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PROGRAM

NOVA 800 Instruction Timer

TAPES

Binary 095-000046

ABSTRACT

NOVA 800 Instruction Timer is a maintenance program designed to test the CPU clock circuits by timing the instruction set. The 100 MS teletype clock is used for calibration and is assumed accurate.

097-000024-00

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0001  .MAIN
01
02                ;                NOVA 800 INSTRUCTION TIMER
03
04                ;1.      ABSTRACT
05                ;             NOVA 800 INSTRUCTION TIMER IS A MAIN-
06                ;             TENANCE PROGRAM DESIGNED TO TEST THE CPU
07                ;             CLOCK CIRCUTS BY TIMING THE INSTRUCTION
08                ;             SET. THE 100 MS TELETYPE CLOCK IS USED
09                ;             FOR CALIBRATION AND IS ASSUMED ACCURATE.
10
11                ;2.      MACHINE REQUIREMENTS
12                ;             NOVA-800 PROCESSOR
13                ;             A TYPE 33 OR 35 TELETYPE
14
15                ;3.      SWITCH SETTINGS
16                ;             STARTING ADDRESS=2  PRINT TIMES
17                ;             STARTING ADDRESS=3  PRINT TIMES IF IN ERROR
18
19                ;4.      OPERATING PROCEEDURE
20                ;4.1          LOAD THE PROGRAM VIA THE BINARY LOADER
21                ;4.2          SET SWITCHES TO 3
22                ;4.3          PRESS START
23                ;4.4          THE PROGRAM WILL PRINT RUB-OUT CHARACTERS
24                ;             AND ANY INSTRUCTION TIME IN ERROR.
25
26                ;5.      PROGRAM OUTPUT
27                ;5.1          WHEN THE PROGRAM IS STARTED AT LOCATION
28                ;             THREE, ONLY THOSE INSTRUCTIONS WITH TIMING
29                ;             MALFUNCTIONS WILL BE PRINTED. WHEN THE
30                ;             PROGRAM IS STARTED AT LOCATION TWO EACH
31                ;             INSTRUCTION TESTED ALONG WITH ITS EXECUTION
32                ;             TIME WILL BE PRINTED.
33                ;5.2          FOR EXAMPLE:
34                ;                  INSTRUCTION EXECUTION TIMES
35                ;                  MOV 0,0          803
36                ;                  ADD 0,0          803
37                ;                  AND 0,0          803
38                ;                  COM 0,0,SKP      1003
39                ;                  LDA 0,0          1603
40                ;                  STA 0,0          1603
41                ;                  ISZ 0            1802
42                ;                  DSZ 0            1802
43                ;                  JMP .+1          804
44                ;                  JSR .+1          804
45                ;                  LDA 0,0,2        1603
46                ;                  LDA 0,@0         2402
47                ;                  LDA 0,@21        2602
48                ;                  LDA 0,@31        2601
49                ;                  LDA 0,@(@0)      3201
50                ;                  DIA 0,0          2202
51                ;                  DOA 0,0          2202
52                ;                  NIOS 0           2801
53                ;                  INTA 0           2202
54                ;                  SKPBN 0          1403
55                ;                  SKPBZ 0          1599
56                ;                  DIVIDE           8794
57                ;                  MULTIPLY         8794
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```
A 0002  .MAIN
01
02                ;6.      PROGRAM DESCRIPTION
03                ;6.1         THE FOLLOWING PROCEDURE IS USED TO CALCULATE
04                ;            THE INSTRUCTION TIMES, THE TELETYPE IS COM-
05                ;            MANED TO PRINT A CHARACTER, A "INC"
06                ;            INSTRUCTION THEN RECORDS THE NUMBER OF TIMES
07                ;            A SMALL LOOP IS ITERATED BEFORE THE TELETYPE
08                ;            BUSY FLAG IS ZERO, THIS COUNT REPRESENTS 100
09                ;            MILLISECONDS, AND IS USED FOR CALIBRATION,
10                ;            A 1000 WORD BUFFER IS FILLED WITH THE INST-
11                ;            RUCTION TO BE TIMED, A CHAR, IS AGAIN SENT
12                ;            TO THE TELETYPE AND PROGRAM CONTROL IS TRANS-
13                ;            FERED TO THE BUFFER, THE BUFFER IS EXE, 10
14                ;            TIMES, WHEN THE INSTRUCTION IN QUESTION HAS
15                ;            BEEN EXECUTED 10000 TIMES (1000*10) THE PRO-
16                ;            GRAM THEN TIMES THE REMAINDER OF THE TTY
17                ;            BUSY FLAG, THIS VALUE IS SUBTRACTED
18                ;            FROM THE 100MS CALIB, TIME, THE DIFFIRENCE
19                ;            REPRESENTS THE TIME FOR 10000 INSTRUCTIONS,
