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DECUS NO.	8-95
TITLE	TRACE for EAE
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SOURCE LANGUAGE	

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2. ABSTRACT

TRACE INTERPRETIVELY EXECUTES A PDP-8 PROGRAM. AT THE SAME TIME A PRINTOUT IS PROVIDED OF THE CONTENTS OF THE PROGRAM COUNTER, THE INSTRUCTION, THE LINK, ACCUMULATOR, AND MULTIPLIER-QUOTIENT REGISTERS, AND WHERE APPLICABLE, THE EFFECTIVE ADDRESS, AND THE CONTENTS OF THE EFFECTIVE ADDRESS. THIS PRINTOUT MAY BE FOR ALL INSTRUCTIONS OR FOR A SELECTED TYPE OF INSTRUCTION WITHIN SELECTED MEMORY BOUNDS. THE PROGRAM IS CAPABLE OF HANDLING ALL PDP-8 INSTRUCTIONS INCLUDING IOT, TWO-WORD EAE, AND INTERRUPT INSTRUCTIONS. TRACE CANNOT BE DESTROYED BY THE PROGRAM BEING TRACED.

3. REQUIREMENTS

3.1. TRACE REQUIRES TWO AND ONE-HALF PAGES OF MEMORY. THE HALF PAGE MAY BE DELETED IF NO INTERRUPT PROCESSING IS NEEDED. THE PROGRAM MAY BE ASSEMBLED FOR LOCATION IN ANY AREA OF MEMORY. HOWEVER, IF THE PROGRAM IS TO BE LOCATED IN NON-CONSECUTIVE PAGES THE SELF-PROTECT FEATURE MUST BE DISABLED (SEE SECTION 4.5 - 4.6).

3.3. OUTPUT IS ON THE ASR-33 TELETYPE. THE PROGRAM USES THE TYPE 182 EXTENDED ARITHMETIC ELEMENT.

4. USAGE

4.3. INPUTS TO TRACE ARE BY SWITCH SETTINGS. SEE SEC. 4.4.

4.4. (A) START THE PROGRAM AT EITHER OF ITS STARTING ADDRESSES (SEE (E) BELOW). COMPUTER WILL HALT.
(B) ENTER THE INSTRUCTION MASK IN THE SR.
(C) PRESS CONTINUE.
(D) REPEAT (B) AND (C) FOR THE DETERMINING BITS OF THE INSTRUCTION, THE LOWER BOUND - 1 FOR TYPEOUT, THE UPPER BOUND FOR TYPEOUT, AND THE STARTING ADDRESS OF THE PROGRAM TO BE TRACED.
(E) STARTING AT "BEGIN" WILL CLEAR THE PSEUDO-LINK, PSEUDO-ACCUMULATOR, AND THE LINE COUNTER IN THE PAGE FORMAT ROUTINE. STARTING AT "BEGIN"+1 WILL SAVE THE PREVIOUS CONTENTS OF THE THREE REGISTERS (I. E., STARTING AT "BEGIN" SIMULATES "START", AND STARTING STARTING AT "BEGIN"+1 SIMULATES "CONTINUE").

4.5. (A) EXECUTION OF A TCF (6042) INSTRUCTION WILL HANG UP THE PROGRAM.
(B) ANY MEMORY REFERENCE INSTRUCTION WHICH REFERENCES AN ADDRESS WITHIN THE BOUNDS OF TRACE IS NOT EXECUTED. COMPUTER WILL HALT AT "BEGIN"+175.

4.6. (A) RECOVERY FROM HANGUP IS TO PROCEED PAST THE WAITING LOOP. SET "BEGIN"+61 INTO THE PROGRAM COUNTER. PRESS CONTINUE.
(B) IF THE INSTRUCTION CAN BE IGNORED, SIMPLY PRESS CONTINUE. THE INSTRUCTION WILL BE TREATED AS A "NOP" AND THE PROGRAM CONTINUES. IF TRACE HAS BEEN ASSEMBLED FOR NON-CONSECUTIVE PAGES AND THE REFERENCE IS TO A LOCATION BETWEEN THE PAGES, THE SELF-PROTECT FEATURE MAY BE DISABLED BY PLACING A "NOP" IN LOCATION "CONT".

