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SYM-PHYSIS

THE SYM USERS' GROUP NEWSLETTER

DOUBLE ISSUE
VOLUME III, NUMBER 3 (ISSUE NO. 13) - AUTUMN 1982 (JUL/AUG/SEP)
VOLUME III, NUMBER 4 (ISSUE NO. 14) - WINTER 1982 (OCT/NOV/DEC)

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SUBSCRIPTION RATES: (Volume III, 1982, Issues 11 - 14)

USA/Canada - $10.50 for a volume of four issues. Elsewhere - $14.00. Make checks payable in US dollars to "SYM Users' Group", P. O. Box 319, Chico, CA 95927, Telephone (916) 895-8751.

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Issue 0, the Introductory Issue (1979), and Issues 1 through 6 (Volume I, 1980), are available, as a package, for $12.00, US/Canada, and $16.00, First Class/Airmail, elsewhere.

Issues 7 through 10 (Volume II, 1981), are available for $10.50, US/Canada, and $14.00, First Class/Airmail, elsewhere.

RAM-B'LINGS

This "double-issue" marks the end of our third full year of publication (add a half-year, if you count the introductory issue). With the final issue of each volume, we must decide, each year, if we should try for still another. We seem to be living our lives on a one-year-at-a-time basis! We wondered why the quarterly publication deadlines seemed so much more difficult to meet than the bi-monthly publication schedule, and we finally figured it out.

Our university, California State University, Chico, is on a semester, rather than on a quarterly basis. Since the newsletter preparation cycle must be meshed in with our teaching schedule, which is actually trimestrial in nature, if the summer period is taken into account, either three issues/year, or six issues/year, would be much more commensurate with our three cycle/year teaching load than the four issues per year we have been trying for during the past two years.

We feel that preparing one issue each semester, and a third during the shorter summer session, when the teaching load is lighter, would make for a much more sensibly distributed workload. We will go on, then, with Volume 4, on a thriceannually basis, with Spring, Summer, and Fall issues (numbers 15, 16, and 17, respectively).

Each of the three issues will be some 52 pages, instead of the current 40 pages, so that Volume 4 will contain very nearly the same amount of text as the current volume. Unfortunately for California subscribers, however, any periodical published less frequently than quarterly is not

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FORTH IN ROM/EPROM - A PRELIMINARY REPORT

Jerry Larsen of Synertek Systems sent us a 2732 EPROM containing a preliminary version of the object code for a 4K FORTH in ROM which Synertek is planning to release for the SYM-1/SYM-2. He asked us to give the chip a good workout, and to report any problems back to him, together with any comments or suggestions we might care to make. Here are some extracts from his letter:

> We plan to supply a copy of Brodie's book (Starting Forth) with the chip as a tutorial text along with a (better) copy of the glossary included with this chip. The program itself is a subset of the Forth-79 Standard. Word definitions therefore follow the Standard, Brodie's book and then fig-Forth in that order. This will lead to some differences from the Forth by Jack Brown. The major exception to the Standard, besides some words which were omitted, is that we do not support double length numbers. It was not felt necessary since this Forth is intended as a control system language for the SYM-1. If needed, the user can write his own double length routines and a new definition for NUMBER. The code field address for the new NUMBER is then placed in memory at $CC-$CD and double length numbers will be available. We plan application notes on this and other extended features such as disk I/O.

We installed the EPROM on a new 4K RAM SYM-1 in socket U21, after first modifying the jumpers to conform to a 2732 at $C000-$CFFF (FORTH overlays the lower half of BAS-1), and began our checkout. Incidentally, the 2732 differs sufficiently in its pinout from the 2332/2532 ROM/EPROM pair that it cannot be used in a socket jumpered for the lower half of BAS-1 (if you have installed the earlier version of BAS-1, which came in a pair of 2332 ROMs).

Reproduced below is a printout of the listing produced by the FORTH word VLIST (short for VOCABULARY LIST):

```
FORTH  X.2
COPYRIGHT 1982 SYNERTEK CORP.
VLIST
  4 TAS   3 MON   3 GET   3 PUT   6 ACC    4 LOA   1 P     1 L
  4 WIP   4 LIN   4 FIL   3 L/S   5 VLI   10 VOC   5 DOE   7 <BU
  1 ?     2 U.    1 .     2 .R    3 (.)    2 #S    1 #     4 SIG
  2 #>    2 <#    3 PAD   4 HOL   6 SPA    3 MIN   3 MAX   3 ABS
  2 */    5 */M   3 MOD   1 /     4 /MO    1 *     4 ?DU   9 IMM
  6 FOR   5 ABO   4 QUI  11 DEF   5 FOR    7 LIT   9 [CO   1 ]
  1 [     9 INT   1 '     6 NUM   6 CRE    1 (     4 WOR   1
  5 QUE   6 EXP   4 ELS   5 WHI   2 IF     6 REP   5 AGA   5 UNT
  5 +LO   4 LOO   2 DO    5 BEG   4 THE    7 DEC   3 HEX   2 ."
  4 TYP   5 COU   7 COM   5 SPA   2 BL     3 ROT   1 >     1 <
  1 =     1 -     2 C,    1 ,     5 ALL    4 HER   2 2+    2 1+
  2 BS    3 TOP   4 BUF   4 BAS   5 STA    3 BLK   3 >IN   7 CUR
  7 CON   1 H     1 2     1 1     1 0      8 VAR   8 CON   5 ;CO
  1 ;     1 :     9 ?TE   2 CR    4 EMI    3 KEY   5 CMO   7 EXE
  6 (FI   5 DIG   5 U/M   2 U*    3 XOR    3 AND   6 NEG   1 +
  2 0<    2 0=    2 -R    5 LEA   4 EXI    1 I     2 R>    2 >R
  4 SWA   4 DRO   4 OVE   3 DUP   3 SP@    2 +!    2 C!    1 !
  2 C@    1 @    OK
```

As you can see, the "dictionary" stores each of the words in an abbreviated form requiring exactly four bytes for each. The format consists of one hex byte containing the length (number of characters) of the entry followed by the first three ASCII characters of the word. Short names are padded to three characters with trailing spaces. The current trend in implementing FORTH is to provide for variable length names (unabridged). A VLIST then omits the length digit and all of the words are spelled out in full, although not so neatly tabulated.

While we do prefer the variable length word names as providing greater recognition capability, we are willing to give them up for the sake of getting more important capabilities into the 4K allocated. Besides this FORTH is intended for control applications, and who uses VLIST in a control application?

The major difference between this FORTH and the fig-FORTH and the 79-STANDARD models is in the omission of the double precision capability. This was a reasonable compromise, since 16 bits is more than adequate for any analog process control.

As noted earlier, we would much rather see a VLIST in which the words are spelled out in full. For example, it took us a few minutes to figure out that 4 TAS stood for TASK, as in FORGET TASK. TASK can actually be forgotten, i.e., deleted from the vocabulary. Incidentally, TASK is copied from ROM into RAM in page 02 in order to mark both the starting point of the dictionary and the starting point of the user space; it is otherwise essentially equivalent to the 6502 NOP. All default values are copied down to page 00, as are two vectors which may be changed to permit easier expansion to the full 79-STANDARD model.

We found one very obvious "bug" by inspecting the original VLISTing (this has been corrected in the version above). Fixing the bug required changing one byte in the object code, but since we did not have our 2732 EPROM burner finished, and since we prefer to work from RAM anyway, at least for software still in the development stage, we decided to relocate the object code at $9000, using Dessaintes' Disassembler.

Now, FORTH is a "threaded" language, which means that the "compiled" form consists of "strings" (into, or onto, which the words are "threaded"). Actually, each word is assigned a 16-bit (two-byte) vector; it is these vectors which are the "beads" on the strings. Furthermore, only a very small portion of the FORTH "implementer" (we deliberately avoid the use of the terms "compiler" or "interpreter" here), need be written in the "native" machine language (ML). Once a few FORTH words are defined in ML the rest of the words may be defined in terms of these, with only occasional requirements for additional ML sections. This means that the majority of the FORTH implementer is written in FORTH itself, sort of on a bootstrap principle.

Thus, it turned out that less than 20% of the 4K object code was written in ML, the remainder consisting of vectors and isolated one or two byte "literals" and ASCII encoded messages. The disassembler created gibberish for this portion, but since we had some a priori knowledge of FORTH's structure, it was omly a matter of many hours of dog-work to come up with a reasonably complete source code. Since the FORTH words are precisely defined in an accompanying glossary, the source code is almost self commenting.

We hope that Synertek will see fit to provide the source code with the release package, or authorize its independent publication, since we feel that one very good way to really understand how to use FORTH is to see how it builds itself up from a very simple nucleus.

The following extract from the (uncopyrighted) FORTH-79 Standard, available from the FORTH INTEREST GROUP, P. O. Box 1105, San Carlos, CA 94070, is reproduced for the convenience of those who may wish to compare the VLIST above against the standard:

10. REQUIRED WORD SET

The words of the Required Word Set are grouped to show like characteristics. No implementation requirements should be inferred from this grouping.

Nucleus Words

```
!   *  */  */MOD  +   +!  +loop  -  /
/MOD  0<  0=  0>  1+  1-  2+  2-  <
=  >  >R  ?DUP  @  ABS  AND  begin  C!
C@  colon  CMOVE  constant  create  D+
D<  DEPTH  DNEGATE  do  does>
DROP  DUP  else   EXECUTE  EXIT  FILL  I
if  J  LEAVE  literal  loop  MAX  MIN
MOD  MOVE  NEGATE  NOT  OR  OVER  PICK
R>  R@  repeat  ROLL  ROT  semicolon
SWAP  then  U*  U/  U<  until  variable
while  XOR
```

(note that the lower case entries refer to just the run-time code corresponding to a compiling word.)

Interpreter Words

```
#  #>  #S  '  (  -TRAILING  .
79-STANDARD  <#  >IN  ?  ABORT  BASE  BLK
CONTEXT  CONVERT  COUNT  CR  CURRENT
DECIMAL  EMIT  EXPECT  FIND  FORTH  HERE
HOLD  KEY  PAD  QUERY  QUIT  SIGN  SPACE
SPACES  TYPE  U.  WORD
```

Compiler Words

```
+LOOP  ,   ."   :   ;  ALLOT  BEGIN
COMPILE  CONSTANT  CREATE  DEFINITIONS  DO
DOES>  ELSE  FORGET  IF  IMMEDIATE
LITERAL  LOOP  REPEAT  STATE  THEN  UNTIL
VARIABLE  VOCABULARY  WHILE  [  [COMPILE]
```

Device Words

```
BLOCK   BUFFER   EMPTY-BUFFERS   LIST
LOAD  SAVE-BUFFERS   SCR   UPDATE
```

MORE ON FORTH

If we could have but one higher level language for our SYM-1, or for any other system, for that matter (see below), our choice would be FORTH. Here are some of our reasons:

First, what FORTH provides, in essence, is a STANDARDIZED set of macros to supplement the natural machine language of the host computer. This means that if your applications programs are written wholly in terms of these macros (i. e., FORTH words), they are 100% transportable between systems, independent of the nature of the host computer! (One exception, of course, is time-dependent programs, such as music applications, unless the programs include allowances for differing clock rates, etc.)

Second, FORTH is the easiest higher level language to implement on any microcomputer, especially after you have implemented it on your first one, or have disassembled a working version for any particular microprocessor. More on this below.

Third, because of its "threaded" structure, FORTH is nearly as fast as machine language itself, and requires far less memory than any other higher level language. Furthermore it is infinitely extensible; you can add as many new words as desired, organizing them into separate VOCABULARY groups for different applications, if you wish.

It is convenient to extend FORTH to include an ASSEMBLER vocabulary, so that ML programs may be incorporated into applications programs where maximum speed is required. More sophisticated editing capabilities may be added by incorporating any one of the EDITOR vocabularies appearing in the open literature (much FORTH material is in the public domain). Thus FORTH can include a Resident Assembler Editor (RAE), if desired.

Forth(!), FORTH customarily treats any supplementary mass storage as virtual memory, so that very little RAM is actually required for even the most elaborate development systems. A 32K SYM-1 with a pair of floppies, any size, should handle just about any control application that can be assigned to a microprocessor system.

