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IDENTIFICATION

PRODUCT CODE: MAINDEC-11-DØRA

PRODUCT NAME: PDP-11 POWER FAIL

DATE: MARCH 14, 1970

MAINTAINER: DIAGNOSTIC GROUP

AUTHOR: EARL HAIGHT

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1. ABSTRACT

THE PDP-11 POWER FAIL DIAGNOSTIC CONSIST OF TWO PARTS, ONE OF WHICH IS A EXERCISER TEST WHICH CHECK ALL FACETS OF POWER FAIL. (REF SEC. 5.2)

PART TWO IS MADE UP OF SEVERAL SMALL TESTS WHICH ENABLE THE USER TO TROUBLE-SHOOT THE POWER FAIL MODULE WITH SMALL BASIC ROUTINES. (REF. SEC. 5.2)

2. REQUIREMENTS

2.1 EQUIPMENT

PDP-11/20 STANDARD COMPUTER
(MACHINE MAY HAVE UP TO 32K OF MEMORY)

2.2 STORAGE

2.2.1 THE MAIN BODY OF THE PROGRAM OCCUPIES FROM LOCATION 0 TO 3066

2.2.2 THE POWER FAIL EXERCISER USES ALL OF MEMORY UP TO THE LOADERS. FOR A MEMORY VOLATILITY TEST

3. LOADING PROCEDURE

3.1 METHOD

PROCEDURE FOR NORMAL ABSOLUTE TAPES SHOULD BE FOLLOWED.

4. STARTING PROCEDURE

4.1 CONTROL SWITCH SETTING

SR15 SET ALLOWS OPERATOR TO LOOP ON DIAGNOSTIC ROUTINES. DIAGNOSTIC WILL STILL HALT ON ERROR, BUT WILL NOT HALT AT THE END OF EACH PASS OF THE DIAGNOSTIC ROUTINE. WHEN SWITCH IS SET.

4.2 STARTING ADDRESS OR ADDRESSES

4.2.1 EXERCISER TEST

SR=200 IS THE STARTING ADDRESS OF THE POWER FAIL EXERCISER.

4.2.2 DIAGNOSTIC TESTS

SR=204 TEST POWER FAIL TRAP CAPABILITY

SR=210 TEST POWER FAIL RE-START CAPABILITY (USING WAIT INSTRUCTION)

SR=214 TEST POWER FAIL RE-START CAPABILITY (USING BR. INSTRUCTION)

SR=220 TEST POWER FAIL RE-START CAPABILITY (USING EMT INSTRUCTION)

SR=224 TEST 2MILLI SEC. SHUT DOWN CAPABILITY OF POWER FAIL

SR=230 TEST 2 MILLI SEC. UP TIME OF POWER FAIL.

4.3 PROGRAM AND/OR OPERATOR ACTION

THE OPERATOR HAS A LARGE PART IN THIS TEST. IT IS HIS RESPONSIABILITY TO GENERATE A POWER FAIL CONDITION. A POWER FAIL MAY BE GENERATED BY EITHER OF THE FOLLOWING WAYS.

STEP#1. TURN CONSOLE KEY OFF AND ON SEVERAL TIMES.

STEP#2. UN-PLUG THE AC LINE TO THE PROCESSOR (IN-HOUSE THIS MAY BE DONE WITH A POWER INTERRUPTER)

5. ROUTINE ABSTRACTS

5.1 MASTER EXERCISER TEST

THIS ROUTINE INCORPORATES A MEMORY VOLATILITY TEST WHILE WAITING FOR A POWER FAILURE. THE ROUTINE FIRST DETERMINES THE AMOUNT OF MEMORY ON THE SYSTEM AND THEN FILLS THAT MEMORY WITH A 152525 PATTERN. THE ROUTINE THEN CHECKS MEMORY FOR THE CORRECT DATA. IF A POWER FAILURE OCCURS THE ROUTINE WILL STORE ALL OF THE ACTIVE REGISTERS AND WAIT FOR 2 MILLISECONDS AND HALT. THE ROUTINE ON RESTART RESTORES THE ACTIVE REGISTERS AND WAITS TO SEE THAT NO OTHER POWER FAILURE OCCURS WITHIN A 2 MILLISECOND PERIOD. WHEN THE ROUTINE EXITS FROM THE RESTORE IT GOES BACK TO CHECKING MEMORY.

5.2 DIAGNOSTIC SUBROUTINE ABSTRACTS

POWER FAIL TRAP CAPABILITY

IN THIS TEST THE ABILITY OF THE POWER FAIL TO TRAP TO LOCATION 24 ON POWER DOWN AND POWER UP IS TESTED THE STACK IS CHECKED FOR THE CORRECT VALUE AND THE STACK POINTER IS TESTED FOR THE CORRECT CONTENTS.

A WAIT OCCURS WHEN POWER IS RESTORED. THE OPERATOR MUST DEPRESS CONTINUE TO COMPLETE TEST.

POWER FAIL RE-START CAPABILITY (WAIT)

IN THIS ROUTINE THE ABILITY OF THE POWER FAIL TO TRAP AND STORE ACTIVE REGISTERS AND RESTART CORRECTLY USING A WAIT INSTRUCTION TO WAIT FOR POWER FAILURE IS TESTED HERE

POWER FAIL RE-START CAPABILITY (BR,)

IN THIS ROUTINE THE ABILITY OF THE POWER FAIL TO TRAP AND STORE ACTIVE REGISTERS, AND RESTART CORRECTLY USING A BR, TO WAIT FOR POWER FAILURE IS TESTED HERE.

