

PDP-11/70

DIAGNOSTIC/BOOTSTRAP
MD-11-DEKBH-A
(M9301-YC) PATTERN

EP-DEKBH-A-DL
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IDENTIFICATION

PRODUCT CODE: MAINDEC-11-DEKBH-A-D
PRODUCT NAME: PDP-11/70 DIAGNOSTIC/BOOTSTRAP (M9381-YC) PATTERN
DATE CREATED: 21-JULY-75
MAINTAINER: DIAGNOSTIC ENGINEERING
AUTHOR: DALE A. ROEDGER

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1) ABSTRACT

THIS PROGRAM IS THE ROM DIAGNOSTIC/BOOTSTRAP FOR THE M9381-YC
IT IS MEANT TO BE FOR THE PDP-11/70 ONLY, AND WILL FAIL ON ALL
OTHER PDP-11 PROCESSORS.

THE DIAGNOSTIC PORTION OF THE PROGRAM WILL TEST THE BASIC CPU,
INCLUDING: THE BRANCHES, THE REGISTERS, ALL ADDRESSING MODES,
AND MOST OF THE INSTRUCTIONS IN THE PDP-11 REPERTOIRE. IT WILL
THEN SET THE STACK POINTER TO KERNEL D-SPACE P.A.R. 7, CHECK
AND TURN ON, IF REQUESTED, MEMORY MANAGEMENT AND THE UNIBUS MAP,
AND CHECK MEMORY FROM VIRTUAL ADDRESS 1000 TO 157776. AFTER
MAIN MEMORY HAS BEEN VERIFIED, WITH THE CACHE OFF, THE CACHE
MEMORY WILL BE TESTED TO VERIFY THAT "HITS" OCCUR PROPERLY.
THEN MAIN MEMORY WILL BE SCANNED AGAIN TO INSURE THAT THE CACHE
IS WORKING PROPERLY THROUGHOUT THE 28K OF MEMORY TO BE USED IN
THE "BOOT" OPERATION.

IF ONE OF THE CACHE MEMORY TESTS FAILS, THE OPERATOR CAN ATTEMPT
TO "BOOT" THE SYSTEM ANYWAY BY PRESSING "CONTINUE". THIS WILL
CAUSE THE PROGRAM TO FORCE "MISSES" IN BOTH GROUPS OF THE CACHE
BEFORE GOING TO THE BOOTSTRAP SECTION OF THE PROGRAM.

THE BOOTSTRAP PORTION OF THE PROGRAM LOOKS AT THE LOWER BYTE OF
THE SWITCH REGISTER TO DETERMINE WHICH ONE OF 9 DEVICES AND WHICH
DRIVE NUMBER TO ATTEMPT THE "BOOT" FROM. SWITCHES <02 | 00>
SELECT THE DRIVE NUMBER (0 - 7), AND SWITCHES <06 | 03> SELECT
THE DEVICE CODE (1 - 11). IF THE LOWER BYTE OF THE SWITCH REGIS-
TER IS ZERO, THE PROGRAM WILL READ THE SET OF SWITCHES ON THE
M9381-YC TO DETERMINE THE DEVICE AND DRIVE NUMBER. THESE SWITCHES
CAN BE SET BY FIELD SERVICE TO SELECT A "DEFAULT BOOT" DEVICE.

IF THE BOOTSTRAP OPERATION FAILS AS A RESULT OF A HARDWARE ERROR
IN THE PERIPHERAL DEVICE THE PROGRAM WILL DO A "RESET" INSTRU-
CTION AND JUMP BACK TO THE TEST THAT SETS UP AND TURNS ON MEMORY
MANAGEMENT AND TESTS MEMORY. THEN THE PROGRAM WILL ATTEMPT TO
"BOOT" AGAIN.

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2) STARTING PROCEDURE

2.1 SWITCH SETTINGS

THE LOWER BYTE OF THE SWITCH REGISTER SHOULD BE SET TO HAVE THE DRIVE NUMBER (0 - 7) IN SWITCHES <02 : 00>, AND THE DEVICE CODE (1 - 11) IN SWITCHES <06 : 03>.

THE UPPER BYTE OF THE SWITCH REGISTER SHOULD BE SET TO HAVE THE BANK NUMBER OF THE 32K BLOCK OF MEMORY TO BE USED FOR THE BOOTSTRAP OPERATION (0 - 17) IN SWITCHES <15 : 12>.

THE DEVICE CODES ARE AS FOLLOWS:

- 1) TM11/TU10 MAGNETIC TAPE, TM11
- 2) TC11/TU50 DECTAPE, TC11-0
- 3) RK11/RK05 DECPACK DIS CARTRIDGE, RK11-0
- 4) RP11/RP03 DISK PACK, RP11-C
- 5) RESERVED FOR FUTURE DEVICE
- 6) RH70/TU16 MAGNETIC TAPE SYSTEM, THU16
- 7) RH70/RP04 DISK PACK, RMP04
- 10) RH70/R504 FIXED HEAD DISK, RWS04 (OR MWS03)
- 11) RX11/RX01 DISKETTE

THE MEMORY BLOCKS ARE AS FOLLOWS:

- 0) PHYSICAL MEMORY 0 - 28K
- 1) PHYSICAL MEMORY 32K - 60K
- 2) PHYSICAL MEMORY 64K - 92K
- 3) PHYSICAL MEMORY 96K - 124K
- 4) PHYSICAL MEMORY 128K - 156K
- .
- 13) PHYSICAL MEMORY 256K - 284K
- .
- 14) PHYSICAL MEMORY 384K - 412K
- 15) PHYSICAL MEMORY 416K - 444K
- 16) PHYSICAL MEMORY 448K - 476K
- 17) PHYSICAL MEMORY 480K - 508K

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2.2 STARTING ADDRESSES

THE NORMAL STARTING ADDRESS FOR THIS PROGRAM IS 177765000.

IF THE DIAGNOSTIC PORTION OF THIS PROGRAM FAILS AND THE OPERATOR WANTS TO ATTEMPT TO "BOOT" ANYWAY, HE MUST FOLLOW THESE STEPS:

- 1) SET UP MEMORY MANAGEMENT IF "BOOTING" INTO OTHER THAN THE LOWER 20K OF MEMORY.
- 2A) IF DEVICE IS ON MASSBUS;
SET STACK POINTER TO A VALID ADDRESS AND LOAD THAT ADDRESS WITH THE MEMORY BANK NUMBER HE WOULD PUT INTO SWITCHES <15:12>.
- 2B) IF DEVICE IS ON UNIBUS;
SET UP UNIBUS MAP REGISTERS 0 THRU 6 TO MAP TO SAME MEMORY AS MEMORY MANAGEMENT.
- 3) DEPOSIT ADDRESS 173000 INTO THE PC.
- 4) SET THE DEVICE CODE AND DRIVE NUMBER IN THE LOWER BYTE OF THE SWITCH REGISTER.
- 5) PRESS CONTINUE.

EXAMPLES:

- A) RP04 -- SET STACK POINTER TO 40000
LOAD 000000 INTO ADDRESS 40000
LOAD 173000 INTO THE PC (17777707)
SET 0000/0 INTO SWITCHES (RP04 DRIVE 0)
PRESS "CONTINUE"
- B) RK05 -- LOAD 173000 INTO THE PC (17777707)
SET 0000/0 INTO SWITCHES (RK05 DRIVE 0)
PRESS "CONTINUE"

2.3 OPERATOR ACTION

IF THE DIAGNOSTIC PORTION OF THE ROM FAILS BEYOND THE PC OF THE "HALT" INSTRUCTION AND REFER TO THE LISTING TO FIND OUT WHAT PORTION OF THE MACHINE FAILED.

.REM \
3) ERRORS

3.1 LIST OF ERROR HALTS INDEXED BY THE ADDRESS DISPLAYED

ADDRESS DISPLAYED	TEST NUMBER AND SUBSYSTEM UNDER TEST
17765004	TEST 1 BRANCH TEST
17765020	TEST 2 BRANCH TEST
17765036	TEST 3 BRANCH TEST
17765052	TEST 4 BRANCH TEST
17765068	TEST 5 BRANCH TEST
17765076	TEST 6 BRANCH TEST
17765134	TEST 7 REGISTER DATA PATH TEST
17765148	TEST 10 BRANCH TEST
17765168	TEST 11 CPU INSTRUCTION TEST
17765204	TEST 12 CPU INSTRUCTION TEST
17765214	TEST 13 CPU INSTRUCTION TEST
17765222	TEST 14 "COM" INSTRUCTION TEST
17765236	TEST 14 CPU INSTRUCTION TEST
17765260	TEST 15 CPU INSTRUCTION TEST
17765270	TEST 16 BRANCH TEST
17765312	TEST 16 CPU INSTRUCTION TEST
17765348	TEST 17 CPU INSTRUCTION TEST
17765360	TEST 20 CPU INSTRUCTION TEST
17765374	TEST 20 CPU INSTRUCTION TEST
17765450	TEST 21 KERNEL P.A.R. TEST
17765474	TEST 22 KERNEL P.D.R. TEST
17765510	TEST 23 "JSR" TEST
17765520	TEST 23 "JSR" TEST
17765530	TEST 23 "RTS" TEST
17765542	TEST 23 "RTI" TEST
17765590	TEST 23 "JMP" TEST
17765760	TEST 25 MAIN MEMORY DATA COMPARE ERROR
17766000	TEST 25 MAIN MEMORY PARITY ERROR NO RECOVERY POSSIBLE FROM THIS ERROR
17773644	TEST 26 CACHE MEMORY DATA COMPARE ERROR
17773654	TEST 26 CACHE MEMORY NO "HIT" PRESSING "CONTINUE" HERE WILL CAUSE "BOOT" ATTEMPT FORCING "MISSES"
17773736	TEST 27 CACHE MEMORY DATA COMPARE ERROR
17773746	TEST 27 CACHE MEMORY NO "HIT" PRESSING "CONTINUE" HERE WILL CAUSE "BOOT" ATTEMPT FORCING "MISSES"
17773764	TEST 25 OR 26 CACHE MEMORY PARITY ERROR PRESSING "CONTINUE" HERE WILL CAUSE "BOOT" ATTEMPT FORCING "MISSES"

3.2 ERROR RECOVERY

MOST OF THE ABOVE ERROR HALTS ARE "HARD" FAILURES, WHICH MEANS
THAT THERE IS NO RECOVERY FROM THEM. ESPECIALLY THE TWO (2) MAIN

MEMORY HALTS ARE NOT RECOVERABLE, YOUR BEST BET IS TO TRY TO
"BOOT" INTO ANOTHER 32K BANK OF MEMORY IF IT APPEARS TO
BE A MAIN MEMORY FAILURE.