(continued to page 13/14-30)

```
                0010 ; "SKELETONIZED" FORTH FOR DEMONSTRATION PURPOSES
                0020
                0030            .BA $9000
                0040
                0050 ; NOTICE THE INITIAL PORTION IS MAINLY MACHINE LANGUAGE
                0060
                0070 ; FETCH, "@", AND STORE, "!", ARE THE ROOT "PRIMITIVES"
                0080
9000- 01        0090 FETCH.     .BY $01
9001- 40 20 20  0100            .BY '@ ' $20
9004- 00 00     0110            .BY $00 $00  ;END OF DICTIONARY MARKER
9006- 08 90     0120 FETCH      .SI FETCHX
                0130
9008- B5 01     0140 FETCHX     LDA *$01,X
900A- 95 FF     0150            STA *$FF,X
900C- A1 FF     0160            LDA ($FF,X)
900E- 48        0170            PHA
900F- F6 FF     0180            INC *$FF,X
9011- D0 02     0190            BNE =+3
                0200
9013- F6 00     0210            INC *$00,X
9015- A1 FF     0220            LDA ($FF,X)
9017- 4C 48 90  0230            JMP ENTER
                0240
901A- 01        0250 STORE.     .BY $01      ;NUMBER OF CHARACTERS IN WORD
901B- 21 20 20  0260            .BY '! ' $20 ;FIRST THREE CHARACTERS OF WORD
901E- 00 90     0270            .SI FETCH.   ;POINTER TO NEXT WORD
9020- 22 90     0280 STORE      .SI STOREX   ;POINTER TO MACHINE LANGUAGE
                0290
9022- B5 01     0300 STOREX     LDA *$01,X
9024- 95 FF     0310            STA *$FF,X
9026- B5 03     0320            LDA *$03,X
9028- 81 FF     0330            STA ($FF,X)
902A- F6 FF     0340            INC *$FF,X
902C- D0 02     0350            BNE =+3
                0360
902E- F6 00     0370            INC *$00,X
9030- B5 02     0380            LDA *$02,X
9032- 81 FF     0390            STA ($FF,X)
                0400
                0410 ;  STACK MANAGEMENT UTILITIES
                0420
9034- E8        0430 POPTWO     INX
9035- E8        0440            INX
9036- E8        0450 POPONE.N   INX
9037- E8        0460            INX
9038- D0 13     0470            BNE NEXT     ;ALWAYS
                0480
903A- E8        0490 POPONE.E   INX
903B- E8        0500            INX
903C- D0 0A     0510            BNE ENTER    ;ALWAYS
                0520
903E- 48        0530 NOPUSHENT  PHA
903F- A9 00     0540            LDA #$00
9041- F0 05     0550            BEQ ENTER    ;ALWAYS
                0560
9043- 48        0570 PUSHENT    PHA
9044- A9 00     0580            LDA #$00
9046- CA        0590 PUSH       DEX
9047- CA        0600            DEX
9048- 95 00     0610 ENTER      STA *$00,X
904A- 68        0620            PLA
904B- 95 01     0630            STA *$01,X
904D- A5 DA     0640 NEXT       LDA *$DA
904F- 18        0650 NEXT1      CLC
9050- 69 02     0660            ADC #$02
```

```
9052- 85 DA     0670            STA *$DA
9054- 90 02     0680            BCC =+3
                0690
9056- E6 DB     0700            INC *$DB
9058- A0 01     0710            LDY #$01
905A- B1 DA     0720            LDA ($DA),Y
905C- 85 DE     0730            STA *$DE
905E- 88        0740            DEY
905F- B1 DA     0750            LDA ($DA),Y
9061- 85 DD     0760            STA *$DD
9063- 4C DC 00  0770            JMP $DC
                0780
                0790 ;   END OF UTILITIES
                0800
9066- 03        0810 DUP.       .BY $03
9067- 44 55 50  0820            .BY 'DUP'
906A- 1A 90     0830            .SI STORE.
906C- 6E 90     0840 DUP        .SI DUPX
                0850
906E- B5 01     0860 DUPX       LDA *$01,X
9070- 48        0870            PHA
9071- B5 00     0880            LDA *$00,X
9073- 4C 46 90  0890            JMP PUSH
                0900
9076- 04        0910 OVER.      .BY $04
9077- 4F 56 45  0920            .BY 'OVE'
907A- 66 90     0930            .SI DUP.
907C- 7E 90     0940 OVER       .SI OVERX
                0950
907E- B5 03     0960 OVERX      LDA *$03,X
9080- 48        0970            PHA
9081- B5 02     0980            LDA *$02,X
9083- 4C 46 90  0990            JMP PUSH
                1000
9086- 04        1010 DROP.      .BY $04
9087- 44 52 4F  1020            .BY 'DRO'
908A- 76 90     1030            .SI OVER.
908C- 36 90     1040 DROP       .SI POPONE.N
                1050
908E- 04        1060 SWAP.      .BY $04
908F- 53 57 41  1070            .BY 'SWA'
9092- 86 90     1080            .SI DROP.
9094- 96 90     1090 SWAP       .SI SWAPX
                1100
9096- B5 03     1110 SWAPX      LDA *$03,X
9098- 48        1120            PHA
9099- B5 01     1130            LDA *$01,X
909B- 95 03     1140            STA *$03,X
909D- B5 02     1150            LDA *$02,X
909F- B4 00     1160            LDY *$00,X
90A1- 94 02     1170            STY *$02,X
90A3- 4C 48 90  1180            JMP ENTER
                1190
90A6- 04        1200 EXIT.      .BY $04
90A7- 45 58 49  1210            .BY 'EXI'
90AA- 8E 90     1220            .SI SWAP.
                1230
                1240 DOSEMICOLN ;(ALTERNATE NAME FOR EXIT)
                1250
90AC- AE 90     1260 EXIT       .SI EXITX
                1270
90AE- 68        1280 EXITX      PLA
90AF- 85 DB     1290            STA *$DB
90B1- 68        1300            PLA
90B2- 4C 4F 90  1310            JMP NEXT1
```

```

90B5- 02         ZEROEQ.      .BY $02
90B6- 30 3D 20                .BY '0= '
90B9- A6 90                   .SI EXIT.
90BB- BD 90      ZEROEQ       .SI ZEROEQX

90BD- B5 00      ZEROEQX      LDA *$00,X
90BF- 15 01                   ORA *$01,X
90C1- D0 01                   BNE =+2

90C3- C8                      INY
90C4- 98                      TYA
90C5- 4C 3E 90                JMP NOPUSHENT

90C8- 02         ZEROLESS.    .BY $02
90C9- 30 3C 20                .BY '0<
90CC- B5 90                   .SI ZEROEQ.
90CE- D0 90      ZEROLESS     .SI ZEROLESSX

90D0- B5 00      ZEROLESSX    LDA *$00,X
90D2- 29 80                   AND #$80
90D4- 0A                      ASL A
90D5- 2A                      ROL A
90D6- 4C 3E 90                JMP NOPUSHENT


90D9- 06         NEGATE.      .BY $06
90DA- 4E 45 47                .BY 'NEG'
90DD- C8                      .BY ZEROLESS.
90DE- E0 90      NEGATE       .SI NEGATEX

90E0- 38         NEGATEX      SEC
90E1- 98                      TYA
90E2- F5 01                   SBC *$01,X
90E4- 48                      PHA
90E5- 98                      TYA
90E6- F5 00                   SBC *$00,X
90E8- 4C 48 90                JMP ENTER

90EB- 01         PLUS.        .BY $01
90EC- 2B 20 20                .BY '+ ' $20
90EF- D9 90                   .SI NEGATE.
90F1- F3 90      PLUS         .SI PLUSX

90F3- 18         PLUSX        CLC
90F4- B5 01                   LDA *$01,X
90F6- 75 03                   ADC *$03,X
90F8- 48                      PHA
90F9- B5 00                   LDA *$00,X
90FB- 75 02                   ADC *$02,X
90FD- 4C 3A 90                JMP POPONE.E

                 ; NOTE THAT NOT ALL FORTH WORDS NEED BE IN THE DICTIONARY

9100- 02 91      BRANCH       .SI BRANCHX

9102- A0 02      BRANCHX      LDY #$02
9104- B1 DA                   LDA ($DA),Y
9106- A0 00                   LDY #$00
9108- C9 00                   CMP #$00
910A- 10 01                   BPL =+2

910C- 88                      DEY
910D- 18                      CLC
910E- 65 DA                   ADC *$DA
9110- 85 DA                   STA *$DA
```

```
9112- 98                      TYA
9113- 65 DB                   ADC *$DB
9115- 85 DB                   STA *$DB
9117- 4C 4D 90                JMP NEXT


911A- 1C 91      ZBRANCH      .SI ZBRANCHX

911C- E8         ZBRANCHX     INX
911D- E8                      INX
911E- B5 FE                   LDA *$FE,X
9120- 15 FF                   ORA *$FF,X
                 ;            BNE FIXUP

9122- F0 DE                   BEQ BRANCHX  ;ALWAYS

9124- A5 DA      DOCOLON      LDA *$DA
9126- 48                      PHA
9127- A5 DB                   LDA *$DB
9129- 48                      PHA
912A- A5 DE                   LDA *$DE
912C- 85 DB                   STA *$DB
912E- A5 DD                   LDA *$DD
9130- 4C 4F 90                JMP NEXT1

                 ; NOTICE THE FINAL PORTION IS MAINLY "COMPILED" FORTH
                 ; STRUCTURE IS DOCOLON WORD1 WORD2 ... WORDN DOSEMICOLON

9133- 01         EQUAL.       .BY $01
9134- 3D 20 20                .BY '= ' $20
9137- EB 90                   .SI PLUS.
9139- 24 91      EQUAL        .SI DOCOLON
913B- 63 91                   .SI MINUS
913D- BB 90                   .SI ZEROEQ
913F- AC 90                   .SI DOSEMICOLN

9141- 01         LESS.        .BY $01
9142- 3C 20 20                .BY '< ' $20
9145- 33 91                   .SI EQUAL.
9147- 24 91      LESS         .SI DOCOLON
9149- 63 91                   .SI MINUS
914B- CE 90                   .SI ZEROLESS
914D- AC 90                   .SI DOSEMICOLN

914F- 01         GREATER.     .BY $01
9150- 3E 20 20                .BY '> ' $20
9153- 41 91                   .SI LESS.
9155- 24 91      GREATER      .SI DOCOLON
9157- 94 90                   .SI SWAP
9159- 47 91                   .SI LESS
915B- AC 90                   .SI DOSEMICOLN


915D- 01         MINUS.       .BY $01
915E- 2D 20 20                .BY '- ' $20
9161- 4F 91                   .SI GREATER.
9163- 24 91      MINUS        .SI DOCOLON
9165- DE 90                   .SI NEGATE
9167- F1 90                   .SI PLUS
9169- AC 90                   .SI DOSEMICOLN


916B- 03         ABS.         .BY $03
916C- 41 42 53                .BY 'ABS'
916F- 5D 91                   .SI MINUS.
9171- 24 91      ABS          .SI DOCOLON
```

```
9173- 6C 90     2640            .SI DUP
9175- CE 90     2650            .SI ZEROLESS
9177- 1A 91     2660            .SI ZBRANCH
9179- 03        2670            .BY ABS1-=
                2680
917A- DE 90     2690            .SI NEGATE
917C- AC 90     2700 ABS1       .SI DOSEMICOLN
                2710
917E- 03        2720 MAX.       .BY $03
917F- 4D 41 58  2730            .BY 'MAX'
9182- 6B 91     2740            .SI ABS.
                2750
9184- 24 91     2760 MAX        .SI DOCOLON
9186- 7C 90     2770            .SI OVER
9188- 7C 90     2780            .SI OVER
918A- 47 91     2790            .SI LESS
918C- 1A 91     2800            .SI ZBRANCH
918E- 03        2810            .BY MAX1-=
                2820
918F- 94 90     2830            .SI SWAP
9191- 8C 90     2840 MAX1       .SI DROP
9193- AC 90     2850            .SI DOSEMICOLN
                2860
9195- 03        2870 MIN.       .BY $03
9196- 4D 49 4E  2880            .BY 'MIN'
9199- 7E 91     2890            .SI MAX.
919B- 24 91     2900 MIN        .SI DOCOLON
919D- 7C 90     2910            .SI OVER
919F- 7C 90     2920            .SI OVER
91A1- 55 91     2930            .SI GREATER
91A3- 1A 91     2940            .SI ZBRANCH
91A5- 03        2950            .BY MIN1-=
                2960
91A6- 94 90     2970            .SI SWAP
91A8- 8C 90     2980 MIN1       .SI DROP
91AA- AC 90     2990            .SI DOSEMICOLN
                3000            .EN
```

ADJUSTABLE REAL TIME (SWISS) CLOCK - ERNST SCHUMACHER

Here is one of the finest clock programs we've ever seen for an almost unexpanded SYM-1. We say almost, because the program spills over four bytes beyond the first 1K of RAM. Of course, we could cheat a little and put some of the program into page one, and still .S2 and .L2 it in one segment. We don't approve of reading cassette dumps back in over the stack area, however, and certainly reading cassette dumps back in over the top of page zero is not possible, so page zero is out for multipage saves and loads.

We could not figure a way to trim away the four bytes. But, once you have added the additional 1K of RAM, there should be lots of room left to bring the SYM-1 up to the performance level of the inexpensive digital watches which also include a calendar, an audible, independently setable alarm, and a stopwatch/timer combo!