POWER FAIL RE-START CAPABILITY (EMT)

IN THIS ROUTINE THE ABILITY OF THE POWER FAIL TO TRAP AND STORE ACTIVE REGISTERS, AND RESTART CORRECTLY USING A EMT TO WAIT FOR THE POWER FAILURE IS TESTED HERE

TEST 2 MILLISECONDS DOWN TIME

IN THIS TEST THE AMOUNT OF TIME THE PROCESSOR HAS TO STORE THE ACTIVE REGISTERS IS CHECKED THIS TIME SHOULD EQUAL 2 MILLISECONDS BEFORE ALL PROCESSOR ACTION MUST BE STOPPED.

TEST 2 MILLISECONDS UP TIME

IN THIS TEST THE POWER FAIL LOCK OUT OF 2 MILLISECONDS DURING RE-START IS CHECKED. DURING RESTORE FOR 2 MILLISECONDS THE PROCESSOR WILL NOT ALLOW A POWER FAIL TRAP TO OCCUR

6. ERROR

6.1 ERROR HALTS AND DESCRIPTION

REFER TO LISTING FOR ALL HALTS AND DESCRIPTIONS

6.2 ERROR RECOVERY

IN THE EXERCISER MEMORY VOLATILITY TEST THERE ARE TWO RECOVERABLE HALTS,

HALT NO.1, DATA LIGHTS CONTAIN BAD MEMORY LOCATION (DEPRESS CONTINUE TO TEST SEE DATA)

HALT NO.2, DATA LIGHTS CONTAIN DATA OF BAD MEMORY LOCATION (DEPRESS CONTINUE TO TEST NEXT WORD)

7. RESTRICTIONS

NONE

8. MISCELLANEOUS

8.1 EXECUTION TIME

THE EXERCISER TEST IS A CONTINUOUS RUNNING TEST.