IF THE PROCESSOR HALTS IN ONE OF THE TWO CACHE TESTS THE ERROR
CAN BE RECOVERED FROM. BY PRESSING "CONTINUE" THE PROGRAM WILL
EITHER ATTEMPT TO FINISH THE TEST (IF AT EITHER: 17773644 OR
17773736) OR FORCE "MISSES" IN BOTH GROUPS OF THE CACHE AND
ATTEMPT TO "BOOT" THE SYSTEM MONITOR WITH THE CACHE FULLY
DISABLED (IF AT EITHER: 17773654, 17773740, OR 17773764).

4) EXECUTION TIME

THE RUN TIME FOR THIS PROGRAM IS APPROXIMATELY 3 SECONDS.

.END

ERRORS DETECTED: 0

*.DEKBHA/NL:SEQ/NL:LOC/NL:BIN/NL:SYM=DEKBHA.MAN
RUN-TIME: 0 1 0 SECONDS
CORE USED: 4K

TABLE OF CONTENTS

110	TEST1	THIS TEST VERIFIES THE UNCONDITIONAL BRANCH
130	TEST2	TEST "SUB", MODE "0", AND "BHI", "BVS", "MHI", "BLOS"
147	TEST3	TEST "DEC", MODE "0", AND "BPL", "BEQ", "MGE", "BGT", "MLE"
169	TEST4	TEST "ROR", MODE "0", AND "BVC", "BHIS", "BHI", "BNE"
190	TEST5	TEST "BHI", "BLT", AND "BLOS"
210	TEST6	TEST "BLE" AND "BGT"
220	TEST7	TEST REGISTER DATA PATH AND MODES "2", "3", "6"
257	TEST10	TEST "ROL", "BCC", "BLT", AND MODE "6"
277	TEST11	TEST "ADD", "INC", "COM", AND "MCS", "BLE"
301	TEST12	TEST "ROR", "BIS", "ADD", AND "BLO", "BGE"
324	TEST13	TEST "DEC" AND "BLOS", "BLT"
343	TEST14	TEST "COM", "BIC", AND "BGT", "BGE", "BLE"
368	TEST15	TEST "ADC", "CMP", "BIT", AND "BNE", "MGT", "BEQ"
394	TEST16	TEST "MOVB", "SOB", "CLR", "TST" AND "BPL", "BNE"
421	TEST17	TEST "ASR", "ASL"
452	TEST20	TEST ASH, AND SWAB
480	TEST21	TEST 16 KERNEL P.A.R.'S
517	TEST22	TEST AND LOAD KIPDR'S
545	TEST23	TEST "JSR", "RTS", "RTI", & "JMP"
576	TEST24	LOAD AND TURN ON MEMORY MANAGEMENT AND THE UNIBUS MAP
630	TEST25	TEST MAIN MEMORY FROM VIRTUAL 1000 TO 20K
682		BOOTSTRAP ENTRY POINT IS AT 17773000
707		CODE TO WAIT FOR TU10 TO COME ON LINE
714		THIS IS THE CODE TO READ THE SWITCH REGISTER AND DECODE IT
736		THIS IS THE START OF THE TM11/TU10 BOOT STRAP (MAGNETIC TAPE, TM11)
754		THIS IS THE START OF THE TC11/TU56 BOOT STRAP (DECTAPE, TC11-G)
767		THIS IS THE START OF THE RK11/RK05 BOOT STRAP (DECPACK DISK CARTRIDGE, RK11-D)
775		THIS IS THE START OF THE RP11/RP03 BOOT STRAP (DISK PACK, RP11-C)
780		THIS IS THE START OF THE COMMON READ CODE
800		THIS IS THE START OF THE RH70/TU16 BOOT STRAP (MAGNETIC TAPE SYSTEM, THU16)
822		THIS IS THE START OF THE RH70/RP04 BOOT STRAP (DISK PACK, RHP04)
832		THIS IS THE START OF THE RH70/R504 BOOT STRAP (FIXED HEAD DISK, RWS04)
839		THIS IS THE START OF THE COMMON RH-70 CODE
845		THIS IS THE START OF THE RX11/RX01 BOOT STRAP (FLOPPY DISK)
872		THIS IS THE START RESERVED FOR A FUTURE DEVICE
887		FUNCTION CODES FOR THE ALL OF THE DEVICES
912		COMMAND AND STATUS REGISTER ADDRESS TABLE
924		FUNCTION POINTER TABLE
936		STARTING ADDRESS TABLE
949		CACHE MEMORY DIAGNOSTIC TESTS
967	TEST26	TEST CACHE DATA MEMORY
1009	TEST27	TEST VIRTUAL 20K WITH CACHE ON

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*
* PROGRAMMER DALE A. ROEDGER
*


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129      ;|.....
130      .SBTTL TEST2  TEST "SUB", MODE "B", AND "BHI","BVS","BHI","BLOS"
131      ;|
132      ;| THE REGISTERS AND CONDITION CODES ARE ALL UNDEFINED WHEN
133      ;| THIS TEST IS ENTERED.  UPON COMPLETION OF THIS TEST THE "SP"
134      ;| (R6) SHOULD BE ZERO AND ONLY THE "Z" FLIP-FLOP WILL BE SET.
135      ;|
136      ;|.....
137      165004  TST2:
138
139      165004  J05006      CLR      SP      ;N=0,Z=1;V=0,C=0,SP=000000
140      165006  100403      BHI     18      ; V 324 BRANCH IF N=1
141      165010  122402      BVS     18      ; V 324 BRANCH IF V=1
142      165012  101001      BHI     18      ; V 321 BRANCH IF B AND C ARE BOTH 0
143      165014  101401      BLOS   TST3    ; 325 BRANCH IF (Z XOR C)=1
144      165016  000000      18:     HALT
145
146      ;|.....
147      .SBTTL TEST3  TEST "DEC", MODE "B", AND "BPL","BEQ","BGE","BGT","BLE"
148      ;|
149      ;| UPON ENTERING THIS TEST THE CONDITION CODES ARE:
150      ;| N = 0, Z = 1, V = 0, AND C = 0.
151      ;| THE REGISTERS ARE: R0 = ?, R1 = ? R2 = ?
152      ;| R3 = ? R4 = ? R5 = ? SP = 000000
153      ;| UPON COMPLETION OF THIS TEST THE CONDITION CODES WILL BE:
154      ;| N = 1, Z = 0, V = 0, AND C = 0
155      ;| THE REGISTERS AFFECTED BY THE TEST ARE:
156      ;| SP = 17777
157      ;|
158      ;|.....
159      165020  TST3:
160      165020  005306      DEC     SP      ;N=1,Z=0;V=0,C=0,SP=177777
161      165022  100904      BPL     18      ; V 321 BRANCH IF N=0
162      165024  J01403      BEQ     18      ; V 324 BRANCH IF Z=1
163      165026  J02002      BGE     18      ; V 322 BRANCH IF (N XOR V)=0
164      165030  003001      BGT     18      ; V 322 BRANCH IF Z AND (N XOR V) ARE BOTH 0
165      165032  003401      BLE     TST4    ; 326 BRANCH IF [Z OR (N XOR V)]=1
166      165034  J00000      18:     HALT
167
168      ;|.....
169      .SBTTL TEST4  TEST "ROR", MODE "B", AND "BVC","BHS","BHI","BNE"
170      ;|
171      ;| UPON ENTERING THIS TEST THE CONDITION CODES ARE:
172      ;| N = 1, Z = 0, V = 0, AND C = 0.
173      ;| THE REGISTERS ARE: R0 = ?, R1 = ? R2 = ?
174      ;| R3 = ? R4 = ? R5 = ? SP = 177777
175      ;| UPON COMPLETION OF THIS TEST THE CONDITION CODES WILL BE:
176      ;| N = 0, Z = 0, V = 1, AND C = 1
177      ;| THE REGISTERS AFFECTED BY THE TEST ARE:
178      ;| SP = 07777
179      ;|
180      ;|.....
181      165036  TST4:
182      165036  006000      ROR     SP      ;N=0,Z=0;V=1,C=1,SP=077777
    
