
717	1703	1061	TAD	M0020	
718	1704	3040	DCA	BCNTR	/AND COUNTER
719	1705	1441	TAD I	BPNTR	/GET OUTPUT STATUS
720	1706	7710	SPA CLA		/R.M.?
721	1707	5775	JMP	T0010	/YES
722	1710	2041	ISE	BPNTR	/NO
723	1711	2040	ISE	BCNTR	
724	1712	5305	JMP	,=3	/TRY NEXT OUTPUT
725	1713	5774	JMP	10011+4	/NO R.M.'S CONNECTED

726
727
728
729 1714 0000
730 1715 7604
731 1716 7006
732 1717 7710
733 1720 5334
734 1721 4125
735 1722 1356
736 1723 4502
737 1724 1070
738 1725 4503
739 1726 1044
740 1727 4502
741 1730 1045
742 1731 0051
743 1732 4503
744 1733 4125
745 1734 7604
746 1735 7004
747 1736 7700
748 1737 7402
749 1740 5714
750
751
752 1741 1742
753 1742 4016
754 1743 1724
755 1744 4024
756 1745 2522
757 1746 1605
758 1747 0440
759 1750 1706
760 1751 0640
761 1752 0231
762 1753 4023
763 1754 3106
764 1755 4000
765
766 1756 1757
767 1757 5252
768 1760 0302
769 1761 5252
770 1762 4017
771 1763 2524
772 1764 2025
773 1765 2440
774 1766 0000
775 1767 1744

/SUBROUTINE TO HANDLE CLEAR OUTPUT CROSSTALK ERRORS

```

ERR0, 0
      LAS
      RTL
      SPA CLA          /TYPE OUT ERRORS?
      JMP E0008-3     /NO
      JMS CRLF        /YES
      TAD PM8C
      JMS I PMESAG   /TYPE OUT ERROR CODE AND "OUTPUT"
      TAD ONOW
      JMS I PPRINT   /TYPE OUTPUT NUMBER
      TAD HEADER
      JMS I PMESAG   /TYPE REST OF MESSAGE
      TAD INOW
      AND K0377
      JMS I PPRINT   /TYPE OUT OTHER NUMBER
      JMS CRLF
      LAS
      RAL
      SMA CLA          /HALT ON ERROR?
E0008, HLT           /YES
      JMP I ERR0

```

/NOT TURNED OFF BY SYF

```

PM8B, .+1
      4016
      1724
      4024
      2522
      1605
      0440
      1706
      0640
      0231
      4023
      3106
      4000
      /**CB** OUTPUT
PM8C, .+1
      5252
      0302
      5252
      4017
      2524
      2025
      2440
      0
PM8A, PM8B+3

```

776
 777 1774 2260
 778 1775 2000
 779 1776 0410
 780 1777 2557
 2000
 781
 782
 783
 784
 785
 786
 787
 788 2000 7200
 789 2001 1261
 790 2002 3044
 791 2003 4777
 792 2004 4125
 793 2005 1776
 794 2006 4502
 795 2007 4125
 796 2010 6175
 797 2011 7412
 798 2012 5210
 799 2013 4107
 800 2014 1472
 801 2015 3070
 802 2016 1047
 803 2017 3041
 804 2020 1061
 805 2021 3040
 806 2022 7300
 807 2023 1441
 808 2024 7700
 809 2025 5234
 810 2026 4174
 811 2027 1070
 812 2030 1074
 813 2031 4504
 814 2032 6173
 815 2033 4241
 816 2034 2070
 817 2035 2041
 818 2036 2040
 819 2037 5222
 820 2040 5775

