

PDP11/45

STATES 11/45

MD-11-DCKBO-A

EP DCKBO A DL A

OCT 1976

COPYRIGHT ©1976

digital

FICHE 1 OF 1

Made in U.S.A.

This microfiche card contains 40 frames of data arranged in a 10x4 grid. Each frame displays a different page of a document, likely a technical manual or report. The text is small and dense, typical of microfiche storage. The frames are separated by thin white lines, and the overall layout is organized and systematic.

801

MAINDEC-11-DCKBO-A PROCESSER STATES TEST
DCKBOA.P11

MACY11 27(732) 03-SEP-76 18:18 PAGE 1

.REM %

IDENTIFICATION

PRODUCT CODE: MAINDEC-11-DCKBO-A1-D
PRODUCT NAME: 11/45 STATES TEST
DATE CREATED: 15 MAR 1972
MAINTAINER: DIAGNOSTIC GROUP
AUTHOR: JOHN ADAMS

COPYRIGHT(C) 1972
DIGITAL EQUIPMENT CORPORATION
MAYNARD, MASS

11/45 STATES TEST

80
81
82
83
84
85
86
87
88
89
90
91

1.0 ABSTRACT

THIS PROGRAM TESTS THAT 11/45 INSTRUCTIONS ARE EXECUTED PROPERLY IN THE THREE 11/45 STATES. (KERNEL, SUPERVISOR, AND USER) THE MTPD/I AND MFPD/I INSTRUCTIONS ARE ALSO TESTED. CONDITIONS ARE ALSO TESTED.

2.0 REQUIREMENTS

2.1 EQUIPMENT

BASIC 11/45 SYSTEM

2.2 STORAGE

THIS PROGRAM USES 0 THRU 17500

2.3 PRELIMINARY PROGRAMS

DOAA THRU DOMA

3.0 LOADING PROCEDURE

LOAD PROGRAM USING ABS LOADER

4.0 STARTING PROCEDURE

LOAD ADDRESS 200. PRESS START. THE PROGRAM WILL LOOP AND RING BELL ON PASS COMPLETION.

5.0 OPERATING PROCEDURE

5.1 SWITCH SETTINGS

NONE

5.2 SUBROUTINE ABSTRACTS

5.2.1 SCOPE

SCOPE IS A MOVE PC,R1 AND STORES THE PC+2 IN R1.

5.2.2 HLT

HLT IS A HALT INSTRUCTION.

6.0 ERRORS

ALL ERRORS WILL CAUSE A HALT
TRAP AND INTERRUPT ERRORS WILL CAUSE A HALT AT VECTOR+2.

6.1 ERROR RECOVERY

PRESS CONTINUE TO PROCEED TO NEXT TEST

6.2 ERROR LOOPING

TO LOOP ON AN ERROR, PLACE A BRANCH TO THE PREVIOUS SCOPE INSTRUCTION IN PLACE OF THE HALT INSTRUCTION.
NOTE THAT IF THE ERROR IS INTERMITTANT THAT THE TEST WILL DROP THRU THE HALT AND PROCEED TO THE NEXT TEST.
THEREFORE, TO LOOP THE TEST CONTINUOUSLY REPLACE THE BEQ .+4 INSTRUCTION IMMEDIATELY PRECEDING THE HALT WITH A BRANCH BACK TO THE PREVIOUS SCOPE.

TO LOOP ON TRAP FAILURES, PATCH IN THE FOLLOWING ROUTINE AT THE ADDRESS OF THE TRAP VECTOR.

11030
11031
11032
11033
11034
11035
11036
11037
11038
11039
11040
11041
11042
11043

```
TRAPVEC:          TRAPVEC+4
TRAPVEC+2:        0
TRAPVEC+4:        012716 ;MOVE SCOPE ADDRESS TO STACK
TRAPVEC+6:        ADDRESS ;ADDRESS OF PREVIOUS SCOPE
TRAPVEC+10:       000006 ;RETURN TO TEST AT SCOPE
```

RESTORE ALL LOCATIONS BEFORE PROCEEDING TO NEXT TEST.

- 7.0 RESTRICTIONS
NONE
- 8.0 MISCELLANEOUS
ON TRAP ERRORS THE STACK POINTER(R6) WILL CONTAIN THE ADDRESS WHERE THE TRAP OCCURED.
- 8.1 EXECUTION TIME
THIS PROGRAM TAKES ABOUT 1 MINUTE.
- 8.2 STACK POINTER
THIS PROGRAM INITIALLY SETS THE STACK POINTER AT 500.
*
.TITLE MAINDEC-11-DCKBO-A PROCESSOR STATES TEST
.NLIST MC,MD,SEQ
.ABS

```
;TEST DCKBOA THIS TEST TESTS FEATURES OF THE THREE PROCESSOR STATES AND INCLUDES
;TRAPS FROM ALL STATES TO ALL OTHER STATES, AND HFP/HTP INSTRUCTIONS IN ALL
;STATES AND PREVIOUS STATES.
;NOTE: ALL TESTS ARE ENTERED AND EXITED IN KERNEL MODE.
```

```
;STARTING PROCEEDURE
LOAD ADDRESS=200
PRESS START
KERNEL STACK POINTER IS AT 500
SUPER STACK POINTER IS AT 600
USER STACK POINTER IS AT 700
BELL WILL RING WHEN TEST IS COMPLETE
```

.REGISTER ASSIGNMENTS

000000
000001
000002
000003
000004
000005
000007
000000
000001
000002
000003
000004
000005

```
R0=%0
R1=%1
R2=%2
R3=%3
R4=%4
R5=%5
PC=%7
R10=%0
R11=%1
R12=%2
R13=%3
R14=%4
R15=%5
```

;STACK POINTERS

000006
000006

```
KSP=%6
SSP=%6
```

```
;KERNEL STACK POINTER
;SUPERVISOR STACK POINTER
```

000006
000000
010701
000003
000140
000200
000340

USP=x6
HLT=HALT
SCOPE=010701
TRT=3
PTY3=140
PTY4=200
PTY7=340

;USER STACK POINTER
;MOVE PC TO R1
;TRACE TRAP...

000004
000030
000034
000020
000014
000014
000064
000240

;VECTOR ADDRESSES
ERRVEC=4
EMTVEC=30
TRAPVEC=34
IOTVEC=20
TBITVEC=14
TRTVEC=14
TPVEC=64
PIRVEC=240

;ADDRESS OF ERROR VECTOR
;ADDRESS OF EMT VECTOR
;ADDRESS OF TRAP VECTOR
;ADDRESS OF IOT VECTOR
;ADDRESS OF 'T' BIT TRAP VECTOR
;ADDRESS OF 'TRACE' TRAP
;ADDRESS OF TTY PRINTER INTERRUPT VECTOR
;ADDRESS OF PIRG VECTOR

177776
177774
177772
177770
177560
177562
177564
177566
177570
177570

;HARDWARE REGISTER ASSIGNMENTS
PSW=177776
SLR=177774
PIRQ=177772
UBREAK=177770
TKS=177560
TKB=177562
TPS=177564
TPB=177566
SMR=177570
DISPLAY=177570

;ADDRESS OF STATUS REGISTER
;ADDRESS OF STACK LIMIT REGISTER
;ADDRESS OF PROGRAM INTERRUPT REQUEST
;ADDRESS OF MICRO BREAK REGISTER
;ADDRESS OF KEYBOARD CSR
;ADDRESS OF KEYBOARD BUFFER
;ADDRESS OF TELEPRINTER CSR
;ADDRESS OF TELEPRINTER BUFFER
;ADDRESS OF CONSOL SWITCH REGISTER
;ADDRESS OF CONSOL DISPLAY REGISTER

000500
000600
000700
001000
000736

;INITIAL STACK POINTER SETTINGS
KPTR=500
SPTR=600
LPTR=700
YELPTR=1000
REDPTR=736

;KERNEL INITIAL STACK POINTER VALUE
;SUPERVISOR INITIAL STACK POINTER VALUE
;USER INITIAL STACK POINTER VALUE
;STACK POINTER VALUE FOR 'YELLOW' OVFLW
;STACK POINTER VALUE FOR 'RED' OVFLW

100000
040000
020000
000100

;MISC. BIT ASSIGNMENTS
BIT15=100000
BIT14=40000
BIT13=20000
BIT6=100

140000
100000
040000
000000
030000
010000
000000
004000
000020
000001
000002
000004
000010

;STATUS REGISTER BIT ASSIGNMENTS
UM=140000
SM=100000
PM=040000
KM=0
PUM=030000
PSM=010000
PKM=0
REG=004000
TBIT=20
C=1
V=2
Z=4
N=10

;USER MODE
;ILLEGAL MODE
;SUPERVISOR MODE
;KERNEL MODE
;PREVIOUS USER MODE
;PREVIOUS SUPERVISOR MODE
;PREVIOUS KERNEL MODE
;REGISTER BIT
;'T' BIT IN PSW
;'C' BIT IN PS
;'V' BIT IN PS
;'Z' BIT IN PS
;'N' BIT IN PS

F01

MAINDEC-11-DCKBO-A PROCESSOR STATES TEST
DCKBOA.P11

MACY11 27(732) 03-SEP-76 18:18 PAGE 5

	010000		PIR4=10000		;LEVEL 4 REQUEST IN PIR0
	000000		. = 0		
000200	000200 000167	000606	. = 200 JMP	START	;GO START
	001000		. = 1000		
			;TAGS		
001000	000000		ICNT: 0		;CONTAINS PASS COUNT
001002	000000 001012		TEMP: 0 . = . + 6		

```

001012 012706 000500      START:  MOV    #KPTR,KSP
001016 005067 177756      CLR    ICNT
:TEST THAT PROCESSOR POWERED UP OK FOR THE TEST
001022 032737 174000 177776  PWRUP:  BIT    @UM+PUM+REG,@PSW  ;IS STATUS CORRECT
001030 001377      BNE    .                ;LOOP HERE IF NOT

001032 012706 000500      BEGIN:  MOV    #KPTR,KSP      ;INITIALIZE THE STACK POINTER
001036 016737 177736 177570  MOV    ICNT,@DISPLAY    ;DISPLAY PASS COUNT IN LIGHT REGISTER
001044 032737 000400 177570  BIT    @400,@SMR        ;LOAD MICRO BREAK REGISTER
001052 001403      BEQ    .+10
001054 113737 177570 177770  MOVB   @SMR,@SUBREAK    ;LOAD MICRO BREAK REG WITH SRO-7

;CHECK THAT THE SPL INSTRUCTION IS A 'NOP' IN SUPERVISORY/USER MODE.
;SUPERVISORY MODE.
001062 010701      T0:    SCOPE
001064 012737 040340 177776  MOV    @SM+PRTY7,@PSW  ;SUPERVISORY MODE, PRIORITY LEVEL 7
001072 000230      SPL    0                ;TRY TO SET PRIORITY LEVEL =0
001074 013700 177776      MOV    @PSW,R0         ;GET PSM
001100 005037 177776      CLR    @PSW
001104 022700 040340      CMP    @SM+PRTY7,R0
001110 001401      BEQ    .+4
001112 000000      HLT                    ;ERROR! INCORRECT STATUS AFTER SPL

;USER MODE
001114 010701      T1:    SCOPE
001116 012737 140000 177776  MOV    @UM,@PSW        ;USER MODE, PRIORITY LEVEL 0
001124 000237      SPL    7                ;TRY TO SET PRIORITY LEVEL 7
001126 013700 177776      MOV    @PSW,R0         ;GET PSM
001132 005037 177776      CLR    @PSW            ;KERNEL MODE!!!
001136 022700 140000      CMP    @UM,R0          ;TEST THAT SPL DID NOT ALTER PSM
001142 001401      BEQ    .+4
001144 000000      HLT                    ;ERROR! SPL CHANGED STATUS WORD

;CHECK THAT RESET IS A 'NOP' IN SUPERVISORY/USER MODE
;SUPERVISORY MODE
001146 010701      T2:    SCOPE
001150 012737 070340 177776  MOV    @SM+PUM+PRTY7,@PSW ;PRESET STATUS
001156 052767 000100 176374  BIS    @BIT6,TKS        ;SET IE BIT IN TKS
001164 000005      RESET
001166 013700 177776      MOV    @PSW,R0         ;GET STATUS WORD
001172 016702 176352      MOV    TKS,R2          ;GET TKS
001176 005037 177776      CLR    @PSW            ;KERNEL MODE !!!
001202 005067 176352      CLR    TKS             ;CLEAR IE BIT
001206 022700 070340      CMP    @SM+PUM+PRTY7,R0;TEST THAT STATUS DID NOT CHANGE
001212 001401      BEQ    .+4
001214 000000      HLT                    ;ERROR! STATUS CHANGED BY RESET
001216 032702 000100      BIT    @BIT6,R2        ;TEST THAT IE BIT DID NOT CLEAR
001222 001001      BNE    .+4
001224 000000      HLT                    ;ERROR! RESET CLEARED IE BIT IN TKS

;USER MODE
001226 010701      T3:    SCOPE
001230 012737 154340 177776  MOV    @UM+PSM+REG+PRTY7,@PSW ;PRESET STATUS
001236 052767 000100 176314  BIS    @BIT6,TKS        ;SET IE BIT IN TKS
001244 000005      RESET

```

```

001246 013700 177776      MOV      2@PSW,R10      ;GET STATUS WORD
001252 016702 176302      MOV      TKS,R12      ;GET TKS
001256 005067 176276      CLR      TKS          ;CLEAR IE BIT
001262 042737 140000 177776 BIC      @UM,2@PSW     ;KERNEL MODE!!!
001270 022700 154340      CMP      @UM+PSW+REG+PRTY7,R10 ;CHECK STATUS AFTER RESET
001274 001401      BEQ      .+4
001276 000000      HLT
001300 032702 000100      BIT      @BIT6,R12    ;ERROR! INCORRECT STATUS AFTER RESET
001304 001001      BNE      .+4          ;CHECK IE BIT AFTER RESET
001306 000000      HLT
001310 005037 177776      CLR      2@PSW        ;ERROR! IE BIT WAS CLEARED BY RESET

;TEST A TRAP FROM SUPERVISOR TO KERNEL MODE
T4:  SCOPE
001314 010701      MOV      @KPTR,KSP    ;SET KERNEL STACK POINTER
001316 012706 000500      MOV      @T4A,TRAPVEC
001322 012767 001362 176504      MOV      @PRTY7+17,TRAPVEC+2
001330 012767 000357 176500      MOV      @SM,2@PSW    ;SUPERVISORY MODE!!!
001336 012737 040000 177776      MOV      @SPTR,SSP    ;SET SUPERVISORS STACK POINTER
001344 012706 000600      CCC      ;CLEAR CONDITION CODES
001352 104400      TRAP
001354 005037 177776      T4AA:  CLR      2@PSW
001360 000000      HLT      ;ERROR! DID NOT TRAP
001362 013700 177776      T4A:   MOV      2@PSW,R0
001366 005037 177776      CLR      2@PSW
001372 022700 010357      CMP      @KM+PSW+PRTY7+17,R0 ;IS NEW STATUS CORRECT?
001376 001401      BEQ      .+4
001400 000000      HLT      ;ERROR! INCORRECT NEW STATUS
001402 022767 001354 177064      CMP      @T4AA,KPTR-4 ;WAS RETURN ADDRESS SAVED ON KERNEL'S
001410 001401      BEQ      .+4          ;STACK?
001412 000000      HLT
001414 022767 040000 177054      CMP      @SM,KPTR-2    ;WAS OLD STATUS SAVED ON KERNEL'S
001422 001401      BEQ      .+4          ;STACK?
001424 000000      HLT
001426 022706 000474      CMP      @KPTR-4,KSP
001432 001401      BEQ      .+4
001434 000000      HLT
001436 012737 040000 177776      MOV      @SM,2@PSW    ;ENTER SUPERVISORY MODE TO GET
001444 010600      MOV      SSP,R0      ;SUPERVISOR STACK POINTER
001446 005037 177776      CLR      2@PSW
001452 022700 000600      CMP      @SPTR,R0
001456 001401      BEQ      .+4
001460 000000      HLT
001462 012767 000036 176344      MOV      @TRAPVEC+2,TRAPVEC
001470 005067 176342      CLR      TRAPVEC+2

;TEST TRAP FROM USER MODE TO KERNEL MODE
T5:  SCOPE
001474 010701      MOV      @KPTR,KSP    ;SET KERNEL STACK PTR
001476 012706 000500      MOV      @T5A,@IOTVEC ;SET IOT TRAP VECTOR
001502 012737 001540 000020      MOV      IOTVEC+2     ;KERNEL MODE AFTER IOT
001510 005067 176306      CLR      IOTVEC+2
001514 012737 150340 177776      MOV      @UM+PSW+PRTY7,2@PSW ;USER MODE!!!
001522 012706 000700      MOV      @UPTR,USP    ;SET USER STACK PTR
001526 000277      SCC      ;PRESET CONDITION CODES
001530 000004      IOT      ;TRAP USER MODE TO KERNEL MODE
001532 005037 177776      T5AA:  CLR      2@PSW    ;KERNEL MODE!!!