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183 165040 102003          BVC      15          ; V 321 BRANCH IF V=0
184 165042 103002          BHS      15          ; V 321 BRANCH IF C=0
185 165044 101001          BHI      15          ; V 321 BRANCH IF C AND Z ARE BOTH 0
186 165046 001001          BNE      TEST5       ; 320 BRANCH IF Z=0
187 165050 000000          IS:      HALT
188
189
190
191
192
193
194
195
196
197
198
199
200
201 165052
202 165052 000204          .SBTTL  TEST5  TEST "BHI", "BLT", AND "BLOS"
203 165054 101003          ;
204 165056 000270          ;
205 165060 002401          ; UPON ENTERING THIS TEST THE CONDITION CODES ARE:
206 165062 101401          ; N = 0, Z = 0, V = 1, AND C = 1.
207 165064 000000          ; THE REGISTERS ARE: R0 = ?, R1 = ?, R2 = ?
208
209
210
211
212
213
214
215
216
217
218
219
220
221 165066
222 165066 000244          ; UPON COMPLETION OF THIS TEST THE CONDITION CODES WILL BE:
223 165070 003401          ; N = 1, Z = 1, V = 1, AND C = 1.
224 165072 003001          ; THE REGISTERS ARE: R0 = ?, R1 = ?, R2 = ?
225 165074 000000          ; R3 = ?, R4 = ?, R5 = ?, SP = 077777
226
227
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237 ;0 R0 = 125252, R1 = 000000, R2 = 125252, R3 = 125252
238 ;0 R4 = 125252, R5 = 125252, SP = 125252, AND MAPL00 = 125252
239 ;0
240 ;|.....
241 165076 ;0 TST7:
242 165076 012706 125252 MOV 0125252,SP ;N=1,Z=0;V=0,C=1,SP=125252
243 165102 010000 MOV SP,R0 ;N=1,Z=0;V=0,C=1,R0=125252
244 165104 010001 MOV R0,R1 ;N=1,Z=0;V=0,C=1,R1=125252
245 165106 010102 MOV R1,R2 ;N=1,Z=0;V=0,C=1,R2=125252
246 165110 010203 MOV R2,R3 ;N=1,Z=0;V=0,C=1,R3=125252
247 165112 010304 MOV R3,R4 ;N=1,Z=0;V=0,C=1,R4=125252
248 165114 010405 MOV R4,R5 ;N=1,Z=0;V=0,C=1,R5=125252
249 165116 010537 MOV R5,0(PC)+ ;N=1,Z=0;V=0,C=1
250 165120 170200 ;INDMAP: ,WORD MAPL0 ;MAPL0=125252
251 165122 167701 177772 SUB 0(INDMAP,R1 ;N=0,Z=1;V=0,C=0, AND R1=000000
252 165126 002401 BLT 18 ; V 324 BRANCH IF (N XOR V)=1
253 165130 001401 BEQ TST10 ; 326 BRANCH IF Z=1
254 165132 000000 18: HALT
255 ;|.....
256 ;|.....
257 ;|.....
258 ;|.....
259 ;|.....
260 ;|.....
261 ;|.....
262 ;|.....
263 ;|.....
264 ;|.....
265 ;|.....
266 ;|.....
267 ;|.....
268 ;|.....
269 ;|.....
270 165134 ;0 TST10:
271 165134 006107 003040 ROL MAPL0 ;N=0,Z=0;V=1,C=1, AND MAPL0 = 092524
272 165140 103001 BCC 18 ; V 321 BRANCH IF C=0
273 165142 002401 BLT TST11 ; 326 BRANCH IF (N XOR V)=1
274 165144 000000 18: HALT
275 ;|.....
276 ;|.....
277 ;|.....
278 ;|.....
279 ;|.....
280 ;|.....
281 ;|.....
282 ;|.....
283 ;|.....
284 ;|.....
285 ;|.....
286 ;|.....
287 ;|.....
288 ;|.....
289 ;|.....
290 165146 ;0 TST11:

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291                                     ; (MAPL00 = 052524) + (R3 = 125252)
292 165146 266703 133020 ADD MAPL0,R3 ; N=1,Z=0,V=0,C=0, AND R3=177776
293 165152 235233 INC R3 ; N=1,Z=0,V=0,C=0, AND R3=177777
294 165154 205103 COM R3 ; N=0,Z=1,V=0,C=1, AND R3 = 000000
295 165156 060301 ADD R3,R1 ; N=0,Z=1,V=0,C=0, AND R1 = 000000
296 165160 103401 BCS 15 ; V 324 BRANCH IF C=1
297 165162 003401 BLE TST12 ; * 326 BRANCH IF [Z OR (N XOR V)]=1
298 165164 000000 15: HALT
    
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299
300 ;|.....
301 ;| .SBTTL TEST12 TEST "ROR", "BIS", "ADD", AND "BLO", "BGE"
302 ;|
303 ;| WHEN THIS TEST IS ENTERED THE CONDITION CODES ARE:
304 ;| N = 0, Z = 1, V = 0, AND C = 0.
305 ;| THE REGISTERS ARE: R0 = 125252, R1 = 000000, R2 = 125252
306 ;| R3 = 000000, R4 = 125252, R5 = 125252, SP = 125252.
307 ;| UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
308 ;| N = 0, Z = 1, V = 0, AND C = 0.
309 ;| THE REGISTERS ARE LEFT UNCHANGED EXCEPT FOR
310 ;| R3 WHICH SHOULD BE MODIFIED BACK TO 000000, AND
311 ;| R4 WHICH SHOULD NOW EQUAL 052520
312 ;|
    
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313 ;|.....
314 TST12:
315 165166 000004 ROR R4 ; N=0,Z=0,V=1,C=0, AND R4 = 052525
316 165170 050403 BIS R4,R3 ; N=0,Z=0,V=0,C=0, AND R3 = 052525
317 165172 060503 ADD R5,R3 ; N=1,Z=0,V=0,C=0, AND R3 = 177777
318 165174 005203 INC R3 ; N=0,Z=1,V=0,C=0, AND R3 = 000000
319 165176 103401 BLO 15 ; V 324 BRANCH IF C=1
320 165200 002001 BGE TST13 ; * 328 BRANCH IF (N XOR V)=0
321 165222 000000 15: HALT
    
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322 ;|.....
323 ;| .SBTTL TEST13 TEST "DEC" AND "BLOS", "BLT"
324 ;|
325 ;| WHEN THIS TEST IS ENTERED THE CONDITION CODES ARE:
326 ;| N = 0, Z = 1, V = 0, AND C = 0.
327 ;| THE REGISTERS ARE: R0 = 125252, R1 = 000000, R2 = 125252
328 ;| R3 = 000000, R4 = 052525, R5 = 125252, SP = 125252.
329 ;| UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
330 ;| N = 1, Z = 0, V = 0, AND C = 0.
331 ;| THE REGISTERS ARE LEFT UNCHANGED EXCEPT FOR
332 ;| R1 WHICH SHOULD NOW EQUAL 177777
    
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333 ;|.....
334 TST13:
335 165204
336 165204 005301 DEC R1 ; N=1,Z=0,V=0,C=0,R1=177777
337 165204 131401 BLOS 15 ; V 324 BRANCH IF (Z OR C)=1
338 165206 002401 BLT TST14 ; * 326 BRANCH IF (N XOR V)=1
339 165210 000000
340 165212 000000 15: HALT
    
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341 ;|.....
342 ;| .SBTTL TEST14 TEST "COM", "BIC", AND "BGT", "BGE", "BLE"
343 ;|
344
    
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345      ;0      WHEN THIS TEST IS ENTERED THE CONDITION CODES ARE:
346      ;0      N = 1, Z = 0, V = 0, AND C = 0,
347      ;0      THE REGISTERS ARE: R0 = 125252, R1 = 177777, R2 = 125252
348      ;0      R3 = 000000, R4 = 052525, R5 = 125252, SP = 125252.
349      ;0      UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
350      ;0      N = 0, Z = 0, V = 1, AND C = 1.
351      ;0      THE REGISTERS ARE LEFT UNCHANGED EXCEPT FOR
352      ;0      R0 WHICH SHOULD NOW EQUAL 052525, AND
353      ;0      R1 WHICH SHOULD NOW EQUAL 052524
354      ;0
355      ;|.....|
356      165214  TST14:
357      165214  305100      COM      R0      ;N=0,Z=0,V=0,C=1, AND R0 = 052525
358      165216  101401      BLOS    28      ; = 325 BRANCH IF (Z OR C)=1
359      165220  000000      HALT                    ;STOP HERE IF BRANCH FAILED
360      165222  040001      28:    BIC      R0,R1      ;N=1,Z=0,V=0,C=1, AND R1 = 125252
361      165224  060101      ADD     R1,R1      ;N=0,Z=0,V=1,C=1, AND R1 = 052524
362      165226  033002      BGT     18      ; V 322 BRANCH IF Z AND (N XOR V) ARE BOTH 0
363      165230  002001      BGE     18      ; V 322 BRANCH IF (N XOR V)=0
364      165232  003401      BLE     TST15      ; = 326 BRANCH IF (Z OR (N XOR V))=1
365      165234  000000      18:    HALT
366
367      ;|.....|
368      ;|.....|
369      ;|.....|
370      ;|.....|
371      ;|.....|
372      ;|.....|
373      ;|.....|
374      ;|.....|
375      ;|.....|
376      ;|.....|
377      ;|.....|
378      ;|.....|
379      ;|.....|
380      ;|.....|
381      165236  TST15:
382      165236  005501      ADC     R1      ;N=0,Z=0,V=0,C=0, AND R1 = 052525
383      165240  020401      CMP     R4,R1      ;N=0,Z=1;V=0,C=0
384      165242  001005      BNE     18      ; V 322 BRANCH IF Z=0
385      ;|.....|
386      165244  030105      BIT     R1,R5      ;R1 = 052525 R5 = 125252
387      165246  033003      BGT     18      ;N=0,Z=1;V=0,C=0
388      165250  005105      ; V 322 BRANCH IF Z AND (N XOR V) ARE BOTH 0
389      165252  160501      COM     R5      ;N=0,Z=0,V=0,C=1, AND R5 = 052525
390      165254  001401      SUB     R5,R1      ;N=0,Z=1,V=0,C=0, AND R1 = 000000
391      165256  000000      BEQ     TST16      ; = 326 BRANCH IF Z=1
392      ;|.....|
393      ;|.....|
394      ;|.....|
395      ;|.....|
396      ;|.....|
397      ;|.....|
398      ;|.....|
399      ;|.....|