*2000

/NOW TO GET TO THE TESTS WHICH ARE PARTICULAR TO
 /THE RETENTIVE MEMORIES.,

/

/FIRST, ALL RETENTIVE MEMORIES WILL BE SET TO 0
 /THEN THE OPERATOR WILL POWER DOWN THE PDP-14
 /THEN HE WILL POWER IT BACK UP AGAIN

```
T0010,  CLA
        TAD      PM10
        DCA      HEADER
        JMS      CLROUT  /CLEAR ALL OUTPUTS
        JMS      CRLF
        TAD      PMES3
        JMS I    PMESAG  /TYPE OUT POWER DOWN MESSAGE
        JMS      CRLF
        SCRFB    /WAIT FOR PDP-14 POWER DOWN
        SKP HLT
        JMP      ,=2
        JMS      EXTERN  /PUT THE 14 IN EXTERNAL MODE WHEN POWER RETURNS
        TAD I    SLOT
        DCA      ONOW
        TAD      K0020
        DCA      BPNTR
        TAD      M0020
        DCA      BCNTR
L0010,  CLA CLL
        TAD I    BPNTR
        SMA CLA  /RETENTIVE MEMORY?
        JMP      I0010 /NO
        CTFB    /CLEAR TEST FLOP
        TAD      ONOW
        TAD      TYF
        JMS I    PINTER /EXCUTE A TYF N
        STFB    /TEST FLOP SET?
        JMS      ERR10  /NO, ERROR
I0010,  ISZ     ONOW  /INCREMENT OUTPUT ADDRESS
        ISZ     BPNTR  /INCREMENT STATUS WORD POINTER
        ISZ     BCNTR  /INCREMENT COUNTER
        JMP     L0010  /NOT DONE
        JMP     T0011
```

```

821 2041 0000 ERR10, 0
822 2042 7604 LAS
823 2043 7006 RTL
824 2044 7710 SPA CLA /TYPE OUT ERRORS?
825 2045 5254 JMP E0010-3 /NO
826 2046 4125 JMS CRLF
827 2047 1044 TAD HEADER
828 2050 4502 JMS I PMESAG /TYPE OUT ERROR
829 2051 1070 TAD ONOW
830 2052 4503 JMS I PPRINT /TYPE OUT ADDRESS
831 2053 4125 JMS CRLF
832 2054 7604 LAS
833 2055 7004 RAL
834 2056 7700 SMA CLA /HALT ON ERROR?
835 2057 7402 E0010, HLT /YES
836 2060 5641 JMP I ERR10
837
838 2061 2062 PM10, +1
839 2062 5252 5252 /*,*
840 2063 0306 0306 /C,F
841 2064 5252 5252 /*,*
842 2065 4032 4032 /SP,Z
843 2066 0522 0522 /E,R
844 2067 1740 1740 /O,SP
845 2070 1417 1417 /L,B
846 2071 2324 2324 /S,T
847 2072 4011 4011 /SP,I
848 2073 1640 1640 /N,SP
849 2074 2017 2017 /P,O
850 2075 2705 2705 /H,E
851 2076 2240 2240 /R,SP
852 2077 2310 2310 /S,H
853 2100 2524 2524 /U,T
854 2101 5504 5504 /-D
855 2102 1727 1727 /O,W
856 2103 1640 1640 /N,SP
857 2104 0231 0231 /B,Y
858 2105 4022 4022 /SP,R
859 2106 1540 1540 /M,SP
860 2107 0000 0 /END

```

861 2175 2200
 862 2176 2314
 863 2177 0422
 2200

*2200

/NOW ALL RETENTIVE MEMORIES WILL BE SET TO 1
 /THEN THE OPERATOR WILL POWER DOWN THE PDP-14
 /THEN HE WILL POWER IT BACK UP AGAIN