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```
                        ;PDP-11 POWER FAIL TEST
                        ;THIS PROGRAM CONSIST OF SEVERAL TEST THAT INSURE THAT
                        ;POWER FAIL IS OPERATING CORRECTLY.
                        ;
                        ;
                        ;**** PRELIMINARY****
                        ;
                        ;
                        ;
                        ;POWER FAIL TRAPS TO LOCATION 24
                        ;
                        ;
                        ;
                        ;
                        ;
  000000                        .=0
  000005                        .REPT   5
                                .+2
                                HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
                                .ENDR
000000  000002                  .+2
000002  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000004  000006                  .+2
000006  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000010  000012                  .+2
000012  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000014  000016                  .+2
000016  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000020  000022                  .+2
000022  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000024  000000          PFHAND: 0                       ;ADDRESS OF POWER FAIL HANDLER
000026  000000                  0                       ;STATUS
  000072                        .REPT   72
                                .+2
                                HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
                                .ENDR
000030  000032                  .+2
000032  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000034  000036                  .+2
000036  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000040  000042                  .+2
000042  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000044  000046                  .+2
000046  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000050  000052                  .+2
000052  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000054  000056                  .+2
000056  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000060  000062                  .+2
000062  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000064  000066                  .+2
000066  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000070  000072                  .+2
000072  000000                  HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
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000074  000076                  .+2
000076  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000100  000102                  .+2
000102  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000104  000106                  .+2
000106  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000110  000112                  .+2
000112  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000114  000116                  .+2
000116  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000120  000122                  .+2
000122  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000124  000126                  .+2
000126  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000130  000132                  .+2
000132  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000134  000136                  .+2
000136  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000140  000142                  .+2
000142  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000144  000146                  .+2
000146  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000150  000152                  .+2
000152  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000154  000156                  .+2
000156  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000160  000162                  .+2
000162  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000164  000166                  .+2
000166  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000170  000172                  .+2
000172  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000174  000176                  .+2
000176  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000200  000202                  .+2
000202  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000204  000206                  .+2
000206  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000210  000212                  .+2
000212  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000214  000216                  .+2
000216  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000220  000222                  .+2
000222  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000224  000226                  .+2
000226  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000230  000232                  .+2
000232  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000234  000236                  .+2
000236  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000240  000242                  .+2
000242  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000244  000246                  .+2
000246  000000                  HALT                ;POWER FAIL TRAPPED TO WRONG LOCATION
000250  000252                  .+2
```

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000252  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000254  000256                          .+2
000256  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000260  000262                          .+2
000262  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000264  000266                          .+2
000266  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000270  000272                          .+2
000272  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000274  000276                          .+2
000276  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000300  000302                          .+2
000302  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000304  000306                          .+2
000306  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000310  000312                          .+2
000312  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000314  000316                          .+2
000316  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000320  000322                          .+2
000322  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000324  000326                          .+2
000326  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000330  000332                          .+2
000332  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000334  000336                          .+2
000336  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000340  000342                          .+2
000342  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000344  000346                          .+2
000346  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000350  000352                          .+2
000352  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000354  000356                          .+2
000356  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000360  000362                          .+2
000362  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000364  000366                          .+2
000366  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000370  000372                          .+2
000372  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
000374  000376                          .+2
000376  000000                          HALT                    ;POWER FAIL TRAPPED TO WRONG LOCATION
                                ;