```


001536	000000			HLT						;ERROR! FAILED TO TRAP
001540	013700	177776		MOV	2@PSW,RO					;SAVE STATUS
001544	005037	177776		CLR	2@PSW					;KERNEL MODE!!!
001550	022700	030000		CMR	8KH+PUM,RO					;CHECK STATUS AFTER IOT
001554	001401			BEG	.+4					
001556	000000			HLT						;ERROR! INCORRECT STATUS AFTER IOT
001560	022767	001532	176706	CMR	8T5AA,KPTR-4					;CHECK KERNEL STACK PTR
001566	001401			BEG	.+4					
001570	000000			HLT						;ERROR! INCORRECT KSP AFTER IOT
001572	022767	150357	176676	CMR	8UM+PSM+PRTY7+17,KPTR-2					;CHECK SAVED STATUS ON IOT
001600	001401			BEG	.+4					
001602	000000			HLT						;ERROR! INCORRECT STATUS SAVED ON STACK AFTER IOT
001604	022706	000474		CMR	8KPTR-4,KSP					;CHECK RETURN PC ON IOT
001610	001401			BEG	.+4					
001612	000000			HLT						;INCORRECT RETURN PC SAVED ON STACK
001614	012737	140000	177776	MOV	8UM,2@PSW					;USER MODE!!!
001622	010600			MOV	USP,RO					
001624	005037	177776		CLR	2@PSW					;KERNEL MODE!!!
001630	022700	000700		CMR	8UPTR,RO					;CHECK THAT USER STACK PTR
001634	001401			BEG	.+4					;WAS NOT AFFECTED BY IOT TRAP
001636	000000			HLT						;ERROR! USP WAS CHANGED ON IOT
001640	012737	000022	000020	MOV	8IOTVEC+2,2@IOTVEC					

:TEST TRAP FROM USER MODE TO SUPERVISOR MODE

001646	010701			T6:	SCOPE					
001650	012737	001720	000030	MOV	8T6A,2@EMTVEC					;SET EMT TRAP VECTOR
001656	012737	040000	000032	MOV	8SM,2@EMTVEC+2					;SUPER MODE AFTER EMT
001664	012737	044000	177776	MOV	8SM+REG,2@PSW					;SUPER MODE!!!
001672	012706	000600		MOV	8SPTR,SSP					;SET SUPER STACK PTR
001676	012737	144000	177776	MOV	8UM+REG,2@PSW					;USER MODE!!!
001704	012706	000700		MOV	8UPTR,USP					;SET USER STACK POINTER
001710	104000			EMT						;TRAP USER TO SUPERVISOR
001712	005037	177776		T6AA:	CLR	2@PSW				;KERNEL MODE!!!
001716	000000			HLT						;ERROR! EMT FAILED TO TRAP
001720	013700	177776		T6A:	MOV	2@PSW,RO				;SAVE STATUS AFTER EMT TRAP
001724	010602			MOV	SSP,R2					;SAVE SUPER STACK PTR
001726	005037	177776		CLR	2@PSW					;KERNEL MODE!!!
001732	022700	070000		CMR	8SM+PUM,RO					;CHECK STATUS AFTER EMT TRAP
001736	001401			BEG	.+4					
001740	000000			HLT						;ERROR! INCORRECT STATUS AFTER EMT TRAP
001742	022767	001712	176624	CMR	8T6AA,SPTR-4					;CHECK RETURN PC ON SUPER STACK
001750	001401			BEG	.+4					
001752	000000			HLT						;ERROR! INCORRECT RETURN PC ON SUPER STACK AFTER EMT
001754	022767	144000	176614	CMR	8UM+REG,SPTR-2					;CHECK STATUS SAVED ON SUPER STACK
001762	001401			BEG	.+4					
001764	000000			HLT						;ERROR! INCORRECT STATUS SAVED ON STACK HLT
001766	022702	000574		CMR	8SPTR-4,R2					;CHECK SUPER STACK PTR AFTER EMT
001772	001401			BEG	.+4					
001774	000000			HLT						;ERROR! INCORRECT SSP AFTER EMT TRAP
001776	012737	140000	177776	MOV	8UM,2@PSW					;USER MODE!!!
002004	010600			MOV	USP,RO					;SAVE USER STACK PTR
002006	005037	177776		CLR	2@PSW					;KERNEL MODE!!!
002012	022700	000700		CMR	8UPTR,RO					;CHECK THAT USP WAS NOT CHANGED ON TRAP
002016	001401			BEG	.+4					
002020	000000			HLT						;ERROR! INCORRECT USP AFTER EMT TRAP

```

:TEST TRAP FROM USER TO USER MODE
↑7:  SCOPE
002022 010701                                MOV      @T7A,@TRTVEC ;SET TRACE TRAP VECTOR
002024 012737 002062 000014                MOV      @UM+REG,@TRTVEC+2 ;USER MODE AFTER TRAP
002032 012737 140000 000016                MOV      @UM,@PSW ;USER MODE!!!
002040 012737 140000 177776                MOV      @UPTR,USP ;SET USER STACK PTR
002046 012706 000700                        TRT ;TRACE TRAP
002052 000003                                HLT ;KERNEL MODE!!!
002054 005037 177776                        T7AA:   CLR      @PSW ;ERROR! TRT FAILED TO TRAP
002060 000000                                HLT ;SAVE STATUS AFTER TRAP
002062 013700 177776                        T7A:   MOV      @PSW,R10 ;SAVE STATUS AFTER TRAP
002066 010602                                MOV      USP,R12 ;SAVE USER STACK PTR
002070 042737 140000 177776                BIC      @UM,@PSW ;KERNEL MODE!!!
002076 022767 002054 176570                CMP      @T7AA,UPTR-4 ;CHECK RETURN PC ON USER STACK
002104 001401                                BEQ      .+4
002106 000000                                HLT ;ERROR! INCORRECT RETURN PC ON USER STACK
002110 022700 174000                        CMP      @UM+PUM+REG,R10 ;CHECK STATUS AFTER TRT TRAP
002114 001401                                BEQ      .+4
002116 000000                                HLT ;ERROR! INCORRECT STATUS AFTER TRT TRAP
002120 012767 000016 175666                MOV      @TRTVEC+2,TRTVEC
002126 005067 175664                        CLR

```

```

:TEST TRAP SEQUENCE FROM SUPERVISOR TO SUPERVISOR
↑10: SCOPE
002132 010701                                MOV      @T10A,@EMTVEC ;SET EMT TRAP VECTOR
002134 012737 002172 000030                MOV      @SM,@EMTVEC+2 ;SUPER MODE AFTER EMT
002142 012737 040000 000032                MOV      @SM,@PSW ;SUPER MODE!!!
002150 012737 040000 177776                MOV      @SPTR,SSP ;SET SUPER STACK PTR
002156 012706 000600                        EMT+377 ;TRAP SUPER TO SUPER
002162 104377                                CLR      @PSW ;KERNEL MODE!!!
002164 005037 177776                        T10AA:  HLT ;ERROR! EMT FAILED TO TRAP
002170 000000                                HLT ;SAVE STATUS AFTER EMT TRAP
002172 013700 177776                        T10A:  MOV      @PSW,R0 ;KERNEL MODE!!!
002176 005037 177776                        CLR      @PSW ;CHECK RETURN PC ON SUPER STACK
002202 022767 002164 176364                CMP      @T10AA,SPTR-4
002210 001401                                BEQ      .+4
002212 000000                                HLT ;ERROR! INCORRECT RETURN PC ON SUPER STACK AFTER TRAP
002214 022700 050000                        CMP      @SM+PSW,R0 ;CHECK STATUS AFTER TRAP
002220 001401                                BEQ      .+4
002222 000000                                HLT ;ERROR! INCORRECT STATUS AFTER TRAP
002224 012737 000032 000030                MOV      @EMTVEC+2,@EMTVEC
002232 005037 000032                        CLR

```

```

:TEST TRAP SEQUENCE SUPERVISOR TO USER
↑11: SCOPE
002236 010701                                MOV      @T11A,TRAPVEC ;SET TARP TRAP VECTOR
002240 012767 002306 175566                MOV      @UM,TRAPVEC+2 ;USER MODE AFTER TARP
002246 012767 140000 175562                MOV      @UM,@PSW ;USER MODE
002254 012737 140000 177776                MOV      @UPTR,USP ;SET USER STACK PTR
002262 012706 000700                        MOV      @SM,@PSW ;SUPERVISORY MODE!!!
002266 012737 040000 177776                SCC ;PRE SET CONDITION CODES
002274 000277                                TRAP+377 ;TRAP SUPER TO USER
002276 104777                                CLR      @PSW ;KERNEL MODE!!!
002300 005037 177776                        T11AA:  HLT ;ERROR! TRAP FAILED TO TRAP
002304 000000                                HLT ;SAVE STATUS AFTER TRAP
002306 013700 177776                        T11A:  MOV      @PSW,R0 ;SAVE STATUS AFTER TRAP
002312 010602                                MOV      USP,R2 ;SAVE USER STACK PTR
002314 005037 177776                        CLR      @PSW ;KERNEL MODE!!!
002320 022722 002300                        CMP      @T11A,(R2)+ ;CHECK RETURN PC ON USER STACK

```

002324	001401			BEG	.+4	
002326	000000			HLT		;ERROR! INCORRECT RETURN PC ON USER STACK
002330	022712	040017		CMP	#SM+17,(R2)	;CHECK SAVED STATUS
002334	001401			BEG	.+4	
002336	000000			HLT		;ERROR! SAVED STATUS ON USER STACK INCORRECT
002340	022700	150000		CMP	#UM+PSM,RO	;CHECK STATUS AFTER TRAP
002344	001401			BEG	.+4	
002346	000000			HLT		;ERROR! STATUS AFTER TRAP INCORRECT
002350	012767	000036	175456	MOV	#TRAPVEC+2,TRAPVEC	
002356	005067	175454		CLR	TRAPVEC+2	

;TEST THAT THE 'HALT' INSTRUCTION CAUSES A TRAP TO LOCATION 4 IN
;SUPERVISORY MODE.

002362	010701			T12:	SCOPE	
002364	012737	002420	000004	MOV	#T12A,#ERRVEC	;SET ERROR TRAP VECTOR
002372	005067	175410		CLR	ERRVEC+2	;KERNEL MODE ON TRAP
002376	012706	000500		MOV	#KPTR,KSP	;SET KERNEL STACK PTR
002402	012737	040000	177776	MOV	#SM,#PSW	;SUPER MODE!!!
002410	000000			HLT		;HALT TRAPS IN SUPERVISORY MODE
002412	005037	177776		T12AA:	CLR	#PSW
002416	000000			HLT		;KERNEL MODE!!!
002420	013700	177776		T12A:	MOV	#PSW,RO
002424	005037	177776		CLR	#PSW	;SAVE STATUS AFTER TRAP
002430	022700	010000		CMP	#SM+PSM,RO	;CHECK STATUS AFTER TRAP
002434	001401			BEG	.+4	
002436	000000			HLT		;ERROR! INCORRECT STATUS AFTER TRAP
002440	022767	002412	176026	CMP	#T12AA,KPTR-4	;CHECK RETURN PC
002446	001401			BEG	.+4	
002450	000000			HLT		;ERROR! INCORRECT RETURN PC ON KERNEL STACK

;USER MODE

002452	010701			T13:	SCOPE	
002454	012737	002504	000004	MOV	#T13A,#ERRVEC	;SET ERROR TRAP VECTOR
002462	012706	000500		MOV	#KPTR,KSP	;SET KERNEL STACK PTR
002466	012737	140000	177776	MOV	#UM,#PSW	;USER MODE!!!
002474	000000			HLT		;HALT TRAP TO 4 IN USER MODE
002476	005037	177776		T13AA:	CLR	#PSW
002502	000000			HLT		
002504	013700	177776		T13A:	MOV	#PSW,RO
002510	005037	177776		CLR	#PSW	
002514	022700	030000		CMP	#SM+PSM,RO	
002520	001401			BEG	.+4	
002522	000000			HLT		
002524	022767	002476	175742	CMP	#T13AA,KPTR-4	
002532	001401			BEG	.+4	
002534	000000			HLT		
002536	012737	000006	000004	MOV	#ERRVEC+2,#ERRVEC	

;TEST INTERRUPT SEQUENCE SUPERVISOR TO KERNEL MODE

002544	010701			T14:	SCOPE	
002546	000237			SPL	7	;SET PROCESSOR PRIORITY LEVEL 7
002550	012767	002624	175306	MOV	#T14A,TPVEC	;LOAD TELEPRINTER
002556	012767	004200	175302	MOV	#REG+PTY4,TPVEC+2	;VECTOR ADDRESSES
002564	012706	000500		MOV	#KPTR,KSP	;SET KERNEL STACK
002570	052737	070000	177776	BIS	#SM+PSM,#PSW	;SUPERVISORY MODE,PREVIOUS USER MODE
002576	012706	000600		MOV	#SPTR,SSP	

```

002602 052737 000100 177564      BIS      @BIT6,@@TPS      ;SET IE BIT IN TELEPRINTER
002610 042737 000340 177776      BIC      @PTY7,@@PSW      ;ALLOW INTERRUPT
002616 005037 177776      CLR      @@PSW            ;KERNEL MODE
002622 000000      HLT                               ;ERROR NO INTERRUPT
002624 013700 177776      T14AA:  MOV      @@PSW,R10
002630 042737 140000 177776      BIC      @UM,@@PSW
002636 042737 000100 177564      BIC      @BIT6,@@TPS      ;CLEAR IE BIT IN TELEPRINTER
002644 022700 014200      CMP      @KM+@PSM+@REG+@PTY4,R10 ;CHECK 'NEW' STATUS
002650 001401      BEQ      .+4
002652 000000      HLT                               ;ERROR! 'NEW' STATUS IS INCORRECT
002654 022706 000474      CMP      @KPTR-4,KSP
002660 001401      BEQ      .+4
002662 000000      HLT
002664 022767 002616 175602      CMP      @T14AA,KPTR-4
002672 001401      BEQ      .+4
002674 000000      HLT
002676 022767 070000 175572      CMP      @SM+@UM,KPTR-2
002704 001401      BEQ      .+4
002706 000000      HLT
002710 012767 000066 175146      MOV      @TPVEC+2,TPVEC
002716 005067 175144      CLR      TPVEC+2

```

:TEST INTERRUPT SEQUENCE USER TO KERNEL MODE

```

002722 010701      T15:  SCOPE
002724 012706 000500      MOV      @KPTR,KSP      ;SET KERNEL STACK POINTER
002730 012737 170340 177776      MOV      @UM+@UM+@PTY7,@@PSW ;USER MODE!!!
002736 012737 003000 000240      MOV      @T15A,@@PIRVEC    ;LOAD PROGRAM INTERRUPT RQST VEC.
002744 012737 010200 000242      MOV      @KM+@PSM+@PTY4,@@PIRVEC+2
002752 012706 000700      MOV      @UPT,USP      ;SET USER STACK POINTER
002756 042737 000200 177776      BIC      @PTY4,@@PSW      ;SET PRIORITY LEVEL=3
002764 012737 010000 177772      MOV      @PIR4,@@PIRQ    ;REQUEST AN INTERRUPT AT LEVEL 4
002772 005037 177776      T15AA: CLR      @@PSW      ;KERNEL MODE!!!
002776 000000      HLT                               ;ERROR! NO INTERRUPT REQUEST
003000 013700 177776      T15A:  MOV      @@PSW,R0      ;GET 'NEW' PSW
003004 005067 174762      CLR      PIRQ            ;DISABLE REQUEST
003010 005037 177776      CLR      @@PSW
003014 022700 030200      CMP      @KM+@UM+@PTY4,R0 ;TEST THAT 'NEW' PSW IS CORRECT
003020 001401      BEQ      .+4              ;(@@PIRVEC+2)
003022 000000      HLT                               ;ERROR! 'NEW' PSW NOT = TO (@@PIRVEC+2)
003024 022767 002772 175442      CMP      @T15AA,KPTR-4 ;IS RETURN ADDRESS ON KERNEL STACK
003032 001401      BEQ      .+4
003034 000000      HLT                               ;ERROR! RETURN ADDRESS NOT ON KERNEL STACK
003036 022767 170140 175432      CMP      @UM+@UM+@PTY3,KPTR-2 ;TEST THAT 'OLD' PSW WAS SAVED ON
003044 001401      BEQ      .+4              ;KERNEL STACK
003046 000000      HLT                               ;ERROR!
003050 012737 000242 000240      MOV      @PIRVEC+2,@@PIRVEC
003056 005037 000242      CLR      @@PIRVEC+2

```

:TEST THAT THERE IS NO STACK OVERFLOW IN SUPERVISORY MODE.

```

003062 010701      T16:  SCOPE
003064 012737 001000 177774      MOV      @1000,@@SLR     ;SET STACK LIMIT=1400
003072 012737 070000 177776      MOV      @SM+@UM,@@PSW  ;SUPERVISORY MODE
003100 012706 000600      MOV      @SPTR,SSP      ;SET SUPERVISOR STACK
003104 012716 125252      MOV      @125252,(SSP)  ;PRE SET STACK
003110 012737 003302 000030      MOV      @T16G,@@EMTVEC
003116 012737 040000 000032      MOV      @SM,@@EMTVEC+2 ;ENTER SUPERVISORY MODE ON EMT

```

```

003124 012737 003330 000004      MOV      #T16ERR, @ERRVEC
003132 005067 175644      CLR      TEMP                ; CLEAR INDICATOR LOCATION
003136 004767 000000      JSR      7, T16B             ; GO TO T16B
003142 052767 000001 175632  T16A:   BIS      #1, TEMP            ; SET INDICATOR BIT
003150 004567 000000      JSR      5, T16C
003154 052767 000002 175620  T16C:   BIS      #2, TEMP            ; SET INDICATOR BIT
003162 052737 004000 177776      BIS      @REG, @PSW          ; SELECT R10-R15
003170 004767 000000      JSR      7, T16D
003174 052767 000004 175600  T16D:   BIS      #4, TEMP            ; SET INDICATOR BIT
003202 004567 000000      JSR      R15, T16E
003206 052767 000010 175566  T16E:   BIS      #10, TEMP           ; SET INDICATOR BIT
003214 014616      MOV      -(SSP), (SSP)
003216 052767 000020 175556      BIS      #20, TEMP           ; SET INDICATOR BIT
003224 012767 003250 174632      MOV      #T16F, TPVEC        ; LOAD TELEPRINTER VECTOR
003232 012767 044000 174626      MOV      @SM+REG, TPVEC+2    ; AND 'NEW' STATUS
003240 052737 000100 177564      BIS      #BIT6, @TPS         ; GENERATE AN INTERRUPT (VIA TELEPRINTER)
003246 000001      WAIT
003250 042737 000100 177564  T16F:   BIC      #BIT6, @TPS         ; WAIT FOR INTERRUPT
003256 012767 000066 174600      MOV      #TPVEC+2, TPVEC
003264 005067 174576      CLR      TPVEC+2
003270 052767 000040 175504      BIS      #40, TEMP           ; SET INDICATOR BIT
003276 104377      EMT+377                      ; EMT TRAP
003300 000000      HLT
003302 052767 000100 175472  T16G:   BIS      #100, TEMP          ; SET INDICATOR BIT
003310 005037 177776      CLR      @PSW                ; KERNEL MODE!!!
003314 022767 000177 175460      CMP      #177, TEMP          ; TEST THAT ALL INSTRUCTIONS WHICH COULD
003322 001401      BEQ      .+4                  ; CAUSE OVERFLOW DID NOT OVERFLOW.
003324 000000      HLT                          ; ERROR!
003326 000403      BR       T16X                 ; EXIT TEST
003330 005037 177776      T16ERR: CLR      @PSW
003334 000000      HLT                          ; ERROR! STACK OVERFLOWED IN SUPER
                                           ; SUPERVISORY MODE TEMP GIVES THE INST-
                                           ; RUTION WHICH CAUSED THE OVERFLOW.
003336 005037 177774      T16X:   CLR      @SLR
003342 012737 000032 000030      MOV      @EMTVEC+2, @EMTVEC ; CLEAR STACK LIMIT
003350 005037 000032      CLR      @EMTVEC+2

: USER MODE
T17:   SCOPE
003354 010701      MOV      #400, @SLR          ; SET STACK LIMIT =1000
003356 012737 000400 177774      MOV      @UM+PSW, @PSW       ; USER MODE!!!
003364 012737 150000 177776      MOV      #T17ERR, @ERRVEC
003372 012737 003622 000004      MOV      @UPTA, USP
003400 012706 000700      MOV      TEMP, USP           ; SET USER STACK POINTER
003404 005067 175372      CLR      TEMP                ; CLEAR INDICATOR LOCATION
003410 004767 000006 175360  T17A:   JSR      7, T17B             ; PUSH ONTO USER STACK
003414 052767 000400 175352  T17B:   BIS      #400, TEMP         ; SET ERROR INDICATOR BIT
003422 052767 000001 175352  T17B:   BIS      #1, TEMP            ; SET INDICATOR BIT
003430 004567 000006      JSR      5, T17C             ; PUSH ONTO USER STACK
003434 052767 001000 175340  T17C:   BIS      #1000, TEMP        ; SET ERROR INDICATOR BIT
003442 052767 000002 175332  T17C:   BIS      #2, TEMP            ; SET INDICATOR BIT
003450 050546      BIS      R5, -(SSP)           ; PUSH ONTO USER STACK
003452 052767 000004 175322      BIS      #4, TEMP            ; SET INDICATOR BIT
003460 052737 004000 177776      BIS      @REG, @PSW          ; SELECT R10-R15
003466 004767 000006      JSR      7, T17D
003472 052767 002000 175302  T17D:   BIS      #2000, TEMP         ; PUSH ONTO USER STACK
003500 052767 000010 175274      BIS      #10, TEMP           ; SET ERROR INDICATOR BIT