864
 865
 866
 867
 868 2200 7200
 869 2201 1266
 870 2202 3044
 871 2203 1472
 872 2204 3070
 873 2205 1047
 874 2206 3041
 875 2207 1061
 876 2210 3040
 877 2211 7300
 878 2212 1441
 879 2213 7700
 880 2214 5220
 881 2215 1070
 882 2216 1077
 883 2217 4504
 884 2220 2070
 885 2221 2041
 886 2222 2040
 887 2223 5211
 888 2224 4125
 889 2225 1314
 890 2226 4502
 891 2227 4125
 892 2230 6175
 893 2231 7412
 894 2232 5230
 895 2233 4107
 896 2234 1472
 897 2235 3070
 898 2236 1047
 899 2237 3041
 900 2240 1061
 901 2241 3040
 902 2242 7300
 903 2243 1441
 904 2244 7700
 905 2245 5254
 906 2246 4174
 907 2247 1070
 908 2250 1075
 909 2251 4504
 910 2252 6173
 911 2253 4777

```

T0011,  CLA      PM11
        TAD      HEADER
        DCA
        TAD I    SLOT      /SET UP LOCATIONS
        DCA      ONOW
        TAD      K0020     /TO ENABLE SETTING
        DCA      BPNTR
        TAD      M0020     /OF ALL R.M.'S
        DCA      BCNTR

L0011A, CLA CLL
        TAD I    BPNTR
        SMA CLA  /RETENTIVE MEMORY?
        JMP      ,*4      /NO
        TAD      ONOW
        TAD      SYN
        JMS I    PINTER  /EXECUTE A SYN "N"
        ISZ     ONOW
        ISZ     BPNTR
        ISZ     BCNTR     /TURNED ON ALL R.M.'S
        JMP     L0011A   /NO
        JMS     CRLF
        TAD     PMES3
        JMS I   PMESAG  /TYPE OUT POWER DOWN MESSAGE
        JMS     CRLF
        SCRF
        SKP HLT
        JMP     ,*2
        JMS     EXTERN
        TAD I   SLOT
        DCA     ONOW
        TAD     K0020
        DCA     BPNTR
        TAD     M0020
        DCA     BCNTR

L0011B, CLA CLL
        TAD I   BPNTR
        SMA CLA /RETENTIVE MEMORY?
        JMP     I0011  /NO
        CTFF
        TAD     ONOW
        TAD     TYN
        JMS I   PINTER /EXECUTE A TYF N
        STFF
        TAD     ERR10  /TEST FLOP SET?
        JMS     /NO, ERROR
    
```

912 2254 2070
 913 2255 2041
 914 2256 2040
 915 2257 5242
 916
 917 2260 7200
 918 2261 1265
 919 2262 4117
 920 2263 7402
 921 2264 5776
 922
 923 2265 0207
 924 2266 2267
 925 2267 5252
 926 2270 0307
 927 2271 5252
 928 2272 4017
 929 2273 1605
 930 2274 4014
 931 2275 1723
 932 2276 2440
 933 2277 1116
 934 2300 4020
 935 2301 1727
 936 2302 0522
 937 2303 4023
 938 2304 1025
 939 2305 2455
 940 2306 0417
 941 2307 2716
 942 2310 4002
 943 2311 3140
 944 2312 2215
 945 2313 4000
 946

10011, ISZ ONOW /INCREMENT OUTPUT ADDRESS
 ISZ BPNTN /INCREMENT STATUS WORD POINTER
 ISZ BCNTR /INCREMENT COUNTER
 JMP L0011B /NO DONE
 /PROGRAM HAS COMPLETED 1 PASS
 CLA
 TAD K0207
 JMS TYPE /RING BELL
 HLT
 JMP STRTST
 K0207, 207
 PM11, .*1
 5252 /*,*
 0307 /C,G
 5252 /*,*
 4017 /SP,O
 1605 /N,E
 4014 /SP,L
 1723 /O,S
 2440 /T,SP
 1116 /I,N
 4020 /SP,P
 1727 /O,W
 0522 /E,R
 4023 /SP,S
 1025 /H,U
 2455 /T,-
 0417 /D,O
 2716 /W,N
 4002 /SP,B
 3140 /Y,SP
 2215 /R,M
 4000 /SP,END