                                ;
                                ;
                                ;
                                ;400 TO 1000 IN MEMORY IS ASSIGNED TO THE STACK
                                ;
                                ;
                                ;
                                ;
                                ;
                                ;
```

```
        000200                  .=200
000200  000167  002112  MASTER: JMP     TEST5           ;COMPLETE TEST OF POWER FAIL
000204  000167  000570  START1: JMP     TEST1           ;ENTER TEST 1 (TEST TRAP CAPABILITY)
000210  000167  000650  START2: JMP     TEST2           ;ENTER TEST2 (TEST RE-START CAPABILITY)
000214  000167  001116  STR2A:  JMP     ALTEST          ;TEST RE-START USING BR. INSTRUCTION
000220  000167  001250  STR2B:  JMP     ALTST1          ;TEST RE-START USING EMT INSTRUCTION
000224  000167  001472  START3: JMP     TEST3           ;ENTER TEST3 (TEST FOR 2 MILLISECONDS TIME) DOWN TIME
000230  000167  001656  START4: JMP     TEST4           ;ENTER TEST4 (TEST FOR TWO MILLISECONDS) UP TIME
        000006                  SP=%6                   ;STACK
        000000                  LIGHTS=%0               ;DATA LIGHTS
        177776                  STATUS=177776           ;LOCATION OF STATUS REGISTER
        177570                  SWRG=177570             ;LOCATION OF CONSOLE SWITCH REGISTER
        000007                  PC=%7                   ;LOCATION OF PC
        000030                  EMTRP=30                ;EMULATOR TRAP LOCATION
        001000                          .=1000
                                ;
                                ;BASIC POWER FAIL TEST
                                ;
                                ;TEST1 IS A ROUTINE USED TO THE POWER FAIL'S ABILITY
                                ;TO TRAP TO LOCATION 24.
                                ;
                                ;OPERATOR INSTRUCTIONS
                                ;
                                ;
001000  012706  001000  TEST1:  MOV     #1000,SP        ;SET UP STACK
001004  012767  001022  177012          MOV     #TEST1H,PFVAND  ;SET UP POINTER
001012  052767  000357  176756          BIS     #357,STATUS     ;SET STATUS BITS
001020  000001                  WAIT                    ;WAIT FOR POWER FAIL OPERATOR SHOULD TURN OFF HERE
001022  000000  TEST1H: HALT                    ;POWER FAIL HALTS HERE ON WAY DOWN
                                ;
                                ;TEST1 CHECK - CHECK IF STACK WAS DECREMENTED AND
                                ;STATUS WAS SET UP.
001024  026727  177744  001022  TEST1CH:       CMP     774,#TEST1H     ;CHECK PC AND SP (LOCATION)
001032  001401                  BEQ     .+4             ;ARE THEY EQUAL
001034  000000  HALT1:  HALT                    ;ERROR! PROCESSOR FAILED TO TRAP
                                                        ;LOCATION 774 SHOULD CONTAIN #TEST1H IN STACK
001036  026727  177734  000357          CMP     776,#357        ;WAS THE STATUS STORED CORRECTLY
001044  001401                  BEQ     .+4             ;TEST
001046  000000  HALT2:  HALT                    ;ERROR THE STATUS BEFORE THE TRAP WAS NOT STORED
001050  012700  000210          MOV     #START2,LIGHTS  ;SET UP LIGHTS WITH ADDRESS
001054  005767  176510          TST     SWRG            ;TEST SWITCH REGISTER
001060  100747                  BMI     TEST1           ;IS BIT 15 SET
001062  000000                  HALT                    ;NORMAL HALT NO ERRORS
```

```
                                ;
                                ;TEST ROUTINE TO CHECK RE-START CAPABILITY
                                ;USING THE WAIT INSTRUCTION
                                ;OPERATOR MUST SET HALT SWITCH TO ENABLE POSITION
                                ;
                                ;
001064  012767  000357  176704  TEST2:  MOV     #357,STATUS     ;SET UP CONDITION CODES
001072  012767  000005  176726          MOV     #5,PFHAND+2     ;SET UP POWER FAIL CODES
001100  012767  001142  176716          MOV     #TEST2A,PFHAND  ;SET UP POINTER TO STORE ROUTINE
001106  012706  001000                  MOV     #1000,SP        ;SP UP STACK POINTER
001112  012700  152525                  MOV     #152525,%0      ;SET UP FAST MEMORY
001116  010001                          MOV     %0,%1
001120  010102                          MOV     %1,%2
001122  010203                          MOV     %2,%3
001124  010304                          MOV     %3,%4
001126  010405                          MOV     %4,%5
001130  000001                          WAIT                    ;WAIT FOR POWER FAIL TRAP
001132  005767  176432                  TST     SWRG            ;LOOP ON TEST
001136  100752                          BMI     TEST2           ;IF SR=15=1 LOOP ON TEST
001140  000000                          HALT                    ;NORMAL TEST HALT NO ERRORS
                                ;OPERATOR MUST TURN POWER OFF HERE
                                ;ROUTINE TO STORE ACTIVE REG.
001142  022706  000774          TEST2A: CMP     #774,SP         ;IS STACK CORRECT
001146  001406                          BEQ     TEST2B
001150  010667  001672                  MOV     SP,SAVE         ;CONTENTS OF STACK SAVED.
001154  012767  001162  176642          MOV     #HALT3E,PFHAND  ;STACK CONTAINS WRONG ADDR
001162  000000                  HALT3E: HALT
001164  010046                  TEST2B: MOV     %0,-(SP)        ;STORE REG 0
001166  010146                          MOV     %1,-(SP)        ;STORE REG 1
001170  010246                          MOV     %2,-(SP)        ;STORE REG 2
001172  010346                          MOV     %3,-(SP)        ;STORE REG 3
001174  010446                          MOV     %4,-(SP)        ;STORE REG 4
001176  010546                          MOV     %5,-(SP)        ;STORE REG RE STACK
001200  022706  000760                  CMP     #760,SP         ;IS STACK CORRECT
001204  001404                          BEQ     TEST2D
001206  012767  001214  176610          MOV     #HALT4E,PFHAND  ;THE STACK IS WRONG
001214  000000                  HALT4E: HALT                    ;WAIT FOR RESTART
001216  012767  001240  176600  TEST2D: MOV     #TEST2CH,PFHAND ;SET UP NEW POINTER
001224  012767  000005  176574          MOV     #5,PFHAND+2
001232  010667  001610                  MOV     SP,SAVE
001236  000000                          HALT                    ;ALL ACTIVE REG. STORED. WAIT FOR RESTART.
                                ;
                                ;OPERATOR MUST TURN POWER ON HERE
                                ;ROUTINE TO RE-STORE ACTIVE REGISTER AFTER RE-START.
                                ;
```

```
001240  016706  001602          TEST2CH:        MOV     SAVE,SP
001244  022726  152525                  CMP     #152525,(SP)+   ;TEST SAVE REG FOR FAST MEMORY
001250  001401                  BEQ     .+4             ;TEST FAST MEMORY %5
001252  000000          HALT5E: HALT                    ;SAVE REG IN ERROR
001254  022726  152525                  CMP     #152525,(SP)+   ;TEST SAVE REG FOR FAST MEMORY
001260  001401                  BEQ     .+4             ;TEST FAST MEMORY %4
001262  000000          HALT6E: HALT                    ;SAVE REG IN ERROR
001264  022726  152525                  CMP     #152525,(SP)+   ;TEST SAVE REG FOR FAST MEMORY
001270  001401                  BEQ     .+4             ;TEST FAST MEMORY %3
001272  000000          HALT7E: HALT                    ;SAVE REG IN ERROR
001274  022726  152525                  CMP     #152525,(SP)+   ;TEST SAVE REG. FOR FAST MEMORY
001300  001401                  BEQ     .+4             ;TEST FAST MEMORY %2