5. RESTRICTIONS (NONE)

6. DESCRIPTION

6.1. TRACE IS A GENERAL DEBUGGING PROGRAM. IT WILL PROVIDE A LISTING OF PROGRAM STEPS AS THEY ARE EXECUTED. THIS IS PARTICULARLY USEFUL IN DEBUGGING PROGRAMS WHICH CONTAIN ERRORS WHICH CAUSE THESE PROGRAMS TO DESTROY THEMSELVES. A PRINTOUT IS PROVIDED OF THE CONTENTS OF THE PROGRAM COUNTER, THE INSTRUCTION, THE CONTENTS OF THE LINK, ACCUMULATOR, AND MULTIPLIER QUOTIENT REGISTERS, AND, WHERE APPLICABLE, THE EFFECTIVE ADDRESS, AND THE CONTENTS OF THE EFFECTIVE ADDRESS. THE TYPE OF INSTRUCTION AND/OR THE SECTION OF MEMORY TO BE DOCUMENTED MAY BE SELECTED WHEN THE PROGRAM IS STARTED. THE INSTRUCTION MASK ENTERED WILL DETERMINE WHICH BITS ARE TO BE INSPECTED, AND THE DETERMINING BITS WILL SPECIFY THE STATE REQUIRED. THIS ALLOWS FLEXIBILITY AND ALLOWS DEBUGGING TO BE DONE FASTER BY DUMPING ONLY INSTRUCTIONS WHICH ARE SUSPECTED OF CAUSING TROUBLE OR WHICH WILL SHOW THE PATH OF THE PROGRAM. ALSO IF THE AREA OF THEPROGRAM WHICH IS CAUSING TROUBLE IS KNOWN, THE MEMORY BOUNDS FOR THE TYPEOUT MAY BE SELECTED TO GIVE TYPEOUT ONLY WHEN THE PROGRAM IS IN THE TROUBLE AREA. IT IS POSSIBLE TO STOP TRACE AND RESTART WITH DIFFERENT MASKS AND BOUNDS BY SIMPLY STOPPING THE PROGRAM WHILE A LINE IS BEING TYPED, RESTARTING AT "BEGIN"+1 (BY PRESSING CONTINUE AFTER SETTING THE PC), AND SETTING THE NEW MASKS AND BOUNDS AS IN SECTION 4.4. THE PROGRAM IS SELF-PROTECTING. ANY ATTEMPT TO REFERENCE A LOCATION WITHIN TRACE IS IGNORED (SEE SECTIONS 4.5(B) - 4.6(B)). OTHERWISE ALL INSTRUCTIONS MAY BE EXECUTED (SEE SECTION 4.5(A) FOR POSSIBLE EXCEPTION). HALTS AND INTERRUPTS ARE GIVEN SPECIAL TREATMENT HALTS CAUSE TYPING OF THE ADDRESS AT WHICH THEY OCCUR AND THE MESSAGE "HLT". THE PROGRAM COUNTER SHOWS "BEGIN"+341 WHEN THE INSTRUCTION IS EXECUTED AND COMPUTER HALTS. THE PSEUDO-PC, I. E., THE ADDRESS OF THE INSTRUCTION WHICH WAS ABOUT TO BE EXECUTED, FOLLOWED BY THE MESSAGE "INT". SEE EXAMPLE 3, SECTION 6.2 FOR EXAMPLES OF BOTH HALTS AND INTERRUPTS.

6.2. EXAMPLES.

THE MOST COMMON USES OF THIS PROGRAM ARE TO: (1) LIST ALL PROGRAM STEPS, OR (2) LIST ALL JUMPS.