947	2314	2315	PMES3,	1,1	
948	2315	2017		2017	/P,O
949	2316	2705		2705	/W,E
950	2317	2255		2255	/R,-
951	2320	0417		0417	/D,O
952	2321	2716		2716	/W,N
953	2322	4024		4024	/SP,T
954	2323	1005		1005	/H,E
955	2324	4020		4020	/SP,P
956	2325	0420		0420	/D,P
957	2326	5561		5561	/-,1
958	2327	6454		6454	/4,,
959	2330	4024		4024	/SP,T
960	2331	1005		1005	/H,E
961	2332	1640		1640	/N,SP
962	2333	2017		2017	/P,O
963	2334	2705		2705	/W,E
964	2335	2240		2240	/R,SP
965	2336	1124		1124	/I,T
966	2337	4025		4025	/SP,U
967	2340	2040		2040	/P,SP
968	2341	0107		0107	/A,G
969	2342	0111		0111	/A,I
970	2343	1654		1654	/N,,
971	2344	4004		4004	/SP,D
972	2345	0520		0520	/E,P
973	2346	2205		2205	/R,E
974	2347	2323		2323	/S,S
975	2350	4020		4020	/SP,P
976	2351	0420		0420	/D,P
977	2352	5570		5570	/-,B
978	2353	4003		4003	/SP,C
979	2354	1716		1716	/O,N
980	2355	2411		2411	/T,I
981	2356	1625		1625	/N,U
982	2357	0500		0500	/E,END

983
 984 2376 0400
 985 2377 2041
 2400
 986
 987
 988 2400 0000
 989 2401 6165
 990 2402 4203
 991 2403 0000
 992 2404 6175
 993 2405 5222
 994 2406 6161
 995 2407 7410
 996 2410 5220
 997 2411 2203
 998 2412 5204
 999 2413 4125
 1000 2414 1225
 1001 2415 4502
 1002 2416 4125
 1003 2417 7402
 1004 2420 7200
 1005 2421 5600
 1006 2422 4125
 1007 2423 1234
 1008 2424 5215
 1009
 1010
 1011 2425 2426
 1012 2426 2004
 1013 2427 2055
 1014 2430 6164
 1015 2431 4010
 1016 2432 2516
 1017 2433 0700
 1018
 1019
 1020 2434 2435
 1021 2435 2004
 1022 2436 2055
 1023 2437 6164
 1024 2440 4023
 1025 2441 2417
 1026 2442 2020
 1027 2443 0504
 1028 2444 0000

*2400
 /INTERRUPT THE PDP-14 AND EXECUTE 1 INSTRUCTION (IN AC)
 INTER: 0
 I LEX /INTERRUPT AND EXECUTE
 JMS , *1
 0
 SCRF
 JMP NORUN
 SIDF
 SKP
 JMP EXIT1
 ISZ INTER+3
 JMP INTER+4
 JMS CRLF
 TAD PHUNG
 JMS I PMESAG
 JMS CRLF
 INSTER, HLT
 EXIT1, CLA
 JMP I INTER
 NORUN, JMS CRLF
 TAD PNORUN
 JMP INSTER=2