Many of our non-computer oriented friends, and even some of our computer science students, find it difficult to believe that digital timepieces are really general purpose microcomputers (or should they be called nanocomputers?) which are programmed in almost exactly the same way as the larger computers to which they are more accustomed. Showing them how the SYM can be programmed to do the same job, even though at much greater cost, and letting them look at a listing of the program could prove very instructive.

```
0010
0020 ;                                    Bern, 23 jul 1982
0030 ;Dear Lux:
0035
0040 ;Here is another SYM-clock. It works with the HKB but can
0050 ;be changed to CRT as indicated in SYMPHYSIS. To a Swiss,
0060 ;nostalgic over a once active watch industry, a clock
0070 ;must be regulateable and setable while it runs and to
0080 ;the limits of the precision of the given oscillator.
0090 ;That's in this program. A regulation to +/- 1 us/s gives
0100 ;not more than +/- 1 s in 11 days or +/- 30 s a year, much
0110 ;better than most 'quartz-watches' available today. This
0120 ;should be so, since the quartz in the SYM costs about as
0130 ;much as a complete digital watch.  You can set the
0140 ;flicker-free (!) keyboard display for hours, minutes,
0150 ;seconds, and 1/20 second without stopping the clock.
0155
0160 ;To change the display, press the keys
0165
0170 ;        4  5  for + or -  1/20 second  [reg $F7 not displ.]
0180 ;        6  7  for + or -  seconds      [reg $F6]
0190 ;        8  9  for + or -  minutes      [reg $F5]
0200 ;        A  B  for + or -  hours        [reg $F4]
0205
0210 ;When pressed continuously the digits whizz up or down
0220 ;through their ranges with correct over or underflow into
0230 ;the next digits. The 1/20 seconds are not displayed but
0240 ;can be examined in register $F7 after pressing 01 which
0250 ;brings the monitor back in while the clock ticks on. To
0260 ;jump back into the display, type G 0.
0265
0270 ;My SYM persistently shows a precision better than 1 sec
0280 ;in 11 days if it is not exposed to temperature changes
0290 ;of more than +/- 3 deg. centigrade for several days.
0300 ;+/- 1 us/s regulation is by pressing either 03 or 02
0310 ;on the HKB. The changes are not displayed but can be
0320 ;examined in regs. $F2 and $F3 [MIKSEC, LNIB].
0325
0330 ;The set-display interpreter is from lines 1470-2670.
0340 ;The clock regulation is explained from 3040-3650.
0350 ;Thanks for all you do !      Ernst Schumacher
0360
0370            .OS
0380            .LS
0390 START      .DE $0200
0400            .BA START
0405            .MC $9000
0410
0420 ;*******************************************************
0430 ;*                                                     *
0440 ;*        R E A L   T I M E   C L O C K   for SYM-1    *
0450 ;*                                                     *
0460 ;*     Clock can be regulated to 1 usec; display on    *
0470 ;*     SYM Hex-keyboard is HH.MM.SS; it can be set     *
0480 ;*     +/- .05 s, +/- 1 s, +/- 1 min, and +/- 1 hour   *
0490 ;*              while the clock is running.            *
0500 ;*          E.S. 23 jul 1982    CH-3000 Bern 9         *
0510 ;*                                                     *
0520 ;*******************************************************
0530
0540
0550 ;          DEFINITIONS
0560
0570 IRQVEC     .DE $A67E
0580 DISBUF     .DE $A640
```

```
                 Ø59Ø DISBUF2    .DE $A641
                 Ø6ØØ DISBUF4    .DE $A643
                 Ø61Ø ACCESS     .DE $8B86
                 Ø62Ø SCAND      .DE $89Ø6
                 Ø63Ø LRNKEY     .DE $892C
                 Ø64Ø MIKSEC     .DE $ØØF2
                 Ø65Ø LNIB       .DE $ØØF3
                 Ø66Ø HOUR       .DE $ØØF4
                 Ø67Ø MIN        .DE $ØØF5
                 Ø68Ø SEC        .DE $ØØF6
                 Ø69Ø COUNT      .DE $ØØF7
                 Ø7ØØ NIBASC     .DE $83Ø9
                 Ø71Ø ASCIM1     .DE $8BEE
                 Ø72Ø SEGSM1     .DE $8C28
                 Ø73Ø T1LL       .DE $AØØ6
                 Ø74Ø T1CH       .DE $AØØ5
                 Ø75Ø ACR        .DE $AØØB
                 Ø76Ø IER        .DE $AØØE
                 Ø77Ø ZERO       .DE $ØØØØ
                 Ø78Ø
                 Ø79Ø ;          INITIALIZATION
                 Ø8ØØ
Ø2ØØ- 2Ø 98 Ø3   Ø81Ø CSTART     JSR INICLCK  ;init clock-routine
Ø2Ø3- 2Ø 86 8B   Ø82Ø WSTART     JSR ACCESS   ;come here after clck stops
Ø2Ø6- A9 B7      Ø83Ø            LDA #L,CLOCK         ;set interrupt
Ø2Ø8- 8D 7E A6   Ø84Ø            STA IRQVEC
Ø2ØB- A9 Ø3      Ø85Ø            LDA #H,CLOCK         ;vector for clock
Ø2ØD- 8D 7F A6   Ø86Ø            STA IRQVEC+1
Ø21Ø- A9 4C      Ø87Ø            LDA #$4C     ;put a JMP at
Ø212- 85 ØØ      Ø88Ø            STA *ZERO    ; zero location for
Ø214- A9 Ø3      Ø89Ø            LDA #L,WSTART        ; finding WSTART by
Ø216- 85 Ø1      Ø9ØØ            STA *ZERO+1  ; G Ø
Ø218- A9 Ø2      Ø91Ø            LDA #H,WSTART        ; after a call to
Ø21A- 85 Ø2      Ø92Ø            STA *ZERO+2  ; monitor
Ø21C- D8         Ø93Ø            CLD
                 Ø94Ø ;           start display from right to left
Ø21D- AØ ØØ      Ø95Ø LOOP1      LDY #ØØ      ;initial pointer into DISBUF
Ø21F- A5 F4      Ø96Ø            LDA *HOUR
Ø221- 2Ø 78 Ø3   Ø97Ø            JSR OUTBT
Ø224- A5 F5      Ø98Ø            LDA *MIN
Ø226- 2Ø 78 Ø3   Ø99Ø            JSR OUTBT
Ø229- A5 F6      1ØØØ            LDA *SEC
Ø22B- 2Ø 78 Ø3   1Ø1Ø            JSR OUTBT
Ø22E- AD 41 A6   1Ø2Ø            LDA DISBUF2
Ø231- Ø9 8Ø      1Ø3Ø            ORA #$8Ø     ;set period
Ø233- 8D 41 A6   1Ø4Ø            STA DISBUF2
Ø236- AD 43 A6   1Ø5Ø            LDA DISBUF4
Ø239- Ø9 8Ø      1Ø6Ø            ORA #$8Ø     ;set second period
Ø23B- 8D 43 A6   1Ø7Ø            STA DISBUF4
Ø23E- 2Ø Ø6 89   1Ø8Ø            JSR SCAND
                 1Ø9Ø
                 11ØØ ;          DISPLAY ROUTINE
                 111Ø
Ø241- AØ Ø4      112Ø LOOP       LDY #4       ;display routine HKB, flicker-free
Ø243- A9 14      113Ø            LDA #$14     ;updates display only when digits
Ø245- C5 F7      114Ø            CMP *COUNT   ; change; writes seconds first
Ø247- DØ 2B      115Ø            BNE LIGHT
Ø249- A5 F6      116Ø            LDA *SEC
Ø24B- 2Ø 78 Ø3   117Ø            JSR OUTBT
Ø24E- AØ Ø2      118Ø            LDY #$Ø2
Ø25Ø- A5 F6      119Ø            LDA *SEC
Ø252- DØ 2Ø      12ØØ            BNE LIGHT
Ø254- A5 F5      121Ø            LDA *MIN
Ø256- 2Ø 78 Ø3   122Ø            JSR OUTBT
```

```
Ø259- AD 43 A6   123Ø            LDA DISBUF4
Ø25C- Ø9 8Ø      124Ø            ORA #$8Ø
Ø25E- 8D 43 A6   125Ø            STA DISBUF4
Ø261- AØ ØØ      126Ø            LDY #ØØ
Ø263- A5 F5      127Ø            LDA *MIN
Ø265- DØ ØD      128Ø            BNE LIGHT
Ø267- A5 F4      129Ø            LDA *HOUR
Ø269- 2Ø 78 Ø3   13ØØ            JSR OUTBT
Ø26C- AD 41 A6   131Ø            LDA DISBUF2
Ø26F- Ø9 8Ø      132Ø            ORA #$8Ø
Ø271- 8D 41 A6   133Ø            STA DISBUF2
Ø274- 2Ø Ø6 89   134Ø LIGHT      JSR SCAND     ;scan the display and watch
Ø277- FØ C8      135Ø            BEQ LOOP      ; for key down ? no, continue
Ø279- 2Ø 2C 89   136Ø            JSR LRNKEY    ;yes. Wait with
Ø27C- A2 2Ø      137Ø            LDX #$2Ø      ; debounce loop to
Ø27E- AØ FF      138Ø LP1        LDY #$FF      ; prevent multiple operations.
Ø28Ø- EA         139Ø LP2        NOP   ;         It is 82 ms, long enough
Ø281- EA         14ØØ            NOP   ;         to make sure that one clock-
Ø282- EA         141Ø            NOP   ;         cycle has gone before new
Ø283- 88         142Ø            DEY   ;         changes are made.
Ø284- DØ FA      143Ø            BNE LP2
Ø286- CA         144Ø            DEX
Ø287- DØ F5      145Ø            BNE LP1       ;end debounce loop
                 146Ø
                 147Ø ;          CMD INTERPRETER HKB
                 148Ø
Ø289- C9 31      149Ø            CMP #$31      ;key Ø1: SYM-1 monitor warm entry
Ø28B- FØ 3A      15ØØ            BEQ WARM
Ø28D- C9 32      151Ø            CMP #$32      ;key Ø2: clock faster -1 usec/sec
Ø28F- FØ 39      152Ø            BEQ FASTER
Ø291- C9 33      153Ø            CMP #$33      ;key Ø3: clock slower +1 usec/sec
Ø293- FØ 45      154Ø            BEQ SLOWER
Ø295- C9 34      155Ø            CMP #$34      ;key Ø4: set display +1/2Ø sec
Ø297- FØ 51      156Ø            BEQ PLUS2Ø
Ø299- C9 35      157Ø            CMP #$35      ;key Ø5: set display -1/2Ø sec
Ø29B- FØ 58      158Ø            BEQ MINUS2Ø
Ø29D- C9 36      159Ø            CMP #$36      ;key Ø6: set display +1 sec
Ø29F- FØ 65      16ØØ            BEQ PLUSEC
Ø2A1- C9 37      161Ø            CMP #$37      ;key Ø7: set display -1 sec
Ø2A3- DØ Ø3      162Ø            BNE PLUMN
Ø2A5- 4C 38 Ø3   163Ø            JMP MINUSEC
                 1635
Ø2A8- C9 38      164Ø PLUMN      CMP #$38      ;key Ø8: set display +1 min
Ø2AA- DØ Ø3      165Ø            BNE MINMN
Ø2AC- 4C 68 Ø3   166Ø            JMP PLUMIN
                 1665
Ø2AF- C9 39      167Ø MINMN      CMP #$39      ;key Ø9: set display -1 min
Ø2B1- DØ Ø3      168Ø            BNE PLUHR
Ø2B3- 4C 6C Ø3   169Ø            JMP MINMIN
                 1695
Ø2B6- C9 41      17ØØ PLUHR      CMP #$41      ;key ØA: set display +1 hour
Ø2B8- DØ Ø3      171Ø            BNE MINHR
Ø2BA- 4C 7Ø Ø3   172Ø            JMP PLUHOR
                 1725
Ø2BD- C9 42      173Ø MINHR      CMP #$42      ;key ØB: set display -1 hour
Ø2BF- DØ Ø3      174Ø            BNE LOP       ;for all other keys depressed
Ø2C1- 4C 74 Ø3   175Ø            JMP MINHOR
                 1755
Ø2C4- 4C 41 Ø2   176Ø LOP        JMP LOOP
                 1765
Ø2C7- 4C Ø3 8Ø   177Ø WARM       JMP $8ØØ3     ;back to the display by .G Ø
                 1775
Ø2CA- A5 F2      178Ø FASTER     LDA *MIKSEC   ;set clock 1 us/s faster
Ø2CC- DØ Ø6      179Ø            BNE LOPQ      ;go do it
```

```
Ø2CE- A9 14     18ØØ          LDA #$14     ;to prevent underflow
Ø2DØ- 85 F2     181Ø          STA *MIKSEC  ; load jiffy-count and
Ø2D2- C6 F3     182Ø          DEC *LNIB    ; adjust LNIB, keeping the time
Ø2D4- C6 F2     183Ø LOPQ     DEC *MIKSEC  ;now regulate clock
Ø2D6- 1Ø EC     184Ø          BPL LOP      ;normally; but an interrupt could
Ø2D8- 3Ø ØC     185Ø          BMI LOPP     ; have lowered MIKSEC to FF !
Ø2DA- A5 F2     186Ø SLOWER   LDA *MIKSEC  ;set clock 1 us/s slower
Ø2DC- C9 14     187Ø          CMP #$14     ;is it below max jiffy ?
Ø2DE- 9Ø Ø6     188Ø          BCC LOPP     ;yes, go on as usual
Ø2EØ- A9 ØØ     189Ø          LDA #Ø       ;no, reduce it to Ø
Ø2E2- 85 F2     19ØØ          STA *MIKSEC  ; put it there and adjust
Ø2E4- E6 F3     191Ø          INC *LNIB    ; LNIB, which is equivalent time
Ø2E6- E6 F2     192Ø LOPP     INC *MIKSEC  ;one more in 2Ø jiffies with +1 us
Ø2E8- 1Ø DA     193Ø          BPL LOP      ;always
Ø2EA- C6 F7     194Ø PLUS2Ø   DEC *COUNT   ;make it one shorter
Ø2EC- DØ D6     195Ø          BNE LOP      ; and continue
Ø2EE- A9 14     196Ø          LDA #$14     ;spec.treatment if zero
Ø2FØ- 85 F7     197Ø          STA *COUNT   ; full jiffy but
Ø2F2- 4C Ø6 Ø3  198Ø          JMP PLUSEC   ; one sec more
                1985
Ø2F5- A5 F7     199Ø MINUS2Ø  LDA *COUNT
Ø2F7- C9 14     2ØØØ          CMP #$14
Ø2F9- FØ Ø4     2Ø1Ø          BEQ LOPN     ;spec. treatment
Ø2FB- E6 F7     2Ø2Ø          INC *COUNT   ;make jiffy 1 more to count to Ø
Ø2FD- DØ C5     2Ø3Ø          BNE LOP      ; and go back
Ø2FF- A9 Ø1     2Ø4Ø LOPN     LDA #$1      ;one more, but at
Ø3Ø1- 85 F7     2Ø5Ø          STA *COUNT
Ø3Ø3- 4C 38 Ø3  2Ø6Ø          JMP MINUSEC  ;one sec less
                2Ø65
Ø3Ø6- F8        2Ø7Ø PLUSEC   SED
Ø3Ø7- A9 Ø1     2Ø8Ø          LDA #Ø1
Ø3Ø9- 18        2Ø9Ø          CLC
Ø3ØA- 65 F6     21ØØ          ADC *SEC
Ø3ØC- 85 F6     211Ø          STA *SEC
Ø3ØE- C9 6Ø     212Ø          CMP #$6Ø
Ø31Ø- DØ 22     213Ø          BNE EXIT
Ø312- A9 ØØ     214Ø          LDA #Ø
Ø314- 85 F6     215Ø          STA *SEC
Ø316- A9 Ø1     216Ø PLUSMN   LDA #Ø1
Ø318- 18        217Ø          CLC
Ø319- 65 F5     218Ø          ADC *MIN
Ø31B- 85 F5     219Ø          STA *MIN
Ø31D- C9 6Ø     22ØØ          CMP #$6Ø
Ø31F- DØ 13     221Ø          BNE EXIT
Ø321- A9 ØØ     222Ø          LDA #Ø
Ø323- 85 F5     223Ø          STA *MIN
Ø325- A9 Ø1     224Ø PLUSHR   LDA #Ø1
Ø327- 18        225Ø          CLC
Ø328- 65 F4     226Ø          ADC *HOUR
Ø32A- 85 F4     227Ø          STA *HOUR
Ø32C- C9 24     228Ø          CMP #$24
Ø32E- DØ Ø4     229Ø          BNE EXIT
Ø33Ø- A9 ØØ     23ØØ          LDA #Ø
Ø332- 85 F4     231Ø          STA *HOUR
Ø334- D8        232Ø EXIT     CLD
Ø335- 4C 1D Ø2  233Ø          JMP LOOP1
                2335
Ø338- F8        234Ø MINUSEC  SED
Ø339- A5 F6     235Ø          LDA *SEC
Ø33B- 38        236Ø          SEC
Ø33C- E9 Ø1     237Ø          SBC #Ø1
Ø33E- 85 F6     238Ø          STA *SEC
Ø34Ø- C9 99     239Ø          CMP #$99
Ø342- DØ FØ     24ØØ          BNE EXIT
Ø344- A9 59     241Ø          LDA #$59
```

```
Ø346- 85 F6     242Ø          STA *SEC
Ø348- A5 F5     243Ø MINIMN   LDA *MIN
Ø34A- 38        244Ø          SEC
Ø34B- E9 Ø1     245Ø          SBC #Ø1
Ø34D- 85 F5     246Ø          STA *MIN
Ø34F- C9 99     247Ø          CMP #$99
Ø351- DØ E1     248Ø          BNE EXIT
Ø353- A9 59     249Ø          LDA #$59
Ø355- 85 F5     25ØØ          STA *MIN
Ø357- A5 F4     251Ø MINIHR   LDA *HOUR
Ø359- 38        252Ø          SEC
Ø35A- E9 Ø1     253Ø          SBC #Ø1
Ø35C- 85 F4     254Ø          STA *HOUR
Ø35E- C9 99     255Ø          CMP #$99
Ø36Ø- DØ D2     256Ø          BNE EXIT
Ø362- A9 23     257Ø          LDA #$23
Ø364- 85 F4     258Ø          STA *HOUR
Ø366- DØ CC     259Ø          BNE EXIT
Ø368- F8        26ØØ PLUMIN   SED
Ø369- 4C 16 Ø3  261Ø          JMP PLUSMN
                2615
Ø36C- F8        262Ø MINMIN   SED
Ø36D- 4C 48 Ø3  263Ø          JMP MINIMN
                2635
Ø37Ø- F8        264Ø PLUHOR   SED
Ø371- 4C 25 Ø3  265Ø          JMP PLUSHR
                2655
Ø374- F8        266Ø MINHOR   SED
Ø375- 4C 57 Ø3  267Ø          JMP MINIHR
                268Ø
Ø378- 48        269Ø OUTBT    PHA  ;save display byte
Ø379- 4A        27ØØ          LSR A
Ø37A- 4A        271Ø          LSR A
Ø37B- 4A        272Ø          LSR A
Ø37C- 4A        273Ø          LSR A
Ø37D- 2Ø 81 Ø3  274Ø          JSR NBASO1
Ø38Ø- 68        275Ø          PLA
Ø381- 2Ø Ø9 83  276Ø NBASO1   JSR NIBASC
Ø384- A2 ØA     277Ø OUTDS    LDX #$ØA
Ø386- DD EE 8B  278Ø OUD2     CMP ASCIM1,X         ;  in ASCII-table
Ø389- FØ Ø5     279Ø          BEQ GETSGS
Ø38B- CA        28ØØ          DEX
Ø38C- DØ F8     281Ø          BNE OUD2
Ø38E- FØ Ø7     282Ø          BEQ EXITOT
Ø39Ø- BD 28 8C  283Ø GETSGS   LDA SEGSM1,X         ;segment-table for numbers
Ø393- 99 4Ø A6  284Ø          STA DISBUF,Y
Ø396- C8        285Ø          INY  ;bump pointer into DISBUF
Ø397- 6Ø        286Ø EXITOT   RTS
                287Ø
Ø398- A9 1Ø     288Ø INICLCK  LDA #$1Ø     ;init counter for start
Ø39A- 85 F7     289Ø          STA *COUNT
Ø39C- 8D ØB AØ  29ØØ          STA ACR      ;set bits 7,6 low in aux.ctr.reg.
Ø39F- A9 CØ     291Ø          LDA #$CØ     ;set bits 7,6 high in
Ø3A1- 8D ØE AØ  292Ø          STA IER      ; interrupt enable reg. timer1
Ø3A4- A9 31     293Ø          LDA #$31     ;init. low. nib. of timer1 and
Ø3A6- 85 F3     294Ø          STA *LNIB    ;save [assume 1.ØØØØØØ MHz qrtz]
Ø3A8- A9 ØA     295Ø          LDA #$ØA     ;init. midway between
Ø3AA- 85 F2     296Ø          STA *MIKSEC  ; Ø and 14 hex
Ø3AC- A9 24     297Ø          LDA #$24     ;1st loop of timer1 shorter
Ø3AE- 8D Ø6 AØ  298Ø          STA T1LL
Ø3B1- A9 C3     299Ø          LDA #$C3     ; and start w. hi nib. of
Ø3B3- 8D Ø5 AØ  3ØØØ          STA T1CH     ; timer1 for 49957 usec
Ø3B6- 6Ø        3Ø1Ø          RTS
```

(continued to page 13/14-29)