EXAMPLE 1. TO LIST ALL PROGRAM STEPS.
(A) START PROGRAM.
(B) ENTER 0000 IN SR. CONTINUE.
(C) CONTINUE.
(D) CONTINUE.
(E) ENTER 7777 IN SR. CONTINUE.
(F) ENTER SA OF PROGRAM TO BE TRACED IN SR. CONTINUE.

THE FIRST SEVERAL LINES OF A TRACE OF THE TRACE PROGRAM STARTING AT 200 ARE SHOWN BELOW.

```
0200   5231   00000   0000   0231   3722
0231   3722   00000   0000   0560   0000
0232   3626   00000   0000   0556   0000
0233   7040   00000   0000
0234   1310   07777   0000   0310   7716
0235   3306   07715   0000   0306   7716
0236   5201   00000   0000   0201   7602
0201   7602   00000   0000
0201   HLT
0202   7406   00000   0000
0202   HLT
0203   3623   00000   0000   0562   0000
0204   7406   00000   0000
0204   HLT
0205   0623   00000   0000   0562   0000
0206   7041   00000   0000
0207   3624   10000   0000   0561   0000
0210   7406   10000   0000
0210   HLT
0211   7040   10000   0000
0212   3227   17777   0000   0227   0000
0213   7406   10000   0000
0213   HLT
0214   7040   17777   0000
0215   3230   10000   0000   0230   0000
0216   7404   10000   0000
0217   3625   11000   0000   0554   0000
0220   6046   10000   0000
0221   5622   10000   0000   0401   4772
0401   4772   10000   0000   0615   0000
0616   1254   10000   0000   0654   0001
0617   7640   10001   0000
0620   5251   10000   0000   0651   1255
```

EXAMPLE 2. TO LIST ALL JUMPS (JMP AND JMS).

(A) START PROGRAM.

(B) ENTER 6000 IN SR. CONTINUE. (JUMP INSTRUCTIONS ARE DETERMINED BY THE STATE OF THE FIRST TWO BITS.)

(C) ENTER 4000 IN SR. CONTINUE. BIT 0 OF A JUMP INSTRUCTION IS ON, BIT 1 IS OFF.

(D) ENTER 0000 IN SR. CONTINUE.

(E) SEE STEPS (E) AND (F) IN EXAMPLE 1.

THE FIRST FEW LINES OF THE SAME PROGRAM AS ABOVE ARE SHOWN ON THE NEXT PAGE. THE SAME PORTION AS ABOVE IS SHOWN.

```
0200   5231   00000   0000   0231   3722
0236   5201   00000   0000   0201   7602
0201   HLT
0202   HLT
0204   HLT
0210   HLT
0213   HLT
0221   5622   10000   0000   0401   4772
0401   4772   10000   0000   0615   0402
0620   5251   10000   0000   0651   1255
```

EXAMPLE 3. ILLUSTRATION OF INTERRUPT PROCRESSING.
INTERRUPT TESTING IS DONE INTERPRETIVELY. ONLY SPECIFIC FLAGS ARE TESTED. THIS IS DONE IN SUBROUTINE "INT", AND FLAG TESTS FOR ANY DESIRED DEVICES CAN BE KEYED INTO THE APPROPRIATE LOCATIONS OR INSERTED IN THE SOURCE PROGRAM IN THIS SUBROUTINE.

```
1000   6026   00000   0000
1001   6001   00000   0000
1002   5202   00000   0000   1002   5202
1002   INT
0001   7402   00000   0000
0001   HLT
```

7. METHODS

7.1. EACH INSTRUCTION IS EXAMINED IN TURN AND GROUPES AS AN IOT OR OPERATE INSTRUCTION OR AS A MEMORY REFERENCE INSTRUCTION. THE ADDRESS REFERENCED BY MEMORY REFERENCE INSTRUCTIONS IS DETERMINED AND STORED IN A SPECIFIC MEMORY LOCATION (ADDR). THE ADDRESS IS THEN TESTED TO CHECK IF IT IS WITHIN THE BOUNDS OF TRACE. IF SO, THE EXECUTION IS DELETED, AND THE COMPUTER HALTS. RESTARTING FROM HERE STARTS HTE PROCRDURE OVER WITH THE NEXT INSTRUCTION IN THE PROGRAM BEING TRACED.