 /PDP-14 HUNG
 PHUNG, , *1
 2004
 2055
 6164
 4010
 2516
 0700

 /PDP-14 STOPPED
 PNORUN, , *1
 2004
 2055
 6164
 4023
 2417
 2020
 0504
 0

1029
1030
1031
1032
1033 2445 0000
1034 2446 3304
1035 2447 1704
1036 2450 0306
1037 2451 7450
1038 2452 5645
1039 2453 7112
1040 2454 7012
1041 2455 7012
1042 2456 3043
1043 2457 1043
1044 2460 1311
1045 2461 7710
1046 2462 1307
1047 2463 1310
1048 2464 1043
1049 2465 4117
1050 2466 1704
1051 2467 0305
1052 2470 7450
1053 2471 5645
1054 2472 3043
1055 2473 1043
1056 2474 1311
1057 2475 7710
1058 2476 1307
1059 2477 1310
1060 2500 1043
1061 2501 4117
1062 2502 2304
1063 2503 5247
1064 2504 0000
1065 2505 0077
1066 2506 7700
1067 2507 0100
1068 2510 0200
1069 2511 7740
1070
1071
1072
1073 2512 0000
1074 2513 3334
1075 2514 1336
1076 2515 3335
1077 2516 1334
1078 2517 7104
1079 2520 7004
1080 2521 7006
1081 2522 3334
1082 2523 1334
1083 2524 0135

/MESSAGE PRINT SUBROUTINE
/ENTER WITH MESSAGE ADDRESS IN AC

MESAG: 0
DCA MPNTR
TAD I MPNTR
AND K7700
SNA
JMP I MESAG
RTR CLL
RTR
RTR
DCA CHAR
TAD CHAR
TAD M0040
SPA CLA
TAD K0100
TAD K0200
TAD CHAR
JMS TYPE
TAD I MPNTR
AND K0077
SNA
JMP I MESAG
DCA CHAR
TAD CHAR
TAD M0040
SPA CLA
TAD K0100
TAD K0200
TAD CHAR
JMS TYPE
ISE MPNTR
JMP MESAG+2

MPNTR: 0
K0077: 77
K7700: 7700
K0100: 100
K0200: 200
M0040: -40

/TYPE OUT THE CONTENTS OF THE AC IN OCTAL

PRINT: 0
DCA NUMBER
TAD M0004
DCA PCNTR
TAD NUMBER
RAL CLL
RAL
RTL
DCA NUMBER
TAD NUMBER
AND K0007

1084	2525	1136
1085	2526	4117
1086	2527	1334
1087	2530	2535
1088	2531	5320
1089	2532	7200
1090	2533	5712
1091	2534	0000
1092	2535	0000
1093	2536	7774

TAD	K0260
JMS	TYPE
TAD	NUMBER
ISZ	PCNTR
JMP	,=11
CLA	
JMP I	PRINT
NUMBER,	0
PCNTR,	0
M0004,	=4

1094
 1095
 1096
 1097 2537 0000
 1098 2540 7604
 1099 2541 7006
 1100 2542 7710
 1101 2543 5352
 1102 2544 4125
 1103 2545 1044
 1104 2546 4502
 1105 2547 1073
 1106 2550 4503
 1107 2551 4125
 1108 2552 7604
 1109 2553 7004
 1110 2554 7700
 1111 2555 7402
 1112 2556 5737
 1113
 1114
 1115
 1116
 1117 2557 0000
 1118 2560 7300
 1119 2561 1057
 1120 2562 3010
 1121 2563 3011
 1122 2564 2011
 1123 2565 5364
 1124 2566 2010
 1125 2567 5364
 1126 2570 5757
 1127
 1128 2571 0000
 1129 2572 7300
 1130 2573 1052
 1131 2574 3010
 1132 2575 2010
 1133 2576 5375
 1134 2577 5771

/TEST FLOP ERROR ROUTINE

```

FLPERR, 0
  LAS
  RTL
  SPA CLA /TYPE OUT ERRORS
  JMP EFLOP-3 /NO
  JMS CRLF /YES
  TAD HEADER
  JMS I PMESAG /TYPE OUT HEADER
  TAD TSTNOW
  JMS I PPRINT /TYPE OUT INSTRUCTION ADDRESS
  JMS CRLF
  LAS
  RAL
  SMA CLA /HALT ON ERROR?
  EFLOP, HLT /YES
  JMP I FLPERR
  