20                ;            THIS TIME IS CONVERTED TO NANO SECONDS
21                ;            FOR PRINTING,
22                ;6.2         THE NUMBER +1 IS MULTIPLYED BY +2, IF THE
23                ;            RESULT IS +2 THE MUL/DIV OPTION IS ASSUMED TO
24                ;            EXIST,  IF THE RESULT IS NOT +2 THE MUL/DIV
25                ;            TIMES ARE NOT TESTED, TIMES REPRESENT THE
26                ;            NUMBER (125252) MULTIPLIED AND DIVIDED BY
27                ;            THE NUMBER +1,
28
29                ;7.      LIMITATIONS/MISC
30                ;            THIS PROGRAM WILL NOT FUNCTION PROPERLY WITH
31                ;            A TYPE 37 TELETYPE,
32                ;            PROGRAM MEASUREMENTS FALL WITHIN + OR -
33                ;            6NS,  A MEASUREMENT OUTSIDE THE RANGE
34                ;            + OR - 20NS IS CONSIDERED IN ERROR,
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```
A 0003  .MAIN
01
02          000002 .LOC 2
03 00002 002050          JMP @B1
04 00003 002051          JMP @B2
05
06          000050 .LOC 50
07
08 00050 000400 B1:      BEGIN
09 00051 000401 B2:      BEGIN+1
10 00052 000000 PSWIT:   0
11 00053 000000 CALIBR:  0
12 00054 003210 ICRLF:   CRLF
13 00055 003065 IMESS:   MESS
14 00056 000570 CITAB:   ITABL-1
15 00057 001110 IBUFF:   BBUF
16 00060 003060 FBUFF:   FBUF
17 00061 023420 C23420:  23420
18 00062 000000 TIMEX:   0
19 00063 000012 C12:     12
20 00064 003107 IPDEC:   PDEC
21 00065 000000 MSAV:    0
22 00066 177760 M20:     -20
23 00067 100000 ZPOINT:  @0
24 00070 000060 C60:     60
25 00071 000024 C24:     24
26 00072 100001 CSKP1:   COM 0,0,SKP
27 00073 063500 CSKP2:   SKPBZ 0
28 00074 073101 CDIV:    DOCS 2,1
29 00075 073301 CMUL:    DOCP 2,1
30 00076 000000 MDOPT:   0
31 00077 000000 TEN0:    0
32 00100 125252 C5252:   125252
33
34          000400 .LOC 400
35
36 00400 102401 BEGIN:   SUB 0,0,SKP      ;PRINT
37 00401 102000          ADC 0,0          ;DON'T PRINT
38 00402 040052          STA 0,PSWIT
39 00403 102400          SUB 0,0
40 00404 126520          SUBZL 1,1        ;LOOK FOR M/D OPTION
41 00405 131120          MOVZL 1,2
42 00406 073301          DOCP  2,1        ;MULTIPLY
43 00407 146400          SUB 2,1
44 00410 044076          STA 1,MDOPT      ;C(1)=0 IF PRESENT.
45 00411 004524          JSR TIMER
46 00412 152000          ADC 2,2
47 00413 071111          DOAS 2,TTO
48 00414 004521          JSR TIMER
49 00415 071111          DOAS 2,TTO
50 00416 004517          JSR TIMER        ;CALIBRATE ON
51 00417 040053          STA 0,CALIBR     ;100 MS CLOCK.
52
53
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```
A 0004  .MAIN
01
02 00420 020052 BEG2:   LDA 0,PSWIT
03 00421 101004         MOV 0,0,SZR
04 00422 000405         JMP BEG1        ;DON'T PRINT
05 00423 006054         JSR @ICRLF      ;HEADER
06 00424 006054         JSR @ICRLF
07 00425 006055         JSR @IMESS
08 00426 000677         HEADER
09
10 00427 020056 BEG1:   LDA 0,CITAB     ;INITIALIZE INST
11 00430 040020         STA 0,20        ;TO BE TIMED.
12 00431 034076 BEG:    LDA 3,MDOPT
13 00432 030075         LDA 2,CMUL
14 00433 024074         LDA 1,CDIV
15 00434 022020         LDA 0,@20
16 00435 106404         SUB 0,1,SZR
17 00436 112405         SUB 0,2,SNR
18 00437 175005         MOV 3,3,SNR     ;A M/D INSTRUCTION
19 00440 101005         MOV 0,0,SNR
20 00441 000757         JMP BEG2        ;END OF TABLE
21 00442 024063         LDA 1,C12
22 00443 030072         LDA 2,CSKP1
23 00444 034073         LDA 3,CSKP2     ;IF SKP TYPE INST EXE
24 00445 142414         SUB# 2,0,SZR    ;THE BUFFER 20 TIMES
25 00446 162415         SUB# 3,0,SNR
26 00447 024071         LDA 1,C24
27 00450 044077         STA 1,TEN0
28 00451 030057         LDA 2,IBUFF     ;FILL A 1K BUFFER
29 00452 034060         LDA 3,FBUFF     ;WITH INSTRUCTIONS.
30 00453 041000         STA 0,0,2
31 00454 151400         INC 2,2
32 00455 156404         SUB 2,3,SZR
33 00456 000774         JMP .-4
34
35 00457 054000 INIT:   STA 3,0         ;INIT FOR @ TEST.
36 00460 054021         STA 3,21
37 00461 152220         ADCZR 2,2
38 00462 151220         MOVZR 2,2
39 00463 050031         STA 2,31
40 00464 004451         JSR TIMER       ;WAIT IF TTO BUSY.
41 00465 071111         DOAS 2,TTO
42 00466 004447         JSR TIMER
43 00467 102400         SUB 0,0
44 00470 024100         LDA 1,C5252
45 00471 034057         LDA 3,IBUFF
46 00472 030077         LDA 2,TEN0
47 00473 151200         MOVR 2,2
48 00474 151203         MOVR 2,2,SNC
49 00475 000404         JMP .+4
50 00476 152520         SUBZL 2,2       ;NO-SKIP INST
51 00477 071111         DOAS 2,TTO      ;START THE TTO
52 00500 001410         JMP 10,3        ;EXIT TO BUFFER
53
54 00501 152520         SUBZL 2,2       ;SKIP INSTRUCTION
55 00502 071111         DOAS 2,TTO      ;START TTO
56 00503 001550         JMP 150,3       ;EXIT TO BUFFER
```