```

```

003506 012702 003522      MOV      #T17E,R12      ;SET UP RETURN FOR RTS
003512 000202      RTS      R12          ;GO TO T16E
003514 052767 004000 175260  T17E:  BIS      #4000,TEMP    ;SET INDICATOR TO SHOW ERROR
003522 052767 000020 175252  BIS      #20,TEMP
003530 004567 000006      JSR      R15,T17F
003534 052767 010000 175240  T17F:  BIS      #10000,TEMP   ;SET ERROR INDICATOR BIT
003542 052767 000040 175232  BIS      #40,TEMP
003550 012767 003574 174256  MOV      #T17G,TRAPVEC ;SET UP TRAP VECTOR FOR TRAP
003556 012767 144000 174252  MOV      #UM+REG,TRAPVEC+2
003564 104400      TRAP
003566 052767 020000 175206  T17G:  BIS      #20000,TEMP
003574 052767 000100 175200  BIS      #100,TEMP
003602 005037 177776      CLR      @#PSW        ;KERNEL MODE!!!
003606 022767 000177 175166  CMP      #177,TEMP
003614 001401      BEQ     .+4
003616 000000      HLT
003620 000403      BR     T17X
003622 005037 177776  T17ERR: CLR      @#PSW
003626 000000      HLT                    ;ERROR! OVERFLOW OCCURED
003630 005037 177774  T17X:  CLR      @#SLR
003634 012767 000036 174172  MOV      #TRAPVEC+2,TRAPVEC
003642 005067 174170  CLR      TRAPVEC+2

;TEST TRAP & RETURN SUPERVISOR-KERNEL-SUPERVISOR
003646 010701      T20:  SCOPE
003650 012706 000500      MOV      #KPTR,KSP
003654 012737 004000 000022      MOV      #REG,@#IOTVEC+2
003662 012737 003764 000020      MOV      #T20A,@#IOTVEC
003670 012737 044200 177776      MOV      #SM+REG+PRTY4,@#PSW
003676 005000      CLR      R10
003700 000004      IOT
003702 013767 177776 175072  T20AA: MOV      @#PSW,TEMP    ;GET RETURN STATUS FROM IOT TRAP
003710 042737 140000 177776      BIC      #UM,@#PSW    ;KERNEL MODE!!!
003716 022767 003702 174550      CMP      #T20AA,KPTR-4 ;CHECK THAT RETURN ADDRESS WAS
003724 001401      BEQ     .+4           ;SAVED ON KERNEL STACK ON IOT TRAP
003726 000000      HLT                    ;ERROR!
003730 022767 044204 174540      CMP      #SM+REG+PRTY4+Z,KPTR-2 ;CHECK THAT STATUS WAS SAVED
003736 001401      BEQ     .+4           ;CORRECTLY ON KERNEL STACK
003740 000000      HLT                    ;ERROR! INCORRECT STATUS SAVED
003742 022767 044204 175032      CMP      #SM+REG+PRTY4+Z,TEMP ;CHECK STATUS RETURNED BY RTT
003750 001401      BEQ     .+4
003752 000000      HLT                    ;ERROR
003754 005200      INC     R10          ;CHECK THAT COM R10 WAS EXECUTED
003756 001404      BEQ     T21
003760 000000      HLT                    ;ERROR! COM R10 NOT EXECUTED AT T20A
003762 000402      BR     T21           ;GO TO NEXT TEST
003764 005100  T20A:  COM      R10
003766 000006      RTT

;TEST THAT MTPD/I POPS WORD OFF THE THE APPROPRIATE STACK (AS
;DETERMINED BY BITS 15&14 IN PSW.)
;MTPD, KERNEL MODE
003770 010701      T21:  SCOPE
003772 005037 177776      CLR      @#PSW
003776 012706 000500      MOV      #KPTR,KSP    ;SET KERNEL STACK POINTER
004002 012700 177777      MOV      #-1,R0      ;PRE-SET R0

```

004006	005016			CLR	(KSP)	:PUT 0 ON THE STACK
004010	012737	010011	177776	MOV	#PSW+N+C, @PSW	:PRE SET STATUS
004016	106600			MTPD	R0	:R0+(KSP)+
004020	013702	177776		MOV	@PSW, R2	:GET STATUS
004024	022702	010005		CMP	#PSW+Z+C, R2	:CHECK STATUS AFTER MTPD
004030	001401			BEQ	.+4	
004032	000000			HLT		:ERROR! INCORRECT STATUS
004034	022706	000502		CMP	#KPTR+2, KSP	:DID KSP INCREMENT BY 2
004040	001401			BEQ	.+4	
004042	000000			HLT		:ERROR! KSP DID NOT POP
004044	005700			TST	R0	:DID WORD ON STACK (0) GET TO R0?
004046	001401			BEQ	.+4	
004050	000000			HLT		:ERROR! MTPD DID NOT POP 0 OFF :KSP INTO R0

:MTPD, KERNEL MODE

004052	010701			↑22: SCOPE		
004054	005037	177776		CLR	@PSW	:KERNEL MODE!!!
004060	012706	000500		MOV	#KPTR, KSP	:SET KERNEL STACK PTR
004064	005002			CLR	R2	:PRESET R2
004066	012716	177777		MOV	#-1, (KSP)	:PRESET DATA ON THE STACK
004072	012737	030006	177776	MOV	#PUM+Z+V, @PSW	:PRESET STATUS
004100	006602			MTPD	R2	:R2+(KSP)+
004102	013700	177776		MOV	@PSW, R0	:GET STATUS
004106	022700	030010		CMP	#PUM+N, R0	:CHECK STATUS
004112	001401			BEQ	.+4	
004114	000000			HLT		:ERROR! INCORRECT STATUS
004116	022706	000502		CMP	#KPTR+2, KSP	:CHECK STACK PTR AFTER MTPD
004122	001401			BEQ	.+4	
004124	000000			HLT		:ERROR! INCORRECT STACK PTR
004126	005202			INC	R2	:CHECK THAT MTPD MOVED DATA
004130	001401			BEQ	.+4	:FROM STACK TO R2
004132	000000			HLT		:ERROR!

:MTPD, SUPERVISORY MODE

004134	010701			↑23: SCOPE		
004136	005003			CLR	R3	:PRESET R3
004140	012737	044000	177776	MOV	#SM+REG, @PSW	:SUPER MODE!!!
004146	012706	000600		MOV	#SPTR, SSP	:SET SUPER STACK PTR
004152	052716	177777		BIS	#-1, (SSP)	:PRESET DATA ON SUPER STACK
004156	005003			CLR	R13	:PRESET R13
004160	000261			SEC		:SET 'C'
004162	106603			MTPD	R13	:R13+(SSP)+
004164	013700	177776		MOV	@PSW, R10	:SAVE STATUS
004170	010602			MOV	SSP, R12	:SAVE SUPER STACK POINTER
004172	042737	140000	177776	BIC	#UM, @PSW	:KERNEL MODE!!!
004200	022700	044011		CMP	#SM+REG+N+C, R10	:CHECK STATUS RESULT
004204	001401			BEQ	.+4	
004206	000000			HLT		:ERROR! INCORRECT STATUS AFTER MTPD
004210	022702	000602		CMP	#SPTR+2, R12	:CHECK SUPER STACK POINTER
004214	001401			BEQ	.+4	
004216	000000			HLT		:ERROR! INCORRECT SUPER STACK POINTER
004220	005203			INC	R13	:CHECK RESULT OF MTPD
004222	001401			BEQ	.+4	
004224	000000			HLT		:ERROR! MTPD FAILED TO LOAD R13

```

004226 005037 177776          CLR      @PSW          ;KERNEL MODE!!!, R0-R5
004232 005703                TST      R3           ;CHECK THAT R3 WAS NOT CHANGED
004234 001401                BEQ      .+4
004236 000000                HLT
                                     ;ERROR! MTPD CHANGED INCORRECT REGISTER

:MTPI, SUPERVISORY MODE
t24:
004240 010701                SCOPE
004242 012737 070000 177776    MOV      @SM+PUM,@PSW ;SUPER MODE!!!, PREV USER MODE!!
004250 012706 000600                MOV      @SPTR,SSP   ;SET SUPER STACK PTR
004254 005016                CLR      (SSP)       ;PRESET DATA ON SUPER STACK
004256 012704 177777                MOV      @-1,R4      ;PRESET R4
004262 000262                SEV
004264 006604                MTPD
004266 013700 177776                MOV      @PSW,R0     ;SET 'V'
004272 010602                MOV      SSP,R2      ;R4+(SSP)+
004274 005037 177776                CLR      @PSW        ;SAVE STATUS
004300 022700 070004                CMP      @SM+PUM+2,R0 ;SAVE SUPER STACK PTR
004304 001401                BEQ      .+4         ;KERNEL MODE!!!
004306 000000                HLT                 ;CHECK STATUS AFTER MTPD
004310 022702 000602                CMP      @SPTR+2,R2 ;ERROR! INCORRECT STATUS AFTER MTPD
004314 001401                BEQ      .+4         ;CHECK SUPER STACK PTR AFTER MTPD
004316 000000                HLT                 ;ERROR! INCORRECT SUPER STACK PTR AFTER MTPD
004320 005704                TST      R4          ;CHECK THAT DATA WAS MOVED
004322 001401                BEQ      .+4         ;FROM SUPER STACK TO R4
004324 000000                HLT                 ;ERROR! MTPD FAILED TO MOVE DATA TO R4

:MTPD, USER MODE
t25:
004326 010701                SCOPE
004330 012737 150000 177776    MOV      @UM+PSM,@PSW ;USER MODE!!!
004336 012706 000700                MOV      @UPTR,USP   ;SET USER STACK PTR
004342 052716 177777                BIS      @-1,(USP)  ;PRESET DATA ON USER STACK
004346 000261                SEC
004350 042705 177777                BIC      @-1,RS      ;SET 'C'
004354 106605                MTPD
004356 013700 177776                MOV      @PSW,R5     ;PRESET RS
004362 010602                MOV      USP,R2      ;RS+(USP)+
004364 005037 177776                CLR      @PSW        ;SAVE STATUS AFTER MTPD
004370 022700 150011                CMP      @UM+PSM+H+C,R0 ;SAVE USER STACK PTR
004374 001401                BEQ      .+4         ;KERNEL MODE!!!
004376 000000                HLT                 ;CHECK STATUS AFTER MTPD
004400 022702 000702                CMP      @UPTR+2,R2 ;ERROR! INCORRECT STATUS AFTER MTPD
004404 001401                BEQ      .+4         ;CHECK USER STACK PTR AFTER MTPD
004406 000000                HLT                 ;ERROR! INCORRECT USP AFTER MTPD
004410 005205                INC      R5          ;CHECK THAT MTPD MOVED DATA FROM
004412 001401                BEQ      .+4         ;USER STACK TO RS
004414 000000                HLT                 ;ERROR! MTPD FAILED

:MTPI, USER MODE
t26:
004416 010701                SCOPE
004420 012737 140000 177776    MOV      @UM,@PSW    ;USER MODE!!!
004426 012706 000700                MOV      @UPTR,USP   ;SET USER STACK PTR
004432 042716 177777                BIC      @-1,(USP)  ;PRESET DATA ON USER STACK
004436 052700 177777                BIS      @-1,R0     ;PRESET R0
004442 000257                CCC
004444 006600                MTPD
                                     ;PRESET STATUS (ALL CC'S=0)
                                     ;R0+(USP)+

```


004446	013702	177776		MOV	2@PSW,R2	:SAVE STATUS AFTER MTP1
004452	010603			MOV	USP,R3	:SAVE USP AFTER MTP1
004454	005037	177776		CLR	2@PSW	:KERNEL MODE!!!
004460	022702	140004		CHP	2UM+2,R2	:CHECK STATUS AFTER MTP1
004464	001401			BEQ	.+4	
004466	000000			HLT		:ERROR! INCORRECT STATUS AFTER MTP1
004470	022703	000702		CHP	2UPTR+2,R3	:CHECK USP AFTER MTP1
004474	001401			BEQ	.+4	
004476	000000			HLT		:ERROR! INCORRECT USP AFTER MTP1
004500	005700			TST	RO	:CHECK THAT MTP1 MOVED DATA ON
004502	001401			BEQ	.+4	:USER STACK TO RO
004504	000000			HLT		:ERROR! MTP1 FAILED
:TEST THAT MTP D/I POPS WORD OFF STACK (AS DETERMINED BY BITS 15 & 14						
:INTO STACK POINTER (AS DETERMINED BY BITS 13 & 12).						
:SSP+(KSP)+, MTPD						
004506	010701			↑27: SCOPE		
004510	012737	040000	177776	MOV	2SM,2@PSW	:SUPER MODE!!!
004516	005006			CLR	SSP	:PRE SET SUPERVISORS STACK POINTER
004520	012737	010000	177776	MOV	2KM+PSW,2@PSW	:KERNEL MODE!!! PREV SUPER MODE!!
004526	012706	000500		MOV	2KPTR,KSP	:SET KERNEL STACK POINTER
004532	012716	000600		MOV	2SPTR,(KSP)	
004536	000277			SCC		:PRESET CC'S
004540	106606			MTPD	SSP	:SSP+(KSP)+
004542	013702	177776		MOV	2@PSW,R2	:SAVE STATUS
004546	012737	040000	177776	MOV	2SM,2@PSW	:SUPER MODE!!!
004554	010600			MOV	SSP,RO	:GET SUPER STACK POINTER
004556	005037	177776		CLR	2@PSW	:KERNEL MODE!!!
004562	022700	000600		CHP	2SPTR,RO	:CHECK THAT SUPER STACK POINTER WAS
004566	001401			BEQ	.+4	:SET BY MTPD INST.
004570	000000			HLT		:ERROR! MTPD FAILED TO SET SUPER STACK POINTER
004572	022702	010001		CHP	2PSW+C,R2	:CHECK STATUS AFTER MTPD
004576	001401			BEQ	.+4	
004600	000000			HLT		:ERROR! INCORRECT STATUS AFTER MTPD
:USP+(KSP)+, MTPD						
004602	010701			↑30: SCOPE		
004604	012737	140000	177776	MOV	2UM,2@PSW	:USER MODE!!!
004612	005006			CLR	USP	:PRESET USER STACK POINTER
004614	012737	030000	177776	MOV	2KM+PUM,2@PSW	:KERNEL MODE!!! PREV USER MODE!!
004622	012706	000500		MOV	2KPTR,KSP	:SET KERNEL STACK POINTER
004626	012716	000700		MOV	2UPTR,(KSP)	
004632	000277			SCC		:PRESET CC'S
004634	106606			MTPD	USP	:USP+(KSP)+
004636	013702	177776		MOV	2@PSW,R2	:SAVE CC'S
004642	012737	140000	177776	MOV	2UM,2@PSW	:USER MODE!!!
004650	010600			MOV	USP,RO	:GET USER STACK POINTER
004652	005037	177776		CLR	2@PSW	:KERNEL MODE!!!
004656	022700	000700		CHP	2UPTR,RO	:CHECK THAT MTPD SET USER STACK
004662	001401			BEQ	.+4	:POINTER PROPERLY
004664	000000			HLT		:ERROR!
004666	022706	000502		CHP	2KPTR+2,KSP	:CHECK KERNEL STACK POINTER
004672	001401			BEQ	.+4	
004674	000000			HLT		

Address	PC	PSW	SPSR	Instruction	Comment
:KSP+(KSP)+, MTPD					
004676	010701			T31: SCOPE	
004700	012706	000500		MOV #KPTR, KSP	
004704	012716	000736		MOV #REDPTR, (KSP)	:PRESET DATA ON KERNEL STACK
004710	106606			MTPD KSP	:KSP+(KSP)+
004712	022706	000736		CMP #REDPTR, KSP	:CHECK THAT MTPD MOVED DATA ON
004716	001401			BEQ .+4	:KERNEL STACK TO KERNEL STACK PTR
004720	000000			HLT	:ERROR! MTPD FAILED
:SSP+(SSP)+					
004722	010701			T31A: SCOPE	
004724	012737	050000	177776	MOV #SM+PSW, @PSW	:SUPER MODE!!! PREV SUPER MODE!!
004732	005006			CLR SSP	:SET SUPER STACK POINTER
004734	012737	000600	000000	MOV #SPTR, @0	:PUT NEW STACK POINTER VALUE ON STACK
004742	000277			SCC	:PRESET CC'S
004744	106606			MTPD SSP	:SSP+(SSP)+
004746	013702	177776		MOV @PSW, R2	:SAVE RESULT STATUS
004752	010600			MOV SSP, R0	:SAVE NEW SUPER STACK POINTER
004754	005037	177776		CLR @PSW	:KERNEL MODE!!!
004760	022700	000600		CMP #SPTR, R0	:CHECK THAT MTPD SET SUPER STACK
004764	001401			BEQ .+4	:POINTER PROPERLY
004766	000000			HLT	:ERROR!
004770	022702	050001		CMP #SM+PSW+C, R2	:CHECK STATUS RESULT
004774	001401			BEQ .+4	
004776	000000			HLT	:ERROR! INCORRECT STATUS AFTER MTPD
:USP+(SSP)+, MTPD					
005000	010701			T31B: SCOPE	
005002	012737	140000	177776	MOV #UM, @PSW	:USER MODE!!!
005010	012706	000700		MOV #UPTR, USP	:SET USER STACK POINTER
005014	012737	070000	177776	MOV #SM+PUM, @PSW	:SUPER MODE!!! PREV USER MODE!!
005022	012706	000600		MOV #SPTR, SSP	:SET SUPER STACK POINTER
005026	005046			CLR -(SSP)	:PUSH NEW USER STACK POINTER ONTO
					:SUPER STACK
					:PRESET CC'C
005030	000277			SCC	
005032	000244			CLZ	
005034	106606			MTPD USP	:USP+(SSP)+
005036	013702	177776		MOV @PSW, R2	:SAVE RESULT STATUS
005042	010600			MOV SSP, R0	:SAVE SUPER STACK POINTER
005044	052737	140000	177776	BIS #UM, @PSW	:USER MODE!!!
005052	010603			MOV USP, R3	:GET USER STACK POINTER
005054	005037	177776		CLR @PSW	:KERNEL MODE!!!
005060	022702	070005		CMP #SM+PUM+Z+C, R2	:CHECK RESULT STATUS
005064	001401			BEQ .+4	
005066	000000			HLT	:ERROR! INCORRECT STATUS AFTER MTPD
005070	022700	000600		CMP #SPTR, R0	:CHECK SUPER STACK POINTER
005074	001401			BEQ .+4	
005076	000000			HLT	:ERROR! INCORRECT SUPER STACK PINTER
005100	005703			TST R3	:CHECK USER STACK POINTER
005102	001401			BEQ .+4	
005104	000000			HLT	:ERROR! MTPD FAILED TO SET USER STACK POINTER
:USP+(USP)+, MTPD					
005106	010701			T31C: SCOPE	
005110	012737	170000	177776	MOV #UM+PUM, @PSW	:USER MODE!!! PREV USER MODE!!
005116	012706	000700		MOV #UPTR, USP	:SET USER STACK POINTER