IF THE INSTRUCTION REFERENCES A LEGAL ADDRESS IT IS NEXT TESTED FOR A JUMP (JMP OR JMS). IF THE OPERATION IS NOT A JUMP THE INSTRUCTION IS ASSEMBLED AS X I ADDR WHERE X IS THE OPERATION AND ADDR IS THE LOCATION OF THE ADDRESS REFERENCED. THE INSTRUCTION IS THEN EXECUTED. JUMP INSTRUCTIONS ARE EXECUTED INTERPRETIVELY. OPERATE AND IOT INSTRUCTIONS ARE TESTED FOR HALT INSTRUCTIONS, INTERRUPT INSTRUCTIONS, AND TWO-WORD EAE INSTRUCTIONS. THESE THREE TYPES OF INSTRUCTIONS MUST BE SPECIALLY HANDLED. ALL OTHERS ARE DIRECTLY EXECUTED. INTERRUPT INSTRUCTIONS SET THE PSEUDO-ION FLAG. HALT INSTRUCTIONS CAUSE TYPING OUT OF THE MESSAGE XXXX HLT, WHERE XXXX IS THE LOCATION OF THE HALT INSTRUCTION, BEFORE EXECUTION. FOR TWO-WORD EAE INSTRUCTIONS THE SECOND WORD IS FETCHED AND THE INSTRUCTION THEN EXECUTED.

8. FORMAT.

8.3. OUTPUT FROM TRACE IS ONE LINE PER INSTRUCTION, 50 LINES PER PAGE. ALL VALUES ARE IN OCTAL DIGITS AND ARE AS FOLLOWS: PROGRAM COUNTER, INSTRUCTION, LINK AND ACCUMULATOR, MULTIPLIER-QUOTIENT REGISTER, ADDRESS REFERENCED, AND CONTENTS OF SAME. THE LAST TWO ARE APPLICABLE ONLY TO MEMORY REFERENCE INSTRUCTIONS. SEE EXAMPLE BELOW.

PC	INST	L AC	MQ	ADDR	(ADDR)
1001	6001	00000	0000		
1002	5202	00000	0000	1002	5202

9. EXECUTION TIME

THE PROGRAM IS USUALLY LIMITED BY THE SPEED OF THE TELETYPE. SINCE EACH LINE CONSISTS OF EITHER 27 OR 39 CHARACTERS THIS MEANS AN EXECUTION TIME OF 2.7 OR 3.9 SECONDS PER INSTRUCTION. HOWEVER, IF NO TYPING IS DONE, EXECUTION TIME IS ABOUT 50 TIMES THE NORMAL PROGRAM EXECUTION TIME.

10. PROGRAM.

10.4. PROGRAM LISTING. SEE FOLLOWING PAGES FOR A PASS THREE LISTING FROM PAL III OF TRACE ASSEMBLED TO START AT LOCATION 200.

11. DIAGRAMS (NONE)

12. REFERENCES (NONE)

13. ADDENDA

POSSIBLE MODIFICATIONS.

(A) IF THE PROGRAM TO BE TRACED HAS NO "ION" INSTRUCTION, THE FOLLOWING CHANGES MAY BE MADE.

(1) "NOP" TO LOCATION BEGIN+201.
(2) DELETE BEGIN+306.
(3) DELETE BEGIN+374 AND BEGIN+375.
(4) DELETE 3RD PAGE.

(B) IF TYPEOUT OF SOME REGISTERS IS NOT REQUIRED THE APPROPRIATE PAIR OF INSTRUCTIONS MAY BE DELETED OR ALTERNATIVELY, THE "JMS I OCT" MAY BE REPLACED BY "CLA".