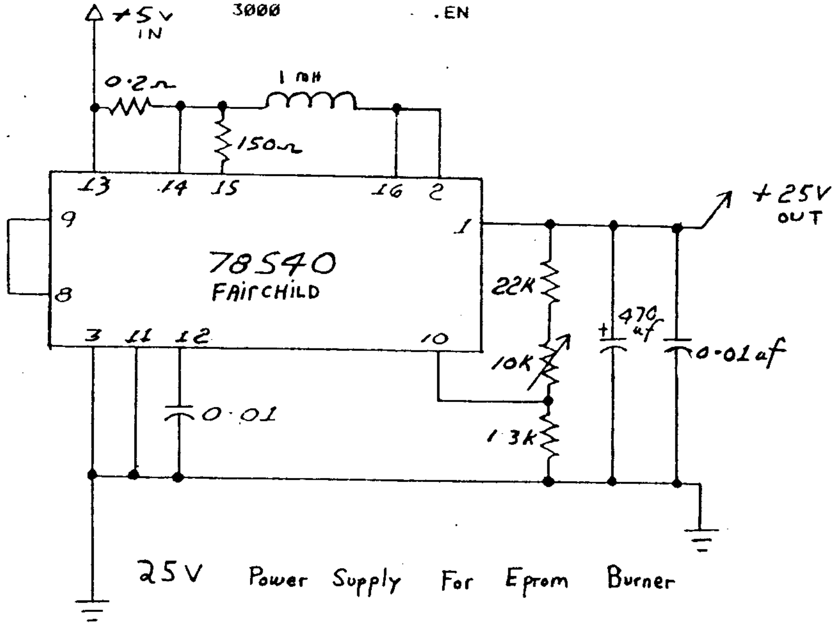
```
               0010            ; *** 2758/2716/2732 ***
               0020            ; EPROM PROGRAMMER FOR SYM-1
               0030            ; BY PETER G. FONG SAM
               0040            ; AND PAUL L. BEAUPRE
               0050
               0060            ; SINGLE LETTER COMMANDS ARE USED.
               0070            ; TYPE IN LETTER COMMANDS FOLLOWED
               0080            ; BY EPROM TYPE, I.E. 2716, AND THEN
               0090            ; MEMORY STARTING ADDRESS, FOLLOWED BY
               0100            ; MEMORY ENDING ADDRESS AND THEN FOLLOWED
               0110            ; BY A CR. ALL ENTRIES ARE TO BE SEPARATED
               0120            ; BY COMMAS AS PER THE SYM-1 ENTRY MODE
               0130
               0140            ; >>> COMMANDS <<<
               0150
               0160            ; B = BLANK TEST
               0170            ; C = COPY EPROM TO MEMORY SPECIFIED
               0180            ; L = LIST EPROM BY LINES SPECIFIED
               0190            ; P = PROGRAM EPROM FROM MEMORY SPECIFIED
               0200            ; V = VERIFY CONTENTS OF EPROM TO MEMORY
               0210            ;     LOCATIONS SPECIFIED
               0220
               0230            ; RETURN KEY = RETURN TO MONITOR
               0240            ; BREAK = BREAK FROM LIST OR PROGRAM ONLY
               0250
               0260 ACCESS     .DE $8B86
               0270 CRLF       .DE $834D
               0280 EPROM      .DE $A646
               0290 ERMSG      .DE $8171
               0300 INCHAR     .DE $8A1B
               0310 INSTAT     .DE $8386
               0320 LSTCOM     .DE $A657
               0330 MONITR     .DE $8000
               0340 OUTBYT     .DE $82FA
               0350 OUTCHR     .DE $8A47
               0360 OUTQM      .DE $8320
               0370 PAD        .DE $A001
               0380 PADD       .DE $A003
               0390 PARNR      .DE $A649
               0400 PBD        .DE $A000
               0410 PBDD       .DE $A002
               0420 P1H        .DE $A64F
               0430 P1L        .DE $A64E
               0440 P2H        .DE $A64D
               0450 P2L        .DE $A64C
               0460 P2SCR      .DE $829C
               0470 P3H        .DE $A64B
               0480 P3L        .DE $A64A
               0490 SIZE       .DE $A647
               0500 SPACE      .DE $8342
               0510 STATUS     .DE $A407
               0520 STOCOM     .DE $8120
               0530
               0540 TEMP1      .DE $FE
               0550 TEMP2      .DE $FF
               0560
               0570 T1024      .DE $A41F
               0580
               0590            .BA $9000    ; OR WHEREVER
               0600            .OS
               0610
9000- 20 86 8B 0620 START      JSR ACCESS
9003- A9 FF    0630 RESET      LDA #$FF
9005- 8D 02 A0 0640            STA PBDD
9008- A9 A0    0650            LDA #$A0
900A- 8D 00 A0 0660            STA PBD
```

```
900D- 20 4D 83 0670 PROMPT     JSR CRLF
9010- A9 2A    0680            LDA #'*
9012- 20 47 8A 0690            JSR OUTCHR
9015- 20 20 83 0700            JSR OUTQM
9018- 20 42 83 0710            JSR SPACE
901B- 20 1B 8A 0720 INCOM      JSR INCHAR
901E- C9 0D    0730            CMP #$0D
9020- D0 03    0740            BNE OKCOM
9022- 4C 00 80 0750            JMP MONITR
               0760
9025- 20 20 81 0770 OKCOM      JSR STOCOM
9028- C9 0D    0780            CMP #$0D
902A- D0 39    0790            BNE OUTERR
902C- AD 49 A6 0800            LDA PARNR
902F- 0A       0810            ASL A
9030- A8       0820            TAY
9031- B9 49 A6 0830            LDA PARNR,Y
9034- C9 27    0840            CMP #$27
9036- D0 2D    0850            BNE OUTERR
9038- 88       0860            DEY
9039- B9 49 A6 0870            LDA PARNR,Y
903C- C9 16    0880            CMP #$16
903E- D0 0C    0890            BNE SIZE4K
9040- A9 08    0900 SIZE2K     LDA #8
9042- 8D 47 A6 0910            STA SIZE
9045- A9 00    0920            LDA #0
9047- 8D 46 A6 0930            STA EPROM
904A- F0 1F    0940            BEQ CHECK
904C- C9 32    0950 SIZE4K     CMP #$32
904E- D0 0A    0960            BNE SIZE1K
9050- A9 10    0970            LDA #$10
9052- 8D 46 A6 0980            STA EPROM
9055- 8D 47 A6 0990            STA SIZE
9058- D0 11    1000            BNE CHECK
905A- C9 58    1010 SIZE1K     CMP #$58
905C- D0 07    1020            BNE OUTERR
905E- A9 04    1030            LDA #4
9060- 8D 47 A6 1040            STA SIZE
9063- D0 E0    1050            BNE SIZE2K+5
9065- 20 73 81 1060 OUTERR     JSR ERMSG+2
9068- 4C 0D 90 1070            JMP PROMPT
               1080
906B- 20 9C 82 1090 CHECK      JSR P2SCR
906E- AD 49 A6 1100            LDA PARNR
9071- C9 01    1110            CMP #1
9073- D0 09    1120            BNE THREE
9075- AD 57 A6 1130            LDA LSTCOM
9078- C9 42    1140            CMP #'B
907A- D0 E9    1150            BNE OUTERR
907C- F0 22    1160            BEQ BLANK
907E- C9 03    1170 THREE      CMP #3
9080- D0 E3    1180            BNE OUTERR
9082- AD 57 A6 1190            LDA LSTCOM
9085- C9 43    1200            CMP #'C
9087- D0 02    1210            BNE LISTPR
9089- F0 61    1220            BEQ COPY
908B- C9 4C    1230 LISTPR     CMP #'L
908D- D0 03    1240            BNE PROG
908F- 4C 0D 91 1250            JMP LIST
               1260
9092- C9 50    1270 PROG       CMP #'P
9094- D0 03    1280            BNE VER
9096- 4C 50 91 1290            JMP PROGRM
9099- C9 56    1300 VER        CMP #'V
909B- D0 C8    1310            BNE OUTERR
909D- 4C 89 91 1320            JMP VERIFY
```

```

                      ; BLANK TEST

90A0- A9 00     BLANK   LDA #0
90A2- 8D 03 A0          STA PADD
90A5- A8                TAY
90A6- AD 46 A6          LDA EPROM
90A9- 8D 00 A0          STA PBD
90AC- 20 CD 91          JSR DELAY     ;ALLOWS RELAYS TO SETTLE
90AF- A9 FF             LDA #$FF
90B1- CD 01 A0  CHKBYT  CMP PAD
90B4- D0 1F             BNE ERROR
90B6- EE 00 A0          INC PBD
90B9- CE 00 A0          DEC PBD
90BC- C8                INY
90BD- D0 F2             BNE CHKBYT
90BF- E8                INX
90C0- EC 47 A6          CPX SIZE
90C3- D0 EC             BNE CHKBYT
90C5- 20 4D 83  DONE    JSR CRLF
90C8- A9 4F             LDA #'O
90CA- 20 47 8A          JSR OUTCHR
90CD- A9 4B             LDA #'K
90CF- 20 47 8A          JSR OUTCHR
90D2- 4C 08 90          JMP RESET+5

90D5- 20 4D 83  ERROR   JSR CRLF
90D8- 8A                TXA
90D9- 20 FA 82          JSR OUTBYT
90DC- 98                TYA
90DD- 20 FA 82          JSR OUTBYT
90E0- 20 42 83          JSR SPACE
90E3- AD 01 A0          LDA PAD
90E6- 20 FA 82          JSR OUTBYT
90E9- 4C 08 90          JMP RESET+5

                        ; COPY

90EC- A9 00     COPY    LDA #0
90EE- 8D 03 A0          STA PADD
90F1- AD 46 A6          LDA EPROM
90F4- 8D 00 A0          STA PBD
90F7- 20 CD 91          JSR DELAY
90FA- AD 01 A0  GETCHR  LDA PAD
90FD- 81 FE             STA (TEMP1,X)
90FF- EE 00 A0          INC PBD
9102- CE 00 A0          DEC PBD
9105- 20 DA 91          JSR COMPAR
9108- 90 F0             BCC GETCHR
910A- 4C C5 90          JMP DONE

                        ; LIST

910D- A9 00     LIST    LDA #0
910F- 8D 03 A0          STA PADD
9112- AD 46 A6          LDA EPROM
9115- 8D 00 A0          STA PBD
9118- 20 CD 91          JSR DELAY
911B- 20 F4 91  NEWLIN  JSR LOOK
911E- 20 4D 83          JSR CRLF
9121- A0 00             LDY #0
9123- AD FF 00          LDA TEMP2
9126- 20 FA 82          JSR OUTBYT
9129- AD FE 00          LDA TEMP1
912C- 20 FA 82          JSR OUTBYT
912F- 20 42 83          JSR SPACE
```

```
9132- 20 42 83  DATA    JSR SPACE
9135- AD 01 A0          LDA PAD
9138- 20 FA 82          JSR OUTBYT
913B- EE 00 A0          INC PBD
913E- CE 00 A0          DEC PBD
9141- 20 DA 91          JSR COMPAR
9144- 90 03             BCC CKCNTR
9146- 4C 08 90          JMP RESET+5

9149- C8        CKCNTR  INY
914A- C0 10             CPY #$10
914C- D0 E4             BNE DATA
914E- F0 CB             BEQ NEWLIN

                        ; PROGRAM

9150- A9 FF     PROGRM  LDA #$FF
9152- 8D 03 A0          STA PADD
9155- AD 46 A6          LDA EPROM
9158- F0 07             BEQ NOT4K
915A- A9 1A             LDA #$1A
915C- 8D 00 A0          STA PBD
915F- D0 05             BNE GO
9161- A9 0C     NOT4K   LDA #$C
9163- 8D 00 A0          STA PBD
9166- 20 CD 91  GO      JSR DELAY
9169- 20 F4 91  BURN    JSR LOOK
916C- A1 FE             LDA (TEMP1,X)
916E- 8D 01 A0          STA PAD
9171- EA                NOP
9172- EA                NOP
9173- CE 00 A0          DEC PBD
9176- 20 CD 91  TIMOUT  JSR DELAY
9179- EE 00 A0          INC PBD
917C- 20 DA 91          JSR COMPAR
917F- 90 E8             BCC BURN
9181- A9 80             LDA #$80
9183- 8D 00 A0          STA PBD
9186- 20 9C 82          JSR P2SCR

                        ; VERIFY

9189- A9 00     VERIFY  LDA #0
918B- 8D 03 A0          STA PADD
918E- AD 46 A6          LDA EPROM
9191- 8D 00 A0          STA PBD
9194- 20 CD 91          JSR DELAY
9197- AD 01 A0  NEXBYT  LDA PAD
919A- C1 FE             CMP (TEMP1,X)
919C- D0 0E             BNE ERRPTR
919E- EE 00 A0          INC PBD
91A1- CE 00 A0          DEC PBD
91A4- 20 DA 91          JSR COMPAR
91A7- 90 EE             BCC NEXBYT
91A9- 4C C5 90          JMP DONE

                        ; DISPLAY ERROR AS MEMORY LOCATION,
                        ; MEMORY DATA, EPROM CONTENTS

91AC- 20 4D 83  ERRPTR  JSR CRLF
91AF- A5 FF             LDA *TEMP2
91B1- 20 FA 82          JSR OUTBYT
91B4- A5 FE             LDA *TEMP1
91B6- 20 FA 82          JSR OUTBYT
91B9- 20 42 83          JSR SPACE
91BC- A1 FE             LDA (TEMP1,X)
```

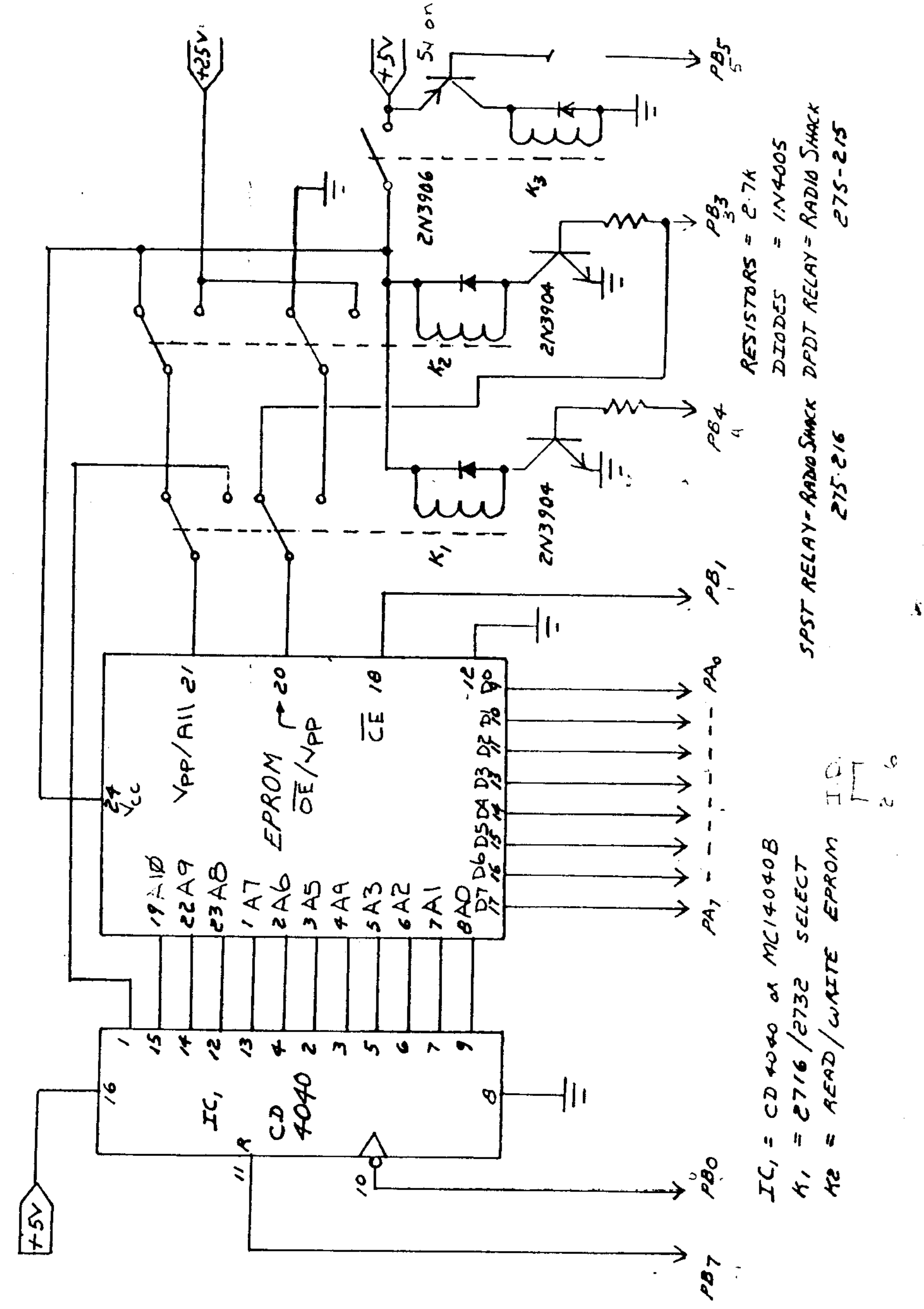
```
91BE- 2Ø FA 82  265Ø           JSR OUTBYT
91C1- 2Ø 42 83  266Ø           JSR SPACE
91C4- AD Ø1 AØ  267Ø           LDA PAD
91C7- 2Ø FA 82  268Ø           JSR OUTBYT
91CA- 4C Ø8 9Ø  269Ø           JMP RESET+5
                27ØØ
91CD- A9 2F     271Ø DELAY     LDA #$2F DELAY FOR 5Ø MS
91CF- 8D 1F A4  272Ø           STA T1Ø24
91D2- AD Ø7 A4  273Ø           LDA STATUS
91D5- 1Ø FB     274Ø           BPL DELAY+5
91D7- A2 ØØ     275Ø           LDX #Ø
91D9- 6Ø        276Ø           RTS
                277Ø
91DA- A5 FE     278Ø COMPAR    LDA *TEMP1
91DC- CD 4A A6  279Ø           CMP P3L
91DF- FØ Ø8     28ØØ           BEQ TESTHI
91E1- E6 FE     281Ø UPLOW     INC *TEMP1
91E3- DØ ØD     282Ø           BNE OUT
91E5- E6 FF     283Ø           INC *TEMP2
91E7- DØ Ø9     284Ø           BNE OUT
91E9- A5 FF     285Ø TESTHI    LDA *TEMP2
91EB- CD 4B A6  286Ø           CMP P3H
91EE- DØ F1     287Ø           BNE UPLOW
91FØ- 38        288Ø           SEC
91F1- 6Ø        289Ø           RTS
                29ØØ
91F2- 18        291Ø OUT       CLC
91F3- 6Ø        292Ø           RTS
                293Ø
91F4- 2Ø 86 83  294Ø LOOK      JSR INSTAT
91F7- BØ Ø1     295Ø           BCS CONT
91F9- 6Ø        296Ø           RTS
                297Ø
91FA- 4C Ø8 9Ø  298Ø CONT      JMP RESET+5
                299Ø
                3ØØØ           .EN
```