001302  000000          HALT8E: HALT                    ;SAVE REG IN ERROR
001304  022726  152525                  CMP     #152525,(SP)+   ;TEST SAVE REG. FOR FAST MEMORY
001310  001401                  BEQ     .+4             ;TEST FAST MEMORY %1
001312  000000          HALT9E: HALT                    ;SAVE REG IN ERROR
001314  022726  152525                  CMP     #152525,(SP)+   ;TEST FAST MEMORY %0
001320  001401                  BEQ     .+4
001322  000000          HALT10E:        HALT            ;SAVE REG. IN ERROR
001324  022706  000774                  CMP     #774,SP         ;TEST STACK FOR CORRECT ADDR.
001330  001401                  BEQ     .+4             ;STACK SHOULD HAVE 2 WORDS,
001332  000000          HALT11E:        HALT            ;STACK HAS WRONG ADDR,
001334  000002                  RTI                     ;RETURN FROM TRAP
```

```
                        ;
                        ;TEST ROUTINE TO CHECK RE-START CAPABILITY
                        ;USING THE BR. INSTRUCTION
                        ;OPERATOR MUST SET HALT SWITCH TO ENABLE POSITION
                        ;
001336  012767  000357  176432  ALTEST: MOV     #357,STATUS     ;SET UP CONDITION CODES
001344  012767  000005  176454          MOV     #5,PFHAND+2     ;SET UP POWER FAIL CODES
001352  012767  001376  176444          MOV     #ALT2,PFHAND    ;SET UP POWER DOWN POINTER
001360  012706  001000                  MOV     #1000,SP        ;SET UP STACK
001364  000777                  REALST: BR      .               ;WAIT FOR POWER FAIL
001366  005767  176176                  TST     SWRG            ;FETCH SWITCH REGISTER
001372  100761                          BMI     ALTEST          ;BIT15=1 LOOP ON TEST
001374  000000                          HALT                    ;NORMAL TEST HALT NO ERRORS
                        ;
                        ;STORE ROUTINE FOR ALTEST
                        ;
001376  022706  000774          ALT2:   CMP     #774,SP         ;HAS STACK BEEN PUSHED TWICE
001402  001406                          BEQ     ALT2A           ;YES STACK CORRECT
001404  010667  001436                  MOV     SP,SAVE         ;SAVE STACK TO INTERAGATE
001410  012767  001416  176406          MOV     #ALT2X,PFHAND   ;SET UP ERROR POINTER
001416  000000                  ALT2X:  HALT                    ;STACK WAS PUSHED >2<
001420  022767  001364  177346  ALT2A:  CMP     #REALST,774     ;DOES STACK CONTAIN CORRECT ADDRESS
001426  001404                          BEQ     ALT2B           ;STACK CONTAIN LOC BR.
001430  012767  001436  176366          MOV     #ALT2AX,PFHAND
001436  000000                  ALT2AX: HALT                    ;LOCATION 774 INCORRECT
001440  010667  001402          ALT2B:  MOV     SP,SAVE         ;SAVE STACK
001444  012767  001462  176352          MOV     #ALT2C,PFHAND   ;SET UP RESTART POINTER
001452  012767  000005  176346          MOV     #5,PFHAND+2
001460  000000                          HALT                    ;END OF STORE ROUTINE
001462  016706  001360          ALT2C:  MOV     SAVE,SP         ;RE-SET STACK
001466  062716  000002                  ADD     #2,(SP)         ;SET NEW RETURN ADDRESS
001472  000002                          RTI                     ;RETURN TO LOC (BR.)+1
                        ;
                        ;
                        ;
                        ;
                        ;
                        ;
                        ;
```

```
                                ;
                                ;TEST ROUTINE TO CHECK RESTART CAPABILITY
                                ;USING THE EMULATOR TRAP FOR A WAIT
                                ;OPERATOR MUST SET HALT SWITCH TO ENABLE POSITION
                                ;
                                ;
001474  012767  000357  176274  ALTST1: MOV#357,STATUS  ;SET UP CONDITION CODES
001502  012767  000005  176316          MOV     #5,PFHAND+2     ;SET UP POWER FAIL CODES
001510  012767  001560  176306          MOV     #ALT3A,PFHAND   ;SET UP POWER DOWN POINTER
001516  012706  001000                  MOV     #1000,SP
001522  012767  003040  176300          MOV     #LRTI,EMTRP     ;SET UP EMT TRAP
001530  012767  000005  176274          MOV     #5,EMTRP+2
001536  104002                  EMTWT:  EMT     +2              ;EMULATOR TRAP
001540  000776                          BR      .-2
001542  016767  001316  176260  ALTST2: MOV     SAVE7,EMTRP
001550  005767  176014                  TST     SWRG            ;TEST SWITCH REGISTER
001554  100747                          BMI     ALTST1          ;LOOP ON TEST
001556  000000                          HALT                    ;NORMAL HALT NO ERRORS
                                ;
                                ;ROUTINE TO STORE ACTIVE REGISTERS
                                ;POWER DOWN
                                ;
001560  016767  176244  001276  ALT3A:  MOV     EMTRP,SAVE7     ;SAVE EMULATOR TRAP
001566  012767  001720  176234          MOV     #ALT3X,EMTRP    ;SET UP ERROR HALT
001574  022706  000774                  CMP     #774,SP         ;HAS STACK BEEN PUSHED TWICE
001600  001414                          BEQ     ALT3C
001602  022706  000770                  CMP     #770,SP         ;HAS STACK BEEN PUSHED 4 TIMES
001606  001411                          BEQ     ALT3C
001610  012767  001630  176206  ALT3B:  MOV     #ALT3BX,PFHAND  ;SET UP POWER FAIL POINTER
001616  012767  000005  176202          MOV     #5,PFHAND+2
001624  010667  001216                  MOV     SP,SAVE         ;SAVE STACK
001630  000000                  ALT3BX: HALT                    ;STACK INCORRECT (STACK PUSHED LESS THAN 2 OR MORE THAN 4)
001632  012767  001654  176164  ALT3C:  MOV     #ALT3D,PFHAND   ;SET UP RE-START POINTER
001640  012767  000005  176160          MOV     #5,PFHAND+2     ;SET UP NEW STATUS
001646  010667  001174                  MOV     SP,SAVE
001652  000000                          HALT                    ;END OF STORE ROUTINE
                                ;ROUTINE TO TEST POWER UP SEQUENCE
                                ;
                                ;
001654  016706  001166          ALT3D:  MOV     SAVE,SP         ;RESTORE STACK
001660  022706  000774                  CMP     #774,SP         ;WAS STACK PUSHED ONLY TWICE
001664  001726                          BEQ     ALTST2          ;
001666  022706  000770                  CMP     #770,SP         ;ARE WE DOING AN EMT
001672  001403                          BEQ     ALT3E
001674  010667  001146                  MOV     SP,SAVE         ;STACK IN SAVE REG.
001700  000000                          HALT                    ;STACK INCORRECT
001702  022767  003040  177060  ALT3E:  CMP     #LRTI,770       ;DOES STACK CONTAIN CORRECT INFO
001710  001714                          BEQ     ALTST2          ;YES EXIT
001712  011667  001130                  MOV     (SP),SAVE
001716  000000                          HALT                    ;STACK CONTAINS WRONG ADDRESS
                                ;
                                ;
                                ;
001720  000000                  ALT3X:  HALT                    ;EMT ACTIVE INSTEAD OF POWER FAIL ON POWER DOWN
```

```
;EMT ACTIVE ON RESTART INSTEAD OF POWER FAIL
```

```
                                ;
                                ;ROUTINE TO CHECK TWO MILLISECOND STORE TIME
                                ;AVERAGE INSTRUCTION TIME
                                ;ROUTINE WAITS FOR SHUT DOWN IN EMT LOOP
                                ;
001722  012706  001000          TEST3:  MOV     #1000,SP        ;SET UP STACK
001726  012767  001754  176070          MOV     #TEST3A,PFHAND  ;SET UP POWER FAIL STORE POINTER