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B1

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399          ;0      R3 = 000000, R4 = 052525, R5 = 052525, SP = 125252.
400          ;0      UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
401          ;0      N = 0, Z = 1, V = 0, AND C = 0.
402          ;0      R0 IS DECREMENTED BY A SOB INSTRUCTION TO 000000
403          ;0      R1 IS CLEARED AND THEN INCREMENTED AROUND TO 000000
404          ;0
405          ;1.....
426 165260          TST16:
427 165260      112700      177401      MOVB      0177401,R0      ;N=0,Z=0,V=0,C=0, AND R0 = 000001
428 165264      130001          BPL      25              ; * 320 BRANCH IF N=0
429 165266      000000          15:      HALT          ;STOP IF "BPL" FAILED
430 165270      077002          25:      SOB      R0,15      ;DO NOT LOOP SINCE (R0 - 1) = 0
431 165272      009001          CLR      R1              ;N=0, Z=1, V=0, C=0, AND R1 = 000000
432 165274      009201          35:      INC      R1              ;INCREMENT 04K TIMES (2 * 16)
433 165276      077002          SOB      R0,35          ;LOOP BACK TO "INC" 04K TIMES
434 165300      009700          TST      R0              ;N=0,Z=1,V=0,C=0, AND R0 = 000000
435 165302      001002          BNE      45              ; V 322 BRANCH IF Z=0
436 165304      009701          TST      R1              ;N=0,Z=1,V=0,C=0, AND R1 = 000000
437 165306      001401          BEQ      TST17          ; * 326 BRANCH IF Z=1
438 165310      000000          45:      HALT
439
440          ;1.....
441          .SBTTL TEST1/ TEST "ASR", "ASL"
442          ;0
443          ;0      WHEN THIS TEST IS ENTERED THE CONDITION CODES ARE:
444          ;0      N = 0, Z = 1, V = 0, AND C = 0.
445          ;0      THE REGISTERS ARE: R0 = 125252, R1 = 000000, R2 = 125252
446          ;0      R3 = 000000, R4 = 052525, R5 = 052525, SP = 125252.
447          ;0      UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
448          ;0      N = 0, Z = 0, V = 0, AND C = 0.
449          ;0      THE REGISTERS ARE LEFT UNCHANGED EXCEPT FOR
450          ;0      R0 WHICH IS NOW EQUAL TO 000000,
451          ;0      R1 WHICH IS NOW 000001, AND
452          ;0      R2 WHICH IS NOW 000000.
453          ;1.....
454          TST17:
455 165312          MOV      0100000,R0      ;R0=100000
456 165312      212700      100000      INC      R1              ;R1=000001
457 165316      025201          MOV      01016,R2      ;SET COUNTER TO 16 DECIMAL
458 165320      012702      030020          15:      ASR      R0              ;RIGHT SHIFT R0, SIGN EXTEND (16 TIMES)
459 165324      006200          ADC      R0              ;ADD CARRY (8 UNTIL LAST TIME)
460 165326      005500          ASL      R1              ;LEFT SHIFT R1 (16 TIMES)
461 165330      006301          ADC      R1              ;ADD CARRY (8 UNTIL LAST TIME)
462 165332      025501          SOB      R2,15          ;LOOP BACK 16 DECIMAL TIMES
463 165334      077205          ;AT THE END OF THE LOOP
464          ;0
465          ;0      ;R0 = 000000 AND R1 = 000001
466 165336      060001          ADD      R0,R1          ;N=0,Z=0;V=0,C=0 R1=000001, R0=000000
467 165340      023401          BLE      25              ; V 324 BRANCH IF [Z OR (N XOR V)] = 1
468 165342      003001          BGT      TST20          ; * 328 BRANCH IF Z AND (N XOR V) ARE BOTH 0
469 165344      000000          25:      HALT
470
471          ;1.....
472          .SBTTL TEST20 TEST ASH, AND SHAB
    
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C1

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453 ;
454 ;
455 ; WHEN THIS TEST IS ENTERED THE CONDITION CODES ARE:
456 ; N = 0, Z = 0, V = 0, AND C = 0.
457 ; THE REGISTERS ARE: R0 = 000000, R1 = 000001, R2 = 000000
458 ; R3 = 000000, R4 = 052525, R5 = 052525, SP = 125252.
459 ; UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
460 ; N = 0, Z = 1, V = 0, AND C = 1.
461 ; THE REGISTERS ARE LEFT UNCHANGED EXCEPT FOR
462 ; R1 WHICH SHOULD NOW EQUAL 000000
463 ;
464 ;.....
464 165346 TST20:
465 165346 272127 300007 ASH 07,R1 ;LEFT SHIFT BITS INTO BIT7
466 ;N=0,Z=0;V=0,C=0, AND R1 = 000200
467 165352 125701 TSTB R1 ;LOWER BYTE SHOULD BE NEGATIVE
468 ;N=1,Z=0,V=0,C=0
469 165354 100401 BHI 15 ; * 325 BRANCH IF N=1
470 165356 300000 HALT ;"ASH" MUST HAVE FAILED
471 165360 000301 15: SWAB R1 ;SWITCH BYTES OF R1, R1 = 100000
472 ;N=1,Z=0,V=0,C=0
473 165362 072127 177761 ASH 0=015,R1 ;RIGHT SHIFT R1 15 PLACES SIGN EXTEND
474 ;N=1,Z=0;V=0,C=0, R1 = 177777
475 165366 005201 INC R1 ;N=0,Z=1;V=0,C=1, R1 = 000000
476 165370 031401 BEQ TST21 ; * 326 BRANCH IF Z=1
477 165372 000000 HALT ;EITHER "SWAB" OR "ASH" FAILED
478 ;
479 ;.....
480 ;.SBTTL TEST21 TEST 16 KERNEL P.A.M.'S
481 ;
482 ; WHEN THIS TEST IS ENTERED THE CONDITION CODES ARE:
483 ; N = 0, Z = 1, V = 0, AND C = 1.
484 ; THE REGISTERS ARE: R0 = 000000, R1 = 000000, R2 = 000000
485 ; R3 = 000000, R4 = 052525, R5 = 052525, SP = 125252.
486 ; UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
487 ; N = 0, Z = 1, V = 0, AND C = 0.
488 ; THE REGISTERS NOW EQUAL:
489 ; R0 = 172400, R1 = 000000, R2 = 000000, R3 = 000000
490 ; R4 = 052525, R5 = 125252, SP = 125252.
491 ; ALL KERNEL P.A.M.'S = 125252.
492 ;
493 ;.....
494 165374 TST21:
495 165374 012700 172340 MOV 0KIPANS,R0 ;FIRST "PAR" TO BE CHECKED
496 165400 012701 000020 MOV 0=016,R1 ;DO KIPANS THRU KOPAR7
497 165404 005105 COM R5 ;R5=125252
498 165406 010420 15: MOV R4,(R5)+ ;PAR=052525
499 165410 020400 177776 CMP R4,-2(R5) ;DID IT LOAD PROPERLY?
500 165414 001014 BNE 25 ; V BRANCH IF NO R0 = PAR + 2
501 165416 105140 COMB =(R0) ;COMPLEMENT HIGH BYTE PAR=125125
502 165420 120510 CMPB R5,(R5) ;CHECK THE HIGH BYTE
503 165422 001011 BNE 25 ; V BRANCH IF BAD R0 = PAR + 1
504 165424 120440 CMPB R4,-(R0) ;CHECK THE LOW BYTE DIDN'T CHANGE
505 165426 031007 BNE 25 ; V BRANCH IF IT CHANGED R0 = PAR
506 165430 105110 COMB (R0) ;COMPLEMENT THE LOW BYTE PAR=125252
    
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507 165432 120520          CMPB   R9,(R0)+      ;CHECK THE LOW BYTE
508 165434 001004          BNE    25             ; V BRANCH IF BAD R0 = PAR + 1
509 165436 120520          CMPB   R9,(R0)+      ;CHECK THE HIGH BYTE
510 165440 001002          BNE    25             ; V BRANCH IF IT FAILED R0 = PAR + 2
511 165442 077117          SOB    R1,15         ;LOOP UNTIL KOPAR7 HAS BEEN TESTED
512 165444 000401          BR     TST22        ; * BRANCH TO NEXT TEST
513 165446 000000          25:   HALT         ;A P.A.R. FAILED TO HOLD THE RIGHT DATA
514                                     ;CHECK R0 FOR THE ADDRESS
515
516 ;|.....
517 ;.SBTTL TEST22 TEST AND LOAD KIPDR'S
518 ;|
519 ;| WHEN THIS TEST IS ENTERED THE CONDITION CODES ARE:
520 ;| N = 0, Z = 1, V = 0, AND C = 0.
521 ;| THE REGISTERS ARE: R0 = 172400, R1 = 000000, R2 = 000000
522 ;| R3 = 000000, M4 = 052525, R5 = 125252, SP = 125252.
523 ;| UPON COMPLETION OF THIS TEST THE CONDITION CODES ARE:
524 ;| N = 0, Z = 1, V = 0, AND C = 0.
525 ;| THE REGISTERS THAT ARE MODIFIED ARE:
526 ;| R0 = 172300, M1 = 000000, R2 = 077406
527 ;| ALL KERNEL 1-SPACE P.D.R.'S (172300 = 172310) = 077406
528 ;|
529 ;|.....
530 TST22:
531 165450 012700 172320      MOV    #KIPDR7+2,R0  ;START WITH LAST "PDR"
532 165454 012701 000010      MOV    #00,R1        ;00 KIPDR7 THRU KIPDR0
533 165460 012702 077406      MOV    #077406,R2    ;PATTERN TO TEST "PDR'S"
534 165464 010240 15:        MOV    R2,-(R0)      ;LOAD "PDR" UNDER TEST
535 165466 021002          CMP    (R0),R2       ;SEE IF THE DATA LOADED IS CORRECT
536 165470 001401          BEQ    25           ;BRANCH IF THE DATA MATCHES
537 165472 000000          HALT                ;A "PDR" HAS FAILED
538                                     ;R0 WAS THE ADDRESS OF THE BAD "PDR"
539                                     ;R2 WAS THE EXPECTED DATA
540 165474 077105 25:        SOB    R1,15         ;LOOP UNTIL ALL EIGHT "PDR'S" HAVE BEEN
541                                     ;TESTED
542
543 ;|.....
544 ;.SBTTL TEST23 TEST "JSR", "RTS", "RTI", & "JMP"
545 ;|
546 ;| THIS TEST FIRST SETS THE STACK POINTER TO "KOPAR7" (172376),
547 ;| AND THEN VERIFIES THAT "JSR", "RTS", "RTI", AND "JMP"
548 ;| ALL WORK PROPERLY.
549 ;|
550 ;| ON ENTRY TO THIS TEST THE STACK POINTER "SP" IS INITIALIZED
551 ;| TO 172376 AND IS LEFT THAT WAY ON EXIT.
552 ;|
553 ;|.....
554 TST23:
555 165476 012700 172376      MOV    #KOPAR7,SP    ;SET UP THE STACK POINTER
556 165502 024767 000002      JSR    PC,15         ;TRY TO JSR TO 15
557 165506 000000 105:       HALT                ;THE "JSR" MUST HAVE FAILED
558 165510 022716 165506      15:   CMP    #105,(SP)   ;WAS THE CORRECT ADDRESS PUSHED?