005122	005016			CLR	(USP)	:PUT NEW STACK VALUE ON STACK
005124	000257			CCC		:PRESET CC'S
005126	106606			MTPD	USP	:USP+(USP)+
005130	013700	177776		MOV	@PSW,RO	:SAVE CC'S
005134	010602			MOV	USP,R2	:SAVE USER STACK POINTER
005136	005037	177776		CLR	@PSW	:KERNEL MODE!!!
005142	022700	170004		CMP	@UM+PUM+Z,RO	:CHECK STATUS
005146	001401			BEQ	+.4	
005150	000000			HLT		:ERROR! INCORRECT STATUS AFTER MTPD
005152	005702			TST	R2	:CHECK NEW STACK POINTER VALUE
005154	001401			BEQ	+.4	
005156	000000			HLT		:ERROR! MTPD FAILED TO SET USER STACK POINTER
:SSP+(KSP)+, MTPD						
005160	010701			↑32: SCOPE		
005162	012737	040000	177776	MOV	@SH,@PSW	:SUPERVISORY MODE!!!
005170	005006			CLR	SSP	:PRESET SUPER STACK POINTER
005172	006237	177776		ASR	@PSW	
005176	006237	177776		ASR	@PSW	:KERNEL MODE!!!, PREV SUPER MODE!!
005202	012716	000600		MOV	@SPTR,(KSP)	
005206	006606			MTPD		:SSP+(KSP)+
005210	006337	177776		ASL	@PSW	
005214	006337	177776		ASL	@PSW	:SUPERVISORY MODE!!!
005220	010667	173556		MOV	SSP,TEMP	:GET SUPER STACK POINTER
005224	005037	177776		CLR	@PSW	:KERNEL MODE!!!
005230	022767	000600	173544	CMP	@SPTR,TEMP	:CHECK THAT TOP WORD ON KSP (@SPTR)
005236	001401			BEQ	+.4	:WAS SET INTO SUPER STACK POINTER (SSP)
005240	000000			HLT		:ERROR!
:USP+(KSP)+, MTPD						
005242	010701			↑32A: SCOPE		
005244	012737	140000	177776	MOV	@UM,@PSW	:USER MODE
005252	012706	177777		MOV	@-1,USP	:PRESET USER STACK POINTER
005256	012737	030000	177776	MOV	@UM+PUM,@PSW	:CURRENT KERNEL, PREVIOUS USER
005264	005046			CLR	-(KSP)	:PRESET DATA ON KERNEL STACK
005266	006606			MTPD	USP	:USP+(KSP)+
005270	012737	140000	177776	MOV	@UM,@PSW	:USER MODE!!!
005276	010600			MOV	USP,RO	:GET USER STACK POINTER
005300	005037	177776		CLR	@PSW	:KERNEL MODE!!!
005304	005700			TST	RO	:CHECK THAT DATA ON KERNEL STACK
005306	001401			BEQ	+.4	:WAS MOVED TO USER STACK PTR
005310	000000			HLT		:ERROR! MTPD FAILED
:USP+(SSP)+, MTPD						
005312	010701			↑33: SCOPE		
005314	012737	140000	177776	MOV	@UM,@PSW	:USER MODE!!!
005322	005006			CLR	USP	:PRE SET USR STACK POINTER
005324	012737	070000	177776	MOV	@SH+PUM,@PSW	:CURRENT SUPERVISOR, PREVIOUS USER
005332	012746	000700		MOV	@UPTR,-(SSP)	:PRESET DATA ON SUPER STACK
005336	006606			MTPD	USP	:USP+(SSP)+
005340	012737	140000	177776	MOV	@UM,@PSW	:USER MODE!!!
005346	010600			MOV	USP,RO	:SAVE USER STACK PTR
005350	005037	177776		CLR	@PSW	:KERNEL MODE!!!
005354	022700	000700		CMP	@UPTR,RO	:CHECK THAT MTPD MOVED DATA FROM
005360	001401			BEQ	+.4	:SUPER STACK TO USER STACK PTR

```

005362 000000 HLT ;ERROR! MTP1 FAILED

:SSP+(SSP)+ MTP1
†34: SCOPE
005364 010701 MOV #SM+PSM, @#PSW ;SUPER MODE!!! PREV SUPER MODE!!
005366 012737 050000 177776 CLR SSP ;SET SUPER STACK PTR
005374 005006 MOV #SPTR, (SSP) ;PRESET DATA ON SUPER STAC
005376 012716 000600 MTP1 SSP ;SSP+(SSP)+
005402 006606 MOV SSP, RO ;GET SUPER STACK PTR
005404 010600 CLR @#PSW ;KERNEL MODE!!!
005406 005037 177776 CMP #SPTR, RO ;CHECK THAT MTP1 MOVED DATA ON
005412 022700 000600 BEQ .+4 ;SUPER STACK TO SUPER STACK PTR
005416 001401 HLT ;ERROR! MTP1 FAILED
005420 000000

:USP+(USP)+
†35: SCOPE
005422 010701 MOV #UM+PUM, @#PSW ;USER MODE!!! PREV USER MODE!!
005424 012737 170000 177776 MOV #SPTR, USP ;SET USER STACK PTR
005432 012706 000600 MOV #UPTR, (USP) ;PRESET DATA ON USER STACK
005436 012716 000700 MTP1 USP ;USP+(USP)+
005442 006606 MOV USP, RO ;SAVE USER STACK PTR IN RO
005444 010600 CLR @#PSW ;KERNEL MODE!!!
005446 005037 177776 CMP #UPTR, RO ;CHECK THAT MTP1 MOVED DATA ON
005452 022700 000700 BEQ .+4 ;USER STACK TO USER STACK PTR
005456 001401 HLT ;ERROR! MTP1 FAILED
005460 000000

:TEST THAT MTPD/I TRAPS ON AN ODD ADDRESS DESTINATION
:KERNEL MODE
†36: SCOPE
005462 010701 CLR @#PSW
005464 005037 177776 MOV #KPTR, KSP
005470 012706 000500 MOV @-1, (KSP)
005474 012716 177777 MOV #T36A, @#ERRVEC
005500 012737 005520 000004 CLR ERRVEC+2
005506 005067 172274 MTPD -1 ;TRAPS ON ODD ADDRESS
005512 106667 172261 HLT ;ERROR! DID NOT TRAP
005516 000000 T36AA: ;IS KSP CORRECT?(1 POP AND 2
005520 022706 000476 T36A: CMP #KPTR-2, KSP ;PUSHES)
005524 001401 BEQ .+4 ;ERROR! INCORRECT VALUE IN KSP
005526 000000 HLT ;CHECK RETURN PC ON STACK
005530 022767 005516 172740 CMP #T36AA, KPTR-2
005536 001401 BEQ .+4 ;ERROR! RETURN PC NOT ON STACK
005540 000000 HLT

:SUPERVISORY MODE
†37: SCOPE
005542 010701 MOV #SM+REG, @#PSW ;PRESET R10
005544 012737 044000 177776 CLR R10 ;RO-R5
005552 005000 BIC #REG, @#PSW ;RO CONTAINS AN ODD ADDRESS
005554 042737 004000 177776 MOV @1, RO ;SET SUPERVISOR'S STACK POINTER
005562 012700 000001 MOV #SPTR, SSP ;-1 IS THE DATA TO BE MOVED
005566 012706 000600 MOV @-1, (SSP) ;LOAD ERROR VECTOR
005572 012716 177777 MTPD (RO)+ ;TRAPS ON ODD ADDRESS
005576 012737 005622 000004 MOV #SM, @#ERRVEC+2
005604 012737 040000 000006 HLT ;ERROR! DID NOT TRAP
005612 106620 T37AA: CLR @#PSW
005614 005037 177776 HLT
005620 000000

```

```

005622 010602          T37A:  MOV      SSP,R2      ;GET SUPERVISOR STACK POINTER
005624 005037 177776  CLR      @#PSW      ;KERNEL MODE!!!
005630 022702 000576  CMP      @SPTR-2,R2 ;CHECK SUPER STACK PTR AFTER
005634 001401          BEQ      .+4        ;MTPD AND TRAP
005636 000000          HLT                    ;ERROR! INCORRECT SSP
005640 022767 005614 172730  CMP      @T37AA,SPTR-2 ;CHECK RETURN PC ON SUPER STACK
005646 001401          BEQ      .+4
005650 000000          HLT                    ;ERROR! INCORRECT RETURN PC ON STACK
005652 022700 000003  CMP      @3,R0      ;CHECK AUTO-INC OF R0
005656 001401          BEQ      .+4
005660 000000          HLT                    ;ERROR! R0 FAILED TO AUTO-INC

;USER MODE
T40:  SCOPE
005662 010701          MOV      @UM+PUM,@#PSW ;USER MODE!!!, PREV USER MODE!!
005664 012737 170000 177776  CLR      R2
005672 005002          BIS      @REG,@#PSW   ;SELECT R10-R15
005674 052737 004000 177776  MOV      @1,R12
005702 012702 000001          MOV      @UPTR,USP    ;SET USER STACK POINTER
005706 012706 000700          MOV      @125252,(USP);PRESET USER STACK
005712 012716 125252          MOV      @T40A,@ERRVEC ;LOAD ERROR VECTOR
005716 012737 005742 000004  MOV      @UM+REG,@ERRVEC+2
005724 012737 144000 000006  MTPD    -(R12)       ;-(R12)+(USP)+; SHOULD TRAP ON ODD ADDS
005732 006642          CLR      @#PSW      ;KERNEL MODE!!!
005734 005037 177776  T40AA:  HLT                    ;ERROR DID NOT TRAP
005740 000000          MOV      USP,R10     ;GET USERS STACK POINTER
005742 010600  T40A:  BIC      @UM,@#PSW   ;KERNEL MODE!!!
005744 042737 140000 177776  CMP      @UPTR-2,R10 ;CHECK THAT USER STACK POINTER
005752 022700 000676          BEQ      .+4        ;PUSHED PROPERLY (1 POP, 2 PUSHES)
005756 001401          HLT                    ;ERROR! INCORRECT USER STACK POINTER
005760 000000          CMP      @UM+PUM+REG+N,@#UPTR ;CHECK THAT CORRECT STATUS WAS
005762 022737 174010 000700  BEQ      .+4        ;SAVED ON USER STACK ('N' IS DATA POPPED)
005770 001401          HLT                    ;ERROR! INCORRECT STATUS SAVED ON USER STACK
005772 000000          CMP      @T40AA,UPTR-2 ;CHECK THAT RETURN ADDRESS WAS
005774 022767 005734 172674  BEQ      .+4        ;SAVED ON USER STACK
006002 001401          HLT                    ;ERROR! RETURN PC NOT ON USER STACK
006004 000000          CMP      @-1,R12    ;DID R12 DECREMENT BY 2
006006 022702 177777          BEQ      .+4
006012 001401          HLT                    ;ERROR! AUTO-DEC FAILED
006014 000000          CLR      @#PSW
006016 005037 177776

;TEST THAT MTP D/I CAN LOAD MEMORY ADDRESSES.
;KERNEL MODE
T41:  SCOPE
006022 010701          CLR      @#PSW      ;KERNEL MODE!!!
006024 005037 177776  MOV      @-1,R0     ;PRESET R0
006030 012700 177777          MOV      @T41A,@ERRVEC ;SET ERROR VECTOR
006034 012737 006070 000004  CLR      ERRVEC+2
006042 005067 171740          BIS      @REG,@#PSW   ;R10-R15
006046 052737 004000 177776  CLR      R10
006054 005000          MOV      @2,-(KSP)   ;PRESET R10
006056 012746 000002          SEC                    ;PRESET DATA ON STACK
006062 000261          MTPD    (R10)+      ;SET 'C'
006064 106620          BR      .+4          ;(R10)+(KSP)+
006066 000401          HLT                    ;ERROR! TRAPPED
006070 000000  T41A:  BCS      .+4          ;MTP D/I SHOULD NOT AFFECT CARRY
006072 103401

```

```

006074 000000          HLT                               ;BIT ERROR! CARRY BIT BUT CLEARED.
006076 022767 000002 171674  CMP      #2,0                ;CHECK THAT DATA WAS MOVED
006104 001401          BEQ      .+4                    ;FROM KERNEL STACK TO MEM ADDRESS
006106 000000          HLT

006110 010701          T41B: SCOPE
006112 012737 004000 177776  MOV      @REG,@PSW          ;KERNEL MODE!!!
006120 012737 006146 000004  MOV      @T41BB,@ERRVEC    ;LOAD ERROR VECTOR
006126 012706 000500          MOV      @KPTR,KSP         ;SET KERNEL STACK POINTER
006132 012716 177777          MOV      @-1,(KSP)        ;LOAD KERNEL STACK
006136 000257          CCC
006140 106637 001002          MTPD     @TEMP            ;@TEMP+(KSP)+

006144 000401          T41BB: BR      .+4
006146 000000          HLT                               ;ERROR! TRAPPED
006150 013700 177776          MOV      @PSW,R10         ;SAVE CC'S
006154 022700 004010          CMP      @REG+N,R10       ;CHECK RESULT STATUS
006160 001401          BEQ      .+4
006162 000000          HLT                               ;ERROR! INCORRECT STATUS AFTER MTPD
006164 005237 001002          INC      @TEMP            ;CHECK RESULT
006170 001401          BEQ      .+4
006172 000000          HLT                               ;ERROR! MTPD FAILED

: SUPERVISORY MODE
006174 010701          T42: SCOPE
006176 005037 177776          CLR      @PSW
006202 012702 052525          MOV      @52525,R2
006206 012737 006250 000004  MOV      @T42A,@ERRVEC    ;
006214 052737 044000 177776  BIS      @SM+REG,@PSW
006222 012702 001002          MOV      @TEMP,R12
006226 012767 177777 172546  MOV      @-1,TEMP
006234 012706 000600          MOV      @SPTR,SSP

006240 005016          CLR      (SSP)
006242 000262          SEV
006244 006622          MTPD     (R12)+           ;(R12)++(SSP)+
006246 000401          BR      .+4
006250 000000          T42A: HLT                               ;ERROR TRAPPED ON ODD ADDRESS
006252 013700 177776          MOV      @PSW,R10         ;GET CC'S
006256 042737 140000 177776  BIC      @UM,@PSW
006264 022700 044004          CMP      @SM+REG+2,R10
006270 001401          BEQ      .+4
006272 000000          HLT
006274 005767 172502          TST     TEMP
006300 001401          BEQ      .+4
006302 000000          HLT

006304 010701          T43B: SCOPE
006306 012767 177777 172466  MOV      @-1,TEMP         ;PRESET TEMP
006314 012737 006346 000004  MOV      @T43BB,@ERRVEC   ;LOAD ERROR VECTOR
006322 012737 074000 177776  MOV      @SM+PUM+REG,@PSW ;SUPERVISORY MODE!!! PREV USER MODE!!
006330 012706 000600          MOV      @SPTR,SSP       ;SET SUPER STACK POINTER
006334 005046          CLR      -(SSP)          ;PRESET SUPER STACK
006336 000257          CCC
006340 106667 172436          MTPD     TEMP            ;PRESET CC'S
                                ;TEMP+(SSP)+

```

```

006344 000401
006346 000000
006350 013702 177776
006354 010600
006356 022702 074004
006362 001401
006364 000000
006366 022700 000600
006372 001401
006374 000000
T4388: BR .+4
HLT ;ERROR! TRAPPED
MOV @#PSW,R12 ;SAVE CC'S
MOV SSP,R10 ;SAVE SUPER STACK POINTER
CMP @#N+@#P+@#REG+Z,R12 ;CHECK STATUS RESULT
BEQ .+4
HLT ;ERROR! INCORRECT STATUS
CMP @#SPTR,R10 ;CHECK SUPER STACK POINTER
BEQ .+4
HLT ;ERROR! INCORRECT SUPER STACK POINTER

```

```

:USER MODE
T43: SCOPE
006376 010701
006400 005037 177776
006404 012703 177777
006410 012737 006450 000004
006416 012737 144000 177776
006424 012703 001004
006430 005067 172346
006434 012706 000700
006440 052716 177777
006444 006643
006446 000401
006450 000000
006452 013700 177776
006456 042737 140000 177776
006464 122700 000010
006470 001401
006472 000000
006474 005167 172302
006500 001401
006502 000000
006504 012737 000006 000004
006512 005067 171270
T43A: HLT ;ERROR TRAPPED
MOV @#PSW,R10 ;KERNEL MODE!!!
BIC @#N,@#PSW
CMPB @#N,R10
BEQ .+4
HLT
COM TEMP
BEQ .+4
HLT
MOV @#ERRVEC+2,@#ERRVEC
CLR @#ERRVEC+2

```

:TEST THAT MFP D/I PUSHES DESTINATION REGISTER DATA ONTO THE APPROPRIATE STACK
:(AS DETERMINED BY PSM BITS 15 & 14)

:KERNEL MODE MFPD

```

T44: SCOPE
006516 010701
006520 012706 000500
006524 012716 125252
006530 005027 000000
006534 012737 004000 177776
006542 012700 177777
006546 000261
006550 106500
MOV @#KPTR,KSP
MOV @125252,(KSP)
CLR @#R0
MOV @#REG,@#PSW
MOV @-1,R10
SEC
MFPD R10 ;-(KSP)+R10,(R10)=-1
MOV @#PSW,R12 ;GET STATUS RESULT
CMP @#REG+@#N+C,R12
BEQ .+4
HLT ;ERROR! INCORRECT STATUS RESULT
CMP @#KPTR-2,KSP ;DID KERNEL STACK POINTER GET
BEQ .+4 ;PUSHED?
HLT ;ERROR!
COM (KSP) ;TEST THAT CORRECT DATA(-1) GOT
BEQ .+4 ;PUSHED ONTO KERNEL STACK

```

K02

MAINDEC-11-DCKBO-A PROCESSOR STATES TEST
DCKBOA.P11

MACY11 27(732) 03-SEP-76 18:18 PAGE 23

006602	000000			HLT		;ERROR! -1NOT PUSHED ONTO KERNEL STACK
				MODE MFP1		
				SCOPE		
006604	010701			MOV	#KPTR, KSP	
006606	012706	000500		MOV	#52525, (KSP)	;PRE SET STACK
006612	012716	052525		CLR	R4	;PRESET 'WRONG' REGISTER
006616	005004			MOV	#REG+C, #PSW	;SELECT R10-R15, SET C
006620	012737	004001	177776	MOV	#125252, R14	;LOAD DATA TO BE MOVED
006626	012704	125252		MFP1	R14	;-(KSP)+R14, (R14)=125252
006632	006504					
006634	013700	177776		MOV	#PSW, R10	
006640	022700	004011		CMP	#REG+N+C, R10	;CHECK STATUS RESULT
006644	001401			BEQ	.+4	
006646	000000			HLT		;ERROR! INCORRECT STATUS
006650	022706	000476		CMP	#KPTR-2, KSP	;CHECK PUSH
006654	001401			BEQ	.+4	
006656	000000			HLT		;ERROR! KSP DID NOT PUSH DOWN
006660	022716	125252		CMP	#125252, (KSP)	;CHECK DATA ON THE STACK
006664	001401			BEQ	.+4	
006666	000000			HLT		;ERROR! INCORRECT DATA ON THE STACK
						;IF DATA=0 THEN INCORRECT REGISTER
						; (R4), IF DATA=52525 NO DATA PUSHED
						; ON THE STACK.