```

/DELAY SUBROUTINES

```

D120MS, 0 /120 MS (ACTUALLY 128.0MS)
  CLA CLL
  TAD M0007
  DCA 10
  DCA 11
  ISZ 11
  JMP ,=1
  ISZ 10
  JMP ,=3
  JMP I D120MS

D10MS, 0 /10 MS
  CLA CLL
  TAD K4252
  DCA 10
  ISZ 10
  JMP ,=1
  JMP I D10MS
  
```

```

1135
1136          2600      *2600
1137
1138          /DOUBLE PRECISION UNSIGNED DECIMAL TYPEOUT SUBROUTINE
1139          2600      0000      UDPRNT, 0
1140          2601      7300      CLA CLL
1141          2602      1600      TAD I UDPRNT
1142          2603      3263      DCA UDGET
1143          2604      1663      TAD I UDGET
1144          2605      3255      DCA UDHIGH
1145          2606      2263      ISZ UDGET
1146          2607      1663      TAD I UDGET
1147          2610      3256      DCA UDLOW
1148          2611      1252      TAD UDLOOP
1149          2612      3254      DCA UDCNT
1150          2613      1253      TAD UDADDR
1151          2614      3264      DCA UDPTR
1152          2615      2200      ISZ UDPRNT
1153          2616      1664      UDARND, TAD I UDPTR
1154          2617      2264      ISZ UDPTR
1155          2620      3257      DCA UDHSUB
1156          2621      1664      TAD I UDPTR
1157          2622      2264      ISZ UDPTR
1158          2623      3260      DCA UDLSUB
1159          2624      7100      UD00, CLL
1160          2625      1260      TAD UDLSUB
1161          2626      1256      TAD UDLOW
1162          2627      3262      DCA UDTEML
1163          2630      7004      RAL
1164          2631      1257      TAD UDHSUB
1165          2632      1255      TAD UDHIGH
1166          2633      7420      SNL
1167          2634      5242      JMP UDOUT
1168          2635      2261      ISZ UDBOX
1169          2636      3255      DCA UDHIGH
1170          2637      1262      TAD UDTEML
1171          2640      3256      DCA UDLOW
1172          2641      5224      JMP UD00
1173          2642      7200      UDOUT, CLA
1174          2643      1261      TAD UDBOX
1175          2644      1136      TAD K0260
1176          2645      4117      JMS TYPE
1177          2646      3261      DCA UDBOX
1178          2647      2254      ISZ UDCNT
1179          2650      5216      JMP UDARND
1180          2651      5600      JMP I UDPRNT
1181          2652      7770      UDLOOP, =10
1182          2653      2665      UDADDR, UDCON1

```

1183	2654	0000	UDCNT,	0
1184	2655	0000	UDHIGH,	0
1185	2656	0000	UDLOW,	0
1186	2657	0000	UDHSUB,	0
1187	2660	0000	UDLSUB,	0
1188	2661	0000	UDBOX,	0
1189	2662	0000	UDTEML,	0
1190	2663	0000	UDGET,	0
1191	2664	0000	UDPTR,	0
1192	2665	3166	UDCON1,	3166
1193	2666	4600		4600
1194	2667	7413		7413
1195	2670	6700		6700
1196	2671	7747		7747
1197	2672	4540		4540
1198	2673	7775		7775
1199	2674	4360		4360
1200	2675	7777		7777
1201	2676	6030		6030
1202	2677	7777		7777
1203	2700	7634		7634
1204	2701	7777		7777
1205	2702	7766		7766
1206	2703	7777		7777
1207	2704	7777		7777
1208				
1209				