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561	165514	0F1401			BEQ	2S		;BRANCH IF YES
562	165516	000000			HALT			;WRONG THING PUSHED ON STACK
563	165520	012716	165530	2S:	MOV	#3S,(SP)		;CHANGE THE ADDRESS ON THE STACK
564	165524	030207			RTS	PC		;TRY TO RETURN TO 3S
565	165526	000000			HALT			;DID NOT RETURN PROPERLY
566	165530	035046		3S:	CLR	-(SP)		;PUSH A ZERO ON THE STACK
567	165532	012746	165542		MOV	#4S,-(SP)		;PUSH THE RETURN ADDRESS ON STACK
568	165536	000002			RTI			;SEE IF AN "RTI" WORKS
569	165540	000000			HALT			;THE "RTI" FAILED
570	165542	020137	165550	4S:	JMP	005S		;TRY TO "JMP"
571	165546	000000			HALT			;THE "JMP" FAILED
572	165550			5S:				;ADDRESS TO "JMP" TO

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;| .SBTTL TEST24  LOAD AND TURN ON MEMORY MANAGEMENT AND THE UNIBUS MAP
;|
;| THIS TEST IS ONLY EXECUTED IF THE UPPER 4 BITS <15:12> OF
;| THE SWITCH REGISTER ARE NON-ZERO, THE TEST WILL LOAD MEMORY
;| MANAGEMENT TO RELOCATE TO THE 32K BLOCK NUMBER SPECIFIED,
;| IT WILL ALSO SET UP THE UNIBUS MAP REGISTERS 0 THRU 6 TO
;| RELOCATE THE UNIBUS ADDRESSES CORRECTLY. (IE, IF BITS <15:12>
;| SPECIFY BLOCK NUMBER 3, THEN YOU WANT TO BOOT INTO
;| MEMORY FROM 90K TO 120K, THE KIPAR'S WILL BE LOADED AS FOLLOWS:
;| KIPAR0 = 000000, KIPAR1 = 006200, KIPAR2 = 000400, KIPAR3 = 000000
;| KIPAR4 = 007000, KIPAR5 = 007200, KIPAR6 = 007400.)
;| KIPAR7 WILL ALWAYS EQUAL 177600,
;| THE UNIBUS MAP REGISTERS WILL THEN BE SET AS FOLLOWS:
;| MAPL0 = 000000, MAPH0 = 03, MAPL1 = 020000, MAPH1 = 03,
;| MAPL2 = 040000, MAPH2 = 03, MAPL3 = 060000, MAPH3 = 03,
;| MAPL4 = 100000, MAPH4 = 03, MAPL5 = 120000, MAPH5 = 03,
;| MAPL6 = 140000, MAPH6 = 03.
;|
;|-----|

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595 165550
596 165550 013702 177570
597 165554 001002
598 165556 013702 173024
599 165562 072227 177776
600 165566 042702 141777
601 165572 001433
602
603
604
605
606 165574 012700 172340
607 165600 012701 000007
608 165604 010220
609 165606 062702 0A0200
610 165612 077104
611 165614 012710 177600
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;|-----|
;| TST24:
;| MOV    #0SHR,R2      ;READ THE SWITCH REGISTER
;| BNE    10S          ;SKIP THE NEXT INSTRUCTION IF NOT ZERO
;| MOV    #0173024,R2   ;READ THE SWITCHES ON THE M9301
;| ASH    #2,R2        ;RIGHT SHIFT BITS <15:12> 2 PLACES
;| BIC    #0C030000,R2 ;LEAVE ONLY BITS <13:10> IN R2
;| BEQ    TST25        ;GO TO NEXT TEST IF R2 IS ZERO NOW
;|
;| THIS NEXT PORTION OF CODE WILL BE RUN ONLY IF YOU ARE
;| BOOTING INTO MEMORY OTHER THAN PHYSICAL 0 TO 20K.
;|
;| MOV    #KIPAR0,R0    ;ADDRESS OF FIRST "PAR" TO LOAD
;| MOV    #0D7,R1       ;LOAD KIPAR0 THRU KIPAR6
;| MOV    R2,(R0)+      ;LOAD THE KERNEL I-SPACE P.A.R.'S
;| ADD    #200,R2       ;MAKE R2 POINT TO NEXT 4K BLOCK
;| SOB    R1,1S        ;LOOP UNTIL KIPAR6 HAS BEEN LOADED
;| MOV    #177600,(R0)  ;MAP KIPAR7 TO I/O PAGE
;|
;| NOW LOAD THE UNIBUS MAP TO REFERENCE THE SAME MEMORY
;| AS MEMORY MANAGEMENT DOES,
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615                                     ;
616 165620 072227 177760                ASH    0=010,R2    ;RIGHT SHIFT R2 10 PLACES
617 165624 005003                       CLR    R3          ;START WITH R3 = 000000
618 165626 012700 170200                MOV    #MAPLR,R0   ;ADDRESS OF FIRST MAP REGISTER
619 165632 012701 030007                MOV    0'D,R1      ;PREPARE TO LOAD SEVEN MAP REGISTERS
620 165636 010320 28:                   MOV    R3,(R0)+    ;LOAD LOWER 16 BITS OF THE MAP REGISTER
621 165640 010220                       MOV    R2,(R0)+    ;LOAD UPPER 6 BITS OF THE MAP REGISTER
622 165642 062703 020000                ADD    #20000,R3   ;POINT TO THE NEXT 4K BLOCK
623 165646 077105                       SOB    R1,28      ;LOOP UNTIL SEVEN MAP REGS ARE LOADED
624
625 165650 012737 030060 172516         MOV    #00,0MMR3   ;ENABLE 22-BIT MAPPING AND UNIBUS MAP
626 165656 039237 177972                INC    0MMR0      ;TURN ON FULL RELOCATION
627
628
629                                     ;|.....
630                                     |.SBTTL TEST29 TEST MAIN MEMORY FROM VIRTUAL 1000 TO 20K
631                                     ;|
632                                     ;| THIS TEST WILL TEST MAIN MEMORY WITH THE CACHE DISABLED, FROM
633                                     ;| VIRTUAL ADDRESSES 001000 TO 197776, IF THE DATA DOES NOT COMPARE
634                                     ;| PROPERLY THE TEST WILL HALT AT EITHER 165740 OR 165796, IF A
635                                     ;| PARITY ERROR OCCURS THE TEST WILL HALT AT ADDRESS 165776, WITH
636                                     ;| THE PC + 2 ON THE STACK WHICH IS IN THE KERNEL D-SPACE P.A.R.'S.
637                                     ;|
638                                     ;| IN THIS TEST THE REGISTERS ARE INITIALIZED AS FOLLOWS:
639                                     ;| R0 = 001000, R1 = DATA READ, R2 = 067400, R3 = 001000
640                                     ;| R4 = 067400, R5 = 177746 (CONTROL REG.) SP = 172376
641                                     ;|
642                                     ;|.....
643 165662                                     TST25:
644 165662 010216                       MOV    R2,(SP)    ;SAVE R2 FOR THE UPPER SIX BITS
645                                     ;| OF THE MASS BUS DEVICE'S BUS ADDRESS
646                                     ;| IN ADDRESS 17772376 (KOPAR7)
647
648 165664 012737 165776 000114         MOV    #PARHLT,00114 ;SET UP PARITY VECTOR
649 165672 005037 000116                 CLR    00116      ;SET PROCESSOR STATUS WORD TO ZERO
650 165676 012705 177746                 MOV    #177746,R5 ;CACHE CONTROL REGISTER ADDRESS
651 165702 012715 000014                 MOV    #MISS,(R5) ;FORCE MISS BOTH GROUPS
652 165706 012702 067400                 MOV    #067400,R2 ;COUNT STORAGE
653 165712 012703 001000                 MOV    #1000,R3   ;FIRST ADDRESS STORAGE
654 165716 010204                       MOV    R2,R4      ;SETUP COUNTER
655 165720 010300                       MOV    R3,R0      ;SETUP FIRST ADDRESS
656 165722 010020 18:                   MOV    R0,(R0)+   ;LOAD EACH ADDRESS WITH ITS
657                                     ;| OWN ADDRESS
658 165724 077402                       SOB    R4,18      ;LOOP UNTIL DONE
659 165726 010204                       MOV    R2,R4      ;SETUP COUNTER AND FIRST ADDRESS
660 165730 010300                       MOV    R3,R0      ;SET STARTING ADDRESS IN R0
661 165732 011001 28:                   MOV    (R0),R1    ;GET THE DATA
662 165734 020001                       CMP    R0,R1      ;IS IT CORRECT?
663 165736 001401                       BEQ    35         ;BRANCH IF YES
664 165740 000000                       HALT              ;R0=ADDRESS, R1=DATA
665 165742 039120 38:                   COM    (R0)+      ;COMPLEMENT DATA AND INCREMENT ADDRESS
666 165744 077406                       SOB    R4,28      ;LOOP UNTIL DONE
667 165746 014001 48:                   MOV    -(R0),R1   ;READ THE DATA (IT SHOULD NOW BE THE
668                                     ;| COMPLEMENT OF THE ADDRESS)

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669	165750	005101			COM	R1		;COMPLEMENT BEFORE CHECKING
670	165752	020001			CMP	R0,R1		;IS THE DATA CORRECT?
671	165754	001401			BEQ	SS		;BRANCH IF YES
672	165756	000000			HALT			;R0=ADDRESS R1=-DATA
673	165760	077206			SOB	R2,4S		;LOOP UNTIL DONE
674	165762	012737	173762	000114	MOV	@CONT,@0114		;SET PARITY VECTOR TO CODE THAT
675								;WILL TRY TO CONTINUE AND BOOT
676								;IF THE CACHE FAILS,
677	165770	005046			CLR	-(SP)		;SET THE CYCLE FLAG TO ZERO
678	165772	000137	173636		JMP	@TST26		;JUMP TO SECOND HALF OF THE ROM
679	165776	000000			PAEHLT: HALT			;HALTING HERE MEANS A PARITY ERROR
680								