```
A 0005  .MAIN
01
02 00504 004431 TINSR:  JSR TIMER        ;TIME TTO
03 00505 024053          LDA 1,CALIBR
04 00506 106400          SUB 0,1         ;C(1)=10K INST TIME
05 00507 030061          LDA 2,C23420
06 00510 004432          JSR MULT
07 00511 030053          LDA 2,CALIBR    ;C(1)=TIME PER INST
08 00512 004442          JSR .DIV        ;IN NANO SECONDS.
09
10 00513 044062 TLOOK:  STA 1,TIMEX      ;C(1)=ACTUAL TIME
11 00514 034020          LDA 3,20        ;C(2)=CORRECT TIME
12 00515 031430          LDA 2,ITABE-ITABL,3
13 00516 132423          SUBZ 1,2,SNC    ;THEORY-ACTUAL
14 00517 150400          NEG 2,2         ;C(2)=+DIFFIRENCE
15 00520 020071          LDA 0,C24       ;C(0)=20 NANO SECONDS
16 00521 112440          SUBO 0,2
17 00522 030052          LDA 2,PSWIT
18 00523 151006          MOV 2,2,SEZ
19 00524 000705          JMP BEG
20
21 00525 035457          LDA 3,IMEST-ITABL,3
22 00526 054403          STA 3,.+3
23 00527 006054          JSR @ICRLF
24 00530 006055          JSR @IMESS      ;MESSAGE ABOUT
25 00531 000000          0               ;INSTRUCTION TIMED.
26 00532 024062          LDA 1,TIMEX
27 00533 006064          JSR @IPDEC      ;PRINT THE TIME.
28 00534 000675          JMP BEG
29
30 00535 102000 TIMER:  ADC 0,0          ;RECORD THE TIME
31 00536 101400          INC 0,0         ;FOR TTO TO FINISH.
32 00537 063511          SKPBZ TTO
33 00540 000776          JMP .-2
34 00541 001400          JMP 0,3
```