001734  012767  000005  176064          MOV     #5,PFHAND+2     ;SET UP STATUS
001742  000001                         WAIT                    ;WAIT FOR INTERRUPT
001744  005767  175620                 TST     SWRG            ;FETCH SWITCHES AND TEST
001750  100764                         BMI     TEST3           ;IF SR15=1 LOOP ON TEST
001752  000000                         HALT                    ;NORMAL TEST HALT NO ERRORS
                                                                ;LOOP ON TEST
                                                                ;RESTART PROGRAM
                                ;OPERATOR MUST TURN POWER OFF AND ON HERE
                                ;

                                ;TEST FOR 2 MILLISECONDS OF AVERAGE INSTRUCTION TIME
                                ;TIME OF LOOP 57.4 MICROSECONDS
001754  022706  000774          TEST3A: CMP     #774,SP         ;IS STACK CORRECT
001760  001411                         BEQ     TEST3B          ;STACKER IS CORRECT
001762  010667  001060                 MOV     SP,SAVE         ;CONTENTS OF STACK IN SAVE REG.
001766  012767  002002  176030          MOV     #HALT12E,PFHAND ;SETUP ERROR HALT
001774  012767  000000  176024          MOV     #0,PFHAND+2     ;SETUP STATUS WORD
002002  000000                 HALT12E:HALT                    ;WAIT FOR RE-START
002004  012767  003040  176016 TEST3B: MOV     #LRTI,EMTRP     ;SET UP EMULATOR TRAP
002012  012767  000005  176012          MOV     #5,EMTRP+2      ;SET UP EMULATOR STATUS
002020  005067  001040                 CLR     SAVE7           ;SET COUNT TO ZERO
002024  104000                 TIMLOP: EMT+0                   ;EMT TRAP (EMT LOOP=57.4 MICROSEC)
002026  022706  000774                 CMP     #774,SP         ;IS STACK CORRECT AFTER EMT
002032  001407                         BEQ     TEST3D          ;STACK CORRECT CONTINUE
002034  012767  002050  175762          MOV     #HALT13E,PFHAND ;SETUP ERROR HALT
002042  012767  000000  175756          MOV     #0,PFHAND+2     ;SETUP STATUS
002050  000000                 HALT13E:HALT                    ;WAIT FOR RE-START
002052  062767  000001  001004 TEST3D: ADD     #1,SAVE7        ;+1 COUNT
002060  022767  000043  000776          CMP     #35.,SAVE7      ;HAS LOOP TAKEN 2 MILLISECONDS
002066  001356                         BNE     TIMLOP          ;TIME LESS THAN 2 MILLISECONDS
002070  012767  002104  175726          MOV     #TEST3CH,PFHAND ;SET POWER FAIL POINTER
002076  010667  000744                 MOV     SP,SAVE         ;SAVE STACK
002102  000000                         HALT                    ;ROUTINE COMPLETE
```

```
                        ;
                        ;
                        ;PROGRAM RESTART ROUTINE
                        ;
                        ;
002104  016706  000736  TEST3CH:        MOV     SAVE,SP ;RESTORE STACK
002110  000002          RTI                             ;RETURN TO TEST3
                        ;
                        ;
                        ;
```

```
                                ;
                                ;ROUTINE TO TEST FOR 2 MILLISECONDS OF AVERAGE INSTRUCTION TIME
                                ;ACTIVE TIME BEFORE NEXT POWER LOW FLAG.
                                ;EMT LOOP TAKES 56 MICROSECONDS
                                ;THE OPERATOR MUST TURN POWER OFF AND ON
                                ;VIGOROUSLY
002112  012706  001000          TEST4:  MOV     #1000,SP        ;SET UP STACK
002116  012767  002144  175700          MOV     #TEST4A,PFHAND  ;SET POINTER TO HALT
002124  012767  000005  175674          MOV     #5,PFHAND+2     ;SET UP STATUS
002132  000001                          WAIT                    ;WAIT FOR POWER FAIL
002134  005767  175430          TEST4E: TST     SWRG            ;TEST SWITCHES
002140  100764                          BMI     TEST4           ;IF SR15=1 LOOP ON TEST
002142  000000                          HALT                    ;HALT TEST OVER NO ERRORS
                                ;
                                ;
                                ;
002144  022706  000774          TEST4A: CMP     #774,SP         ;IS STACK CORRECT
002150  001411                          BEQ     TEST4B
002152  010667  000670                  MOV     SP,SAVE         ;STACK IN SAVE REG
002156  012767  002172  175640          MOV     #HALT14E,PFHAND
002164  012767  000005  175634          MOV     #5,PFHAND+2
002172  000000          HALT14E:HALT                            ;STACK DID NOT CONTAIN 774
002174  012767  002216  175622  TEST4B: MOV     #TEST4CH,PFHAND ;SET UP RE-START POINTER
002202  012767  000005  175616          MOV     #5,PFHAND+2     ;SET UP STATUS
002210  010667  000632                  MOV     SP,SAVE
002214  000000                          HALT
                                ;
                                ;ROUTINE TO TEST FOR 2 MILLISECONDS UP TIME (AVERAGE INSTRUCTION TIME)
                                ;
                                ;
002216  012767  002312  175600  TEST4CH:MOV     #HALT15E,PFHAND ;SET UP HALT IF TRAP OCCURS BEFORE 2 MILLISECONDS
002224  012767  003040  175576          MOV     #LRTI,EMTRP     ;SET UP EMULATOR TRAP
002232  016706  000610                  MOV     SAVE,SP         ;RESTORE STACK
002236  005067  000622                  CLR     SAVE7           ;ZERO SAVE 7
002242  104001                  UPTIME: EMT+1                   ;EMT TRAP (LOOP=56 MICROSEC)
002244  022706  000774                  CMP     #774,SP         ;TEST STACK
002250  001407                          BEQ     TEST4D          ;STACK IS CORRECT CONTINUE
002252  012767  002314  175544          MOV     #HALT16E,PFHAND ;SET UP ERROR HALT
002260  012767  000000  175540          MOV     #0,PFHAND+2     ;SET UP STATUS
002266  000001                          WAIT                    ;WAIT FOR POWER FAIL
002270  062767  000001  000566  TEST4D: ADD     #1,SAVE7        ;+1 COUNTER
002276  022767  000044  000560          CMP     #36.,SAVE7      ;HAS LOOP TAKEN 2 MILLISECONDS
002304  001356                          BNE     UPTIME          ;NOT YET 2 MILLISECONDS
002306  000167  177622                  JMP     TEST4E          ;THE POWER HAS BEEN UP FOR 2 MILLISECONDS
002312  000000          HALT15E:HALT                            ;WE DID NOT HAVE 2 MILLISECONDS OF POWER OK
002314  000000          HALT16E:HALT                            ;STACK INCORRECT AFTER EMULATOR TRAP
```

```
                                ;
                                ;
                                ;
                                ;
                                ;
                                ;MEMORY POWER ON/OFF TEST
                                ;LOAD MEMORY WITH SET DATA PATTERN
                                ;THEN COMPARE DATA FOR BIT DROP OUT OR BIT PICK UP
                                ;RE-ENTER COMPARE ROUTINE IF POWER FAIL OCCURS
                                ;
                                ;ROUTINE TO DETERMINE THE AMOUNT OF MEMORY
                                ;ROUTINE TESTS FOR A MAX OF 28K
                                ;
002316  012767  002372  175460  TEST5:  MOV     #TREMST,4       ;SET UP FOR BUS TRAP
002324  012767  000340  175454          MOV     #340,6          ;LOCK UP PRIORITY LEVELS
002332  012706  001000                  MOV     #1000,SP
002336  012767  027500  000502          MOV     #27500,SAVE     ;SET UP TEST FOR 8K
002344  012777  000020  000474  EXMST:  MOV     #20,@SAVE       ;TEST MEMORY FOR AVAILABILITY
002352  062767  020000  000466          ADD     #20000,SAVE     ;SET UP TEST FOR NEXT 4K
002360  022767  177500  000460          CMP     #177500,SAVE    ;TEST FOR BUS TRAP ERROR