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735
736          .SBTTL THIS IS THE START OF THE TM11/TU10 BOOT STRAP (MAGNETIC TAPE, TM11)
737          ;COMMAND REGISTER ADDRESS IS 172922
738
739 173070 010211 TU10: MOV R2,(R1) ;LOAD UNIT NUMBER INTO C.S.R.
740 173072 000743 BR WAIT ;GO WAIT FOR SELECTED DRIVE TO COME ONLINE
741 173074 052311 TU102: BIS (R3)+,(R1) ;'ON' REWIND COMMAND INTO C.S.R.
742 ;THIS COMMAND ALSO SETS 000 BPI 9 CHAN.
743 173076 105711 1S: TSTB (R1) ;SEE IF THE REWIND IS COMPLETE
744 173100 100376 BPL 15 ;WAIT FOR BIT 07 OF C.S.R. TO BE SET
745 173102 012761 177777 000002 MOV #=1,2(R1) ;SET RECORD COUNTER TO SKIP ONE RECORD
746 173110 112311 MOVB (R3)+,(R1) ;LOAD SPACE FORWARD COMMAND INTO C.S.R.
747 173112 105711 2S: TSTB (R1) ;SEE IF THE SPACE IS COMPLETE
748 173114 100376 BPL 25 ;WAIT FOR BIT 07 OF C.S.R. TO BE SET
749 173116 005711 TST (R1) ;CHECK THE ERROR FLAG FOR THE TM11/TU10
750 173120 100563 BMI AGAIN ;RE-TRY BOOT IF THERE WAS AN ERROR
751 173122 000417 BR CMNSGO ;BRANCH TO COMMON READ CODE IF NO ERRORS
752
753
754          .SBTTL THIS IS THE START OF THE TC11/TU96 BOOT STRAP (DECTAPE, TC11-G)
755          ;COMMAND REGISTER ADDRESS IS 177342
756
757 173124 010211 TU96: MOV R2,(R1) ;LOAD UNIT NUMBER INTO C.S.R.
758 173126 052311 BIS (R3)+,(R1) ;'ON' REWIND COMMAND INTO C.S.R.
759 173130 005711 1S: TST (R1) ;SEE IF ERROR BIT IS SET
760 173132 100376 BPL 15 ;WAIT UNTIL BIT 15 OF C.S.R. IS SET
761 173134 005761 177776 TST -2(R1) ;IS THE ERROR 'END ZONE'
762 173140 100153 BPL AGAIN ;BRANCH IF NOT 'END ZONE'
763 173142 010211 MOV R2,(R1) ;RE-LOAD DRIVE NUMBER AND CLEAR REVERSE BIT
764 173144 000406 BR CMNSGO ;BRANCH TO COMMON READ CODE
765
766
767          .SBTTL THIS IS THE START OF THE RK11/RK05 BOOT STRAP (DECPACK DISK CARTRIDGE, RK11-0)
768          ;COMMAND REGISTER ADDRESS IS 177404
769
770 173146 072227 000005 RK05: ASH #5,R2 ;LEFT SHIFT UNIT NUMBER 5 PLACES
771 173152 010261 000000 MOV R2,6(R1) ;LOAD UNIT NUMBER INTO DEVICE
772 173156 000401 BR CMNSGO ;BRANCH TO COMMON READ CODE
773
774
775          .SBTTL THIS IS THE START OF THE RP11/RP03 BOOT STRAP (DISK PACK, RP11-C)
776          ;COMMAND REGISTER ADDRESS IS 176714
777
778 173160 010211 RP03: MOV R2,(R1) ;LOAD THE UNIT NUMBER INTO THE COMMAND REG.
779
780          .SBTTL THIS IS THE START OF THE COMMON READ CODE
781
782 173162 012761 177000 000002 CMNSGO: MOV #=512,,2(R1) ;LOAD WORD COUNT OF 512 WORDS
783 173170 111311 MOVB (R3),(R1) ;LOAD READ FUNCTION INTO C.S.R.
784 173172 105711 1S: TSTB (R1) ;SEE IF FUNCTION IS COMPLETE
785 173174 100376 BPL 15 ;WAIT UNTIL BIT 07 OF C.S.R. IS SET
786 173176 005711 TST (R1) ;WERE THERE ANY ERRORS ON THE TRANSFER
787 173200 100007 BPL 25 ;IF NO ERRORS BRANCH TO SEC. BOOT
788 173202 022704 000012 CMP #12,R4 ;IS THIS THE RH70/TU107
    
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789 173206 001130      BNE      AGAIN      ;BRANCH IF NOT TO TRY AGAIN
790 173210 022701 001000 000014    CMP      @FCE,14(R1) ;MAY ERROR A FRAME COUNT ERROR?
791 173216 001124      BNE      AGAIN      ;BRANCH IF NOT TO TRY AGAIN
792 173220 005011      CLR      (R1)        ;CLEAR COMMAND REGISTER THIS WILL STOP
793                                ;THE DECTAPE MOTION IF DEVICE WAS TU56
794 173222 005007      CLR      PC         ;START SECONDARY BOOT AT VIRTUAL ZERO
795
796 173224 165000      .WORD   165000      ;VECTOR TO THE START OF M9301 BOOTSTRAP
797 173226 000340      .WORD   000340      ;PROCESSOR STATUS TO ASSUME AT BOOT TIME
798
799
800                                .SBTTL  THIS IS THE START OF THE RM70/TU16 BOOT STRAP (MAGNETIC TAPE SYSTEM, TU16)
801                                ;COMMAND REGISTER ADDRESS IS 172440
802
803 173230 010002      TU16:  MOV      R0,R2      ;COPY UNIT NUMBER INTO R2
804 173232 022702 001300      BIS      @01300,R2  ;ON: 000 BPI & FORMAT, WITH SLAVE NUMBER
805 173236 010201 000032      MOV      R2,J2(R1)  ;LOAD UNIT NUMBER
806 173242 032701 010000 000012 1S:  BIT      @MOL,12(R1) ;IS THE MEDIUM ON LINE
807 173250 001774      BEQ      1S        ;WAIT FOR BIT 12 OF DRIVE STATUS REG
808 173252 112311      MOVB    (R3)+,(R1)  ;ISSUE REWIND COMMAND
809 173254 105701 000012 2S:  TSTB    12(R1)     ;IS DRIVE READY BIT SET YET?
810 173260 100375      BPL      2S        ;WAIT FOR DRIVE READY BIT
811 173262 112311      MOVB    (R3)+,(R1)  ;ISSUE DRIVE CLEAR COMMAND
812 173264 105701 000012 3S:  TSTB    12(R1)     ;IS DRIVE READY BIT SET?
813 173270 100375      BPL      3S        ;WAIT UNTIL BIT 07 IS SET
814 173272 012701 177777 000006      MOV      @=1,6(R1) ;SET SKIP COUNT TO 1 RECORD
815 173300 112311      MOVB    (R3)+,(R1)  ;ISSUE SPACE FORWARD COMMAND
816 173302 105701 000012 4S:  TSTB    12(R1)     ;HAS THE DRIVE FINISHED THE SPACE?
817 173306 100375      BPL      4S        ;WAIT UNTIL BIT 07 IS SET
818 173310 011601 000034      MOV      (@P),J4(R1) ;LOAD UPPER 6 BITS OF BUS ADDRESS
819 173314 000415      BR      CMNSRM     ;GO JOIN COMMON RM70 CODE
820
821
822                                .SBTTL  THIS IS THE START OF THE RM70/RP04 BOOT STRAP (DISK PACK, RP04)
823                                ;COMMAND REGISTER ADDRESS IS 176700
824
825 173316 110001 000010      RP04:  MOVB    R0,10(R1) ;SELECT UNIT NUMBER TO BOOT FROM
826 173322 112311      MOVB    (R3)+,(R1)  ;ISSUE READ-IN PRESET COMMAND
827 173324 012701 014000 000032      MOV      @14000,J2(R1) ;SET FMT22 & ECC INHIBIT BITS
828 173332 011601 000050      MOV      (@P),J0(R1) ;LOAD UPPER 6 BITS OF BUS ADDRESS
829 173336 000404      BR      CMNSRM     ;GO JOIN THE COMMON RM70 CODE
830
831
832                                .SBTTL  THIS IS THE START OF THE RM70/R004 BOOT STRAP (FIXED HEAD DISK, R004)
833                                ;COMMAND REGISTER ADDRESS IS 172040
834
835 173340 110001 000010      R004:  MOVB    R0,10(R1) ;LOAD THE DRIVE NUMBER TO BOOT FROM
836 173344 011601 000030      MOV      (@P),J0(R1) ;LOAD UPPER 6 BITS OF BUS ADDRESS
837
838
839                                .SBTTL  THIS IS THE START OF THE COMMON RM=70 CODE
840
841 173350 016101 000010 000016  CMNSRM: MOV      10(R1),10(R1) ;TURN OFF ANY ACTIVE ATTENTION FLAGS
842 173356 000701      BR      CMNSGO     ;BRANCH TO COMMON READ CODE
    