1210	2705	2706	PMES2,	.+1
1211	2706	1104		1104 /I,D
1212	2707	0516		0516 /E,N
1213	2710	2411		2411 /T,I
1214	2711	0631		0631 /F,Y
1215	2712	4024		4024 /SP,T
1216	2713	1005		1005 /H,E
1217	2714	4010		4010 /SP,H
1218	2715	0122		0122 /A,R
1219	2716	0427		0427 /O,W
1220	2717	0122		0122 /A,R
1221	2720	0540		0540 /E,SP
1222	2721	0123		0123 /A,S
1223	2722	2317		2317 /S,O
1224	2723	0311		0311 /C,I
1225	2724	0124		0124 /A,T
1226	2725	0504		0504 /E,D
1227	2726	4027		4027 /SP,W
1228	2727	1124		1124 /I,T
1229	2730	1040		1040 /H,SP
1230	2731	0501		0501 /E,A
1231	2732	0310		0310 /C,H
1232	2733	4001		4001 /SP,A
1233	2734	0404		0404 /O,D
1234	2735	2205		2205 /R,E
1235	2736	2323		2323 /S,S
1236	2737	4002		4002 /SP,B
1237	2740	3140		3140 /Y,SP

1238	2741	2431	2431	/T,Y
1239	2742	2011	2011	/P,I
1240	2743	1607	1607	/N,G
1241	2744	7200	7200	/I,END
1242	2745	2746	2440	PMES2A, *1
1243	2746	2440	2440	/T,SP
1244	2747	0617	0617	/F,O
1245	2750	2240	2240	/R,SP
1246	2751	2411	2411	/T,I
1247	2752	1505	1505	/M,E
1248	2753	2254	2254	/R,,
1249	2754	4015	4015	/SP,M
1250	2755	4006	4006	/SP,F
1251	2756	1722	1722	/O,R
1252	2757	4022	4022	/SP,R
1253	2760	0524	0524	/E,T
1254	2761	0516	0516	/E,N
1255	2762	2411	2411	/T,I
1256	2763	2605	2605	/V,E
1257	2764	4015	4015	/SP,M
1258	2765	0515	0515	/E,M
1259	2766	1722	1722	/O,R
1260	2767	3154	3154	/Y,,
1261	2770	4001	4001	/SP,A
1262	2771	1414	1414	/L,L
1263	2772	4005	4005	/SP,E
1264	2773	1423	1423	/L,S
1265	2774	0540	0540	/E,SP
1266	2775	0515	0515	/E,M
1267	2776	2024	2024	/P,T
1268	2777	3100	3100	/Y,END
1269				
1270				

\$

0000	00000000	00000000	00000000	00000000	11111111	11111111	11111111	11111111
0100	11111111	11111111	11111111	11111111	11111111	00000000	00000000	00001111
0200	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11100000
0300	01111111	11111111	11111111	11111111	11100000	00000000	00000000	00000111
0400	11111111	11111111	11111111	11111110	00000000	00000000	00000000	00000000
0500	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000111
0600	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
0700	11111111	11111111	11111111	11111111	11111111	11111111	11100000	00000111
1000	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
1100	11111111	10000000	00000000	00000000	00000000	00000000	00000000	00000001
1200	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
1300	11111111	11000000	00000000	00000000	00000000	00000000	00000000	00000001
1400	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
1500	11111100	00000000	00000000	00000000	00000000	00000000	00000000	00000001
1600	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
1700	11111111	11111111	11111111	11111111	11111111	11111111	11111111	00001111
2000	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
2100	11111111	00000000	00000000	00000000	00000000	00000000	00000000	00000111
2200	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
2300	11111111	11111111	11111111	11111111	11111111	11111111	00000000	00000011
2400	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
2500	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
2600	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
2700	11111111	11111111	11111111	11111111	11111111	11111111	11111111	11111111
3000								
3100								
3200								
3300								
3400								
3500								
3600								
3700								