25V Power Supply For Eprom Burner

SYM-1 2758·2716·2732 Eprom Programmer

All Ports Are Hooked up To U-25 on SYM



ASCII TEXT FILE FOR JEFF LAVIN'S PRINTER PROGRAM: "SUSAN" (ABRIDGED)

```
     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0200 0D 0A 0D 0A 0D 0A 0D 0A 20 20 20 20 20 20 20 20,5C  ........
0210 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,5C
0220 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,5C
0230 20 2E 2E 20 20 20 2E 2E 2E 0D 0A 20 20 20 20 20,79   ..   .....
0240 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,79
0250 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,79
0260 20 41 49 4D 4D 59 49 41 4D 4D 59 59 49 49 2E 2E,DA   AIMMYIAMMYYII..
0270 0D 0A 20 20 20 20 20 20 20 20 20 20 20 20 20 20,B1  ..
0280 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,B1
0290 20 20 20 20 20 20 20 41 49 48 4D 4D 4D 48 4A 49,25         AIHMMMHJI
02A0 4D 4D 49 4C 4C 53 49 49 41 0D 0A 20 20 20 20 20,7D  MMILLSIIA..
02B0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,7D
02C0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 41 49,C7                AI
02D0 48 50 50 2F 3F 2F 20 2F 24 24 2F 50 56 59 4D 4A,A8  HPP/?/ /$$/PVYMJ
02E0 48 49 49 41 2E 0D 0A 20 20 20 20 20 20 20 20 20,28  HIIA...
02F0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,28

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0300 20 20 20 20 20 20 20 20 2E 41 50 2F 2F 24 20 3F,C8          .AP//$ ?
0310 20 2F 2F 24 24 2F 20 2F 2F 2F 2F 56 4D 4D 48 49,1A   //$$/ ////VMMHI
0320 41 2E 0D 0A 20 20 20 20 20 20 20 20 20 20 20 20,20  A...
0330 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,20
0340 20 20 20 20 41 2F 2F 2F 24 2F 24 3F 3F 2F 2F 2F,F0      A///$/$??///
0350 24 20 2F 2F 2F 2F 2F 2F 3F 2F 2F 56 4D 48 49 41,60  $ //////?//VMHIA
0360 0D 0A 20 20 20 20 20 20 20 20 20 20 20 20 20 20,37  ..
0370 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,37
0380 20 41 2F 2F 2F 24 2F 24 2F 3F 2F 2F 2F 2F 20 2F,15   A///$/$/?//// /
0390 20 2F 2F 2F 2F 3F 2F 2F 2F 3F 2F 56 48 48 41 20,72   ////?///?/VHHA
03A0 2E 0D 0A 20 20 20 20 20 20 20 20 20 20 20 20 20,57  ...
03B0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,57
03C0 20 41 2F 2F 2F 2F 24 2F 24 3F 3F 2F 2F 2F 20 2F,45   A////$/$??/// /
03D0 2F 2F 2F 2F 2F 2F 3F 2F 2F 3F 2F 2F 3F 56 4D 4D,C8  //////?//?//?VMM
03E0 41 20 2E 0D 0A 20 20 20 20 20 20 20 20 20 20 20,CE  A ...
03F0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,CE

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0400 20 20 20 2F 2F 2F 2F 24 2F 24 20 3F 3F 2F 2F 2F,BC     ////$/$ ??///
0410 20 2F 2F 2F 2F 2F 2F 3F 2F 2F 2F 2B 2F 3F 2F 2F,B9   //////?///+/?//
0420 56 4D 48 49 59 4D 2E 2E 0D 0A 20 20 20 20 20 20,96  VMHIYM....
0430 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,96
0440 20 20 20 20 20 20 20 41 2F 2F 2F 2F 24 2F 41 4D,54         A////$/AM
0450 4D 4D 4D 4D 4D 48 48 48 41 2F 2F 3F 2F 2F 2F 3F,57  MMMMMHHHA//?///?
0460 2F 2F 3F 2F 2F 2E 49 59 48 4D 4D 4D 4D 2E 0D 0A,E3  //?//.IYHMMMM...
0470 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,E3
0480 20 20 20 20 20 20 20 20 20 20 20 20 2E 48 2F 2F,37              .H//
0490 2F 2F 41 4D 4D 4D 48 48 48 4D 48 4D 4D 4D 48 48,A1  //AMMMHHHMHMMMHH
04A0 48 41 2F 2F 3F 2F 2F 3F 2F 2F 3F 24 56 48 48 48,53  HA//?//?//?$VHHH
04B0 59 59 49 2E 0D 0A 20 20 20 20 20 20 20 20 20 20,D3  YYI...
04C0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,D3
04D0 20 20 41 48 2F 2F 41 4D 4D 48 4D 48 48 4D 48 4D,DC    AH//AMMHMHHMHM
04E0 4D 4D 48 48 48 48 48 48 49 59 2F 2F 3F 2F 2F 3F,02  MMHHHHHHIY//?//?
04F0 24 2F 2F 4D 48 48 48 4D 48 49 2E 0D 0A 20 20 20,2C  $//MHHHMHI...

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0500 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,2C
0510 20 20 20 20 20 20 20 20 20 20 2F 2F 41 48 4D 48,E8            //AHMH
0520 4D 49 49 4D 48 48 49 4D 4D 4D 48 4D 59 48 4D 49,A0  MIIMHHIMMMHMYHMI
0530 49 4D 49 2F 2F 3F 24 2F 2F 2F 4D 4D 4D 48 48 49,BD  IMI//?$///MMMHHI
0540 49 49 0D 0A 20 20 20 20 20 20 20 20 20 20 20 20,B6  II..
0550 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,B6
0560 20 2F 41 48 48 49 48 4D 49 48 49 48 48 48 4D 4D,00   /AHHIHMIHIHHHMM
0570 4D 4D 4D 48 48 48 4D 48 4D 4D 41 2F 24 2F 2F 2F,0F  MMMHHHMHMMA/$///
```

```
0580 4D 4D 4D 4D 48 4D 48 49 49 2E 0D 0A 20 20 20 20,77  MMMMHMHII...
0590 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,77
05A0 20 20 20 20 20 20 20 20 2E 4D 4D 59 59 48 49 49,CB          .MMYYHII
05B0 48 49 49 49 49 48 4D 4D 4D 4D 4D 4D 4D 48 48 4D,77  HIIIIHMMMMMMMHHM
05C0 4D 4D 4D 4D 4D 2F 2F 48 4D 4D 4D 48 4D 48 48 49,F3  MMMMM//HMMMHMHHI
05D0 49 0D 0A 20 20 20 20 20 20 20 20 20 20 20 20 20,F3  I..
05E0 20 20 20 20 20 20 20 20 20 20 2E 41 48 48 48 48,C2            .AHHHH
05F0 49 4D 4D 4D 4D 3A 49 3A 3A 3A 3A 49 49 4D 4D 4D,23  IMMMM:I::::IIMMM

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0600 4D 4D 59 59 4D 4D 4D 4D 4D 4D 4D 4D 48 4D 2F 4D,E8  MMYYMMMMMMMMHM/M
0610 4D 48 48 48 4D 4D 48 0D 0A 20 20 20 20 20 20 20,E6  MHHHMMH..
0620 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,E6
0630 41 49 4A 4D 4D 48 2F 49 3A 4D 49 22 22 4D 4D 3A,FC  AIJMMH/I:MI""MM:
0640 2E 2E 3A 3A 3B 3B 41 59 4D 4D 4D 4D 3A 3A 3A 4D,0B  ..::;;AYMMMM:::M
0650 4D 4D 4D 2F 4D 4D 4D 59 48 49 48 48 49 2E 2E 0D,34  MMM/MMMYHIHHI...
0660 0A 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,1E  .
0670 20 20 20 20 20 20 41 4D 48 49 48 49 49 4D 4D 48,B9        AMHIHIIMMH
0680 49 49 20 49 22 4D 4D 4D 3A 20 2E 3A 3A 49 22 20,44  II I"MMM: .::I"
0690 4D 56 41 3A 3A 3A 2E 4D 4D 4D 4D 4D 4D 59 4D 4D,C5  MVA:::.MMMMMMYMM
06A0 48 49 49 49 49 49 2F 0D 0A 20 20 20 20 20 20 20,A0  HIIIII/..
06B0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 41 49,EA                AI
06C0 49 48 48 48 48 4D 4D 4D 4D 4D 49 49 20 22 56 2E,2C  IHHHHMMMMMII "V.
06D0 22 2E 20 3A 3A 3B 49 49 3B 3A 3A 3A 2E 2E 2E 4D,9D  ". ::;II;:::...M
06E0 4D 4D 4D 4D 4D 4D 4D 4D 48 48 49 49 49 49 49 0D,0F  MMMMMMMMHHIIIII.
06F0 0A 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,F9  .

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0700 20 20 20 20 20 20 56 49 48 48 49 48 48 4D 4D 4D,A8        VIHHIHHMMM
0710 4D 4D 49 27 20 27 2E 2E 27 20 20 3A 3A 3B 3B 3B,E1  MMI' '..'  ::;;;
0720 3A 3A 2E 2E 2E 3A 48 4D 4D 4D 4D 4D 4D 4D 4D 4D,16  ::...:HMMMMMMMMM
0730 48 48 48 49 49 49 2E 0D 0A 20 20 20 20 20 20 20,EE  HHHIII...
0740 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,EE
0750 20 48 48 48 48 4D 4D 4D 4D 4D 27 20 20 2E 2E 2E,A0   HHHHMMMMM'  ...
0760 20 20 20 3A 3A 3A 3B 3B 3A 3A 3A 3A 3A 3A 56 4D,23     :::;;::::::VM
0770 4D 4D 4D 4D 48 48 4D 4D 48 48 49 49 49 49 49 49,C7  MMMMHHMMHHIIIIII
0780 49 2E 0D 0A 20 20 20 20 20 20 20 20 20 20 20 20,D5  I...
0790 20 20 20 20 20 20 20 20 20 20 20 20 48 49 48 4D,7B              HIHM
07A0 4D 4D 4D 4D 4D 41 20 20 20 2E 2E 3A 20 27 3A 3A,EE  MMMMMA   ..: '::
07B0 3A 49 49 3A 3A 3A 3A 3A 3A 3A 3A 4D 4D 4D 4D 4D,0B  :II::::::::MMMMM
07C0 48 48 48 48 48 49 49 48 48 48 48 48 2E 0D 0A 20,D2  HHHHHIIHHHHH...
07D0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,D2
07E0 20 20 20 20 20 20 20 48 48 49 48 4D 4D 4D 4D 4D,54         HHIHMMMMM
07F0 4D 3A 20 20 2E 3A 3A 27 22 3A 49 59 49 3A 49 49,F7  M:  .::'":IYI:II

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
0800 3A 3A 3A 3A 3A 3A 4D 4D 4D 4D 4D 4D 4D 48 4D 4D,50  ::::::MMMMMMMHMM
0810 48 48 48 48 49 49 49 49 0D 0A 20 20 20 20 20 20,6B  HHHHIIII..
0820 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,6B
0830 20 20 48 48 48 48 48 4D 4D 4D 4D 4D 41 20 20 3A,4F    HHHHHMMMMMA  :
0840 49 2E 20 20 2E 3A 3A 3A 3A 3A 4A 49 3A 3A 3A 3A,D1  I.  .:::::JI::::
0850 49 4D 49 4D 48 4D 4D 4D 48 49 48 4D 4D 4D 49 49,7E  IMIMHMMMHIHMMMII
0860 49 49 49 0D 0A 20 20 20 20 20 20 20 20 20 20 20,D0  III..
0870 20 20 20 20 20 20 20 20 20 20 20 20 20 20 56 48,2E                VH
0880 48 49 4D 4D 4D 4D 4D 4D 41 20 3A 3A 59 48 22 22,47  HIMMMMMMA ::YH""
0890 22 22 27 4D 50 3A 3A 3A 2E 2E 3A 4D 4D 59 4D 4D,20  ""'MP:::..:MMYMM
08A0 4D 4D 4D 4D 48 48 4D 4D 48 49 49 49 49 0D 0A 20,21  MMMMHHMMHIIII..
08B0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,21
08C0 20 20 20 20 20 20 20 20 48 48 48 48 49 59 4D 4D,7D          HHHHIYMM
08D0 4D 4D 4D 41 20 2E 2E 56 49 50 48 48 49 22 2E 3A,73  MMMA ..VIPHHI".:
08E0 3A 3A 3A 3A 41 4D 4D 4D 4D 4D 4D 4D 4D 4D 48 49,E2  ::::AMMMMMMMMMHI
08F0 4D 4D 3A 3A 3A 2E 2E 0D 0A 20 20 20 20 20 20 20,7D  MM:::....
```

```
     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
Ø9ØØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 3A,A5                .:
Ø91Ø 48 4D 4D 4D 48 59 59 48 4D 4D 4D 56 4D 24 41 2E,33  HMMMHYYHMMMVM$A.
Ø92Ø 2Ø 2Ø 2Ø 22 22 3A 3A 3A 3A 3A 3A 3A 41 4D 4D 4D,95     "":::::::AMMM
Ø93Ø 59 59 4D 4D 4D 4D 4D 4D 4D 4D 4D 3A 3A 2E 2E 3A,Ø6  YYMMMMMMMMM::..:
Ø94Ø 2E ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,EB  ...
Ø95Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 48 56 2Ø 41 48 4D 4D,EC           HV AHMM
Ø96Ø 48 59 4D 4D 41 2F 56 4D 2F 24 3A 2Ø 2Ø 2Ø 2Ø 2E,75  HYMMA/VM/$:    .
Ø97Ø 2E 3A 3A 3A 3A 49 49 4D 4D 4D 4D 4D 4D 4D 4D 4D,D2  .::::IIMMMMMMMMM
Ø98Ø 4D 4D 4D 56 49 49 3A 3A 3A 2E 2Ø 3A 2E ØD ØA 2Ø,3C  MMMVII:::. :...
Ø99Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,3C
Ø9AØ 2Ø 2Ø 2Ø 2Ø 2Ø 48 48 48 48 49 48 4D 4D 59 59 4D,26       HHHHIHMMYYM
Ø9BØ 4D 2F 2F 2Ø 24 24 3A 3A 2E 2E 3A 3A 3A 3A 49 49,83  M// $$::..::::II
Ø9CØ 49 49 49 49 4D 4D 4D 4D 4D 4D 4D 4D 4D 4D 4D 49,3F  IIIIMMMMMMMMMMMI
Ø9DØ 49 49 49 3A 3A 3A 3A 2E 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø,21  III::::.:..
Ø9EØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,21
Ø9FØ 2Ø 2Ø 2Ø 2Ø 2Ø 48 48 48 4D 2F 2F 48 4D 24 24 2Ø,41       HHHM//HM$$

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
ØAØØ 2F 2Ø 4D 3A 3A 3A 2E 2E 2E 3A 3A 3A 3A 49 49 49,D8  / M:::...::::III
ØA1Ø 49 59 59 59 59 59 59 48 48 49 49 49 49 49 49 3A,B7  IYYYYYYHHIIIIII:
ØA2Ø 3A 3A 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,1Ø  :::::..
ØA3Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 3A,38                .:
ØA4Ø 3A 3A 59 4D 2F 2F 56 53 4D 58 24 24 24 2Ø 2F 49,Ø2  ::YM//VSMX$$$ /I
ØA5Ø 49 3A 3A 2E 2E 2E 3A 3A 3A 3A 49 49 49 49 49 3A,D8  I::...::::IIIII:
ØA6Ø 2E 49 49 49 49 49 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A,B7  .IIIII::::::::::
ØA7Ø ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,8E  ..
ØA8Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 3A 3A 3A 2E 3A 3A 3A 2F 59,8E        .:::.:::/Y
ØA9Ø 2F 41 58 2F 2F 2F 2F 2F 24 4D 4D 49 49 49 3A 3A,4E  /AX/////$MMIII::