```


THIS IS THE START RESERVED FOR A FUTURE DEVICE

		.SBTTL FUNCTION CODES FOR THE ALL OF THE DEVICES		
886				
887				
888				
889	173476	060017	TU10S: .WORD	000017
890	173500	011	.BYTE	011
891	173501	003	.BYTE	003
892				
893	173502	004003	TU56S: .WORD	004003
894	173504		RK05S: .BYTE	005
895	173504	005	RP03S: .BYTE	005
896				
897	173505	007	TU16S: .BYTE	007
898	173506	011	.BYTE	011
899	173507	031	.BYTE	031
900	173510	071	.BYTE	071
921				
902	173511	021	RP04S: .BYTE	021
923	173512	071	RS04S: .BYTE	071
904				
925	173513	007	RX01S: .BYTE	007
926	173514	027	.BYTE	027
907				
928	173515	000	FUTDES: .BYTE	0
909	173516	000000	.WORD	0
910				

:REWINO SELECTED DRIVE AND SET 000 MPI
 :SPACE FORWARD COMMAND FOR TU10
 :READ COMMAND FOR TU10
 :SEARCH FOR BLOCK 0, REVERSE DIRECTION
 :READ COMMAND FOR TU50, RK05, RP03
 :REWINO SELECTED DRIVE
 :DRIVE CLEAR COMMAND
 :SPACE FORWARD
 :READ FORWARD
 :READ-IN PRESET
 :READ COMMAND FOR RP04 & RS04
 :READ SECTOR COMMAND FOR DRIVE ZERO
 :READ SECTOR COMMAND FOR DRIVE ONE
 :SPACE FOR FUTURE DEVICE COMMAND
 :SPACE FOR MORE COMMANDS

M

911					
912			.SBTTL	COMMAND AND STATUS REGISTER ADDRESS TABLE	
913					
914	173520	172522	CSRPTR:	.WORD 172522	; THIS IS THE C.S.R. ADDRESS FOR TU10
915	173522	177342		.WORD 177342	; THIS IS THE C.S.R. ADDRESS FOR THE TU56
916	173524	177404		.WORD 177404	; THIS IS THE C.S.R. ADDRESS FOR THE RK05
917	173526	176714		.WORD 176714	; THIS IS THE C.S.R. ADDRESS FOR THE RP03
918	173530	172000		.WORD 2	; THIS IS THE C.S.R. ADDRESS OF A FUTURE DEVICE
919	173532	172440		.WORD 172440	; THIS IS THE C.S.R. ADDRESS FOR THE RH70/TU10
920	173534	176700		.WORD 176700	; THIS IS THE C.S.R. ADDRESS FOR THE RH70/RP04
921	173536	172040		.WORD 172040	; THIS IS THE C.S.R. ADDRESS FOR THE RH70/R504
922	173540	177170		.WORD 177170	; THIS IS THE C.S.R. ADDRESS FOR RX11/RX01
923					
924			.SBTTL	FUNCTION POINTER TABLE	
925					
926	173542	173476	CMOPTR:	.WORD TU10S	; POINTER TO FUNCTION TABLE FOR THE TU10
927	173544	173502		.WORD TU56S	; POINTER TO FUNCTION TABLE FOR THE TU56
928	173546	173504		.WORD RK05S	; POINTER TO FUNCTION TABLE FOR THE RK05
929	173550	173504		.WORD RP03S	; POINTER TO FUNCTION TABLE FOR THE RP03
930	173552	173510		.WORD FUTDES	; POINTER TO FUNCTION TABLE FOR A FUTURE DEVICE
931	173554	173500		.WORD TU10S	; POINTER TO FUNCTION TABLE FOR THE RH70/TU10
932	173556	173511		.WORD RP04S	; POINTER TO FUNCTION TABLE FOR THE RH70/RP04
933	173560	173512		.WORD R504S	; POINTER TO FUNCTION TABLE FOR THE RH70/R504
934	173562	173513		.WORD RX01S	; POINTER TO FUNCTION TABLE FOR THE RX01
935					
936			.SBTTL	STARTING ADDRESS TABLE	
937					
938	173564	173070	ADDRS:	.WORD TU10	; STARTING ADDRESS FOR THE TM11/TJ10
939	173566	173124		.WORD TU56	; STARTING ADDRESS FOR THE TC11/TU56
940	173570	173146		.WORD RK05	; STARTING ADDRESS FOR THE RK11/RK05
941	173572	173160		.WORD RP03	; STARTING ADDRESS FOR THE RP11/RP03
942	173574	173452		.WORD FUTJEV	; STARTING ADDRESS FOR A FUTURE DEVICE
943	173576	173230		.WORD TU10	; STARTING ADDRESS FOR THE RH70/TU10
944	173600	173310		.WORD RP04	; STARTING ADDRESS FOR THE RH70/RP04
945	173602	173342		.WORD R504	; STARTING ADDRESS FOR THE RH70/R504
946	173604	173362		.WORD RX01	; STARTING ADDRESS FOR THE RX11/RX01
947					

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173606

.SBTTL CACHE MEMORY DIAGNOSTIC TESTS

```

;VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVV
;VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVV
;
; THE FOLLOWING TWO TESTS ARE CACHE MEMORY TESTS, IF EITHER OF
; THEM FAILS TO RUN SUCCESSFULLY THEY WILL COME TO A HALT
; IN THE M9301 ROM. IF YOU DESIRE TO TRY TO BOOT YOUR SYSTEM, OR
; DIAGNOSTIC ANYWAY, YOU CAN PRESS "CONTINUE" AND THE PROGRAM
; WILL FORCE MISSES IN BOTH GROUPS OF THE CACHE AND GO TO THE
; BOOT STRAP THAT HAS BEEN SELECTED.
;
;.....
;.....
    
```

. = BASE2 + 606

.SBTTL TEST20 TEST CACHE DATA MEMORY

```

;
; THIS TEST WILL CHECK THE DATA MEMORY IN THE CACHE, FIRST GROUP
; 0 AND THEN GROUP 1. IT LOADS 052525 INTO AN ADDRESS COMPLEMENTS
; IT TWICE AND THEN READS THE DATA, THEN IT CHECKS TO INSURE THAT
; THE DATA WAS A HIT. THEN THE SEQUENCE IS REPEATED ON THE SAME
; ADDRESS WITH 125252 AS THE DATA. ALL CACHE MEMORY DATA LOCATIONS
; ARE TESTED IN THIS WAY.
; IF EITHER GROUP FAILS AND THE OPERATOR PRESSED CONTINUE THE
; PROGRAM WILL TRY TO BOOT WITH THE CACHE DISABLED.
    
```

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; THE REGISTERS ARE INITIALIZED AS FOLLOWS FOR THIS TEST:
; R0 = 1000 (ADDRESS) R1 = 2 (COUNT), R2 = 1000 (COUNT)
; R3 = 1000 (COUNT), R4 = 125252 (PATTERN) R5 = 177746 (CONTROL REG)
; SP = 172374 (FLAG OF ZERO PUSHED ON STACK)
;.....
    
```

TST26:

173606 012704 125252
173606 012715 000030
173612 010302
173616 010200
173620 012701 000002
173622 005104
173626 010410
173630 005110
173632 005110
173634 021004
173636 001401
173640 000000
173642 006037 177752
173644 103402
173650 000000
173652 000444
173654 077115

```

MOV      #125252,R4      ;SET UP R4 FOR THIS TEST
MOV      @RPS,(R5)      ;FORCE REPLACE GROUP 0 AND FORCE MISS GROUP 1
15:     MOV      R3,R2    ;SET COUNT TO CONTENTS OF R3
MOV      R2,R0          ;SET STARTING ADDRESS INTO R0
25:     MOV      @2,R1    ;USE 2 PATTERNS IN DATA MEMORY
35:     COM      R4       ;COMPLEMENT DATA IN R4
MOV      R4,(R0)        ;WRITE THE TEST PATTERN
COM      (R0)           ;DOUBLE COMPLEMENT DATA AND
COM      (R0)           ;MAKE SURE DATA IS IN THE CACHE
CMP      (R0),R4        ;COMPARE DATA & SET BIT 0 IN HIT/MISS REG.
BEQ      55            ;BRANCH IF DATA MATCHES
HALT     ;DATA DIDN'T MATCH R0 = ADDRESS
55:     ROR      @0177/52 ;WAS THE LAST MEMORY REFERENCE A HIT?
BCS      45            ;BRANCH IF YES
HALT     ;CACHE FAILED TO HIT R0 = ADDRESS
OR       BOOTMISS     ;ABORT REST OF TEST IF "CONTINUE" PRESSED
45:     SOB      R1,35    ;GO BACK ONE TIME TO TRY COMPLEMENT DATA
    
```

```

1002 173660 005720          TST      (R0)+      ;MOVE TO NEXT ADDRESS
1003 173662 077221          SOB      R2,25      ;BRANCH IF NOT DONE
1004 173664 012715 000044  MOV      @GRP1,(R5) ;FORCE REPLACE GROUP 1 AND FORCE MISS GROUP 0
1005 173670 005116          COM      (SP)      ;COMPLEMENT THE CYCLE FLAG
1006 173672 001351          BNE     15         ;LOOP IF NOT DONE
1007
1008
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1028 173674
1029 173674 012702 067400      TST27:
1030 173700 010300          MOV      @07400,R2 ;COUNT STORAGE (20K = 1000 BYTES)
1031 173702 010204          MOV      R3,R0     ;FIRST ADDRESS IS 1000 OCTAL
1032 173704 010020          MOV      R2,R4     ;SETUP COUNTER
1033 173706 077402          15:     MOV      R0,(R0)+ ;FILL MEMORY WITH ADDRESSES
1034 173710 012716 000030  SOB      R4,15     ;LOOP UNTIL DONE
1035 173714 012701 000003  MOV      @GRP0,(SP) ;LOAD CODE TO FORCE GROUP 0 ONTO STACK
1036 173720 010300          MOV      @3,R1     ;SET PASS COUNT TO THREE
1037 173722 010204          25:     MOV      R3,R0     ;FIRST ADDRESS
1038 173724 005110          MOV      R2,R4     ;COUNTER
1039 173726 005110          35:     COM      (R0)   ;DOUBLE COMPLEMENT DATA AND
1040 173730 020020          COM      (R0)     ;MAKE SURE IT IS IN THE CACHE,
1041                                CMP      R0,(R0)+  ;COMPARE DATA, AND SET BIT 0 IN HIT/MISS REG
1042                                ;ALSO POINT TO NEXT ADDRESS
1042 173732 001401          BEQ     55         ;BRANCH IF DATA MATCHES
1043 173734 000000          HALT
1044 173736 006037 177752  55:     ROR      @017752 ;DATA DIDN'T MATCH R0 = ADDRESS + 2
1045 173742 103402          BCS     45         ;WAS THE LAST MEMORY REFERENCE A HIT?
1046 173744 000000          HALT
1047 173746 000407          BR      @00THISS ;BRANCH IF YES
1048 173750 077413          ;HIT FAILED TO OCCUR R0 = ADDRESS + 2
1049 173752 011615          ;ABORT REST OF TEST IF "CONTINUE" PRESSED
1050                                ;LOOP UNTIL DONE
1051                                ;FORCE MISS GRP1 ON PASS 2, FULLY
1051 173754 005016          ;ENABLE CACHE ON PASS THREE.
1052 173756 077120          CLR     (SP)      ;GET READY TO FULLY ENABLE CACHE ON PASS 3
1053 173760 000404          SOB     R1,25     ;RUN THREE PASSES THRU THIS TEST
1054                                ;GO TO BOOT STRAP CODE
1055

```

1056	173762	000000		CONT:	HALT				
1057	173764	022020			CMR	(SP)+,(SP)+			,STOP HERE IF THERE IS A CACHE ERROR
1058	173766			BOOTMISS:					,ADJUST STACK POINTER AFTER ABORT
1059	173766	012715	000014		MOV	0MISS,(M5)			;FORCE MISSES IN BOTH GROUPS OF CACHE
1060	173772	005720		JUMP:	TST	(SP)+			,POINT TO UPPER SIX BITS OF BUS ADDRESS
1061									;THAT DATA IS IN ADDRESS 1772376 (KUPAR7)
1062	173774	000137	173000		JMP	000001			,GO TO BOOT STRAP ENTRY POINT
1063									
1064									
1065		000001							
				.END					