```
^ 0006   .MAIN
01
02 00542 102460 MULT:   SUBC 0,0          ;C(1)*C(2)
03 00543 054065         STA 3,MSAV        ;RESULT TO C(0),C(1)
04 00544 034066         LDA 3,M20
05 00545 125203 MLOOP:  MOVR 1,1,SNC
06 00546 101201         MOVR 0,0,SKP
07 00547 143220         ADDZR 2,0
08 00550 175404         INC 3,3,SZR
09 00551 000774         JMP MLOOP
10 00552 125260         MOVCR 1,1
11 00553 002065         JMP @MSAV
12
13 00554 054065 .DIV:   STA 3,MSAV        ;C(0),C(1)/C(2)
14 00555 034066         LDA 3,M20         ;C(0)=REMAINDER
15 00556 125120         MOVZL 1,1         ;C(1)=QUOIENT
16 00557 101100 DLOOP:  MOVL 0,0
17 00560 142412         SUB# 2,0,SZC
18 00561 142400         SUB 2,0
19 00562 125100         MOVL 1,1
20 00563 175404         INC 3,3,SZR
21 00564 000773         JMP DLOOP
22 00565 151220         MOVZR 2,2         ;ROUND UP
23 00566 142432         SUBZ# 2,0,SZC
24 00567 125400         INC 1,1
25 00570 002065         JMP @MSAV
26
27 00571 101000 ITABL:  MOV 0,0           ;INST TO BE TIMED
28 00572 103000         ADD 0,0
29 00573 103400         AND 0,0
30 00574 100001         COM 0,0,SKP
31 00575 020000         LDA 0,0
32 00576 040000         STA 0,0
33 00577 010000         ISZ 0
34 00600 014000         DSZ 0
35 00601 000401         JMP .+1
36 00602 004401         JSR .+1
37 00603 021000         LDA 0,0,2
38 00604 022000         LDA 0,@0
39 00605 022021         LDA 0,@21
40 00606 022031         LDA 0,@31
41 00607 022067         LDA 0,@ZPOINT
42 00610 060400         DIA 0,0
43 00611 061000         DOA 0,0
44 00612 060100         NIOS 0
45 00613 061477         INTA 0
46 00614 063400         SKPBN 0
47 00615 063500         SKPBZ 0
48 00616 073101         DOCS 2,1
49 00617 073301         DOCP 2,1
50 00620 000000         0
```

```
A 0007   .MAIN
01
02          000012 .RDX 10
03
04 00621 001440 ITABE:  800              /CORRECT TIMES.
05 00622 001440         800
06 00623 001440         800
07 00624 001750         1000
08 00625 003100         1600
09 00626 003100         1600
10 00627 003410         1800
11 00630 003410         1800
12 00631 001440         800
13 00632 001440         800
14 00633 003100         1600
15 00634 004540         2400
16 00635 005050         2600
17 00636 005050         2600
18 00637 006200         3200
19 00640 004230         2200
20 00641 004230         2200
21 00642 005360         2800
22 00643 004230         2200
23 00644 002570         1400
24 00645 003100         1600
25 00646 021140         8800
26 00647 021140         8800
27
28          000010 .RDX 8
29
30 00650 000715 IMEST:  I1
31 00651 000722         I2
32 00652 000727         I3
33 00653 001061         I3.1
34 00654 000734         I4
35 00655 000741         I5
36 00656 000746         I6
37 00657 000752         I7
38 00660 000756         I8
39 00661 000763         I9
40 00662 001070         I9.1
41 00663 000770         I10
42 00664 000776         I11
43 00665 001004         I12
44 00666 001012         I13
45 00667 001021         I14
46 00670 001026         I15
47 00671 001076         I15.1
48 00672 001033         I16
49 00673 001040         I17
50 00674 001103         I17.1
51 00675 001045         I18
52 00676 001052         I19
```