002366  001366                          BNE     EXMST           ;TEST NEXT 4K BLOCK
002370  000000          HALT17E:HALT                            ;BUS TRAP NOT WORKING TRIED TO REFERENCE NON-EXISTENT MEM)
002372  162767  010000  000446  TREMST: SUB     #10000,SAVE     ;SET UP FOR LAST AVAILABLE BANK
002400  016767  000442  000436          MOV     SAVE,HLIMIT     ;LAST AVAILABLE MEMORY ADDRESS
002406  012767  000006  175370          MOV     #6,4            ;RESTORE TRAP HALT POINTER
002414  016767  000416  175364          MOV     HLT,6           ;RESTORE HALT,
002422  012767  002530  175374          MOV     #TEST5A,PFHAND  ;SET UP POINTER
002430  012706  001000                  MOV     #1000,SP        ;SET UP STACK
002434  016702  000402                  MOV     LLIMIT,%2       ;LOW MEMORY LIMIT
002440  012722  152525          FILDAT: MOV     #152525,(2)+    ;LOAD DATA INTO MEMORY
002444  026702  000374                  CMP     HLIMIT,%2       ;COMPARE FOR LAST MEMEORY LOCATION
002450  001373                          BNE     FILDAT          ;LOAD NEXT LOCATION
002452  016702  000364          CMDX:   MOV     LLIMIT,%2       ;SETUP FOR COMPARE
002456  026702  000362          CMDAT:  CMP     HLIMIT,%2       ;TEST FOR LAST ADDRESS
002462  001773                          BEQ     CMDX            ;RE-ENTER COMPARE LOOP
002464  022722  152525                  CMP     #152525,(2)+    ;TEST DATA
002470  001772                          BEQ     CMDAT           ;COMPARE NEXT WORD
002472  010267  000352                  MOV     %2,SAVE1        ;ADDRESS OF ERROR+2
002476  162767  000002  000344          SUB     #2,SAVE1        ;SUBTRACT TO CALCULATE CORRECT ADDRESS
002504  016700  000340                  MOV     SAVE1,LIGHTS    ;DATA ERROR IN THIS ADDRESS
002510  012767  002516  175306          MOV     #HALT18E,PFHAND ;SET UP POWER FAIL TRAP FOR ERROR
002516  000000          HALT18E:HALT                            ;LOC DATA LIGHTS CONTAINS BAD DATA
```

```
                                ;FAILING ADDRESS IN DATA LIGHTS
002520  017700  000324          CONAD1: MOV     @SAVE1,LIGHTS   ;PUT DATA IN DISPLAY LIGHTS
002524  000000                  HALT19E:HALT                    ;BAD DATA
002526  000753                  CONAC1: BR      CMDAT           ;COMPARE NEXT WORD
                                ;ENTER THIS ROUTINE WHEN POWER FAIL OCCURRS
                                ;STORE ALL ACTIVE REGISTERS THEN HALT!
002530  010046                  TEST5A: MOV     LIGHTS,-(SP)    ;SAVE LIGHTS
002532  010246                          MOV     %2,-(SP)        ;SAVE MEMORY ADDRESS
002534  022706  000770                  CMP     #770,SP         ;IS STACK CORRECT
002540  001411                          BEQ     TEST5E          ;STACK CORRECT
002542  010667  000300                  MOV     SP,SAVE         ;STACK SAVED
002546  012767  002562  175250          MOV     #HALT20E,PFHAND
002554  012767  000005  175244          MOV     #5,PFHAND+2     ;SET UP STATUS
002562  000000                  HALT20E:HALT                    ;WAIT FOR RE-START
002564  012767  003032  175232  TEST5E: MOV     #HALT21E,PFHAND ;SET UP FOR 2 MILLISECOND DOWN TIME ERROR
002572  012767  000005  175226          MOV     #5,PFHAND+2     ;AVERAGE INSRUCTION TIME
002600  012767  003040  175222          MOV     #LRTI,EMTRP     ;SET UP EMULATOR TRAP
002606  012767  000005  175216          MOV     #5,EMTRP+2
002614  005067  000244                  CLR     SAVE7           ;CLEAR COUNT REGISTER
002620  104002                  MASTIM: EMT     +2              ;EXECUTE EMT
002622  022706  000770                  CMP     #770,SP         ;IS STACK CORRECT AFTER TRAP
002626  001406                          BEQ     XTIME           ;YES
002630  010667  000212                  MOV     SP,SAVE
002634  012767  002642  175162          MOV     #HALT22E,PFHAND ;NO SET UP ERROR TRAP STACK NOT CORRECT
002642  000000                  HALT22E:HALT                    ;STACK SHOULD EQUAL 770 (SAVE REG,
                                                                ;CONTAINS CONTENTS OF STACK)
002644  062767  000001  000212  XTIME: ADD     #1,SAVE7        ;ADD TO TIME COUNT
002652  022767  000027  000204          CMP     #23.,SAVE7      ;IS TIME OK
002660  001357                          BNE     MASTIM
002662  012767  002704  175134          MOV     #TEST5CH,PFHAND ;YES SETUP RESTART ADDRESS
002670  012767  000005  175130          MOV     #5,PFHAND+2     ;SAVE STACK
002676  010667  000144                  MOV     SP,SAVE         ;
002702  000000                          HALT
```

```
                                ;
                                ;RESTORE ACTIVE REGISTERS AND RETURN FROM INTERRUPT
                                ;
                                ;
                                ;
002704  016706  000136          TEST5CH:MOV     SAVE,SP         ;RESTORE STACK
002710  022706  000770                  CMP     #770,SP         ;IS STACK CORRECT
002714  001404                        BEQ     UPXTIM
002716  012767  002724  175100        MOV     #HALT23E,PFHAND ;SET UP FOR STACK ERROR TRAP
002724  000000          HALT23E:HALT
002726  012767  003034  175070  UPXTIM: MOV     #HALT24E,PFHAND ;SET UP FOR 2 MILLISECOND UP TIME ERROR
002734  012767  000005  175064        MOV     #5,PFHAND+2
002742  005067  000116                CLR     SAVE7           ;CLEAR COUNT REGISTER
002746  104003          EMTUP:  EMT     +3              ;EXECUTE EMULATOR TRAP
002750  062767  000001  000106        ADD     #1,SAVE7        ;INCREMENT EMULATOR TRAP COUNT
002756  022706  000770                CMP     #770,SP         ;IS STACK CORRECT AFTER EMT
002762  001406                        BEQ     CNTEMT          ;YES
002764  012767  002776  175032        MOV     #HALT25E,PFHAND ;STACK NOT CORRECT(SET UP ERROR HALT)
002772  010667  000050                MOV     SP,SAVE
002776  000000          HALT25E:HALT                    ;STACK DID NOT = 770(SAVE REGISTER
                                                        ;CONTAINS CONTENTS OF STACK
003000  022767  000043  000056  CNTEMT: CMP     #35.,SAVE7      ;HAS POWER BEEN UP 2 MILLISECONDS
003006  001357                        BNE     EMTUP
003010  012602                        MOV     (SP)+,%2        ;NO EXECUTE NEXT EMT
003012  012600                        MOV     (SP)+,LIGHTS    ;YES TIME OK
003014  012767  002530  175002        MOV     #TEST5A,PFHAND  ;REST ARE ACTIVE REGISTER
003022  012767  000005  174776        MOV     #5,PFHAND+2     ;RETURN FROM POWER FAIL TRAP
003030  000002                        RTI
003032  000000          HALT21E:HALT                    ;WE DID NOT HAVE TWO MILLISECONDS TO STORE ACTIVE REG.
003034  000000          HALT24E:HALT                    ;POWER WAS NOT ACTIVE FOR TWO MILLISECONDS
                                ;
                                ;
                                ;
                                ;
                                ;
                                ;
                                ;
003036  000000          HLT:    HALT
003040  000002          LRTI:   RTI
003042  004000          LLIMIT: 4000
003044  017500          HLIMIT: 17500
```

```
                                        ;WORK REGISTERS
003046  000000                          SAVE0:  0
003050  000004                          SAVE1:  4
003052  000000                          SAVE2:  0
003054  000000                          SAVE3:  0
003056  000000                          SAVE4:  0
003060  000000                          SAVE5:  0
003062  000000                          SAVE6:  0
003064  000000                          SAVE7:  0

        000001                                  .END
```