R1	=XJ00001	994	1002	1030	1032	1036	1038	1039	1040					
		244	245	251	295	337	300	301	302	303	306	309	411	412
		416	437	441	442	446	405	467	471	473	479	496	911	932
		540	007	610	619	623	661	662	667	669	678	709	751	739
		741	743	745	746	747	749	757	758	759	761	763	771	778
		782	783	784	786	790	792	805	806	808	809	811	812	814
		815	816	818	825	826	827	828	835	836	841	851	853	855
		857	859	862	863	865	909	1001	1039	1052				
R2	=XJ00002	245	246	438	443	533	534	535	596	598	599	600	600	609
		616	621	644	652	654	659	673	729	738	739	757	763	778
		771	778	803	804	805	854	858	865	866	907	908	1003	1029
R3	=XC00003	1031	1037											
		246	247	292	293	294	295	316	317	318	617	628	622	653
		655	668	732	741	746	758	783	808	811	815	826	858	853
		987	1030	1036										
R4	=XJ00004	247	248	315	316	303	498	499	504	654	658	659	666	724
		725	726	727	731	732	733	788	905	998	991	994	1031	1033
R5	=X000005	1037	1048											
		248	249	317	306	308	309	497	502	507	509	650	651	906
		1004	1049	1059										
SP	=XJ00006	139	168	182	242	243	557	560	563	566	567	644	677	818
		828	836	1005	1034	1049	1051	1057	1060					
START	173014	705	716											
SWR	= 177572	10	596	716										
TST1	165000	125												
TST10	165134	253	270											
TST11	165146	273	298											
TST12	165166	297	314											
TST13	165204	320	336											
TST14	165214	339	356											
TST15	165236	364	381											
TST16	165260	392	406											
TST17	165312	417	435											
TST2	165004	126	137											
TST20	165346	448	464											
TST21	165374	476	494											
TST22	165450	512	530											
TST23	165476	555												
TST24	165550	595	604											
TST25	165662	681	643											
TST26	173606	678	904											
TST27	173674	1028												
TST3	165020	143	159											
TST4	165036	165	181											
TST5	165052	186	201											
TST6	165066	206	221											
TST7	165076	224	241											
TUR	= 000001	10	709											
TU10	173070	739	938											
TU105	173476	889	920											
TU102	173074	711	741											
TU16	173230	803	943											
TU165	173509	897	951											
TU56	173124	757	939											

TU56S	173502	8930	927											
WAIT	173002	7090	710	740										
STN	= 000030	10	117	1260	129	1300	143	146	1600	165	168	1820	186	189
		2020	206	209	2220	224	227	2420	253	256	2710	273	276	2910
		297	300	3150	320	323	3370	339	342	3570	364	367	3820	390
		393	4070	417	420	4360	440	451	4600	476	479	4950	512	516
		5310	544	5560	575	5960	601	629	6440	966	9850	1000	10290	
	= 174000	1160	7040	9640										

COMMEN	10	77	100	003	951										
ENDCOM	10	96	112	700	961										
MSG1	1170	119													
MSG10	2560	250													
MSG11	2760	270													
MSG12	3000	302													
MSG13	3230	325													
MSG14	3420	344													
MSG15	3670	369													
MSG16	3930	395													
MSG17	4200	422													
MSG2	1290	131													
MSG20	4510	453													
MSG21	4790	481													
MSG22	5160	510													
MSG23	5440	546													
MSG24	5750	577													
MSG25	6290	631													
MSG26	9660	968													
MSG27	10000	1010													
MSG3	1460	148													
MSG4	1600	170													
MSG5	1890	191													
MSG6	2090	211													
MSG7	2270	229													
NXTTST	10	117	129	146	160	189	209	227	256	270	300	323	342	367	393
	420	451	479	516	544	575	629	966	1000						
SKIP	10	126	143	165	186	206	224	253	273	297	320	339	364	390	417
	448	476	512	601											
STARS	10	117	124	129	136	146	158	168	180	189	200	209	220	227	240
	256	269	276	289	300	313	323	335	342	359	367	380	393	405	420
	434	451	463	479	493	516	529	544	554	575	594	629	642	966	983
	1000	1027													
\$\$\$XT	10	117	129	146	160	189	209	227	256	270	300	323	342	367	393
	420	451	479	516	544	575	629	966	1000						
\$\$\$SKIP	10	126	143	165	186	206	224	253	273	297	320	339	364	390	417
	448	476	512	601											

ADC	382	440	442												
ADD	292	295	317	361	446	689	622								
ASH	465	473	599	616	726	770									
ASL	441														
ASR	439	723													
BCC	272														
BCS	296	998	1045												
BEQ	162	253	390	417	476	536	561	601	603	671	710	807	849	892	860
	995	1042													
BGE	163	320	363												
BGT	164	224	362	387	448										
BHI	142	185	283												
BHIS	184														
BIC	360	600	725	728	848										
BIS	316	741	758	804											
BIT	386	789	806	859											
BITB	851														
BLE	165	223	297	364	447										
BLO	319														
BLOS	143	286	338	358											
BLT	285	252	273	339											
BMI	140	469	750	861											
BNE	186	384	415	508	583	585	588	518	547	717	789	791	1006		
BPL	161	488	744	748	768	762	785	787	818	813	817	856	864	867	
BR	126	512	785	711	748	751	764	772	819	829	842	1008	1047	1053	
BVC	183														
BVS	141														
CLR	139	411	566	617	649	677	742	744	808	1051					
CLZ	222														
CMP	383	499	535	588	662	678	788	748	994	1048	1057				
CMPB	582	584	587	589											
COM	294	357	388	497	665	669	998	992	943	1005	1038	1039			
COMB	581	586													
DEC	168	337													
HALT	127	144	166	187	287	225	254	274	248	321	348	359	365	341	489
	418	449	470	477	513	537	559	562	565	569	571	664	672	674	874
	996	999	1043	1046	1056										
INC	293	318	412	457	475	626	858								
JMP	578	678	733	884	1062										
JSR	558														
MOV	242	243	244	245	246	247	248	249	436	438	495	496	498	931	932
	533	534	557	563	567	596	598	686	687	688	611	618	619	628	621
	625	644	648	658	651	652	653	654	655	656	659	668	661	667	674
	719	724	729	731	732	739	745	757	763	771	778	782	883	885	814
	818	827	828	836	841	854	985	986	987	988	989	991	1004	1029	1038
	1031	1032	1034	1035	1036	1037	1049	1059							
MOVB	487	716	746	783	888	811	815	825	826	835	853	857	862	865	
RESET	883														
ROL	271														
ROR	182	315	997	1044											
RTI	568														
RTS	564														
SEN	284														
SEZ	282														

I2

SDB	410	413	443	911	540	610	623	658	666	673	858	1001	1003	1033	1040
	1052														
SUB	251	389													
SWAB	471	730													
TST	414	416	727	749	759	761	786	1002	1003						
TSTB	467	743	747	784	809	812	816	855	863	866					
.BYTE	890	891	895	897	898	899	900	902	903	905	906	908			
.DSABL	1														
.ENABL	1														
.END	1065														
.ENDC	110	125	127	130	137	144	147	159	166	169	181	187	190	201	207
	210	221	225	228	241	254	257	270	274	277	290	290	301	314	321
	324	336	340	343	356	365	368	381	391	394	406	410	421	439	449
	452	464	477	480	494	513	517	530	545	555	576	595	602	630	643
	967	984	1009	1020											
.EQUIV	1														
.IF	117	124	126	129	136	143	146	158	165	168	180	186	189	200	206
	209	220	224	227	240	253	256	269	273	276	289	297	300	313	320
	323	335	339	342	355	364	367	380	390	393	405	417	420	434	440
	451	463	476	479	493	512	516	529	544	554	575	594	601	629	642
	966	983	1008	1027											
.IFF	117	124	126	129	136	143	146	158	165	168	180	186	189	200	206
	209	220	224	227	240	253	256	269	273	276	289	297	300	313	320
	323	335	339	342	355	364	367	380	390	393	405	417	420	434	440
	451	463	476	479	493	512	516	529	544	554	575	594	601	629	642
	966	983	1008	1027											
.IIF	117	118	119	124	129	130	131	136	146	147	148	150	160	169	170
	180	189	190	191	200	209	210	211	220	227	228	229	240	250	257
	258	269	276	277	278	289	300	301	302	313	323	324	325	339	342
	343	344	355	367	368	369	380	393	394	395	405	420	421	422	434
	451	452	453	463	479	480	481	493	516	517	518	529	544	545	546
	554	575	576	577	594	629	630	631	642	666	667	668	683	1000	1009
	1010	1027													
.LIST	1	77	96	100	112	117	126	129	130	146	160	160	182	189	202
	209	222	227	242	256	271	276	291	300	319	323	337	342	357	367
	382	393	407	420	436	451	465	479	495	516	531	544	556	575	596
	629	644	683	700	951	961	966	985	1000	1020					
.MACRO	1	117	129	146	160	189	209	227	256	276	300	323	342	367	393
	420	451	479	516	544	575	629	666	1000						
.NLIST	1	77	96	100	112	117	126	129	130	146	160	160	182	189	202
	209	222	227	242	256	271	276	291	300	319	323	337	342	357	367
	382	393	407	420	436	451	465	479	495	516	531	544	556	575	596
	629	644	683	700	951	961	966	985	1000	1020					
.PAGE	1	21	75	801	806	911	940								
.REPT	77	96	100	112	683	700	875	951	961						
.SBTYL	110	130	147	169	190	210	220	257	277	301	324	343	360	394	421
	452	480	517	545	576	630	682	707	714	736	754	767	775	780	800
	822	832	839	845	872	887	912	924	936	949	967	1009			
.TITLE	13														
.WORD	250	722	796	797	875	876	877	878	879	880	889	893	909	914	915
	916	917	918	919	920	921	922	926	927	928	929	930	931	932	933
	934	938	939	940	941	942	943	944	945	946					

ERRORS DETECTED: 0

*DEKBHA,DEKBHA,LIS/SOL/CRF*DEKBHA.P11
RUN-TIME: 10 15 2 SECONDS
CORE USED: 9K