```
^ 0008  .MAIN
01
02                HEADER: .TXTE |INSTRUCTION EXECUTION TIMES|
   00677 047311
   00700 152123
   00701 052722
   00702 152303
   00703 147711
   00704 120116
   00705 154305
   00706 141705
   00707 152125
   00710 147711
   00711 120116
   00712 144724
   00713 142515
   00714 000123
03
04                I1:     .TXTE |MOV 0,0          |
   00715 147515
   00716 120126
   00717 126060
   00720 004460
   00721 000011
05                I2:     .TXTE |ADD 0,0          |
   00722 042101
   00723 120104
   00724 126060
   00725 004460
   00726 000011
06                I3:     .TXTE |AND 0,0          |
   00727 047101
   00730 120104
   00731 126060
   00732 004460
   00733 000011
07                I4:     .TXTE |LDA 0,0          |
   00734 042314
   00735 120101
   00736 126060
   00737 004460
   00740 000011
08                I5:     .TXTE |STA 0,0          |
   00741 152123
   00742 120101
   00743 126060
   00744 004460
   00745 000011
09                I6:     .TXTE |ISZ 0            |
   00746 051711
   00747 120132
   00750 004460
   00751 000011
10                I7:     .TXTE |DSZ 0            |
   00752 051504
   00753 120132
   00754 004460
   00755 000011
11                I8:     .TXTE |JMP .+1          |
   00756 046712
```