(C) OUTPUT ON A DEVICE OTHER THAN THE TELETYPE WILL REQUIRE CHANGING LOCATIONS BEGIN+20, -+57, -+61, -+62, AND BEGIN+263.

```
                        /PROGRAM TRACE VERSION 5/VIII/67 - EWW
                         /TRACE - PAGE 1
                        /SETUP AND SUBROUTINES
0200   5231   BEGIN,    JMP  SETUP
0201   7602             HLT  CLA
0202   7406             OSR  HLT     /SET INSTRUCTION MASK
0203   3623             DCA  I MSK
0204   7406             OSR  HLT     /SET INSTRUCTION BITS
0205   0623             AND  I MSK
0206   7041             CMA  IAC
0207   3624             DCA  I SET
0210   7406             OSR  HLT     /SET LOWER BOUNDS
0211   7040             CMA
0212   3227             DCA  LBOUND
0213   7406             OSR  HLT     /SET UPPER BOUND
0214   7040             CMA
0215   3230             DCA  UBOUND
0216   7404             OSR          /SET STARTING ADDRESS
0217   3625             DCA  I PCI
0220   6046             TLS
0221   5622             JMP  I START
0222   0401   START,    RETURN+1
0223   0563   MSK,      MASK
0224   0562   SET,      BITSET
0225   0555   PCI,      PC
0226   0557   LINK,     L
0227   0000   LBOUND,   0
0230   0000   UBOUND,   0
0231   3721   SETUP,    DCA  I ACI   /CLEAR AC AND LINK (PSEUDO)
0232   3626             DCA  I LINK
0233   7040             CMA          /RESET PAGE LINE COUNTER
0234   1307             TAD  M62
0235   3305             DCA  LFC
0236   5201             JMP  BEGIN+1
0237   0000   OCTCO,    0            /TYPE FOUR DIGIT OCTAL NUMBER
0240   7421             MQL
0241   1255             TAD  M4
0242   3266             DCA  CRLF    /PUT AWAY DIGIT COUNTER
0243   7413   SHIFT,    SHL
0244   0002             2
0245   4351             JMS  OUTPUT
0246   4260             4260
0247   2266             ISZ  CRLF
0250   5243             JMP  SHIFT
0251   4351             JMS  OUTPUT /PUT OUT TWO SPACES
0252   0240             240
0253   4240             4240
0254   5637             JMP  I OCTCO
```

```
0255  7774  M4,       -4
0256  0000  TYPE,     0           /TYPE ONE CHARACTER
0257  6041            TSF
0260  5257            JMP .-1
0261  6046            TLS
0262  6041            TSF
0263  5262            JMP .-1
0264  7200            CLA
0265  5656            JMP I TYPE
0266  0000  CRLF,     0           /TYPE CARRIAGE RETURN-LINE FEED
0267  4351            JMS OUTPUT
0270  0215            215
0271  4212            4212
0272  2305            ISZ LFC
0273  5666            JMP I CRLF
0274  1306  PAGE,     TAD M20     /END OF PAGE, TYPE 16 LINE FEEDS
0275  3305            DCA COUNT
0276  4351            JMS OUTPUT
0277  4212            4212
0300  2305            ISZ COUNT
0301  5276            JMP .-3
0302  1307            TAD M62
0303  3305            DCA LFC
0304  5666            JMP I CRLF
      COUNT,
0305  7716  LFC,      -62
0306  7760  M20,      -20
0307  7716  M62,      -62
0310  0000  HALT,     0           /TYPE MESSAGE "HLT"
0311  4266            JMS CRLF
0312  1625            TAD I PCI
0313  4237            JMS OCTCO
0314  4351            JMS OUTPUT
0315  0310            310         /H
0316  0314            314         /L
0317  4324            4324        /T
0320  5710            JMP I HALT
0321  0561  ACI,      AC
0322  7004  JUMP,     RAL         /JUMP INSTRUCTION
0323  7710            SPA CLA     /RETURN JUMP ?
0324  5333            JMP CHDN    /NO
0325  1750            TAD I ADD   /YES
0326  3351            DCA ADDI
0327  1625            TAD I PCI   /PUT PC IN JUMP ADDRESS
0330  7001            IAC
0331  3751            DCA I ADDI
0332  2750            ISZ I ADD
0333  1750  CHDN,     TAD I ADD   /PUT JUMP ADDRESS IN PC
0334  3625            DCA I PCI
0335  5622            JMP I START
```

```
0336  0000  BOUND,    0           /CHECK IF PC WITHIN BOUNDS
0337  7100            CLL
0340  1625            TAD I PCI
0341  1227            TAD LBOUND
0342  7200            CLA
0343  1625            TAD I PCI
0344  1230            TAD UBOUND
0345  7640            SZA CLA     /IN BOUNDS IF OVERFLOW ONLY ONCE