ØAAØ 3A 49 49 49 49 49 49 49 49 49 49 2E 49 3A 3A 3A,87  :IIIIIIIIII.I:::
ØABØ 3A 3A 3A 3A 3A 3A 3A 3A 49 49 ØD ØA 2Ø 2Ø 2Ø 2Ø,8Ø  ::::::::II..
ØACØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 3A,A8                .:
ØADØ 2E 2E 2E 3A 3A 3A 3A 2F 56 59 58 2F 2F 2F 2F 2F,3B  ...::::/VYX/////
ØAEØ 2F 48 48 2F 48 49 49 3A 3A 3A 2E 3A 3A 3A 3A 3A,Ø1  /HH/HII:::.:::::
ØAFØ 3A 3A 3A 3A 3A 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 3A,89  :::::..:::::::::

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
ØBØØ 3A 49 49 49 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,ØF  :III:..
ØB1Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 2E 2E 2E 3A 3A 3A,A3          .....:::
ØB2Ø 3A 2F 2F 2F 2F 2F 2F 2F 2F 2F 2F 2F 49 49 2F 2F,D2  :///////////II//
ØB3Ø 49 49 49 49 49 49 3A 3A 2E 3A 3A 3A 3A 3A 3A 3A,CØ  IIIIII::.:::::::
ØB4Ø 3A 2E 3A 3A 3A 3A 3A 3A 49 3A 3A 3A 49 49 49 3A,9Ø  :.::::::I:::III:
ØB5Ø ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,67  ..
ØB6Ø 2Ø 2Ø 2E 2E 2E 2E 2E 3A 3A 3A 49 3A 2F 2F 2F 2F,7A    .....:::I:////
ØB7Ø 2F 2F 2F 2F 2F 2F 2F 58 2F 2F 2F 49 49 49 49 49,15  ///////X///IIIII
ØB8Ø 49 3A 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 2E 2E 3A 3A,94  I:..::::::::..::
ØB9Ø 3A 3A 49 48 3A 3A 3A 3A 49 49 3A ØD ØA 2Ø 2Ø 2Ø,C4  ::IH::::II:..
ØBAØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 2Ø,EØ               ..
ØBBØ 2Ø 3A 3A 3A 3A 49 49 2F 2F 2F 2F 2F 2F 2F 2F 2F,21   ::::II/////////
ØBCØ 2F 58 2F 2F 2F 2F 3A 3A 3A 49 49 49 3A 2E 2E 3A,BD  /X////:::III:..:
ØBDØ 3A 3A 3A 3A 3A 3A 3A 2E 2E 3A 3A 3A 3A 49 4D 3A,67  :::::::..::::IM:
ØBEØ 3A 3A 3A 49 49 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,F8  :::II:..
ØBFØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 2Ø 2E 3A 3A 3A 49,99          .. .:::I

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
ØCØØ 49 49 49 49 49 3A 2F 2F 2F 2F 2F 2F 58 2F 2F 2F,3F  IIIII://////X///
ØC1Ø 2F 3A 3A 3A 3A 49 49 3A 2E 3A 3A 3A 3A 3A 3A 3A,E6  /::::II:.:::::::
ØC2Ø 3A 3A 2E 2E 3A 3A 3A 3A 49 4D 3A 3A 3A 3A 49 49,AE  ::..::::IM::::II
ØC3Ø 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,9F  :..
ØC4Ø 2Ø 2Ø 2Ø 2E 2E 2Ø 2E 2E 2E 3A 3A 3A 49 49 48 49,D6     .. ...:::IIHI
ØC5Ø 49 49 3A 3A 3A 22 2F 2F 2F 2F 2F 49 3A 3A 3A 3A,54  II:::"/////I::::
ØC6Ø 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 2E 3A,E8  ::::::::::::::.:
ØC7Ø 3A 3A 3A 49 4D 3A 3A 3A 3A 3A 49 3A ØD ØA 2Ø 2Ø,28  :::IM:::::I:..
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ØC8Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E,44                ..
ØC9Ø 2E 2E 3A 3A 3A 3A 3A 49 49 49 49 49 3A 3A 3A 3A,17  ..:::::IIIII::::
ØCAØ 2E 2E 3A 3A 3A 2F 2F 3A 3A 3A 3A 3A 3A 3A 3A 3A,89  ..::://:::::::::
ØCBØ 3A 3A 3A 3A 3A 3A 3A 3A 3A 2E 2E 3A 3A 3A 49 49,2F  :::::::::..:::II
ØCCØ 3A 3A 3A 3A 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,BC  :::::::..
ØCDØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 2E 2E 2E 3A 3A,36           .....::
ØCEØ 3A 3A 49 49 49 49 3A 3A 3A 3A 3A 2E 2E 3A 3A 3A,FA  ::IIII:::::..:::
ØCFØ 3A 3A 3A 3A 3A 3A 2E 2E 3A 3A 3A 3A 3A 2E 3A 3A,76  ::::::..:::::.::

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
ØDØØ 3A 3A 3A 3A 3A 2E 2E 3A 3A 49 49 3A 3A 3A 3A 3A,1C  :::::..::II:::::
ØD1Ø 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,27  ::..
ØD2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 2E 2E 3A 3A 3A 3A 49 49 49 49,6B      ....::::IIII
ØD3Ø 4D 22 3A 3A 3A 3A 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A,EE  M"::::..::::::::
ØD4Ø 2E 2E 2E 2E 3A 3A 3A 2E 2E 2E 2E 3A 3A 3A 3A 3A,2E  ....:::....:::::
ØD5Ø 2E 2E 3A 3A 49 49 3A 2E 2E 3A 3A 3A 3A ØD ØA 2Ø,45  ..::II:..::::..
ØD6Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 3A,5F                 :
ØD7Ø 2E 2E 2E 3A 3A 3A 3A 3A 49 49 49 4D 3A 3A 3A 3A,1B  ...:::::IIIM::::
ØD8Ø 22 2E 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 2E 2E 2E,73  ".:::::::::::...
ØD9Ø 2E 2E 2E 2E 2E 3A 3A 3A 3A 3A 3A 2E 2E 3A 3A 48,CD  .....::::::..::H
ØDAØ 49 3A 2E 2E 3A 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,6B  I:..::::..
ØDBØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 3A 3A 2E 2E 3A 3A,EF            ::..::
ØDCØ 3A 3A 3A 3A 3A 49 4D 3A 3A 3A 22 2E 2E 3A 3A 3A,81  :::::IM:::"..:::
ØDDØ 3A 3A 3A 3A 3A 3A 3A 3A 3A 2E 2E 2E 2E 2E 2E 2E,CD  :::::::::.......
ØDEØ 3A 3A 3A 3A 3A 3A 2E 2Ø 2E 3A 48 4D 49 3A 2E 2E,53  ::::::. .:HMI:..
ØDFØ 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,78  :::..

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
ØEØØ 2Ø 2Ø 2Ø 2Ø 2Ø 3A 3A 2E 3A 3A 3A 3A 3A 3A 3A 3A,8A       ::.::::::::
ØE1Ø 49 4D 49 3A 3A 2Ø 2Ø 2E 2E 3A 3A 3A 3A 3A 3A 3A,ØF  IMI::  ..:::::::
ØE2Ø 3A 3A 3A 3A 3A 3A 2E 2E 2E 3A 3A 3A 3A 3A 3A 3A,8B  ::::::...:::::::
ØE3Ø 2E 2E 2Ø 2E 2E 56 4D 49 3A 2E 2E 3A 3A 3A ØD ØA,AA  .. ..VMI:..:::..
ØE4Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,AA
ØE5Ø 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 49 49 3A 2Ø,4E  ::::::::::::II:
ØE6Ø 2Ø 2Ø 2Ø 2E 3A 3A 3A 3A 3A 3A 3A 3A 3A 49 49 3A,B2     .:::::::::II:
ØE7Ø 3A 2E 2E 2E 3A 3A 3A 3A 3A 3A 2E 2E 2Ø 2Ø 2E 2E,CA  :...::::::..  ..
ØE8Ø 2E 4D 49 3A 2E 2E 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø,89  .MI:..:::..
ØE9Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 3A 3A 3A 3A 3A,ØB             :::::
ØEAØ 3A 3A 3A 3A 3A 3A 49 48 2E 2E 2Ø 2Ø 2Ø 2Ø 27 3A,35  ::::::IH..    ':
ØEBØ 3A 3A 3A 3A 3A 3A 3A 49 49 49 49 3A 3A 2E 2E 2E,ED  :::::::IIII::...
ØECØ 3A 3A 3A 3A 27 2Ø 2Ø 2Ø 2E 2Ø 2E 2E 4D 49 3A 2E,Ø4  ::::'   . ..MI:.
ØEDØ 2E 2E 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,2B  ..::..
ØEEØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 3A 2E 2E 2E 3A 3A 3A 3A 3A 3A,ØB        :...::::::
ØEFØ 3A 3A 4D 3A 27 2Ø 2Ø 2Ø 2Ø 2Ø 27 3A 3A 3A 3A 3A,16  ::M:'     ':::::

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
ØFØØ 3A 49 49 49 49 49 3A 3A 2E 2E 3A 3A 3A 3A 3A 27,D6  :IIIII::..:::::'
ØF1Ø 2Ø 2Ø 2E 2Ø 2E 2Ø 2E 56 49 3A 3A 2E 2E 3A 3A ØD,DØ    . . .VI::..::.
ØF2Ø ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E,C8  .              .
ØF3Ø 49 2E 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 49 3A 2Ø 2Ø,2E  I...::::::::I:
ØF4Ø 2Ø 2Ø 2Ø 2Ø 2E 2Ø 3A 3A 3A 3A 49 49 49 49 49 49,9A      . ::::IIIIII
ØF5Ø 49 3A 3A 3A 3A 3A 49 3A 27 2E 2Ø 2Ø 2E 2Ø 2E 2E,C7  I:::::I:'.  . ..
ØF6Ø 3A 56 2Ø 49 3A 2E 2E 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø,9B  :V I:..:::..
ØF7Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 3A 3A 3A 3A 49 2E 2E 3A,7Ø         .::::I..:
ØF8Ø 3A 3A 3A 3A 3A 3A 3A 49 3A 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,69  :::::::I:
ØF9Ø 2Ø 2E 3A 3A 49 49 49 49 48 48 48 48 48 49 49 3A,83   .::IIIIHHHHHII:
ØFAØ 3A 3A 2Ø 2Ø 2Ø 2Ø 41 4D 49 2Ø 2E 56 2Ø 2Ø 49 3A,B5  ::    AMI .V  I:
ØFBØ 2E 2E 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,F6  ..:::..
ØFCØ 2E 3A 3A 3A 2E 2E 3A 49 3A 2E 2E 3A 3A 3A 3A 3A,69  .:::..:I:..:::::
ØFDØ 3A 3A 49 49 2Ø 41 49 2E 2Ø 2Ø 2Ø 2E 2Ø 2E 3A 3A,97  ::II AI.   . .::
ØFEØ 49 48 48 48 49 3A 49 49 3A 3A 27 2Ø 2Ø 2Ø 2Ø 2Ø,Ø8  IHHHI:II::'
ØFFØ 2Ø 22 57 56 2E 56 27 2Ø 2Ø 49 3A 3A 3A 3A 3A 3A,87   "WV.V'  I::::::
     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
1ØØØ ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 3A 3A 2E 2E 2E 2E 2E,E6  ..      .::.....
1Ø1Ø 2E 2E 49 3A 3A 3A 3A 3A 3A 3A 3A 3A 49 48 4D 2E,A1  ..I:::::::::IHM.
1Ø2Ø 56 4D 41 2E 2E 2E 3A 41 48 49 49 48 48 48 49 49,CE  VMA...:AHIIHHHII
1Ø3Ø 3A 3A 2E 2Ø 2E 2E 2Ø 2Ø 2E 2E 3A 3A 2E 2E 3A 56,E8  ::. ..  ..::..:V
1Ø4Ø 2Ø 2Ø 2Ø 2Ø 3A 3A 3A 3A 2E 2E 3A ØD ØA 2Ø 2Ø 2Ø,5D      ::::..:..
1Ø5Ø 2Ø 2Ø 2E 3A 3A 3A 2E 2E 2E 2E 2E 2E 2E 2E 49 3A,6C    .:::........I:
1Ø6Ø 3A 3A 3A 3A 3A 3A 3A 49 49 49 4D 4D 4D 4D 4D 4D,AB  :::::::IIIMMMMMM
1Ø7Ø 48 48 48 48 48 2E 2E 2E 2E 3A 3A 49 49 49 3A 3A,ØE  HHHHH....::III::
1Ø8Ø 3A 3A 3A 3A 3A 49 49 49 49 56 2Ø 2Ø 2Ø 2Ø 2Ø 3A,Ø4  :::::IIIIV     :
1Ø9Ø 3A 3A 2E 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø 2Ø 2E 3A 3A 3A,C7  ::.:::..    .:::
1ØAØ 3A 3A 3A 3A 3A 3A 3A 2E 2E 49 3A 3A 3A 3A 3A 3A,5E  :::::::..I::::::
1ØBØ 3A 3A 3A 49 49 49 4D 4D 4D 4D 4D 48 48 48 48 48,DØ  :::IIIMMMMMHHHHH
1ØCØ 48 48 48 48 49 49 49 49 48 48 48 4D 4D 4D 48 4D,68  HHHHIIIIHHHMMMHM
1ØDØ 4D 48 48 56 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 3A 3A 3A 3A 2E 3A,AB  MHHV      ::::.:
1ØEØ 3A ØD ØA 2Ø 2Ø 2Ø 2E 2Ø 3A 3A 3A 3A 3A 3A 3A 3A,7A  :..   . ::::::::
1ØFØ 3A 3A 3A 3A 3A 49 3A 3A 3A 3A 3A 3A 3A 3A 3A 49,3B  :::::I:::::::::I

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
11ØØ 49 41 4D 4D 4D 4D 48 48 48 48 48 48 48 48 49 49,C8  IAMMMMHHHHHHHHII
111Ø 49 49 49 49 49 48 48 48 48 48 48 48 48 56 2Ø 2Ø,ØB  IIIIIHHHHHHHHV
112Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 3A 2E 2E 2E 3A ØD ØA 2Ø 2Ø,5C       ..:...:..
113Ø 2E 3A 2Ø 2E 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A,B2  .: ...::::::::::
114Ø 49 3A 3A 3A 3A 3A 3A 3A 3A 3A 49 49 3A 3A 56 4D,AE  I:::::::::II::VM
115Ø 4D 4D 4D 48 48 48 48 48 48 48 49 49 49 49 49 48,42  MMMHHHHHHHIIIIIH
116Ø 48 48 48 48 48 48 48 48 22 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,84  HHHHHHHH"
117Ø 2Ø 3A 3A 2E 2E 2E 3A ØD ØA 2Ø 2Ø 3A 3A 2E 2Ø 2E,23   ::...:..  ::. .
118Ø 3A 3A 3B 3B 3B 3B 3B 3A 3A 3A 3A 49 3A 3A 2E 3A,CB  ::;;;;;::::I::.:
119Ø 3A 3A 3A 3A 49 49 49 3A 3A 49 56 4D 4D 4D 4D 4D,22  ::::III::IVMMMMM
11AØ 4D 4D 48 48 48 48 49 49 49 49 49 49 49 48 48 48,B3  MMHHHHIIIIIIIHHH
11BØ 48 56 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 3A,47  HV           ..:
11CØ 2E 2E ØD ØA 2Ø 2E 3A 3A 3A 2E 2Ø 27 3A 3A 3A 3B,14  .... .:::. ':::;
11DØ 3B 3B 3A 3A 3A 3A 49 3A 3A 2E 2E 3A 3A 3A 3A 3A,AD  ;;::::I::..:::::
11EØ 49 49 3A 3A 3A 3A 3A 3A 3A 56 4D 4D 4D 4D 48 48,EF  II:::::::VMMMMHH
11FØ 48 48 48 48 49 49 49 48 4D 4D 4D 22 2Ø 2Ø 2Ø 2Ø,DB  HHHHIIIHMMM"

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
12ØØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E 2E 2Ø 2E ØD ØA 2Ø,BC           .. ...
121Ø 3A 3A 3A 3A 3A 2E 2Ø 2Ø 2Ø 2Ø 27 3A 3A 3B 3B 3A,D7  :::::.    '::;;:
122Ø 3A 3A 49 2E 2E 2E 3A 3A 3A 3A 49 49 49 49 49 49,BC  ::I...::::IIIIII
123Ø 49 49 3A 3A 3A 3A 56 48 4D 4D 4D 4D 48 48 48 48,28  II::::VHMMMMHHHH
124Ø 49 48 4D 4D 22 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,D5  IHMM"
125Ø 2Ø 2Ø 2Ø 2Ø 27 2E 2E ØD ØA 2Ø 3A 3A 3A 3A 3A 3A,6B      '.... ::::::
126Ø 2E 2Ø 2Ø 2Ø 2Ø 2Ø 27 3A 3B 3B 3B 3A 3A 49 3A 2E,7Ø  .     ':;;;::I:.
127Ø 2E 3A 3A 3A 3A 49 49 49 49 4D 3A 3A 3A 3A 3A 3A,53  .::::IIIIM::::::