:KERNEL
↑45:


```

: SUPERVISORY MODE, MFPD
†46: SCOPE
006670 010701
006672 012737 040340 177776 MOV #SM+PRTY7, @PSW
006700 012706 000600 MOV #SPTR, SSP
006704 012702 177777 MOV #-1, R2
006710 012716 052525 MOV #52525, (SSP)
006714 052737 004000 177776 BIS #REG, @PSW
006722 005002 CLR R12
006724 000262 SEV
006726 106502 MFPD R12 ;-(SSP)+R12, (R12)=0

006730 013700 177776 MOV @PSW, R10
006734 010603 MOV SSP, R13
006736 042737 140000 177776 BIC #UM, @PSW
006744 022700 044344 CMP #SM+REG+PRTY7+Z, R10 ;CHECK STATUS RESULT
006750 001401 BEQ .+4
006752 000000 HLT
006754 022703 000576 CMP #SPTR-2, R13
006760 001401 BEQ .+4
006762 000000 HLT
006764 005713 TST (R13)
006766 001401 BEQ .+4
006770 000000 HLT

: SUPERVISORY MODE, MFPI
†47: SCOPE
006772 010701
006774 012737 040200 177776 MOV #SM+PRTY4, @PSW
007002 012706 000600 MOV #SPTR, SSP
007006 012705 177777 MOV #-1, R5
007012 012716 125252 MOV #125252, (SSP)
007016 052737 004000 177776 BIS #REG, @PSW
007024 012705 052525 MOV #52525, R15
007030 000277 SCC
007032 006505 MFPI R15 ;-(SSP)+R15, (R15)=52525

007034 013700 177776 MOV @PSW, R10
007040 010604 MOV SSP, R14
007042 042737 140000 177776 BIC #UM, @PSW
007050 022700 044201 CMP #SM+REG+PRTY4+C, R10 ;CHECK STATUS RESULT
007054 001401 BEQ .+4
007056 000000 HLT
007060 022704 000576 CMP #SPTR-2, R14
007064 001401 BEQ .+4
007066 000000 HLT
007070 022767 052525 171500 CMP #52525, SPTR-2
007076 001401 BEQ .+4
007100 000000 HLT

```

```

:USER MODE MFPD
↑50: SCOPE
007102 010701 CLR R3 ;PRESET
007104 005003 MOV #UM+REG,#PSW ;USER MODE, R10-R15
007106 012737 144000 177776 MOV #UPTR,USP ;SET USER'S STACK POINTER
007114 012706 000700 MOV #125252,(USP)+ ;PRESET STACK
007120 012726 125252 MOV #-1,R13 ;
007124 012703 177777 CCC ;
007130 000257 MFPD R13 ;-(USP)+R13 (R13)=-1
007132 106503

007134 013700 177776 MOV #PSW,R10
007140 010604 MOV USP,R14
007142 042737 140000 177776 BIC #UM,#PSW
007150 022700 144010 CMP #UM+REG+N,R10
007154 001401 BEQ .+4
007156 000000 HLT
007160 022704 000700 CMP #UPTR,R14
007164 001401 BEQ .+4
007166 000000 HLT
007170 005214 INC (R14)
007172 001401 BEQ .+4
007174 000000 HLT
007176 005037 177776 CLR #PSW

:USER MODE MFPI
↑51: SCOPE
007202 010701 CLR R5
007204 005005 MOV #UM+REG,#PSW ;USER MODE!!!
007206 012737 144000 177776 MOV #UPTR,USP ;SET USER STACK POINTER
007214 012706 000700 MOV #-1,(USP) ;PRESET USER STACK
007220 012716 177777 MOV #UPTR,R15 ;PRESET R15
007224 012705 000700 SCC ;PRESET CONDITION CODES
007230 000277 MFPI R15 ;-(USP)+R15
007232 006505

007234 013700 177776 MOV #PSW,R10 ;GET STATUS RESULT
007240 010602 MOV USP,R12 ;GET USER STACK POINTER
007242 042737 140000 177776 BIC #UM,#PSW ;KERNEL MODE!!!
007250 022700 144001 CMP #UM+REG+C,R10 ;CHECK STATUS RESULT AFTER MFPI INST
007254 001401 BEQ .+4 ;ERROR! INCORRECT STATUS AFTER MFPI
007256 000000 HLT
007260 022702 000676 CMP #UPTR-2,R12
007264 001401 BEQ .+4
007266 000000 HLT
007270 022712 000700 CMP #UPTR,(R12)
007274 001401 BEQ .+4
007276 000000 HLT

```

: TEST THAT MFPD/I PUSHES DESTINATION MEMORY DATA ONTO THE APPROPRIATE
: STACK.

```
: KERNEL MODE, MFPD
↑52: SCOPE
007300 010701 177776 CLR      @#PSW          ; KERNEL MODE!!!
007302 005037 001002 MOV      @TEMP, R0     ; PRESET R0
007306 012700 004000 177776 BIS      @REG, @#PSW   ; SELECT R10-R15
007312 052737 001004 MOV      @TEMP+2, R10 ; PRESET R10
007320 012700 001004 MOV      @-1, TEMP
007324 012767 177777 171450 CLR      TEMP+2
007332 005067 171446 MOV      @KPTR, KSP    ; SET KERNEL STACK POINTER
007336 012706 000500 MOV      @125252, (KSP); PRESET KERNEL STACK
007342 012716 125252 MFPD     (R10)+       ; -(KSP)+(R10)+, R10=TEMP+2, TEMP+2=0
007346 106520

007350 013702 177776 MOV      @#PSW, R12
007354 022702 004004 CMP      @REG+2, R12
007360 001401 BEQ      .+4
007362 000000 HLT
007364 022706 000476 CMP      @KPTR-2, KSP
007370 001401 BEQ      .+4
007372 000000 HLT
007374 005716 TST      (KSP)
007376 001401 BEQ      .+4
007400 000000 HLT

: SUPERVISORY MODE, MFPI
↑53: SCOPE
007402 010701 070000 177776 MOV      @SM+PUM, @#PSW ; SUPERVISORY MODE!!!
007404 012737 001004 MOV      @TEMP+2, R2   ; PRESET R2
007412 012702 004000 177776 BIS      @REG, @#PSW   ; SELECT R10-R15
007416 052737 001006 MOV      @TEMP+4, R12 ; PRESET R12
007424 012702 001006 CLR      TEMP
007430 005067 171346 MOV      @TEMP+2, TEMP+2
007434 012767 001004 171342 MOV      @SPTR, SSP    ; SET SUPERVISORY STACK POINTER
007442 012706 000600 MOV      @52525, (SSP); PRESET SUPER STACK
007446 012716 052525 MFPI     @-(R12)     ; -(SSP)+(R12), R12=TEMP+4, TEMP+2=TEMP+2
007452 006552

007454 013700 177776 MOV      @#PSW, R10    ; GET CONDITION CODE RESULTS
007460 010603 MOV      SSP, R13
007462 042737 140000 177776 BIC      @UM, @#PSW
007470 022700 074000 CMP      @SM+PUM+REG, R10 ; CHECK STATUS AFTER MFPI INST.
007474 001401 BEQ      .+4
007476 000000 HLT          ; ERROR! INCORRECT STATUS AFTER MFPI
007500 022703 000576 CMP      @SPTR-2, R13 ; CHECK SUPER STACK POINTER
007504 001401 BEQ      .+4
007506 000000 HLT          ; ERROR! INCORRECT SSP AFTER MFPI
007510 022713 001004 CMP      @TEMP+2, (R13); CHECK THAT PROPER DATA WAS PUSHED
007514 001401 BEQ      .+4          ; ONTO SUPERVISORY STACK
007516 000000 HLT          ; ERROR! INCORRECT DATA ON SUPER STACK
```

```

:USER MODE MFPI
T54:  SCOPE
007520 010701 150000 177776  MOV  @UM+PSM, @PSM
007522 012737 001004 177776  MOV  @TEMP+2, R3
007530 012703 004340 177776  BIS  @REG+PRTY7, @PSM
007534 052737 001006 171224  MOV  @TEMP+4, R13
007542 012703 171230 171224  CLR  TEMP
007546 005067 177777 171224  MOV  @-1, TEMP+2
007552 012767 000700 171224  MOV  @UPTR, USP
007560 012706 125252 171224  MOV  @125252, (USP)
007564 012716 177776 171224  MFPI  -2(R13) ;-(USP+-2(R13), R13=@TEMP+4, TEMP+2=-1
007570 006563

007574 013700 177776  MOV  @PSM, R10
007600 010602 177776  MOV  USP, R12
007602 042737 140000 177776  BIC  @UM, @PSM
007610 022700 154350 177776  CMP  @UM+PSM+REG+PRTY7+N, R10
007614 001401  BEQ  .+4
007616 000000  HLT
007620 022702 000676  CMP  @UPTR-2, R12
007624 001401  BEQ  .+4
007626 000000  HLT
007630 005112  COM  (R12)
007632 001401  BEQ  .+4
007634 000000  HLT

;TEST OVERFLOW (YELLOW) USING MFPD INSTRUCTION

007636 010701 014000 177776  T55:  SCOPE
007640 012737 001000 177776  MOV  @PSM+REG, @PSM ;KERNEL MODE!!! PREV SUPER MODE
007646 012706 001000 171122  MOV  @YELPTR, KSP ;SET STACK PTR AT TOP OF YELLOW ZONE
007652 012767 177777 171122  MOV  @-1, TEMP ;PRESET DATA
007660 005066 177776 171122  CLR  -2(KSP) ;PRESET STACK DATA
007664 012737 007712 000004  MOV  @T55A, @ERRVEC ;LOAD ERROR TRAP VECTOR
007672 005037 000006 000004  CLR  @ERRVEC+2
007676 012737 000400 177774  MOV  @400, @SLR ;SET STACK LIMIT =1000
007704 106567 171072 171072  MFPD  TEMP ;PUSH TEMP ONTO KERNEL STACK

007710 000000 177777 171056  T55AA: HLT ;SHOULD OVERFLOW STACK
007712 022767 177777 171056  T55A:  CMP  @-1, YELPTR-2 ;ERROR! FAILED TO TRAP ON OVERFLOW
007720 001401  BEQ  .+4 ;CHECK THAT MFPD PUSHED DATA
007722 000000  HLT ;ONTO STACK
007724 022767 014010 171042  CMP  @PSM+REG+N, YELPTR-4 ;ERROR! MFPD FAILED TO PUSH DATA
007732 001401  BEQ  .+4 ;CHECK SAVED STATUS ON TRAP
007734 000000  HLT ;ERROR! INCORRECT STATUS SAVED
007736 022767 007710 171026  CMP  @T55AA, YELPTR-6 ;CHECK SAVED PC ON STACK
007744 001401  BEQ  .+4
007746 000000  HLT ;ERROR! INCORRECT PC SAVED ON STACK
007750 005037 177774  CLR  @SLR ;CLEAR STACK LIMIT REGISTER

```

```

:TEST OVERFLOW (RED) USING MFPI INSTRUCTION
T56:  SCOPE
007754 010701          010030 000004      MOV      @T56A,@ERRVEC ;SET ERROR TRAP VECTOR
007756 012737          010030 000004      MOV      @PUM+REG+PRTY7,@PSW ;KERNEL MODE!!!  PREV USER MODE!!
007764 012737          034340 177776      MOV      @REDPTR,KSP ;SET STACK PTR TO TOP OF RED ZONE
007772 012706          000736          MOV      @-1,-2(KSP) ;PRESET RED LOCATION=-1
007776 012766          177777 177776      MOV      TEMP ;(TEMP)WILL BE THE DATA MOVED
010004 005067          170772          CLR      ;TO RED LOCATION
010010 012703          001004          MOV      @TEMP+2,R13 ;LOAD INDEX REGISTER
010014 012737          000400 177774      MOV      @400,@SLR ;SET STACK LIMIT=1000
010022 006563          177776          MFPI     -2(R13) ;-(KSP)+TEMP SHOULD OVER
                                ;FLOW (RED)
                                ;ERROR! FAILED TO TRAP ON 'RED'
                                ;OVERFLOW
T56AA: HLT ;TEST THAT MFPI DID NOT WRITE
                                ;INTO 'RED' LOCATION
                                ;ERROR!
                                ;STACK SHOULD HAVE GONE TO 0
010026 000000          T56AA: HLT
010030 022737          177777 000734      T56A:  CMP      @-1,@REDPTR-2
010036 001401          BEQ      .+4
010040 000000          HLT
010042 005706          TST      KSP
010044 001401          BEQ      .+4
010046 000000          HLT
010050 022737          034344 000002      CMP      @PUM+REG+PRTY7+Z,@Z ;OLD STATUS SHOULD BE IN 2
010056 001401          BEQ      .+4
010060 000000          HLT
010062 022737          010026 000000      CMP      @T56AA,@Z ;ERROR!
010070 001401          BEQ      .+4 ;AND RETURN IN 0
010072 000000          HLT ;ERROR! INCORRECT PC IN 0
010074 005037          177774          CLR      @SLR
010100 012737          000006 000004      MOV      @ERRVEC+2,@ERRVEC;RESTORE ERROR VECTOR

```

```

:TEST TRAP & RETURN USER-KERNEL-USER
T57:  SCOPE
010106 010701          000500          MOV      @KPTR,KSP ;SET KERNEL STACK POINTER
010110 012706          000500          MOV      @REG,@TRAPVEC+2
010114 012767          004000 167714      MOV      @T57A,@TRAPVEC
010122 012767          010212 167704      MOV      @SUM+REG,@PSW ;USER MODE!!!
010130 012737          144000 177776      CLR      R12 ;TRAP & ENTER KERNEL MODE
010136 005002          TRAP
010140 104400          T57AA: MOV      @PSW,TEMP ;KERNEL MODE!!!
010142 013767          177776 170632      BIC      @1,@PSW
010150 042737          140000 177776      CMP      @T57AA,KPTR-4 ;CHECK THAT RETURN ADDRESS IS ON
010156 022767          010142 170310      BEQ      .+4 ;KERNEL STACK
010164 001401          HLT ;ERROR!RETURN ADDRESS NOT ON STACK
010166 000000          CMP      @SUM+REG+Z,TEMP ;CHECK THAT CORRECT PSW WAS
010170 022767          144004 170604      BEQ      .+4 ;RESTORED ON THE RETURN
010176 001401          HLT ;ERROR! INCORRECT STATUS WAS RETURNED
010200 000000          ;BY KERNEL FROM TRAP
                                ;CHECK THAT TRAP ROUTINE WAS EXECUTED
010202 005102          COM      R12
010204 001401          BEQ      .+4
010206 000000          HLT ;ERROR! KERNEL DID NOT DO COM R12
                                ;(AT T57A)
                                ;EXIT TEST
                                ;COMPLEMENT R12
                                ;AND EXIT
010210 000402          T57A:  BR      T57EX
010212 005102          COM      R12
010214 000002          RTI
010216 000240          T57EX: NOP

```

```

;TEST THAT MFPD/I CAN PUSH ONTO CURRENT STACK (AS DETERMINED BY PS15 &
;PS14) THE PREVIOUS MODES STACK POINTER (AS DETERMINED BY PS13 &PS12)
;-(KSP)+KSP,MFPD
t60: SCOPE
010220 010701
010222 005037 177776 CLR @PSW ;KERNEL MODE!!! PREV KERNEL MODE!!
010226 012706 000500 MOV @KPTR,KSP ;SET KERNEL STACK POINTER
010232 106506 MFPD KSP ;-(KSP)+KSP
010234 022767 000500 170234 CMP @KPTR,KPTR-2 ;TEST THAT VALUE OF KERNEL STACK POINTER
010242 001401 BEQ .+4 ;WAS PUSHED ONTO KERNEL STACK
010244 000000 HLT ;ERROR!

;-(KSP)+SSP,MFPD
t61:SCOPE
010246 010701
010250 012737 014000 177776 MOV @KH+PSH+REG,@PSW ;KERNEL MODE!!! PREV SUPER MODE!!
010256 012706 000500 MOV @KPTR,KSP ;SET KERNEL STACK POINTER
010262 005016 CLR (KSP)
010264 006606 MTPD SSP ;SET SUPER STACK POINTER SSP+(KSP)+
010266 005166 177776 COM -2(KSP) ;PRESET KERNEL STACK
010272 106506 MFPD SSP ;-(KSP)+SSP
010274 022706 000500 CMP @KPTR,KSP ;CHECK THAT KERNEL STACK POINTER
010300 001401 BEQ .+4 ;IS CORRECT
010302 000000 HLT ;ERROR! INCORRECT KERNEL STACK POINTER
010304 005716 TST (KSP) ;CHECK THAT VALUE OF SUPER STACK POINTER
010306 001401 BEQ .+4 ;WAS PUSHED ONTO KERNEL STACK
010310 000000 HLT ;ERROR!

;-(KSP)+USP,MFPD
t62: SCOPE
010312 010701
010314 012737 034000 177776 MOV @KH+PUH+REG,@PSW ;KERNEL MODE!!! PREV USER MODE!!
010322 012706 000500 MOV @KPTR,KSP ;SET KERNEL STACK POINTER
010326 012716 177777 MOV @-1,(KSP)
010332 106606 MTPD USP ;SET USER STACK POINTER USP+(KSP)+
010334 005166 177776 COM -2(KSP) ;PRESET KERNEL STACK
010340 106506 MFPD USP ;-(KSP)+USP
010342 022716 177777 CMP @-1,(KSP) ;CHECK THAT USER STACK POINTER WAS
010346 001401 BEQ .+4 ;PUSHED ONTO KERNEL STACK
010350 000000 HLT ;ERROR!

;-(SSP)+SSP,MFPD
t63: SCOPE
010352 010701
010354 012737 014000 177776 MOV @KH+PSH+REG,@PSW ;KERNEL MODE!!! PREV SUPER MODE!!
010362 012706 000500 MOV @KPTR,KSP ;SET KERNEL STACK POINTER
010366 012716 000630 MOV @SPTR,(KSP) ;SET KERNEL STACK
010372 106606 MTPD SSP ;PUSH TOP WORD ON KERNEL STACK (@SPTR)
;INTO SUPER STACK POINTER SSP+(KSP)+
;SUPER MODE!!!, PREV SUPER MODE!!
010374 052737 040000 177776 BIS @SH,@PSW ;-(SSP)+SSP
010402 106506 MFPD SSP
010404 042737 140000 177776 BIC @UH,@PSW ;KERNEL MODE!!! PREV SUPER MODE!!
010412 106506 MFPD SSP ;PUSH SUPER STACK POINTER ONTO KERNEL STACK
010414 022716 000576 CMP @SPTR-2,(KSP) ;CHECK THAT SUPER STACK POINTER WAS
010420 001401 BEQ .+4 ;PUSHED PROPERLY (ONCE)
010422 000000 HLT ;ERROR!
010424 022767 000600 170144 CMP @SPTR,SPTR-2 ;CHECK THAT VALUE OF SUPER STACK PONTER
010432 001401 BEQ .+4 ;WAS PUSHED ONTO SUPER STACK
010434 000000 HLT ;ERROR!

```

```

:-(SSP)+USP MFPO
↑64:
010436 010701          SCOPE
010440 012737 014000 177776  MOV    @PSW+REG,@PSW    ;KERNEL MODE!!!  PREV SUPER MODE!!
010446 012706 000500          MOV    @KPTR,KSP        ;SET KERNEL STACK POINTER
010452 012716 000600          MOV    @SPTR,(KSP)
010456 106606          MTPD   SSP              ;SET SUPER STACK POINTER
010460 052737 030000 177776  BIS    @PUN,@PSW        ;KERNEL MODE!!!,  PREV USER MODE!!
010466 005016          CLR    (KSP)
010470 106606          MTPD   USP              ;SET USER STACK POINTER=0
010472 052737 040000 177776  BIS    @SM,@PSW         ;SUPER MODE!!!,  PREV USER MODE!!
010500 012767 177777 170070  MOV    @-1,@SPTR-2      ;PRESET SUPER STACK
010506 106506          MFPO   USP              ;PUSH USER STACK POINTER ONTO SUPER STACK
010510 042737 160000 177776  BIC    @UM+BIT13,@PSW   ;KERNEL MODE!!!,  PREV SUPER MODE!!
010516 106506          MFPO   SSP              ;PUSH SUPER STACK POINTER ONTO KERNEL STACK
010520 022716 000576          CMP    @SPTR-2,(KSP)    ;CHECK THAT SUPER STACK POINTER WAS
010524 001401          BEQ    .+4              ;PUSHED ONCE
010526 000000          HLT
010530 005767 170042          TST   SPTR-2
010534 001401          BEQ    .+4
010536 000000          HLT
;ERROR!
;CHECK THAT USER STACK POINTER
;WAS PUSHED ONTO SUPER STACK
;ERROR!