0346  2336            ISZ BOUND   /WITHIN BOUNDS - GO TO CALL + 2
0347  5736            JMP I BOUND
0350  0420  ADD,      ADDR
            ADDI,
0351  0000  OUTPUT,   0           /OUTPUT CHARACTERS UNTIL ONE WITH
0352  1751            TAD I OUTPUT /NEGATIVE SIGN IS FOUND
0353  4256            JMS TYPE
0354  1751            TAD I OUTPUT
0355  2351            ISZ OUTPUT
0356  7700            SMA CLA
0357  5352            JMP OUTPUT+1
0360  5751            JMP I OUTPUT
                      /SELF - PROTECT ROUTINE
0361  7600  FIRST,    -BEGIN
0362  7110  LAST,     -FINAL-1
0363  0000  SELF,     0
0364  7100            CLL
0365  1750            TAD I ADD
0366  1361            TAD FIRST
0367  7200            CLA
0370  1750            TAD I ADD
0371  1362            TAD LAST
0372  7620            SNL CLA     /OVERFLOW TWICE OR NO OVERFLOW
0373  5763            JMP I SELF  /INDICATES ADDR OUTSIDE PROGRAM
0374  3750            DCA I ADD   /ZERO TO ADDRESS IF INSIDE PROGRAM
0375  7402            HLT
0376  5777            JMP I RET1  /DO NOT EXECUTE CURRENT INSTRUCTION
0377  0400  RET1,     RETURN
            LAST01,
```

```
                /TRACE PAGE 2 - BASIC INTERPRETIVE ROUTINES
                        *BEGIN+200
0400  2355  RETURN,    ISZ PC
0401  4773              JMS I INTI
0402  3337              DCA FLAG
0403  1755              TAD I PC    /GET INSTRUCTION
0404  3340              DCA INST2
0405  1755              TAD I PC    /CHECK IF MEMORY REFERENCE
0406  7144              CMA CLL RAL
0407  7720              SMA SNL CLA
0410  5246              JMP DIR
0411  1755  NON,        TAD I PC    /MODIFY INST AND
0412  0351              AND INMK    /DETERMINE OPERAND
0413  1352              TAD CONST   /ADDRESS
0414  3340              DCA INST2
0415  1755              TAD I PC    /INCREMENT AUTO-INDEX REGISTER IF
0416  0371              AND ZMSK    /INSTRUCTION IS AN INDIRECT
0417  3220              DCA .+1     /REFERENCE TO
0420  7402  ADDR,       HLT         /ONE OF THESE
0421  7040              CMA
0422  3337              DCA FLAG
0423  1755              TAD I PC
0424  0354              AND AMSK
0425  3220              DCA ADDR
0426  1755              TAD I PC    /DETERMINE IF ZERO PAGE ADDRESS
0427  7006              RTL
0430  7006              RTL
0431  7700              SMA CLA
0432  5237              JMP ZER     /ZERO PAGE
0433  1355              TAD PC      /ADD PAGE NUMBER
0434  0265              AND CMSK    /FOR CURRENT PAGE
0435  1220              TAD ADDR
0436  3220              DCA ADDR
0437  1755  ZER,        TAD I PC
0440  7006              RTL         /DIRECT OR INDIRECT?
0441  7004              RAL
0442  7700              SMA CLA
0443  5246              JMP DIR     /DIRECT ADDRESS
0444  1620              TAD I ADDR  /INDIRECT ADDRESS
0445  3220              DCA ADDR
0446  4775  DIR,        JMS I BOUNDS
0447  5300              JMP CONT
0450  1755              TAD I PC
0451  0363              AND MASK
0452  1362              TAD BITSET
0453  7640              SZA CLA
0454  5300              JMP CONT
0455  4767              JMS I CRLFI
0456  1355              TAD PC      /YES, TYPE PROGRAM COUNTER
0457  4756              JMS I OCT
```

```
0460  1755          TAD I PC    /TYPE INSTRUCTION
0461  4756          JMS I OCT
0462  1357          TAD L       /LINK
0463  1370          TAD IC260
0464  6046          TLS
0465  7600  CMSK,    7600
0466  1361          TAD AC      /ACCUMULATOR
0467  4756          JMS I OCT
0470  1353          TAD MQ      /MULTIPLIER-QUOTIENT
0471  4756          JMS I OCT
0472  2337          ISZ FLAG
0473  5300          JMP CONT
0474  1220          TAD ADDR    /TYPE ADDRESS REFERENCED
0475  4756          JMS I OCT
0476  1620          TAD I ADDR /AND CONTENTS OF SAME
0477  4756          JMS I OCT
0500  4776  CONT,   JMS I ISELF /NO, DON'T TYPE
0501  1755          TAD I PC    /TEST FOR HALT INSTRUCTION
0502  0364          AND HMSK
0503  1366          TAD IMSK
0504  7650          SNA CLA
0505  4760          JMS I HALTI
0506  4774          JMS I INTERI /CHECK IF INTERRUPT INSTRUCTION