128Ø 3A 49 49 4D 4D 4D 4D 4D 4D 4D 4D 4D 4D 22 2Ø 2Ø,83  :IIMMMMMMMMMM"
129Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2E,91                 .
12AØ 2E 2E ØD ØA 2Ø 3A 3A 3A 3A 2E 2E 3A 3A 3A 2E 2Ø,64  .... ::::..:::.
12BØ 2Ø 2Ø 2Ø 2Ø 3A 3A 3A 3A 49 2E 2Ø 3A 3A 3A 3A 3A,85      ::::I. :::::
12CØ 49 49 49 27 3A 3A 3A 3A 3A 49 49 48 48 4D 4D 4D,B2  III':::::IIHHMMM
12DØ 4D 4D 4D 4D 4D 4D 22 2E 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,DØ  MMMMMM".
12EØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 27 3A 2E ØD ØA 2Ø,D6            ':...
12FØ 3A 3A 3A 2E 2E 2E 3A 3A 3A 3A 49 3A 3A 2Ø 2Ø 2Ø,13  :::...::::I::

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
13ØØ 22 3A 3A 49 3A 2Ø 2E 3A 3A 3A 3A 49 49 49 2E 3A,A5  "::I: .::::III.:
131Ø 3A 3A 3A 3A 49 48 48 4D 4D 4D 4D 4D 4D 4D 4D 4D,1B  ::::IHHMMMMMMMMM
132Ø 56 3A 2E 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,79  V:.
133Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 3A 3A ØD ØA 2Ø 3A 3A 3A 2E 2E,EE        ::.. :::..
134Ø 2E 2E 3A 3A 3A 49 49 49 3A 2Ø 2Ø 2Ø 22 3A 49 3A,4C  ..:::III:   ":I:
135Ø 2E 2Ø 3A 3A 3A 3A 49 49 49 3A 3A 3A 3A 49 49 49,2Ø  . ::::III::::III
136Ø 48 48 48 4D 4D 4D 4D 4D 4D 4D 56 3A 3A 3A 2Ø 2Ø,57  HHHMMMMMMMV:::
137Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,57
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138Ø 2Ø 3A 3A ØD ØA 2Ø 3A 3A 3A 3A 2E 2E 2E 3A 3A 3A,42   ::.. ::::...:::
139Ø 3B 49 49 49 48 2Ø 2Ø 2Ø 2Ø 3A 49 3A 2Ø 27 3A 3A,98  ;IIIH    :I: '::
13AØ 3A 49 49 49 49 3A 49 49 48 48 48 4D 4D 4D 4D 4D,1B  :IIII:IIHHHMMMMM
13BØ 4D 48 48 48 49 49 3A 3A 3A 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,6Ø  MHHHII:::
13CØ 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 27 3A ØD ØA,58              ':..
13DØ 2Ø 3A 3A 3A 3A 2E 2E 2E 3A 3A 3A 3A 3B 3B 49 49,DA   ::::...::::;;II
13EØ 4D 2E 3A 2E 2Ø 49 3A 3A 2E 2E 3A 3A 3A 3A 49 49,7Ø  M.:. I::..::::II
13FØ 48 48 48 48 4D 4D 4D 4D 4D 4D 4D 48 48 48 49 49,15  HHHHMMMMMMMHHHII

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
14ØØ 3A 3A 3A 3A 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,7D  ::::
141Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 27 ØD ØA 2Ø 3A 3A 3A 3A,C3          '.. ::::
142Ø 2E 2E 2E 3A 3A 3A 3A 3A 3B 3B 49 4D 4D 57 48 4D,B4  ...:::::;;IMMWHM
143Ø 49 3A 3A 2E 2E 3A 3A 3A 3A 49 49 49 48 48 48 4D,B5  I::..::::IIIHHHM
144Ø 4D 4D 4D 4D 48 48 48 48 49 49 3A 3A 3A 3A 3A 2Ø,DD  MMMMHHHHII:::::
145Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø,DD
146Ø 2Ø 2Ø 2Ø 2E ØD ØA 2Ø 3A 3A 3A 3A 3A 2E 2E 2E 3A,88     ... :::::...:
147Ø 3A 3A 3A 3B 49 49 48 4D 4D 4D 4D 4D 3A 3A 2E 2E,9C  :::;IIHMMMMM::..
148Ø 2E 3A 3A 3A 3A 49 49 48 48 48 48 48 48 48 48 48,CC  .::::IIHHHHHHHHH
149Ø 48 48 48 49 49 3A 3A 3A 3A 27 ØD ØA 2Ø 3A 3A 3A,2A  HHHII::::'.. :::
14AØ 3A 3A 2E 2E 3B 3A 3A 3A 3A 3B 3B 49 49 48 4D 4D,Ø7  ::..;::::;;IIHMM
14BØ 4D 4D 4D 3A 3A 2E 2E 2E 3A 3A 3A 3A 3A 59 48 48,F7  MMM::...:::::YHH
14CØ 48 48 48 4D 4D 4D 48 48 49 49 49 3A 3A 3A 2E ØD,ØA  HHHMMMHHIII:::..
14DØ ØA 2Ø 3A 3A 3A 3A 3A 2E 2E 2E 3A 3A 3A 3A 3B 3B,3E  . :::::...::::;;
14EØ 49 49 48 4D 4D 4D 4D 4D 49 3A 2E 2E 2E 3A 3A 3A,54  IIHMMMMMI:...:::
14FØ 3A 49 2Ø 3A 22 22 22 22 3A 3A 3A 49 49 49 49 3A,C5  :I :"""":::IIII:

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
15ØØ 3A 3A 3A ØD ØA 2Ø 3A 3A 3A 3A 3A 3A 2E 2E 3A 3A,D6  :::.. ::::::..::
151Ø 3A 3A 3B 3B 3B 49 49 48 4D 4D 4D 4D 4D 3A 3A 2E,F8  ::;;;IIHMMMMM::.
152Ø 2E 3A 3A 3A 3A 3A 49 3A 3A 3A 3A 2E 2E 2E 2Ø 2Ø,43  .:::::I::::...
153Ø 2Ø 2E 2Ø 2E 3A 3A 27 ØD ØA 2Ø 27 3A 3A 3A 3A 3A,FA   . .::'.. ':::::
154Ø 2E 2E 3A 3A 3A 3A 3B 3B 3B 49 49 49 48 4D 4D 4D,F9  ..::::;;;IIIHMMM
155Ø 56 49 3A 2E 2E 3A 2E 3A 3A 3A 49 3A 3A 3A 3A 3A,AF  VI:..:.:::I:::::
156Ø 3A 3B 3B 3B 3B 3A 3A 3A 3A ØD ØA 2Ø 2Ø 27 3A 3A,AF  :;;;;::::..  '::
157Ø 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B 49 49 49 49 4D,A1  ::::::::;;;IIIIM
158Ø 4D 49 3A 3A 49 3A 3A 2E 2E 3A 3A 3A 3A 49 3A 3A,69  MI::I::..::::I::
159Ø 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A ØD ØA 2Ø 2Ø 2Ø,5E  :::::::::::..
15AØ 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B 3B 3B 49,12  ::::::::::;;;;;I
15BØ 49 4D 48 3B 3A 3A 3A 49 3A 3A 2E 2E 3A 3A 3A 49,E9  IMH;:::I::..:::I
15CØ 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A 3A ØD ØA 2Ø 2Ø,F8  ::::::::::::..
15DØ 2Ø 27 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B 3B 3B,7Ø   ':::::::::;;;;;
15EØ 3B 49 4D 3B 3A 3A 3A 3A 49 3A 2E 3A 2E 2E 3A 3A,1F  ;IM;::::I:.:..::
15FØ 31 49 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 27 ØD ØA 2Ø,23  1I..::::::::'..

     ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 ØA ØB ØC ØD ØE ØF
16ØØ 2Ø 2Ø 2Ø 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B 3B,79     :::::::::;;;;
161Ø 3B 3B 49 4D 3A 3A 3A 3A 3A 3A 49 3A 3A 2E 2E 2E,28  ;;IM::::::I::...
162Ø 3A 3A 49 3A 3A 3A 3A 3A 3A 3A 3A 3B 27 ØD ØA 2Ø,4E  ::I::::::::;'..
163Ø 2Ø 2Ø 2Ø 27 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B,9Ø     ':::::::::;;;
164Ø 3B 49 4D 49 3A 3A 3A 3A 3A 3A 3A 49 2E 3A 2E 2E,4D  ;IMI:::::::I.:..
165Ø 3A 3A 2E 49 2E 3A 3A 3A 3A 3A 3B 3B ØD ØA 2Ø 2Ø,55  ::.I.:::::;;..
166Ø 2Ø 2Ø 2Ø 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B 3B 3B,AC     ::::::::;;;;;
167Ø 49 4D 3B 3A 3A 2E 3A 3A 3A 3A 3A 49 49 3A 2E 3A,75  IM;::.:::::II:.:
168Ø 3A 2E 2E 3A 3A 3A 3A 3A 3A 3B 27 ØD ØA 2Ø 2Ø 2Ø,4Ø  :..::::::;'..
169Ø 2Ø 2Ø 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B 49 49,CD    :::::::::;;;II
16AØ 4D 3A 3A 2E 2E 3A 3A 3A 3A 3A 49 49 3A 2E 2E 3A,6E  M::..:::::II:..:
16BØ 3A 2E 49 3A 3A 3A 3B 3B ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 27,21  :.I:::;;..     '
16CØ 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 49 49 4D 3A 3A,F4  :::::::::;;IIM::
16DØ 2E 2E 2E 3A 3A 3A 3A 3A 49 49 3A 2E 2E 3A 2E 3A,6A  ...:::::II:..:.:
16EØ 3B 3B 3B 3B 27 ØD ØA 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 3A 3A 3A,Ø2  ;;;;'..      :::
16FØ 3A 3A 3A 3A 3A 3A 3B 3B 49 48 3A 3A 2E 2E 2E 3A,9D  ::::::;;IH::...:
     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
1700 3A 3A 3A 3A 3A 49 49 49 3A 2E 2E 3A 2E 49 3B 3B,57  :::::III:..:.I;;
1710 56 0D 0A 20 20 20 20 20 20 27 3A 3A 3A 3A 3A 3A,07  V..      '::::::
1720 3A 3A 3B 3B 49 48 3A 3A 2E 2E 2E 3A 3A 3A 3A 3A,A2  ::;;IH::...:::::
1730 3A 3B 49 49 49 2E 3A 3A 3A 2E 49 56 0D 0A 20 20,F2  :;III.:::.IV..
1740 20 20 20 20 20 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 49,20       :::::::::;I
1750 56 3A 3A 2E 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 49 49,D6  V::...::::::::II
1760 49 2E 3A 3A 3A 49 2E 0D 0A 20 20 20 20 20 20 20,69  I.:::I...
1770 27 3A 3A 3A 3A 3A 3A 3A 3B 3B 48 3A 3A 2E 2E 2E,E2  ':::::::;;H::...
1780 3A 3A 3A 3A 3A 3A 3A 3B 3B 4A 49 3A 2E 2E 27 3A,78  :::::::;;JI:..':
1790 3A 41 0D 0A 20 20 20 20 20 20 20 20 3B 3A 3A 3A,F3  :A..        ;:::
17A0 3A 3A 3A 3B 3B 49 3A 3A 2E 2E 2E 2E 3A 3A 3A 3A,74  :::;;I::....::::
17B0 3A 3A 3A 3B 3B 49 49 2E 2E 2E 3A 3A 2E 49 20 20,DF  :::;;II...::.I
17C0 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,DF
17D0 20 20 20 20 20 20 20 20 20 20 20 20 2F 0D 0A 20,C5              /..
17E0 20 20 20 20 20 20 20 3A 3A 3A 3A 3A 3A 3A 3B 48,BE         :::::::;H
17F0 3A 3A 2E 2E 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B,30  ::....::::::::;;

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
1800 49 3A 2E 2E 3A 27 3A 3A 3A 2E 20 20 20 20 20 20,0C  I:..:':::.
1810 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,0C
1820 20 20 20 20 20 20 20 3A 0D 0A 20 20 20 20 20 20,FD         :..
1830 20 20 20 3A 3A 3A 3A 3A 3B 3B 49 3A 3A 2E 2E 2E,3C     :::::;;I::...
1840 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 49 49 3A 2E 2E 27,D0  :::::::::;II:..'
1850 3A 3A 3A 3A 49 20 20 20 20 2E 3A 3A 3A 2E 2E 2E,E7  ::::I    .:::...
1860 2E 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20,F5  .
1870 20 2E 3A 0D 0A 20 20 20 20 20 20 20 20 20 3A 3A,28   .:..         ::
1880 3A 3A 3A 3A 49 3A 3A 2E 2E 2E 2E 3A 3A 3A 3A 3A,A7  ::::I::....:::::
1890 3A 3A 3A 3A 3B 49 3A 2E 2E 2E 2E 3A 3A 49 3A 49,45  ::::;I:....::I:I
18A0 2E 3A 49 3A 3A 3A 49 2E 3A 3A 3A 3A 3A 3A 3A 3A,EB  .:I:::I.::::::::
18B0 3A 3A 2E 20 20 2E 2E 20 20 20 2E 3A 49 49 0D 0A,9A  ::.  ..   .:II..
18C0 20 20 20 20 20 20 20 20 20 27 3A 3A 3A 3A 3A 49,4C           ':::::I
18D0 3A 3A 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 3B 49,E6  ::..::::::::;;;I
18E0 3A 27 2E 3A 3A 49 49 48 49 3A 49 2E 3A 49 49 49,D2  :'.::IIHI:I.:III
18F0 49 49 49 49 49 49 49 49 49 49 49 49 22 22 2F 4D,FE  IIIIIIIIIIII""/M

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
1900 4D 4D 2D 2E 3A 4A 49 48 4D 0D 0A 20 20 20 20 20,0C  MM-.:JIHM..
1910 20 20 20 20 27 3A 3A 3A 3A 49 3A 3A 2E 2E 2E 3A,1C      '::::I::...:
1920 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 49 22 3A 3A 3A 49,C4  ::::::::;;I":::I
1930 49 56 56 49 3A 49 2E 48 48 49 3A 3A 3A 3A 3A 3A,E8  IVVI:I.HHI::::::
1940 49 49 2F 4D 4D 4D 4D 4D 4D 4D 4D 4D 4D 2E 2E 50,57  II/MMMMMMMMMM..P
1950 50 50 50 3A 0D 0A 20 20 20 20 20 20 20 20 20 20,D8  PPP:..
1960 3A 3A 3A 3A 49 3A 3A 2E 2E 2E 3A 3A 3A 3A 3A 3A,63  ::::I::...::::::
1970 3A 3A 3B 3B 3B 49 59 3A 3A 49 56 4D 4D 41 3A 3A,8C  ::;;;IY::IVMMA::
1980 3A 49 48 3A 3A 49 41 3A 3A 3A 41 48 48 4D 4D 4D,BB  :IH::IA:::AHHMMM
1990 56 58 58 58 58 58 56 58 58 49 49 3A 3A 3A 3A 0D,56  VXXXXXVXXII::::.
19A0 0A 20 20 20 20 20 20 20 20 20 20 3A 3A 3A 3A 49,D1  .          ::::I
19B0 3A 27 2E 2E 2E 3A 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B,3C  :'...:::::::::;;
19C0 49 3A 3A 56 4D 48 48 49 49 49 3A 22 49 48 3A 3F,6D  I::VMHHIII:"IH:?
19D0 48 48 41 3A 48 2F 2F 2E 20 58 58 58 58 58 58 58,D4  HHA:H//. XXXXXXX
19E0 2F 22 22 3A 49 3A 3A 3A 49 49 0D 0A 20 20 20 20,A1  /"":I:::II..
19F0 20 20 20 20 20 20 3A 3A 3A 49 3A 3A 2E 2E 2E 3A,90        :::I::...:

     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
1A00 3A 3A 3A 3A 3A 3A 3A 3A 3B 3B 22 2E 3A 2F 41 49,19  ::::::::;;".:/AI
1A10 3A 3A 48 48 48 41 2E 3A 48 3F 48 48 48 48 48 2F,2C  ::HHHA.:H?HHHHH/
1A20 24 58 58 22 24 24 58 58 2E 58 2F 2F 2E 41 49 3A,F0  $XX"$$XX.X//.AI:
1A30 3A 3A 3A 3A 3A 0D 0A 20 20 20 20 20 20 20 20 20,49  :::::..
1A40 20 3A 3A 3A 49 3A 3A 2E 2E 2E 3A 3A 3A 3A 3A 3A,BA   :::I::...::::::
1A50 3A 3A 3A 3B 49 3A 2F 41 49 49 3A 48 22 2E 22 2E,4A  :::;I:/AII:H".".
1A60 22 2E 22 3F 48 48 48 48 48 2F 2F 2F 2F 2F 24 27,99  "."?HHHHH/////$'
1A70 2F 2F 2F 2F 22 2F 2F 2F 41 3A 3A 3A 3A 3A 3A 3A,DB  ////"///A:::::::
REPLACE THE LAST THREE BYTES WITH $0D (CR), $0A (LF), $04 (EOT)
```