```

```

:-(USP)+USP MFPO
↑65:
010540 010701          SCOPE
010542 012737 030000 177776  MOV    @PUN,@PSW        ;KERNEL MODE!!!,  PREV USER MODE!!
010550 012706 000500          MOV    @KPTR,KSP        ;SET KERNEL STACK POINTER
010554 012716 000700          MOV    @UPTR,(KSP)
010560 106606          MTPD   USP              ;SET USER STACK POINTER
010562 005067 170110          CLR    UPTR-2
010566 052737 140000 177776  BIS    @UM,@PSW         ;USER MODE!!!,  PREV USER MODE!!!
010574 106506          MFPO   USP              ;PUSH USER STACK POINTER ONTO USER STACK
010576 042737 140000 177776  BIC    @UM,@PSW        ;KERNEL MODE!!!,  PREV USER MODE!!
010604 106506          MFPO   USP              ;PUSH USER STACK POINTER ONTO KERNEL STACK
010606 022716 000676          CMP    @UPTR-2,(KSP)    ;CHECK THAT USER STACK POINTER WAS
010612 001401          BEQ    .+4              ;PUSHED PROPERLY (ONCE)
010614 000000          HLT
010616 022767 000700 170052  CMP    @UPTR,UPTR-2
010624 001401          BEQ    .+4
010626 000000          HLT
;ERROR!
;CHECK THAT USER STACK POINTER IS ON THE
;USERS STACK
;ERROR!

```

```

:-(KSP)+KSP MFPI
↑66:
010630 010701          SCOPE
010632 005037 177776          CLR    @PSW
010636 012706 000500          MOV    @KPTR,KSP
010642 006506          MFPI   KSP
;KERNEL MODE!!!,  PREV KERNEL MODE!!
;SET KERNEL STACK POINTER
;PUSH KERNEL STACK POINTER ONTO KERNEL
;STACK
010644 022767 000500 167624  CMP    @KPTR,KPTR-2    ;CHECK RESULT
010652 001401          BEQ    .+4
010654 000000          HLT
;ERROR!

```

```

:-(KSP)+SSP MFPI
↑67:
010656 010701          SCOPE
010660 012737 014000 177776  MOV    @PSW+REG,@PSW   ;KERNEL MODE!!!,  PREV SUPER MODE!!
010666 012706 000500          MOV    @KPTR,KSP       ;SET KERNEL STACK POINTER
010672 005016          CLR    (KSP)
010674 006606          MTPD   SSP              ;SET SUPER STACK POINTER
010676 005166 177776          COM    -2(KSP)          ;PRESET KERNEL STACK

```

010702	006506			MFPI	SSP		: PUSH SUPER STACK POINTER ONTO KERNEL STACK
010704	022706	000500		CMP	%KPTR, KSP		: CHECK THAT KERNEL STACK POINTER IS CORRECT
010710	001401			BEQ	.+4		
010712	000000			HLT			: ERROR! INCORRECT KERNEL STACK POINTER
010714	005716			TST	(KSP)		: CHECK THAT SUPER STACK POINTER
010716	001401			BEQ	.+4		: WAS PUSHED ONTO KERNEL STACK
010720	000000			HLT			: ERROR!
: -(KSP)+USP MFPI							
010722	010701			170: SCOPE			
010724	012737	034000	177776	MOV	%PUM+REG, %PSM		: KERNEL MODE!!! PREV USER MODE!!
010732	012706	000500		MOV	%KPTR, KSP		: SET KERNEL STACK POINTER
010736	012716	177777		MOV	%-1, (KSP)		
010742	006606			MTPI	USP		: SET USER STACK POINTER
010744	005166	177776		COM	-2(KSP)		: PRESET KERNEL STACK
010750	006506			MFPI	USP		: PUSH USER STACK POINTER ONTO KERNEL STACK
010752	022716	177777		CMP	%-1, (KSP)		: CHECK RESULT
010756	001401			BEQ	.+4		
010760	000000			HLT			: ERROR! USER STACK POINTER NOT ON KERNEL STACK
: -(SSP)+SSP MFPI							
010762	010701			171: SCOPE			
010764	012737	014000	177776	MOV	%PSM+REG, %PSM		: KERNEL MODE!!! PREV SUPER MODE!!
010772	012706	000500		MOV	%KPTR, KSP		: SET KERNEL STACK POINTER
010776	012716	000600		MOV	%SPTR, (KSP)		
011002	006606			MTPI	SSP		: SET SUPER STACK
011004	052737	040000	177776	BIS	%SM, %PSM		: SUPER MODE!!! PREV SUPER MODE!!
011012	006506			MFPI	SSP		: PUSH SUPER STACK POINTER ONTO SUPER STACK
011014	042737	140000	177776	BIC	%UM, %PSM		: KERNEL MODE!!! PREV SUPER MODE!!
011022	006506			MFPI	SSP		: GET SUPER STACK POINTER
011024	022716	000576		CMP	%SPTR-2, (KSP)		: CHECK THAT SUPER STACK POINTER WAS
011030	001401			BEQ	.+4		: PUSHED PROPERLY (ONCE)
011032	000000			HLT			: ERROR! INCORRECT SUPER STACK POINTER
011034	022767	000600	167534	CMP	%SPTR, SPTR-2		: CHECK THAT SUPER STACK POINTER WAS
011042	001401			BEQ	.+4		: PUSHED ONTO SUPER STACK
011044	000000			HLT			: ERROR!
: -(SSP)+USP MFPI							
011046	010701			172: SCOPE			
011050	012737	014000	177776	MOV	%PSM+REG, %PSM		: KERNEL MODE!!! PREV SUPER MODE!!
011056	012706	000500		MOV	%KPTR, KSP		: SET KERNEL STACK POINTER
011062	012716	000600		MOV	%SPTR, (KSP)		
011066	006606			MTPI	SSP		: SET SUPER STACK POINTER
011070	052737	030000	177776	BIS	%PUM, %PSM		: KERNEL MODE!!!, PREV USER MODE!!
011076	005016			CLR	(KSP)		
011100	006606			MTPI	USP		: SET USER STACK POINTER = 0
011102	052737	040000	177776	BIS	%SM, %PSM		: SUPER MODE!!!, PREV SUPER MODE!!
011110	006506			MFPI	USP		: PUSH USER STACK POINTER ONTO SUPER STACK
011112	042737	160000	177776	BIC	%UM+BIT13, %PSM		: KERNEL MODE!!!, PREV SUPER MODE!!!
011120	006506			MFPI	SSP		: PUSH SUPER STACK POINTER ONTO KERNEL STACK
011122	022716	000576		CMP	%SPTR-2, (KSP)		: CHECK THAT SUPER STACK POINTER IS
011126	001401			BEQ	.+4		: CORRECT
011130	000000			HLT			: ERROR!
011132	005767	167440		TST	SPTR-2		: CHECK THAT USER STACK POINTER IS ON
011136	001401			BEQ	.+4		: SUPER STACK


```

011140 000000          HLT          ;ERROR!

;-(USP)+USP,MFPI
†73:  SCOPE
011142 010701          MOV      @PUM+REG,@PSM ;KERNEL MODE!!!,PREV SUPER MODE!!
011144 012737 034000 177776      MOV      @KPTR,KSP      ;SET KERNEL STACK POINTER
011152 012706 000500          MOV      @UPTR,(KSP)
011156 012716 000700          MTPD    USP            ;SET USER STACK POINTER
011162 006606          CLR      UPTR-2        ;PRESET USER STACK
011164 005067 167506          BIS      @UM,@PSM      ;USER MODE!!!,PREV USER MODE!!
011170 052737 140000 177776      MFPI    USP            ;-(USP)+USP
011176 006506          BIC      @UM,@PSM      ;KERNEL MODE!!!
011200 042737 140000 177776      MFPI    USP            ;GET USER STACK POINTER
011206 006506          CMP      @UPTR-2,(KSP) ;CHECK THAT USER STACK POINTER WAS
011210 022716 000676          BEQ     .+4            ;PUSHED ONCE
011214 001401          HLT
011216 000000          HLT          ;ERROR!
011220 022767 000700 167450      CMP      @UPTR,UPTR-2 ;CHECK THAT USER STACK POINTER WAS PUSHED
011226 001401          BEQ     .+4            ;ONTO USER STACK
011230 000000          HLT          ;ERROR!

;TEST THAT ILLEGAL MODE DOES NOT HANG BUS.
†74:  SCOPE
011232 010701          MOV      @IM,@PSM      ;ILLEGAL MODE!!!
011234 012737 100000 177776      MOV      @PSM,R0       ;GET ILLEGAL MODE
011242 013700 177776          CLR      @PSM          ;KERNEL MODE!!
011246 005037 177776          CMP      @IM,R0        ;CHECK THAT ILLEGAL MODE WAS SET
011252 022700 100000          BEQ     .+4            ;INTO STATUS
011256 001401          HLT
011260 000000          HLT

;TEST THAT KERNEL CAN GET DATA FROM SUPER STACK
†75:  SCOPE
011262 010701          MOV      @KM+PSM+REG,@PSM ;LERNEL MODE!!!,PREV SUPER MODE!!
011264 012737 014000 177776      MOV      @KPTR,KSP      ;SET KERNEL STACK POINTER
011272 012706 000500          MOV      @SPTR,(KSP)
011276 012716 000600          MTPD    SSP            ;SET SUPER STACK POINTER
011302 106606          MOV      @-1,SPTR      ;PRESET SUPER STACK
011304 012767 177777 167266      CLR      (KSP)         ;PRESET KERNEL
011312 005016          CLR      -2(KSP)       ;STACK
011314 005066 177776          SCC
011320 000277          MFPD    SSP            ;PRESET CONDITION CODES
011322 106506          MFPD    @PSM           ;GET SUPER STACK POINTER
011324 106576 000000          NOP
011330 000240          MOV      @PSM,R12      ;SAVE STATUS RESULT
011332 013702 177776          CMP      @SPTR,KPTR    ;TEST THAT SUPER STACK POINTER WAS PUSH-
011336 022767 000600 167134      BEQ     .+4            ;ONTO KERNEL STACK BY MFPD SSP INST.
011344 001401          HLT          ;ERROR!
011346 000000          HLT
011350 022706 000476          CMP      @KPTR-2,KSP   ;TEST THAT KERNEL STACK POINTER IS
011354 001401          BEQ     .+4            ;POSITIONED PROPERLY
011356 000000          HLT          ;ERROR! INCORRECT KERNEL STACK POINTER
011360 005216          INC      (KSP)         ;CHECK THAT DATA WAS MOVED TO KERNEL
011362 001401          BEQ     .+4            ;STACK
011364 000000          HLT          ;ERROR! INCORRECT DATA MOVED TO STACK
011366 022702 014011          CMP      @KM+PSM+REG+N+C,R12 ;CHECK STATUS RESULT
011372 001401          BEQ     .+4
011374 000000          HLT          ;ERROR! INCORRECT STATUS

```

```

:TEST THAT KERNEL CAN GET DATA FROM USER STACK
↑76: SCOPE
011376 010701
011400 012737 034000 177776 MOV #KM+PUM+REG, @#PSW ;KERNEL MODE!!! PREV SUPER MODE!!
011406 012706 000500 MOV #KPTR, KSP ;SET KERNEL STACK POINTER
011412 012716 000700 MOV #UPTR, (KSP)
011416 106606 MTPD USP ;SET USER STACK POINTER
011420 005067 167254 CLR #UPTR ;PRESET USER STACK
011424 005016 CLR (KSP) ;PRESET KERNEL STACK
011426 012766 177777 177776 MOV #-1, -2(KSP)
011434 106506 MFPD USP ;-(KSP)+USP
011436 106576 000000 MFPD @ (KSP) ;LIKE MOV @ (6), -(6)
011442 000240 NOP
011444 013703 177776 MOV @#PSW, R13 ;SAVE STATUS RESULT
011450 022767 000700 167022 CMP #UPTR, KPTR ;CHECK THAT USER STACK POINTER WAS
011456 001401 BEQ .+4 ;PUSHED ONTO KERNEL STACK
011460 000000 HLT ;ERROR!
011462 022706 000476 CMP #KPTR-2, KSP ;CHECK THAT KERNEL STACK POINTER IS POS-
011466 001401 BEQ .+4 ;ITIONED PROPERLY
011470 000000 HLT ;ERROR! INCORRECT KERNEL STACK POINTER
011472 005716 TST (KSP) ;CHECK THAT CORRECT DATA
011474 001401 BEQ .+4 ;WAS PUSHED ONTO KERNEL STACK
011476 000000 HLT ;ERROR!
011500 022703 034004 CMP #KM+PUM+REG+2, R13 ;CHECK STATUS
011504 001401 BEQ .+4
011506 000000 HLT ;ERROR! INCORRECT STATUS

```

```

:TEST THAT SUPERVISOR CAN GET DATA FROM USER STACK
↑77: SCOPE
011510 010701
011512 012737 074000 177776 MOV #SM+PUM+REG, @#PSW ;SUPER MODE!!! PREV USER MODE!!
011520 012706 000600 MOV #SPTR, SSP ;SET SUPER STACK POINTER
011524 012716 000700 MOV #UPTR, (SSP)
011530 106606 MTPD USP ;SET USER STACK POINTER
011532 005037 000700 CLR #UPTR ;PRESET USER STACK
011536 005016 CLR (SSP) ;AND SUPER STACK
011540 012766 177777 177776 MOV #-1, -2(SSP)
011546 000277 SCC ;PRESET CC'S
011550 106506 MFPD USP ;GET USER STACK POINTER
011552 106576 000000 MFPD @ (SSP) ;LIKE MOV @-(6), -(6)
011556 000240 NOP
011560 013704 177776 MOV @#PSW, R14 ;SAVE STATUS
011564 012737 014000 177776 MOV #PSM+REG, @#PSW ;KERNEL MODE!!!, PREV SUPER MODE!!
011572 012706 000500 MOV #KPTR, KSP ;SET KERNEL STACK POINTER
011576 106506 MFPD SSP ;PUSH SUPER STACK POINTER ONTO KERNEL STACK
011600 022716 000576 CMP #SPTR-2, (KSP) ;CHECK THAT SUPER STACK POINTER IS POS-
011604 001401 BEQ .+4 ;ITIONED PROPERLY (1 POP, 2 PUSHES)
011606 000000 HLT ;ERROR! INCORRECT SUPER STACK POINTER
011610 022737 000700 000600 CMP #UPTR, @#SPTR ;CHECK THAT MFPD USP PUSHED USER STACK
011616 001401 BEQ .+4 ;ONTO SUPER STACK
011620 000000 HLT ;ERROR!
011622 005737 000576 TST @#SPTR-2 ;CHECK THAT DATA ON USER STACK WAS PUSH-
011626 001401 BEQ .+4 ;ONTO SUPER STACK (MFPD @ (SSP))
011630 000000 HLT ;ERROR!
011632 022704 074005 CMP #SM+PUM+REG+Z+C, R14 ;CHECK STATUS RESULT
011636 001401 BEQ .+4
011640 000000 HLT ;ERROR! INCORRECT STATUS AFTER MFPD @ (SSP)

```

```

: TEST THAT INTERRUPT SEQUENCE USER TO SUPERVISOR (VIA TTY)
T100:  SCOPE
011642 010701
011644 012737 040000 177776      MOV      #SM, @PSW          ; SUPER MODE!!!
011652 012706 000600          MOV      @SPTR, SSP        ; SET SUPER STACK POINTER
011656 012737 000340 177776      MOV      @PRTY?, @PSW      ; KERNEL MODE!!!, PRIORITY LEVEL 7
011664 012737 000100 177564      MOV      @BIT6, @TPS       ; SET IE BIT IN TELEPRINTER STATUS
011672 012737 011722 000064      MOV      @T100A, @TPVEC    ; LOAD INTERRUPT VECTOR
011700 012767 044000 166160      MOV      @SM+REG, TPVEC+2 ; AND 'NEW' STATUS
011706 012737 140000 177776      MOV      @UM, @PSW        ; USER MODE!!!, ALLOW TTY INTERRUPT
011714 005037 177776      T100AA: CLR      @PSW       ; KERNEL MODE!!!
011720 000000          HLT
011722 013767 177776 167052      T100A:  MOV      @PSW, TEMP   ; SAVE 'NEW' STATUS
011730 012737 010000 177776      MOV      @PSM, @PSW       ; KERNEL MODE!!!, PREV SUPER MODE!!
011736 005067 166622          CLR      TPS              ; CLEAR IE BIT
011742 106506          MFPD   SSP                ; PUSH SUPER STACK PTR ONTO KERNEL STACK
011744 022767 074000 167030      CMP      @SM+PUM+REG, TEMP; CHECK THAT 'NEW' STATUS IS CORRECT
011752 001401          BEQ     .+4
011754 000000          HLT
011756 022716 000574          CMP      @SPTR-4, (KSP)   ; ERROR! INCORRECT STATUS AFTER INTERRUPT
011762 001401          BEQ     .+4              ; CHECK SUPER STACK POINTER
011764 000000          HLT                      ; (2 PUSHES)
011766 022737 011714 000574      CMP      @T100AA, @SPTR-4; ERROR! INCORRECT SUPER STACK POINTER
011774 001401          BEQ     .+4              ; CHECK RETURN PC ON SUPER STACK
011776 000000          HLT
012000 022767 140000 166570      CMP      @UM, SPTR-2      ; ERROR! RETURN PC NOT ON SUPER STACK
012006 001401          BEQ     .+4              ; CHECK THAT STATUS WAS SAVED ON
012010 000000          HLT                      ; SUPER STACK
                                ; ERROR! OLD STATUS NOT ON SUPER STACK

: TEST TRAP & RETURN USER-SUPER-USER
T101:  SCOPE
012012 010701
012014 012737 074000 177776      MOV      @SM+PUM+REG, @PSW ; SUPER MODE!!!, PREV USER MODE!!
012022 012706 000600          MOV      @SPTR, SSP        ; SET SUPER STACK POINTER
012026 012737 012150 000020      MOV      @T101A, @IOTVEC   ; LOAD IOT TRAP VECTOR
012034 012737 044000 000022      MOV      @SM+REG, @IOTVEC+2; AND 'NEW' STATUS
012042 005002          CLR      R12
012044 012737 144000 177776      MOV      @UM+REG, @PSW     ; USER MODE!!!
012052 000004          IOT
012054 013767 177776 166720      T101AA: MOV      @PSW, TEMP       ; TRAP
012062 012737 014000 177776      MOV      @PSM+REG, @PSW    ; SAVE 'OLD' STATUS RETURN BY RTI
012070 022767 012054 166476      CMP      @T101AA, SPTR-4   ; KERNEL MODE!!!, PREV SUPER MODE!!
012076 001401          BEQ     .+4              ; CHECK THAT RETURN PC WAS SAVED ON SUPER
                                ; STACK
012100 000000          HLT                      ; ERROR! RETURN PC NOT SAVED ON SUPER STACK
012102 022767 144000 166466      CMP      @UM+REG, SPTR-2   ; CHECK 'OLD' STATUS SAVED ON SUPER STACK
012110 001401          BEQ     .+4
012112 000000          HLT
012114 022767 174000 166660      CMP      @UM+PUM+REG, TEMP; ERROR! INCORRECT STATUS SAVED
                                ; CHECK RETURNED 'OLD' STATUS
012122 001401          BEQ     .+4
012124 000000          HLT
012126 106506          MFPD   SSP                ; ERROR! RETURNED 'OLD' STATUS INCORRECT
012130 022716 000600          CMP      @SPTR, (KSP)     ; GET SUPER STACK POINTER
012134 001401          BEQ     .+4              ; CHECK SUPER STACK POINTER
012136 000000          HLT                      ; (2 PUSHES, 2 POPS)
012140 005102          COM      R12              ; ERROR! INCORRECT SSP AFTER TRAP & RETURN
012142 001401          BEQ     .+4              ; CHECK THAT COM R12 WAS EXECUTED
012144 000000          HLT                      ; IN IOT ROUTINE AT T101A
012146 000402          BR      T101EX          ; ERROR!
                                ; EXIT TEST