0507  1755          TAD I PC    /CHECK FOR JUMP INSTRUCTION
0510  7004          RAL
0511  7020          CML
0512  7520          SNL SMA
0513  5772          JMP I JUMPI
0514  7300          CLA CLL
0515  1351          TAD INMK    /NOP TO INST2-1
0516  3337          DCA INST2-1
0517  1755          TAD I PC
0520  0365          AND SMSK    /EXTENDED ARITHMETIC INST,
0521  1366          TAD IMSK    /OF TWO WORD TYPE ?
0522  7070          CMA CML RAR
0523  7730          SPA SZL CLA
0524  5332          JMP HOME    /NO, CONTINUE
0525  1755          TAD I PC    /YES, SET UP BOTH WORDS
0526  3337          DCA INST2-1
0527  2355          ISZ PC
0530  1755          TAD I PC    /SECOND WORD
0531  3340          DCA INST2
0532  1357  HOME,   TAD L       /RESTORE OPERATING REGISTERS
0533  7110          CLL RAR
0534  1353          TAD MQ
0535  7421          MQL
0536  1361          TAD AC
0537  0000  FLAG,    0
0540  0000  INST2,   0           /EXECUTE INSTRUCTION
0541  7410          SKP         /IN CASE INSTRUCTION WAS A SKIP
```

```
0542  2355            ISZ PC      /THE PSEUDO-PC IS INCREMENTED
0543  3361            DCA AC      /SAVE OPERATING REGISTERS
0544  7004            RAL
0545  3357            DCA L
0546  7501            MQA
0547  3353            DCA MQ
0550  5200            JMP RETURN /AND GO BACK FOR NEXT INSTRUCTION
                              /TABLE OF VALUES
0551  7000  INMK,     7000
0552  0620  CONST,    AND I ADDR
0553  0000  MQ,       0
0554  0177  AMSK,     177
0555  0000  PC,       0
0556  0237  OCT,      OCTCO
0557  0000  L,        0
0560  0310  HALTI,    HALT
0561  0000  AC,       0
0562  0000  BITSET,   0
0563  0000  MASK,     0
0564  7403  HMSK,     7403
0565  7407  SMSK,     7407
0566  0376  IMSK,     376
0567  0266  CRLFI,    CRLF
0570  0260  IC260,    260
0571  0777  ZMSK,     777
0572  0322  JUMPI,    JUMP
0573  0615  INTI,     INT
0574  0600  INTERI,   INTER
0575  0336  BOUNDS,   BOUND
0576  0363  ISELF,    SELF
            LAST02,
```

```
                /TRACE PAGE 3
                                /INTERRUPT TESTING AND PROCESSING
                                *BEGIN+400
0600  0000  INTER,     0               /CHECK FOR INTERRUPT INSTRUCTION
0601  1657              TAD I PCII
0602  3262              DCA IPC
0603  1662              TAD I IPC
0604  0260              AND C7774
0605  1261              TAD M6000
0606  7640              SZA CLA
0607  5600              JMP I INTER
0610  1662              TAD I IPC
0611  0256              AND C3
0612  7110              CLL RAR
0613  3255              DCA INTFL2
0614  5665              JMP I IRET

0615  0000  INT,        0               /INTERRUPT CHECK
0616  1254              TAD INTFLG
0617  7640              SZA CLA         /IS INTERRUPT ON?
0620  5251              JMP END         /NO
0621  6031              KSF             /YES, CHECK VARIOUS FLAGS
0622  7410              SKP
0623  5234              JMP YES
0624  7000              NOP
0625  7410              SKP
0626  5234              JMP YES
0627  6011              RSF
0630  7410              SKP
0631  5234              JMP YES
0632  6021              PSF
0633  5251              JMP END
0634  7001  YES,        IAC             /SET UP FOR A JMS 0
0635  3255              DCA INTFL2
0636  4664              JMS I CRLI
0637  1657              TAD I PCII
0640  4666              JMS I OCTNO
0641  1657              TAD I PCII
0642  3000              DCA 0
0643  7001              IAC
0644  3657              DCA I PCII
0645  4663              JMS I TYPI
0646  0311              311
0647  0316              316
0650  4324              4324
0651  1255  END,        TAD INTFL2
0652  3254              DCA INTFLG
0653  5615              JMP I INT
0654  0001  INTFLG,     1
0655  0001  INTFL2,     1
```

```
0656   0003   C3,          3
0657   0555   PCII,        PC
0660   7774   C7774,       7774
0661   2000   M6000,       -6000
0662   0000   IPC,         0
0663   0351   TYPI,        OUTPUT
0664   0266   CRLI,        CRLF
0665   0400   IRET,        RETURN
0666   0237   OCTNO,       OCTCO
              FINAL,
```