ALT2	001376	HLT	003036	UPXTIM	002726
ALT2A	001420	LIGHTS	000000R	XTIME	002644
ALT2AX	001436	LLIMIT	003042		
ALT2B	001440	LRTI	003040		
ALT2C	001462	MASTER	000200		
ALT2X	001416	MASTIM	002620		
ALT3A	001560	PC	000007R		
ALT3B	001610	PFWAND	000024		
ALT3BX	001630	REALST	001364		
ALT3C	001632	SAVE	003046		
ALT3D	001654	SAVE1	003050		
ALT3F	001702	SAVE2	003052		
ALT3X	001720	SAVE3	003054		
ALTEST	001336	SAVE4	003056		
ALTST1	001474	SAVE5	003060		
ALTST2	001542	SAVE6	003062		
CMDAT	002456	SAVE7	003064		
CMDX	002452	SP	000006R		
CNTEMT	003000	START1	000204		
CONAC	002526	START2	000210		
CONAD	002520	START3	000224		
FMTRP	000030	START4	000230		
FMTUP	002746	STATUS	177776		
FMTWT	001536	STR2A	000214		
FXMST	002344	STR2B	000220		
FILDAT	002440	SWRG	177570		
HALT1	001034	TEST1	001000		
HALT10	001322	TEST1C	001024		
HALT11	001332	TEST1H	001022		
HALT12	002002	TEST2	001064		
HALT13	002050	TEST2A	001142		
HALT14	002172	TEST2B	001164		
HALT15	002312	TEST2C	001240		
HALT16	002314	TEST2D	001216		
HALT17	002370	TEST3	001722		
HALT18	002516	TEST3A	001754		
HALT19	002524	TEST3B	002004		
HALT2	001046	TEST3C	002104		
HALT20	002562	TEST3D	002052		
HALT21	003032	TEST4	002112		
HALT22	002642	TEST4A	002144		
HALT23	002724	TEST4B	002174		
HALT24	003034	TEST4C	002216		
HALT25	002776	TEST4D	002270		
HALT3E	001162	TEST4E	002134		
HALT4E	001214	TEST5	002316		
HALT5E	001252	TEST5A	002530		
HALT6E	001262	TEST5C	002704		
HALT7E	001272	TEST5E	002564		
HALT8E	001302	TIMLOP	002024		
HALT9E	001312	TREMST	002372		
HLIMIT	003044	UPTIME	002242		

ERRORS DETECTED: 0

RUN-TIME: 5 SECONDS

5K CORE USED