```

```

012150 005102      T101A: COM      R12      ;COMPLEMENT E12
012152 000002      RTI              ;RETURN

012154 000240      T101EX: NOP

;CHECK THAT MTPD CAN LOAD MEMORY ADDRESS DM=7,PC
†102: SCOPE
012156 010701      MOV      %KM+PSM,%PSM ;KERNEL MODE!!!, PREV SUPER MODE!!
012160 012737 010000 177776  MOV      %KPTR,KSP    ;SET KERNEL STACK PTR
012166 012706 000500      CLR      (KSP)        ;PUT DATA ON STACK
012172 005016      MOV      %TEMP,%TEMP+2 ;LOAD ADDRESS
012174 012737 001002 001004  MOV      %-1,TEMP     ;PRESET DATA
012202 012767 177777 166572  MOV      %-1,TEMP     ;PRESET CC'S
012210 000277      SCC              ;PRESET CC'S
012212 106677 166566  MTPD      %TEMP+2     ;TEMP+(KSP)+
012216 013703 177776  MOV      %PSW,R3      ;CHECK CC'S
012222 022703 010005  CMP      %KM+PSM+Z+C,R3 ;CHECK CC'S
012226 001401      BEQ      .+4
012230 000000      HLT
012232 005737 001002  TST      %TEMP        ;ERROR! INCORRECT CC'S AFTER MTPD
012236 001401      BEQ      .+4          ;CHECK RESULT
012240 000000      HLT                  ;ERROR! INCORRECT RESULT

;CHECK THAT MTPD CAN LOAD MEMORY ADDRESS DM=7
†103: SCOPE
012242 010701      MOV      %KM+PUM+REG,%PSM ;KERNEL MODE!!!
012244 012737 034000 177776  MOV      %KPTR,KSP    ;SET KERNEL STACK PTR
012252 012706 000500      MOV      %-1,(KSP)    ;LOAD DATA ONTO STACK
012256 012716 177777      MOV      %-2,R14     ;LOAD INDEX REGISTER
012262 012704 177776      CLR      TEMP        ;PRESET DATA
012266 005067 166510  MOV      %TEMP,TEMP+2 ;TEMP+(KSP)+
012272 012767 001002 166504  MTPD      %TEMP+4(R14) ;TEMP+(KSP)+
012300 006674 001006  MOV      %PSW,R13     ;SAVE STATUS RESULT
012304 013703 177776  CMP      %KPTR+2,KSP  ;CHECK THAT KSP POPPED
012310 022706 000502      BEQ      .+4
012314 001401      HLT
012316 000000      HLT                  ;ERROR! INCORRECT STACK PTR
012320 022703 034010  CMP      %PUM+REG+N,R13 ;CHECK STATUS RESULT
012324 001401      BEQ      .+4
012326 000000      HLT                  ;ERROR! INCORRECT STATUS
012330 005267 166446  INC      TEMP        ;CHECK RESULT
012334 001401      BEQ      .+4
012336 000000      HLT                  ;ERROR! INCORRECT RESULT

;TEST THAT MTPD/I CAN LOAD PC
†104: SCOPE
012340 010701      MOV      %KM+PSM,%PSM ;KERNEL MODE!!!
012342 012737 010000 177776  MOV      %KPTR,KSP    ;SET KERNEL STACK PTR
012350 012706 000500      MOV      %T104A,(KSP) ;PUT NEW PC ON STACK
012354 012716 012366      SCC              ;PRESET CC'S
012360 000277      MTPD      PC         ;PC+(KSP)+
012362 106607      HLT                  ;ERROR! MTPD FAILED TO SET PC
012364 000000      BPL      .+4
012366 100001      HLT                  ;ERROR! 'N' FAILED TO CLEAR IN STATUS
012370 000000      BCS      .+4
012372 103401      HLT                  ;ERROR! 'C' WAS CLEARED BY MTPD
012374 000000      HLT

```

```

: SUPERVISORY MODE
012376 010701
012400 012737 074000 177776 T105: SCOPE
012406 012706 000600 MOV #SM+PUM+REG, @#PSW ; SUPER MODE!!!
012412 012716 012430 MOV #SPTR, SSP ; SET SUPER STACK
012416 000277 MOV #T105A, (SSP) ; PUT NEW PC ON STACK
012420 006607 SCC ; PRESET CC'S
012422 005037 177776 MTP1 PC ; PC+(SSP)+
012426 000000 CLR @#PSW ; KERNEL MODE!!!
012430 013704 177776 T105A: MOV @#PSW, R14 ; ERROR! MTP1 FAILED TO LOAD PC
012434 042737 140000 177776 BIC #UM, @#PSW ; SAVE STATUS RESULT
012442 022704 074001 CMP #SM+PUM+REG+C, R14 ; KERNEL MODE!!!
012446 001401 BEQ .+4 ; CHECK STATUS RESULT
012450 000000 HLT ; ERROR! INCORRECT STATUS RESULT

: USER MODE
012452 010701
012454 012737 170000 177776 T106: SCOPE
012462 012706 000700 MOV #UM+PUM, @#PSW ; USER MODE!!!
012466 012716 012504 MOV #UPTR, USP ; SET USER STACK PTR
012472 000277 MOV #T106A, (USP) ; PUT NEW PC ON STACK
012474 106607 SCC ; PRESET CC'S
012476 005037 177776 MTPD PC ; PC+(USP)+
012502 000000 CLR @#PSW ; KERNEL MODE!!!
012504 013705 177776 T106A: MOV @#PSW, RS ; ERROR! MTPD FAILED TO LOAD PC
012510 005037 177776 CLR @#PSW ; SAVE STATUS
012514 022705 170001 CMP #UM+PUM+C, RS ; KERNEL MODE!!!
012520 001401 BEQ .+4 ; CHECK STATUS
012522 000000 HLT

: TEST ERROR TRAP (ODD ADDRESS) MFPD/I
012524 010701
012526 005037 177776 T107: SCOPE
012532 012706 000500 CLR @#PSW ; KERNEL MODE!!!
012536 012737 012554 000004 MOV #KPTR, KSP ; SET KERNEL STACK PTR
012544 000277 MOV #T107A, @#ERRVEC ; LOAD ERROR VECTOR
012546 106567 165227 SCC ; PRESET CC'S
012552 000000 MFPD 1 ; ODD ADDRESS SHOULD TRAP
012554 022706 000474 T107AA: HLT ; ERROR! FAILED TO TRAP ON ODD ADDRESS
012560 001401 T107A: CMP #KPTR-4, KSP ; CHECK THAT STACK PTR WAS PUSHED
012562 000000 BEQ .+4 ; PROPERLY (2 PUSHES)
012564 022726 012552 CMP #T107AA, (KSP)+ ; ERROR! INCORRECT STACK PTR AFTER ERROR
012570 001401 BEQ .+4 ; CHECK RETURN PC ON STACK
012572 000000 HLT ; ERROR! RETURN PC NOT ON STACK
012574 022716 000017 CMP #17, (KSP) ; CHECK SAVED STATUS ON STACK
012600 001401 BEQ .+4
012602 000000 HLT ; ERROR! INCORRECT STATUS SAVED ON STACK

: SUPER MODE, TIME OUT
012604 010701
012606 012737 040000 177776 T110: SCOPE
012614 012706 000600 MOV #SM, @#PSW ; SUPER MODE!!!
012620 012737 044000 000006 MOV #SPTR, SSP ; SET SUPER STACK
012626 012737 012646 000004 MOV #SM+REG, @#ERRVEC+2 ; LOAD 'NEW' STATUS
012634 106537 177702 MOV #T110A, @#ERRVEC ; AND PC
012640 005037 177776 T110AA: MFPD @#177702 ; 177702 IS NON-EXISTANT ADRS
012644 000000 CLR @#PSW ; KERNEL MODE!!!
HLT ; ERROR! DID NOT TRAP ON NON ADRS

```

```

012646 010603          T110A: MOV    SSP,R13      ;SAVE SUPER STACK PTR
012650 042737 140000 177776 BIC    #UM,@#PSW      ;KERNEL MODE!!!
012656 022703 000574      CMP    #SPTR-4,R13   ;CHECK SUPER STACK PTR
012662 001401          BEQ    .+4
012664 000000          HLT
012666 022723 012640      CMP    #T110AA,(R13)+ ;ERROR! INCORRECT SSP AFTER ERROR TRAP
012672 001401          BEQ    .+4           ;CHECK RETURN PC ON SUPER STACK
012674 000000          HLT
012676 022713 040000      CMP    #SM,(R13)     ;ERROR! RETURN PC NOT ON SUPER STACK
012702 001401          BEQ    .+4           ;CHECK SAVED STATUS
012704 000000          HLT                 ;ERROR! INCORRECT STATUS SAVED ON STACK

```

```

:USER MODE, ODD ADDRESS
012706 010701          †111: SCOPE
012710 012737 144000 177776 MOV    #UM+REG,@#PSW ;USER MODE!!!
012716 012706 000700      MOV    #UPTR,USP     ;SET USER STACK PTR
012722 012737 012750 000004 MOV    #T111A,@#ERRVEC ;LOAD ERROR TRAP VECTOR
012730 012737 140000 000006 MOV    #UM,@#ERRVEC+2
012736 106567 165035      MFPD  -1             ;ODD ADDRESS SHOULD TRAP
012742 005037 177776      T111AA: CLR    @#PSW ;KERNEL MODE!!!
012746 000000          HLT                 ;ERROR! FAILED TO TRAP
012750 010603          T111A: MOV    USP,R3  ;SAVE USER STACK PTR
012752 042737 140000 177776 BIC    #UM,@#PSW      ;KERNEL MODE!!!
012760 022703 000674      CMP    #UPTR-4,R3   ;CHECK USER STACK PTR
012764 001401          BEQ    .+4
012766 000000          HLT                 ;ERROR! INCORRECT USER STACK POINTER
012770 022713 012742      CMP    #T111AA,(R3) ;CHECK RETURN ADDRESS ON USER STACK
012774 001401          BEQ    .+4
012776 000000          HLT                 ;ERROR! RETURN PC NOT ON USER STACK
013000 012737 000006 000004 MOV    #ERRVEC+2,@#ERRVEC ;RESTORE ERROR TRAP TO HALT
013006 005067 164774      CLR    ERRVEC+2

```

```

:TEST THAT MTPD INSTRUCTION CAN LOAD DATA TO AN ADDRESS VIA THE STACK
:KERNEL MODE, PREVIOUS SUPER MODE
013012 010701          †112: SCOPE
013014 012737 010000 177776 MOV    #KM+PSM,@#PSW ;KERNEL MODE!!!, PREV SUPER MODE!!
013022 012706 000500      MOV    #KPTR,KSP    ;SET KERNEL STACK PTR
013026 012746 000600      MOV    #SPTR,-(KSP)
013032 106606          MTPD  SSP           ;SET SUPER STACK PTR
013034 012746 001002      MOV    #TEMP,-(KSP) ;PUT ADDRESS ON THE STACK
013040 012746 177777      MOV    #-1,-(KSP)  ;PUT DATA ON THE STAK
013044 005037 001002      CLR    @#TEMP       ;PRESET DATA
013050 106636          MTPD  @#TEMP+       ;MOVE #-1 TO TEMP
013052 022706 000500      CMP    #KPTR,KSP    ;CHECK STACK PTR AFTER MTPD
013056 001401          BEQ    .+4
013060 000000          HLT                 ;ERROR! INCORRECT STACK PTR AFTER MTPD
013062 005267 165714      INC    TEMP         ;CHECK THAT DATA WAS MOVED TO TEMP
013066 001401          BEQ    .+4
013070 000000          HLT                 ;ERROR! DATA NOT IN TEMP
013072 106506          MFPD  SSP           ;GET SUPER STCAK PTR
013074 022716 000600      CMP    #SPTR,(KSP) ;CHECK THAT SUPER STACK PTR NOT CHANGED
013100 001401          BEQ    .+4           ;BY MTPD INSTRUCTION
013102 000000          HLT                 ;ERROR! SSP WAS CHANGED BY MTPD INST.

```

```

:CHECK THAT MTPD CAN LOAD DATA TO AN ADDRESS VIA THE STACK
:SUPER MODE, PREV USER MODE

```

```

013104 010701          T113: SCOPE
013106 012737 070000 177776 MOV    #SM+PUM, @#PSW    ; SUPER MODE!!!, PREV USER MODE!!
013114 012706 000600          MOV    #SPTR, SSP      ; SET SUPER STACK PTR
013120 012746 000700          MOV    #UPTR, -(SSP)
013124 106606          MTPD   USP             ; SET USER STACK PTR
013126 012746 001002          MOV    #TEMP, -(SSP)   ; PUT ADDRESS ON THE STACK
013132 012746 177777          MOV    #-1, -(SSP)    ; PUT DATA ON THE STACK
013136 005037 001002          CLR   @#TEMP          ; PRESET DATA
013142 006676 000000          MTPD   @#TEMP          ; MOVE #-1 TO TEMP
013146 012737 010000 177776 MOV    #PSM, @#PSW     ; KERNEL MODE!!!, PREV SUPER MODE!!
013154 106506          MFPD   SSP            ; GET SUPER STACK PTR
013156 022726 000576          CMP   #SPTR-2, (KSP)+ ; CHECK SUPER STACK PTR AFTER MTPD
013162 001401          BEQ   .+4
013164 000000          HLT
013166 012737 030000 177776 MOV    #PUM, @#PSW     ; ERROR! INCORRECT SUPER STACK PTR
013174 106506          MFPD   USP            ; KERNEL MODE!!!, PREV USER MODE!!
013176 022726 000700          CMP   #UPTR, (KSP)+   ; GET USER STACK PTR
013202 001401          BEQ   .+4             ; CHECK THAT USER STACK PTR WAS NOT CHANGED
013204 000000          HLT
013206 005267 165570          INC   TEMP            ; ERROR! USER STACK PTR CHANGED BY MTPD
013212 001401          BEQ   .+4             ; CHECK THAT DATA WAS MOVED TO TEMP
013214 000000          HLT                  ; ERROR! INCORRECT DATA IN TEMP AFTER MTPD

```

; TEST THAT MFPI CAN GET DATA FROM AN ADDRESS VIA THE STACK

```

013216 010701          T114: SCOPE
013220 012737 010000 177776 MOV    #KM+PSM, @#PSW  ; KERNEL MODE!!!, PREV SUPER MODE!!
013226 012706 000500          MOV    #KPTR, KSP     ; SET KERENL STACK PTR
013232 012746 000600          MOV    #SPTR, -(KSP)
013236 106606          MTPD   SSP            ; SET SUPER STACK PTR
013240 005066 177776          CLR   -2(KSP)        ; PRESET DATA ON THE STACK
013244 012716 001002          MOV    #TEMP, (KSP)   ; PUT ADDRESS ON THE STACK
013250 012737 177777 001002 MOV    #-1, @#TEMP     ; LOAD DATA INTO ADDRESS
013256 006576 000000          MFPD   @#TEMP          ; MOVE TEMP TO STACK
013262 022706 000476          CMP   #KPTR-2, KSP    ; CHECK STACK PTR AFTER MFPI
013266 001401          BEQ   .+4
013270 000000          HLT                  ; ERROR! INCORRECT STACK PTR AFTER MFPI
013272 022716 177777          CMP   #-1, (KSP)     ; CHECK DATA ON THE STACK
013276 001401          BEQ   .+4
013300 000000          HLT                  ; ERROR! INCORRECT DATA MOVED ONTO THE STACK
013302 006506          MFPD   SSP            ; GET SUPER STACK PTR
013304 022726 000600          CMP   #SPTR, (KSP)+   ; CHECK THAT SUPER STACK PTR WAS NOT
013310 001401          BEQ   .+4             ; BY MFPI
013312 000000          HLT                  ; ERROR! INCORRECT SSP

```

; TEST THAT MFPD CAN GET DATA FROM AN ADDRESS VIA THE STACK

```

013314 010701          T115: SCOPE
013316 012737 070000 177776 MOV    #SM+PUM, @#PSW  ; SUPER MODE!!!, PREV USER MODE!!
013324 012706 000600          MOV    #SPTR, SSP     ; SET SUPER STACK PTR
013330 012746 000700          MOV    #UPTR, -(SSP)
013334 106606          MTPD   USP            ; SET USER STACK PTR
013336 012726 001002          MOV    #TEMP, (SSP)+  ; PUT THE ADDRESS ON THE STACK
013342 005066 177774          CLR   -4(SSP)        ; PRESET DATA ON THE STACK
013346 012737 177777 001002 MOV    #-1, @#TEMP     ; PRESET MEMORY DATA
013354 106556          MFPD   @-(SSP)        ; MOVE TEMP TO THE STACK

```

```

013356 012737 010000 177776      MOV      #KM+PSM, @#PSW      ;KERNEL MODE!!!, PREV SUPER MODE!!
013364 106506                      MFPD     SSP                ;GET SUPER STACK PTR
013366 022726 000576              CMP      #SPTR-2, (KSP)+    ;CHECK SUPER STACK PTR AFTER MFPD
013372 001401                      BEQ      .+4
013374 000000                      HLT
013376 012737 030000 177776      MOV      #KM+PUM, @#PSW    ;KERNEL MODE!!!, PREV USER MODE!!
013404 106506                      MFPD     USP                ;GET USER STACK PTR
013406 022726 000700              CMP      #UPTR, (KSP)+     ;CHECK THAT USP WAS NOT CHANGED
013412 001401                      BEQ      .+4
013414 000000                      HLT
013416 005237 000576              INC      @#SPTR-2          ;ERROR! USP CHANGED BY MFPD
013422 001401                      BEQ      .+4                ;CHECK DATA ON THE SUPER STACK
013424 000000                      HLT
013426 005037 177776              CLR      @#PSW             ;ERROR! INCORRECT DATA ON SUPER STACK
013432 010701                      SCOPE

```

;CHECK TRAP SEQUENCE WHEN SUPERVISOR STACK PTR IS ODD.
;THE TEST TRAPS FROM USER TO SUPERVISOR AND THEN FROM SUPERVISOR TO KERNEL

```

013434 010701                      SCOPE
013436 012706 000500              MOV      #KPTR, KSP        ;SET KERNEL STACK PTR
013442 012737 013526 000004      MOV      #T116A, @#ERRVEC  ;SET ODD ADDRESS ERROR TRAP
013450 005037 000006              CLR      @#ERRVEC+2
013454 012737 013520 000020      MOV      #T116A, @#IOTVEC
013462 012737 040340 000022      MOV      #SM+PRTY7, @#IOTVEC+2
013470 012737 040000 177776      MOV      #SM, @#PSW        ;SUPER MODE!!!
013476 012706 000601              MOV      #SPTR+1, SSP      ;SET SUPER STACK PTR ODD
013502 012737 144000 177776      MOV      #UM+REG, @#PSW   ;USER MODE!!!
013510 000004                      IOT
013512 005037 177776              CLR      @#PSW            ;TRAP TO SUPERVISOR
013516 000000                      HLT                        ;KERNEL MODE!!!
013520 005037 177776      T116A: CLR      @#PSW        ;ERROR! IOT FAILED TO TRAP
013524 000000                      HLT                        ;KERNEL MODE!!!
                                ;ERROR! NO ODD ADDRESS TRAP ON ODD SUP-
                                ;ERVISOR STACK PTR
013526 022706 000474      T116B: CMP      #KPTR-4, KSP   ;CHECK KERNEL STACK PTR
013532 001401                      BEQ      .+4
013534 000000                      HLT                        ;ERROR! INCORRECT KERNEL STACK PTR AFTER
                                ;ODD ADDRESS TRAP
013536 022716 013520              CMP      #T116A, (KSP)    ;CHECK RETURN PC ON KERNEL STACK
013542 001401                      BEQ      .+4
013544 000000                      HLT                        ;ERROR! RETURN PC FROM ODD ADDRESS
                                ;TRAP NOT ON KERNEL STACK
013546 022766 070340 000002      CMP      #SM+PUM+PRTY7, 2(KSP) ;CHECK STATUS ON STACK
013554 001401                      BEQ      .+4
013556 000000                      HLT                        ;ERROR! INCORRECT STATUS ON STACK
013560 106506                      MFPD     SSP                ;GET SUPERVISOR STACK PTR
013562 022716 000575              CMP      #SPTR-3, (KSP)   ;CHECK SUPER STACK PTR
013566 001401                      BEQ      .+4
013570 000000                      HLT                        ;ERROR! INCORRECT SUPER STACK PTR
                                ;AFTER IOT
013572 005037 177776              CLR      @#PSW            ;KERNEL MODE!!!
013576 012737 000006 000004      MOV      #ERRVEC+2, @#ERRVEC
013604 012737 000022 000020      MOV      #IOTVEC+2, @#IOTVEC
013612 005037 000022              CLR      @#IOTVEC+2
013616 005267 165156      END:  INC      ICNT        ;INCREMENT PASS COUNT