/SYMBOL TABLE FOR TRACE
/VERSION 5/VIII/67

AC	0561
ACI	0321
ADD	0350
ADDI	0351
ADDR	0420
AMSK	0554
BEGIN	0200
BITSET	0562
BOUND	0336
BOUNDS	0575
CHDN	0333
CMSK	0465
CONST	0552
CONT	0500
COUNT	0305
CRLF	0266
CRLFI	0567
CRLI	0664
C3	0656
C7774	0660
DIR	0446
END	0651
FINAL	0667
FIRST	0361
FLAG	0537
HALT	0310
HALTI	0560
HMSK	0564
HOME	0532
IC260	0570
IMSK	0566
INMK	0551
INST2	0540
INT	0615
INTER	0600
INTERI	0574
INTFLG	0654
INTFL2	0655
INTI	0573
IPC	0662
IRET	0665
ISELF	0576
JUMP	0322
JUMPI	0572
L	0557
LAST	0362
LAST01	0400
LAST02	0577
LBOUND	0227
LFC	0305
LINK	0226
MASK	0563
MQ	0553
MSK	0223
M20	0306
M4	0255
M6000	0661
M62	0307
NON	0411
OCT	0556
OCTCO	0237
OCTNO	0666
OUTPUT	0351
PAGE	0274
PC	0555
PCI	0225
PCII	0657
RETURN	0400
RETI	0377
SELF	0363
SET	0224
SETUP	0231
SHIFT	0243
SMSK	0565
START	0222
TYPE	0256
TYPI	0663
UBOUND	0230
YES	0634
ZER	0437
ZMSK	0571