```
 0000  .MAIN
  00757 120120
  00760 025456
  00761 004661
  00762 000011
01                I19:     .TXTE |JSR .+1          |
  00763 051712
  00764 120322
  00765 025456
  00766 004661
  00767 000011
02                I10:     .TXTE |LDA 0,@0         |
  00770 042314
  00771 120101
  00772 126060
  00773 030300
  00774 120240
  00775 000011
03                I11:     .TXTE |LDA 0,@21        |
  00776 042314
  00777 120101
  01000 126060
  01001 131300
  01002 004661
  01003 000000
04                I12:     .TXTE |LDA 0,@31        |
  01004 042314
  01005 120101
  01006 126060
  01007 031700
  01010 004661
  01011 000000
05                I13:     .TXTE |LDA 0,@(@0)      |
  01012 042314
  01013 120101
  01014 126060
  01015 024300
  01016 030300
  01017 004651
  01020 000000
06                I14:     .TXTE |DIA 0,0          |
  01021 144504
  01022 120101
  01023 126060
  01024 004460
  01025 000011
07                I15:     .TXTE |DOA 0,0          |
  01026 147504
  01027 120101
  01030 126060
  01031 004460
  01032 000011
08                I16:     .TXTE |INTA 0           |
  01033 047311
  01034 040724
  01035 030240
  01036 004411
  01037 000000
09                I17:     .TXTE |SKPBN 0          |
  01040 045523
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  0010  .MAIN
   01041 041120
   01042 120116
   01043 004460
   01044 000011
01
02
03                I18:    .TXTE |DIVIDE           |
   01045 144504
   01046 144526
   01047 142504
   01050 004411
   01051 000000
04                I19:    .TXTE |MULTIPLY         |
   01052 052515
   01053 152314
   01054 050311
   01055 054714
   01056 120240
   01057 004640
   01060 000000
05                I3,1:   .TXTE |COM 0,0,SKP      |
   01061 147703
   01062 120115
   01063 120060
   01064 120060
   01065 045523
   01066 004520
   01067 000000
06                I9,1:   .TXTE |LDA 0,0,2        |
   01070 042314
   01071 120101
   01072 120060
   01073 120060
   01074 004662
   01075 000000
07                I15,1:  .TXTE |NIOS 0           |
   01076 144516
   01077 051717
   01100 030240
   01101 004411
   01102 000000
08                I17,1:  .TXTE |SKPBZ 0  |
   01103 045523
   01104 041120
   01105 120132
   01106 120060
   01107 000011
09
10
11 01110 000000 BBUF:   0
12       000012 .RDX 10
13       003060 .LOC .+999
14       000010 .RDX 8
15
16 03060 014077 FBUF:   DSZ TEN0
17 03061 002402         JMP @.+2
18 03062 002402         JMP @.+2
19 03063 001110         BBUF
20 03064 000504         TINSR
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0011  .MAIN
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^ 0012  .MAIN
01
02                ;TTO NON INTERRUPT PACKAGE
03                ;"MESS" PRINTS ASCII MESSAGES AS SPECIFIED BY ASSEMBLR
04                ;"CHAR" PRINTS ASCII CHARACTOR, C(0)R,C(0)L MUST BE 0
05                ;WILL RETURN +2 IF C(0)R#0,CORRECTS THE PARITY,33 SIMULATE
06                ;"TYPE" PRINTS C(0)R, MUST HAVE PROPER PARITY, RETURN IS
07                ;TO CALL+1.REPLACE THIS ROUTINE WITH INTERRUPT TYPE IF DESIRED.
08                ;"CRLF" PRINTS A CARRIAGE RETURN
09                ;"POCT" PRINTS C(1) IN OCTAL FOLLOWED BY A TAB
10                ;"PDEC" PRINTS C(1) IN DECIMAL,LEADING ZEROS SUPPRESSED,
11                ;FOLLOWED BY A TAB.
12
13 03065 054545 MESS:   STA 3,MESSR      ;PRINT A TEXT MESSAGE
14 03066 010544          ISZ MESSR
15 03067 031400          LDA 2,0,3        ;C(2) POINTS TO MESSAGE
16 03070 024541          LDA 1,C377       ;A 8 BIT MASK
17 03071 021000          LDA 0,0,2        ;C(2)=DATA WORD
18 03072 125112          MOVL# 1,1,SZC
19 03073 123701          ANDS 1,0,SKP
20 03074 123401          AND 1,0,SKP      ;C(0)=DATA CHARACTOR RIGHT
21 03075 151400          INC 2,2          ;INC TO NEXT WORD
22 03076 124000          COM 1,1          ;FLIP MASK
23 03077 004462          JSR CHAR         ;PRINT
24 03100 000771          JMP MESS+4       ;ANOTHER
25 03101 002531          JMP @MESSR       ;LAST
26
27 03102 020525 ZOCT:   LDA 0,CH240
28 03103 101001          MOV 0,0,SKP
29
30 03104 020070 POCT:   LDA 0,C60
31 03105 030433          LDA 2,OCTAB      ;PRINT C(1) IN OCTAL
32 03106 000403          JMP .+3
33 03107 030441 PDEC:   LDA 2,DECTB      ;PRINT C(1) IN DECIMAL
34 03110 020517          LDA 0,CH240      ;SUPPRESS LEADING  ZEROS
35 03111 054447          STA 3,RADRET     ;BOTH ENTRYS PRINT NUMBER
36 03112 040445          STA 0,ZSUPP      ;THEN TAB TO NEXT POSITION
37 03113 050401          STA 2,.+1
38 03114 000000 DECOCT: 0                ;A"LDA 2,TABLE" INSTRUCTION
39 03115 010777          ISZ .-1
40 03116 034442          LDA 3,RADRET     ;SETUP "TAB" AT END
41 03117 020503          LDA 0,CHTAB
42 03120 151005          MOV 2,2,SNR      ;IF TABLE ENTRY=0
43 03121 000440          JMP CHAR         ;EXIT WITH TAB
44 03122 034435          LDA 3,ZSUPP      ;ZEROS SUPPRESS STUF
45 03123 102400          SUB 0,0
46 03124 146512 DECOT:  SUBL# 2,1,SZC
47 03125 000405          JMP DECP
48 03126 146400          SUB 2,1          ;FORM THE DIGIT
49 03127 034070          LDA 3,C60
50 03130 101400          INC 0,0
51 03131 000773          JMP DECOT
52 03132 151235 DECP:   MOVZR# 2,2,SNR
53 03133 034070          LDA 3,C60
54 03134 054423          STA 3,ZSUPP      ;C(0)=DIGIT
55 03135 163000          ADD 3,0          ;MAKE ASCII
56 03136 004423          JSR CHAR         ;PRINT
57 03137 000755          JMP DECOCT       ;GET NEXT DIGIT
58
```