```


013622	026727	165152	012000	CMP	ICNT, #12000	;1200G PASSES COMPLETED?
013623	001403			BEG	DONE	
013624	000167	165174		JMP	BEGIN	
013625	012767	000007	163722	MOV	#7, TP8	;RING BELL
013626	105767	163714		TSTB	TP8	
013627	100375			BPL	-4	
013628	013702	000042		MOV	#42, R2	;GET DETAPE MONITOR RETURN ADDRESS
013629	001404			BEG	DONE1	;DO NOT RETURN IF (42)=0
013630	004712			JSR	7, (2)	;RETURN TO DETAPE MONITOR
013631	000240			NOP		;OVERLAY AREA FOR
013632	000240			NOP		;ACT11
013633	000240			NOP		
013634	000240			NOP		
013635	000240			NOP		
013636	000240			NOP		
013637	000167	165116		JMP	START	
013638	000001			.END		

CROSS REFERENCE TABLE -- USER SYMBOLS

BEGIN	001032	225#	2058													
BIT13 =	020000	186#	1508	1601												
BIT14 =	040000	185#														
BIT15 =	100000	184#														
BIT6 =	000100	187#	256	265	272	281	498	504	569	571	1725					
C =	000001	200#	667	670	712	759	809	856	876	1162	1176	1181	1232	1278		
DISPLA=	177570	1660	1716	1792	1843	1858										
DONE	013636	175#	226#													
DONE1	013670	2057	2059#													
ENTVEC=	000030	2063	2068#													
END	013616	158#	355#	356#	409#	410#	424#	425#	552#	553#	588#	589#				
ERRVEC=	000004	2055#														
		157#	456#	457#	474#	488#	554#	595#	978#	979#	997#	998#	1022#	1023#		
		1048#	1049#	1066#	1086#	1108#	1129#	1146#	1147#	1368#	1369#	1387#	1412#	1866#		
		1883#	1884#	1904#	1905#	1917#	1918#	2021#	2022#	2051#						
HLT =	000000	149#	240	250	264	267	280	283	301	304	307	310	316	330		
		335	338	341	344	350	363	369	372	375	378	384	394	400		
		403	415	420	423	437	443	446	449	467	470	484	487	501		
		507	510	513	516	530	536	539	542	576	581	584	625	628		
		645	648	651	654	672	675	678	692	695	698	714	718	721		
		725	740	743	746	761	764	767	783	786	789	808	811	828		
		831	841	855	858	878	881	884	899	902	918	932	946	958		
		970	981	984	987	1001	1006	1009	1012	1026	1031	1034	1037	1040		
		1056	1058	1061	1073	1077	1080	1096	1101	1104	1115	1120	1123	1137		
		1142	1145	1164	1167	1170	1183	1186	1189	1211	1214	1217	1234	1237		
		1240	1257	1260	1263	1280	1283	1286	1305	1308	1311	1329	1332	1335		
		1354	1357	1360	1373	1376	1379	1382	1397	1401	1404	1407	1410	1426		
		1429	1433	1449	1461	1464	1476	1491	1494	1512	1515	1530	1533	1543		
		1555	1558	1570	1584	1588	1605	1608	1623	1626	1635	1653	1656	1659		
		1662	1679	1682	1685	1688	1709	1712	1715	1718	1730	1737	1740	1743		
		1746	1761	1764	1767	1771	1774	1794	1797	1811	1814	1817	1826	1828		
		1830	1840	1845	1855	1860	1869	1872	1875	1878	1887	1892	1895	1898		
		1908	1913	1916	1933	1936	1940	1957	1962	1965	1980	1983	1987	2004		
		2009	2012	2030	2032	2036	2040	2044	2048							
		215#	220#	226	2055#	2056										
ICNT	001000	192#	1630	1633												
IM =	100000	160#	323#	324#	351#	636#	637#	1752#	1753#	2023#	2024#	2052#	2053#			
IOTVEC=	000020	194#	299	333	465	482	505	525	534	797	817	924	1453	1468		
KM =	000000	1480	1639	1660	1666	1686	1784	1787	1801	1821	1923	1970	2000	2005		
KPTR =	000500	177#	219	225	288	302	305	308	322	336	339	342	458	468		
		475	485	495	508	511	514	523	537	540	635	643	646	664		
		673	684	693	798	818	829	836	976	982	985	1067	1153	1165		
		1173	1184	1298	1306	1416	1424	1445	1447	1454	1459	1469	1481	1499		
		1520	1538	1541	1548	1553	1563	1575	1593	1613	1640	1651	1654	1667		
		1677	1680	1705	1785	1802	1809	1822	1865	1870	1924	1931	1971	1978		
KSP =	%000006	2020	2034													
		146#	219#	225#	288#	308	322#	342	458#	475#	495#	508	522#	635#		
		664#	666#	673	684#	686#	693	798#	799#	818#	819#	829	836#	837#		
		838#	839	910#	925#	976#	977#	982	1052#	1067#	1068#	1153#	1154#	1165		
		1168#	1173#	1174#	1184	1187	1298#	1299#	1306	1309	1365#	1367#	1389#	1390#		
		1402	1416#	1445#	1446	1454#	1455#	1457#	1459	1462	1469#	1470#	1472#	1474		
		1481#	1482#	1489	1499#	1500#	1503#	1510	1520#	1521#	1528	1538#	1539	1548#		
		1549#	1551#	1553	1556	1563#	1564#	1566#	1568	1575#	1576#	1582	1593#	1594#		
		1597#	1603	1613#	1614#	1621	1640#	1641#	1644#	1645#	1648	1654	1657#	1667#		
		1668#	1671#	1672#	1674	1680	1683	1705#	1707	1738	1769	1785#	1786#	1802#		
		1803#	1809	1822#	1823#	1865#	1870	1873	1876	1924#	1925#	1927#	1928#	1930#		

	1931	1938	1955	1960	1971*	1972*	1974*	1975*	1977	1978	1981	1985	2002
N = 00010	2007	2020*	2034	2038	2042	2046	1075	1140	1162	1181	1255	1352	1377
PC = 000007	1660	1812	1838*	1853*									
PIRG = 177772	1378	1825*	1838*	1853*									
PIRVEC = 000240	1688	528*	532*										
PIR4 = 010000	1648	524*	525*	543*	544*								
PKN = 000000	2058	528											
PRTY3 = 000140	1978												
PRTY4 = 000200	1528	540											
PRTY7 = 000340	1538	494	505	526	527	534	638	646	649	1220	1232		523
PSM = 010000	1548	234	238	235	262	271	278	290	299	325	339	499	523
	1197	1209	1341	1352	1388	1405	1724	2024	2042				
	1968	271	278	299	325	339	421	447	465	505	525	594	667
	670	750	759	797	809	845	856	950	1339	1352	1364	1377	1453
	1480	1498	1547	1574	1592	1639	1660	1704	1732	1758	1784	1792	1821
PSM = 177776	1923	1953	1970	2000									
	1668	222	234*	236	237*	244*	246	247*	255*	258	260*	271*	274
	277*	284*	291*	295*	297	298*	311*	313*	325*	329*	331	332*	345*
	347*	357*	359*	362*	364	366*	379*	381*	390*	393*	395	397*	411*
	414*	416	417*	431*	433*	436*	438	440*	459*	461*	463	464*	476*
	478*	480	481*	496*	499*	500*	502	503*	523*	527*	529*	531	533*
	549*	560*	578*	583*	594*	606*	622*	627*	638*	641	642*	663*	667*
	669	683*	687*	689	703*	709	711*	722*	729*	735	737*	750*	756
	758*	772*	778	780*	795*	797*	802	803*	805*	815*	817*	822	823*
	825*	845*	850	852*	862*	864*	871	873*	875*	888*	894	896*	906*
	908*	909*	912*	913*	915*	922*	924*	927*	929*	936*	938*	941*	943*
	950*	955*	962*	967*	975*	991*	993*	1000*	1003*	1016*	1018*	1025*	1028*
	1041*	1046*	1050*	1065*	1074*	1084*	1087*	1097*	1098*	1109*	1116*	1127*	1130*
	1138	1139*	1156*	1161	1176*	1180	1197*	1201*	1206	1208*	1220*	1224*	1229
	1231*	1245*	1252	1254*	1264*	1268*	1275	1277*	1292*	1294*	1302	1314*	1316*
	1324	1326*	1339*	1341*	1349	1351*	1364*	1388*	1419*	1422	1423*	1444*	1453*
	1468*	1480*	1485*	1487*	1498*	1502*	1505*	1508*	1519*	1524*	1526*	1537*	1547*
	1562*	1574*	1578*	1580*	1592*	1596*	1599*	1601*	1612*	1617*	1619*	1630*	1631
	1632*	1639*	1650	1666*	1676	1692*	1703	1704*	1722*	1724*	1728*	1729*	1731
	1732*	1750*	1755*	1757	1758*	1784*	1791	1801*	1808	1821*	1834*	1839*	1841
	1842*	1849*	1854*	1856	1857*	1864*	1881*	1886*	1889*	1902*	1907*	1910*	1923*
	1945*	1953*	1958*	1970*	1992*	2000*	2005*	2013*	2025*	2027*	2029*	2031*	2050*
PUM = 030000	1958	222	255	262	333	367	401	482	496	514	523	534	540
	549	687	690	729	738	817	864	876	888	897	924	938	962
	1016	1032	1109	1118	1314	1327	1388	1405	1468	1502	1519	1562	1596
	1612	1666	1686	1692	1716	1735	1750	1765	1801	1812	1834	1843	1849
	1858	1945	1958	1992	2005	2042							
PWRUP = 001022	222*												
REDPTR = 000736	1818	837	839	1389	1399								
REG = 004000	1988	222	271	278	357	359	373	389	401	494	505	560	568
	606	618	636	638	646	649	703	712	991	993	1018	1023	1032
	1050	1065	1075	1087	1099	1109	1118	1130	1156	1162	1176	1181	1201
	1209	1224	1232	1245	1255	1268	1278	1294	1303	1316	1327	1341	1352
	1364	1377	1388	1405	1417	1419	1427	1453	1468	1480	1498	1547	1562
	1574	1592	1612	1639	1660	1666	1686	1692	1704	1716	1727	1735	1750
RO = 000000	1753	1755	1758	1762	1765	1801	1812	1834	1843	1883	1902	2027	
	1318	236*	238	246*	248	258*	262	297*	299	312*	314	331*	333
	346*	348	364*	367	380*	382	416*	421	438*	447	463*	465	480*
	482	531*	534	665*	668*	676	689*	690	735*	738	756*	759	775*
	777*	787	804*	806	824*	826	851*	853	872*	879	894*	897	928*

T12AA	002412	461#	468	
T13	002452	473#		
T13A	002504	474	480#	
T13AA	002476	478#	485	
T14	002544	491#		
T14A	002624	493	502#	
T14AA	002616	500#	511	
T15	002722	521#		
T15A	003000	524	531#	
T15AA	002772	529#	537	
T16	003062	547#		
T16A	003136	556#		
T16B	003142	556	557#	
T16C	003154	558	559#	
T16D	003174	561	562#	
T16E	003206	563	564#	
T16ERR	003330	554	583#	
T16F	003250	567	571#	
T16G	003302	552	577#	
T16X	003336	582	587#	
T17	003354	592#		
T17A	003410	598#		
T17B	003422	598	600#	
T17C	003442	601	603#	
T17D	003500	607	609#	
T17E	003522	610	613#	
T17ERR	003622	595	627#	
T17F	003542	614	616#	
T17G	003574	617	621#	
T17X	003630	626	629#	
T2	001146	254#		
T20	003646	634#		
T20A	003764	637	656#	
T20AA	003702	641#	643	
T21	003770	653	655	662#
T22	004052	682#		
T23	004134	701#		
T24	004240	728#		
T25	004326	749#		
T26	004416	771#		
T27	004506	794#		
T3	001226	270#		
T30	004602	814#		
T31	004676	835#		
T31A	004722	844#		
T31B	005000	861#		
T31C	005106	887#		
T32	005160	905#		
T32A	005242	921#		
T33	005312	935#		
T34	005364	949#		
T35	005422	961#		
T36	005462	974#		
T36A	005520	978	982#	
T36AA	005516	981#	985	
T37	005542	990#		

T37A	005622	997	1002#
T37AA	005614	1000#	1007
T4	001314	287#	
T4A	001362	289	297#
T4AA	001354	295#	302
T40	005662	1015#	
T40A	005742	1022	1027#
T40AA	005734	1025#	1035
T41	006022	1045#	
T41A	006070	1048	1056#
T41B	006110	1064#	
T41BB	006146	1066	1073#
T42	006174	1083#	
T42A	006250	1086	1096#
T43	006376	1126#	
T43A	006450	1129	1137#
T43B	006304	1106#	
T43BB	006346	1108	1115#
T44	006516	1152#	
T45	006604	1172#	
T46	006670	1196#	
T47	006772	1219#	
T5	001474	321#	
T5A	001540	323	331#
T5AA	001532	329#	336
T50	007102	1243#	
T51	007202	1266#	
T52	007300	1291#	
T53	007402	1313#	
T54	007520	1338#	
T55	007636	1363#	
T55A	007712	1368	1374#
T55AA	007710	1373#	1380
T56	007754	1386#	
T56A	010030	1387	1399#
T56AA	010026	1397#	1408
T57	010106	1415#	
T57A	010212	1418	1436#
T57AA	010142	1422#	1424
T57EX	010216	1435	1438#
T6	001646	354#	
T6A	001720	355	364#
T6AA	001712	362#	370
T60	010220	1443#	
T61	010246	1452#	
T62	010312	1467#	
T63	010352	1479#	
T64	010436	1497#	
T65	010540	1518#	
T66	010630	1536#	
T67	010656	1546#	
T7	002022	387#	
T7A	002062	388	395#
T7AA	002054	393#	398
T70	010722	1561#	
T71	010762	1573#	

CROSS REFERENCE TABLE -- PERMANENT SYMBOLS

ASL	912	913														
ASR	908	909														
BCS	1057	1829														
BEO	228	239	249	263	279	300	303	306	309	315	324	337	340	343	349	
	368	371	374	377	383	399	402	419	422	442	445	448	466	469	483	
	486	506	509	512	515	535	538	541	580	624	644	647	650	653	671	
	674	677	691	694	697	713	717	720	724	739	742	745	760	763	766	
	782	785	788	807	810	827	830	840	854	857	877	880	883	898	901	
	917	931	945	957	969	983	986	1005	1008	1011	1030	1033	1036	1039	1060	
	1076	1079	1100	1103	1119	1122	1141	1144	1163	1166	1169	1182	1185	1188	1210	
	1213	1216	1233	1236	1239	1256	1259	1262	1279	1282	1285	1304	1307	1310	1328	
	1331	1334	1353	1356	1359	1375	1378	1381	1400	1403	1406	1409	1425	1428	1432	
	1448	1460	1463	1475	1490	1493	1511	1514	1529	1532	1542	1554	1557	1569	1583	
	1587	1604	1607	1622	1625	1634	1652	1655	1658	1661	1678	1681	1684	1687	1708	
	1711	1714	1717	1736	1739	1742	1745	1760	1763	1766	1770	1773	1793	1796	1810	
	1813	1816	1844	1859	1871	1874	1877	1891	1894	1897	1912	1915	1932	1935	1939	
	1956	1961	1964	1979	1982	1986	2003	2008	2011	2035	2039	2043	2047	2057	2063	
BIC	277	397	499	503	504	527	571	642	711	754	774	993	1028	1098	1139	
	1208	1231	1254	1277	1326	1351	1423	1487	1508	1526	1580	1601	1619	1842	1889	
	1910															
BIS	256	272	496	498	557	559	560	562	564	566	569	574	577	599	600	
	602	603	604	605	606	608	609	612	613	615	616	620	621	705	752	
	775	873	1018	1050	1087	1134	1201	1224	1294	1316	1341	1485	1502	1505	1524	
	1578	1596	1599	1617												
BIT	222	227	265	281												
BNE	223	266	282													
BPL	1827	2061														
BR	582	626	655	1055	1072	1095	1114	1136	1435	1775						
CCC	293	776	891	1059	1112	1249										
CLR	220	237	247	260	261	276	284	295	298	313	318	324	329	332	347	
	362	366	381	393	405	414	417	425	436	440	451	457	461	464	478	
	481	500	518	529	532	533	544	555	573	578	583	587	589	597	622	
	627	629	631	639	663	666	683	685	702	706	722	731	737	758	780	
	796	805	816	825	846	852	866	875	890	896	907	915	925	929	937	
	943	951	955	967	975	979	992	1000	1003	1017	1025	1041	1046	1049	1051	
	1084	1092	1111	1127	1132	1147	1155	1175	1202	1244	1264	1267	1292	1297	1318	
	1343	1367	1369	1383	1391	1411	1420	1444	1455	1503	1523	1537	1549	1597	1616	
	1632	1644	1645	1670	1671	1696	1697	1729	1733	1754	1786	1805	1839	1854	1857	
	1864	1886	1907	1918	1929	1951	1974	1997	2013	2022	2029	2031	2050	2053		
CLZ	869															
CMP	238	248	262	278	299	302	305	308	314	333	336	339	342	348	367	
	370	373	376	382	398	401	418	421	441	444	447	465	468	482	485	
	505	508	511	514	534	537	540	579	623	643	646	649	670	673	690	
	693	712	716	738	741	759	762	781	784	806	809	826	829	839	853	
	856	876	879	897	916	944	956	968	982	985	1004	1007	1010	1029	1032	
	1035	1038	1059	1075	1099	1118	1121	1162	1165	1181	1184	1187	1209	1212	1232	
	1235	1238	1255	1258	1278	1281	1284	1303	1306	1327	1330	1333	1352	1355	1374	
	1377	1380	1399	1405	1408	1424	1427	1447	1459	1474	1489	1492	1510	1528	1531	
	1541	1553	1568	1582	1586	1603	1621	1624	1633	1651	1654	1660	1677	1680	1686	
	1707	1710	1716	1735	1738	1741	1744	1759	1762	1765	1769	1792	1809	1812	1843	
	1858	1870	1873	1876	1890	1893	1896	1911	1914	1931	1938	1955	1960	1978	1981	
	1985	2002	2007	2034	2038	2042	2046	2056								
CMPB	1140															
COM	656	1143	1168	1358	1431	1436	1457	1472	1551	1566	1772	1777				
ENT	361	413	575													
HALT	149	208	296	460	462	477	479									

L04

TSTB	2060
WAIT	570
.ABS	115
.END	2069
.NLIST	114
.REM	1
.REPT	208
.TITLE	113

ERRORS DETECTED: 0
DEFAULT GLOBALS GENERATED: 0

#DCKBOA,DCKBOA.SEQ/SOL/CRF/DS:ERFZ/EN:ABS=DSKM:DCKBOA.P11
RUN-TIME: 7 15 5 SECONDS
RUN-TIME RATIO: 632/29=21.7
CORE USED: 9K (18 PAGES)