4000
4100

4200
4300

4400
4500

4600
4700

5000
5100

5200
5300

5400
5500

5600
5700

6000
6100

6200
6300

6400
6500

6600
6700

7000
7100

7200
7300

7400
7500

7600
7700

ABXTST	0200	L0007	1405	PPRINT	0103
BCNTR	0040	L0008	1605	PRINT	2512
BPNTR	0041	L0010	2022	QUES1	0203
CHAR	0043	L0011A	2211	QUES2	0234
CIDF	6167	L0011B	2242	QUESN	0245
CLROUT	0422	LCNTR	0054	ROTR	6176
CNTR	0042	LDEX	6164	SCRF	6175
COTF	6172	LOIN	6162	SIDF	6161
CRLF	0125	LTEMP	0055	SLOT	0072
CFFF	4174	LTEMP1	0056	SOTF	6171
D10MS	2571	M0004	2536	STFF	6173
D120MS	2557	M0007	0057	STRTST	0400
E0004	0667	M0017	0060	SYF	0076
E0008	1737	M0020	0061	SYN	0077
E0010	2057	M0040	2511	T0003	0416
EFLOP	2555	M0300	0062	T0004	0600
ERR10	2041	M0311	0063	T0005	1000
ERR8	1714	M0315	0064	T0006	1200
ERRTYD	1264	M0317	0065	T0007	1400
EXIT1	2420	M0321	0066	T0008	1600
EXTERN	0107	M0324	0067	T0010	2000
FLPERR	2537	MESAG	2445	T0011	2200
GETCHR	0137	MPNTR	2504	TIMCON	0762
HEADER	0044	NORUN	2422	TIME	0646
I0008	1672	NUMBER	2534	TIMEIT	0745
I0010	2034	ONOW	0070	TSTFLP	0105
I0011	2254	OUTCLR	1663	TSTLUP	0410
ILEX	6165	OUTSET	1655	TSTNOW	0073
INCADD	1675	PCNTR	2535	TSTTYD	1203
INOW	0045	PGQBD2	1266	TYD	0101
INSTER	2417	PHUNG	2425	TYDERR	1234
INTER	2400	PINTER	0104	TYDLUP	1205
JFF	0100	PM10	2061	TYDMES	1274
K0007	0135	PM11	2266	TYDTST	0106
K0017	0046	PM4A	0675	TYF	0074
K0020	0047	PM4B	0702	TYN	0075
K0077	2505	PM4C	0714	TYPE	0117
K0100	2507	PM4D	0724	UDADDR	2653
K0200	2510	PM5A	1047	UDARND	2616
K0207	2265	PM5B	1071	UDBOX	2661
K0212	0134	PM7A	1444	UDCNT	2654
K0215	0133	PM7B	1466	UDCON1	2665
K0240	0050	PM8A	1767	UDDO	2624
K0260	0136	PM8B	1741	UDGET	2663
K0377	0051	PM8C	1756	UDHIGH	2655
K0400	0674	PMES1	0324	UDHSUB	2657
K0600	0116	PMES2	2705	UDLOOP	2652
K4252	0052	PMES2A	2745	UDLOW	2656
K7400	0053	PMES3	2314	UDLSUB	2660
K7700	2506	PMESAG	0102	UDOUT	2642
L0004	0613	PNORUN	2434	UDPRNT	2600
L0005	1005	PNTR	0071	UDPTR	2664

ERRORS DETECTED: 0

LINKS GENERATED: 22

RUN-TIME: 10 SECONDS

3K CORE USED

UDLSUB	1158	1160	1187#			
UDOUT	1167	1173#				
UDPRNT	299	1139#	1141	1152	1180	
UDPTR	1151	1153	1154	1156	1157	1191#
UDTEML	1162	1170	1189#			
.L0375	157	224#				
.L0376	154	225#				
.L0377	127	226#				
.L0575	251	268#				
.L0576	242	269#				
.L0577	240	270#				
.L0775	313	396#				
.L0776	309	336	397#			
.L0777	299	398#				
.L1177	440	477#				
.L1377	482	560#				
.L1577	598	639#				
.L1774	725	777#				
.L1775	721	778#				
.L1776	711	779#				
.L1777	666	780#				
.L2175	820	861#				
.L2176	793	862#				
.L2177	791	863#				
.L2376	921	984#				
.L2377	911	985#				