```
^ 0013  .MAIN
01
02
03 03140 030425 OCTAB:  LDA 2,.+1+.-DECOCT
04 03141 100000         100000
05 03142 010000         10000
06 03143 001000         1000
07 03144 000100         100
08 03145 000010         10
09 03146 000001         1
10 03147 000000         0
11
12 03150 030435 DECTB:  LDA 2,.+1+.-DECOCT
13       000012 .RDX 10
14 03151 023420         10000
15 03152 001750         1000
16 03153 000144         100
17 03154 000012         10
18 03155 000001         1
19 03156 000000         0
20       000010 .RDX 8
21
22 03157 000000 ZSUPP:  0
23 03160 000000 RADRET: 0
24
25 03161 054442 CHAR:   STA 3,CHRET      ;PRINT C(0) RIGHT
26 03162 101325         MOVZS 0,0,SNR    ;RETURN +2 IF NULL
27 03163 001401         JMP 1,3
28 03164 040440         STA 0,CHSAV
29 03165 176000         ADC 3,3          ;COMPUTE THE PARITY
30 03166 117000         ADD 0,3
31 03167 163404         AND 3,0,SZR
32 03170 000775         JMP .-3
33 03171 176660         SUBCR 3,3        ;COMBIND PARITY WITH CHAR
34 03172 020432         LDA 0,CHSAV
35 03173 163300         ADDS 3,0
36
37 03174 034426 CHAR1:  LDA 3,CHTAB      ;IS THIS A TAB
38 03175 116405         SUB 0,3,SNR
39 03176 000407         JMP .+7          ;YES
40 03177 004434         JSR TYPE         ;NO PRINT IT
41 03200 002423         JMP @CHRET       ;EXIT
42
43 03201 020424         LDA 0,CHORZ      ;SIMULATE A TAB
44 03202 034424         LDA 3,CHAR7      ;VIA 1 TO 8 SPACES
45 03203 117405         AND 0,3,SNR
46 03204 002417         JMP @CHRET
47 03205 020422         LDA 0,CH240
48 03206 004425         JSR TYPE
49 03207 000772         JMP .-6
50
```

```
^ 0014   .MAIN
01
02
03
04 03210 054420 CRLF:    STA 3,CRLFR      ;SAVE RETURN
05 03211 020410          LDA 0,C215
06 03212 004747          JSR CHAR         ;PRINT CARRIAGE AND LF
07 03213 020405          LDA 0,C212
08 03214 004745          JSR CHAR
09 03215 102400          SUB 0,0
10 03216 040407          STA 0,CHORZ      ;CLEAR HORZ POSISTION
11 03217 002411          JMP @CRLFR       ;EXIT
12
13 03220 000212 C212:    212
14 03221 000215 C215:    215
15 03222 000011 CHTAB:   11
16 03223 000000 CHRET:   0
17 03224 000000 CHSAV:   0
18 03225 000000 CHORZ:   0
19 03226 000007 CHAR7:   7
20 03227 000240 CH240:   240
21 03230 000000 CRLFR:   0
22
23 03231 000377 C377:    377
24 03232 000000 MESSR:   0
25 03233 054406 TYPE:    STA 3,TYPRET     ;TYPE THE C(0)R IF
26 03234 010771          ISZ CHORZ
27 03235 063511          SKPBZ TTO
28 03236 000777          JMP .-1
29 03237 061111          DOAS 0,TTO
30 03240 002401          JMP @TYPRET
31 03241 000000 TYPRET:  0
32
33 03242 000000 LAST:    0
34
35               .END
```