"SUSAN"

To see more of "SUSAN" (right), enter the ASCII Text File (above) and print it with the Text Printer Program (below).

This is an example of very simple Typewriter Graphics. Much finer graphics are possible on printers which respond to BS (backspace, CTRL H), so that multiple overstrikes are posible.

(Most graphics programs available on time share systems are intended for the standard Model 33 TTY)

```
               AIHPP/?/ /$$/PVYMJHIIA.
             .AP//$ ? //$$/ ////VMMHIA.
            A///$/$??///$ //////?//VMHIA
           A///$/$/?//// / ////?///?/VHHA .
          A////$/$??/// ////////?//?//?VMMA .
          ////$/$ ??/// //////?///+/?//VMHIYM..
         A////$/AMMMMMMHHHA//?///?//?//.IYHMMMM.
        .H////AMMMHHHMHMMMHHHA//?//?//?$VHHHYYI.
        AH//AMMHMHHMHMMMHHHHHHIY//?//?$//MHHHMHI.
         //AHMHMIIMHHIMMMHMYHMIIMI//?$///MMMHHIII
         /AHHIHMIHIHHHMMMMMHHHMHMMA/$///MMMMHMHII.
        .MMYYHIIHIIIIHMMMMMMMHHHMMMMM//HMMMHMHHII
   .AHHHHIMMMM:I::::IIMMMMMYYMMMMMMMMHM/MMHHHMMH
   AIJMMH/I:MI""MM:..::;;AYMMMM:::MMMM/MMMYHIHHI..
 AMHIHIIMMHII I"MMM: .::I" MVA:::.MMMMMMYMMHIIIII/
 AIIHHHHMMMMMII "V.". ::;II;:::...MMMMMMMMMMHHIIIII
 VIHHIHHMMMMMI' '..'  ::;;;::...:HMMMMMMMMMMHHHIII.
    HHHHMMMMM'  ...   ::::;;:::::::VMMMMMHHMMMHHIIIIIII.
    HIHMMMMMMA   ..: ':::II::::::::MMMMMHHHHHIIHHHHH.
    HHIHMMMMMM:  .::'"::IYI:II:::::::MMMMMMMHMMHHHHIIII
    HHHHHMMMMMA  :I.  .:::::JI:::::IMIMHMMMHIHMMMIIIII
     VHHIMMMMMMA ::YH""""'MP:::..:MMYMMMMMMMHHMMHIIII
     HHHHIYMMMMMA ..VIPHHI".:::::AMMMMMMMMMHIMM:::..
 .:HMMMHYYHMMMVM$A.   "":::::::AMMMYYMMMMMMMMMM::..:.
  HV AHMMHYMMA/VM/$:     ..:::IIMMMMMMMMMMMMMVII:::. :.
  HHHHIHMMYYMM// $$::..::::IIIIIIMMMMMMMMMMMIIII:::::.:
      HHHM//HM$$ / M:::...::::IIIIYYYYYYHHIIIIII::::::
   .:::YM//VSMX$$$ /II:::...::::IIIII:.IIIII:::::::::::
.:::.:::/Y/AX/////$MMIII:::IIIIIIIIIII.I:::::::::::::II
```

```
                  0010 ;TEXT PRINTER PROGRAM
                  0020 ;ADAPTED BY LUX FROM
                  0030 ;LAVIN'S MODEM PROGRAM
                  0040
                  0050                 .BA $0100
                  0060                 .MC $9000
                  0070                 .OS
                  0080
                  0090 EOT             .DE $04
                  0100
                  0110 POINTER         .DE $00FE
                  0120 TEXTSTART       .DE $0200      ;OR WHEREVER
                  0130
                  0140 INCCMP          .DE $82B2
                  0150 INSTAT          .DE $8386
                  0160 OUTCHR          .DE $8A47
                  0170
0100- A9 02       0180 INIT            LDA #H,TEXTSTART
0102- A0 00       0190                 LDY #L,TEXTSTART
0104- 85 FF       0200                 STA *POINTER+1
0106- 84 FE       0210                 STY *POINTER
                  0220
0108- A0 00       0230 PRINTIT         LDY #$00
010A- B1 FE       0240                 LDA ($FE),Y
010C- C9 04       0250                 CMP #EOT       ;END OF TEXT MARKER (CTRL D)
010E- F0 0B       0260                 BEQ EXIT
                  0270
0110- 20 47 8A    0280                 JSR OUTCHR
0113- 20 B2 82    0290                 JSR INCCMP
0116- 20 86 83    0300                 JSR INSTAT     ;CARRY SET IF BRK KEY HELD DOWN
0119- 90 ED       0310                 BCC PRINTIT
                  0320
011B- 60          0330 EXIT            RTS :          ;BACK TO CALLER
                  0340
                  0350                 .EN
                  3020     (SWISS) CLOCK (continued from page 13/14-14)
                  3030
                  3040 ;Here follows the interrupt driven clock routine. The
                  3050 ;us/s regulation is accomplished with the time spent
                  3060 ;in the interrupt service before the start of
                  3070 ;timer1: Interrupts have to occur every 50000 us, with
                  3080 ;20 'jiffies' to the second. If the timerload is
                  3090 ;changed by +/- 1 this  gives a change of +/- 20 us/s,
                  3100 ;much larger than the precision of the clock. We get
                  3110 ;a resolution of +/- 1 us by making a number A of 20
                  3120 ;jiffies each 1 us longer than the remaining 20-A.
                  3130 ;The size of 0<A<=20 is in MIKSEC and can be changed
                  3140 ;by pressing 02 or 03 on the HKB. It over- or under-
                  3150 ;flows into LNIB of the timer1-load so that a
                  3160 ;continuous regulation is possible. This allows to
                  3170 ;correct deviations of the quartz from 1.000000 MHz,
                  3180 ;which is essential if the clock is supposed to run
                  3190 ;for many days or weeks.
                  3200
                  3210 ;              INTERRUPT SERVICE
                  3220
03B7- 08          3230 CLOCK      PHP  ;save    [from here to start of timer1
03B8- 48          3240            PHA  ; status [30 or 31 usec depending on
03B9- F8          3250            SED  ;        [byte in MIKSEC ]
03BA- A5 F3       3260            LDA *LNIB     ;+/- 1 if over/underflo of MIKSEC
03BC- 8D 06 A0    3270            STA T1LL
03BF- A5 F7       3280            LDA *COUNT
03C1- C5 F2       3290            CMP *MIKSEC   ;adjusts usec in loop !
03C3- B0 01       3300            BCS CONT      ;branch if count >= MIKSEC
03C5- EA          3310            NOP  ; otherwise not, which is 1 usec longer !
03C6- A9 C3       3320 CONT       LDA #$C3      ;hi nib of timer1
03C8- 8D 05 A0    3330            STA T1CH      ;start timer1
03CB- C6 F7       3340            DEC *COUNT    ;  for 49970+30[+1] usecs
03CD- D0 31       3350            BNE EXITC
03CF- A9 14       3360            LDA #$14      ;restore jiffy-counter
03D1- 85 F7       3370            STA *COUNT
03D3- A9 01       3380            LDA #01       ;now, one of the usual routines
03D5- 18          3390            CLC
03D6- 65 F6       3400            ADC *SEC      ; for updating the display-
03D8- 85 F6       3410            STA *SEC      ; registers
03DA- C9 60       3420            CMP #$60
03DC- D0 22       3430            BNE EXITC
03DE- A9 00       3440            LDA #00
03E0- 85 F6       3450            STA *SEC
03E2- A9 01       3460            LDA #01
03E4- 18          3470            CLC
03E5- 65 F5       3480            ADC *MIN
03E7- 85 F5       3490            STA *MIN
03E9- C9 60       3500            CMP #$60
03EB- D0 13       3510            BNE EXITC
03ED- A9 00       3520            LDA #00
03EF- 85 F5       3530            STA *MIN
03F1- A9 01       3540            LDA #01
03F3- 18          3550            CLC
03F4- 65 F4       3560            ADC *HOUR
03F6- 85 F4       3570            STA *HOUR
03F8- C9 24       3580            CMP #$24
03FA- D0 04       3590            BNE EXITC
03FC- A9 00       3600            LDA #00
03FE- 85 F4       3610            STA *HOUR
0400- D8          3620 EXITC      CLD  ;make sure its hex again
0401- 68          3630            PLA  ;restore status
0402- 28          3640            PLP
0403- 40          3650            RTI
                  3655
                  3660            .EN
```

MORE ON FORTH (continued from page 13/14-4)

Incidentally, FORTH is a stack oriented system, making use of both the host system stack (for its "return" stack) and its own stack, which is implemented in page 00 for the 6502, using the X register as its stack pointer. Since stacks are, by their very nature, LIFO (last-in, first-out), Reverse Polish format for both the arithmetic and the language syntax is the inherent way to go. After a little practice, the Reverse Polish Notation (RPN) becomes almost a natural way of logically ordering ideas. There is a close similarity between RPN and the German grammatical structure for complex sentences, in which the verbs from each clause are all "stacked" together at the end of the sentence, LIFO!

Elsewhere in this issue (pages 13/14-5 through 13/14-9) appears a "skeletonized" version of the SYM-FORTH source code, adapted from our disassembly of the FORTH described above, so that you can get some idea of its structure and method of implementation.

Note that only a relatively simple data management (essentially a stack handler) subsystem and the first few FORTH words are written in ML. The remaining words are written in FORTH itself, with only very infrequent references to ML. Only the ML portions need be rewritten for the 6809, for example, and hand assembled into the source code, in .BY $XX $YY $ZZ form, to have a TOTALLY COMPATIBLE FORTH for the MOD-69 SYM. This should not be too difficult, since less than 1K of object code is involved. We will then copy one of the published 6809 FORTH ASSEMBLER vocabularies and have a truly powerful 6809 System.

Note, also, that it will be easier to write other high level languages, e. g., Pascal, in FORTH than in ML, and that the FORTH version will be machine independent. Thus a high level language need be written and debugged only once, for all machines. We're not sure that we'd really want the Pascal if we had the FORTH, but we can see emulating at least the I/O syntax of other languages in FORTH.

```
0010            ;    **** MODIFIED SUPERMON ****
0020
0030            ;         BY PAUL L. BEAUPRE
0040
0050            ; THIS PROGRAM GIVES THE SYM-1 ONE
0060            ; THING IT LACKS, A DTR INPUT.
0070            ; BY MODIFYING THE 'TTY IN' PORT TO
0080            ; AN RS-232 LOOP, YOU CAN HOOK UP YOUR
0090            ; KTM-2'S DTR LINE, PRINTER READY,
0100            ; OR ANYTHING ELSE THAT NEEDS TO
0110            ; HAVE THE SYM WAIT.
0120
0130            ; I BURNED THIS PROGRAM IN A
0140            ; 2732, COPYING SUPERMON WITH A
0150            ; BLOCK MOVE AND MODIFYING LOCATION
0160            ; $8BA7 WHICH WAS FORMERLY THE TTY
0170            ; LOG ON LOCATION. IF YOU DON'T USE
0180            ; A TTY THEN USE THIS LOCATION.YOU
0190            ; MUST ALSO CHANGE LOCATION $8C73 AND
0200            ; $8C74 TO POINT OUTVEC TO THE NEW
0210            ; ROUTINE. THIS WILL PROVIDE THE SYM
0220            ; WITH THIS PROGRAM AUTOMATICALLY.
0230
0240 ACCESS     .DE $8B86
0250 PBDA       .DE $A402
0260 TOUT       .DE $8AA0
0270
0280            .BA $8BA7
0290
```

```
3BA7- 2Ø 86 8B   Ø3ØØ                JSR ACCESS
3BAA- 48         Ø31Ø                PHA
3BAB- AD Ø2 A4   Ø32Ø WAIT           LDA PBDA
3BAE- 29 4Ø      Ø33Ø                AND #$4Ø
3BBØ- FØ F9      Ø34Ø                BEQ WAIT
3BB2- 68         Ø35Ø                PLA
3BB3- 4C AØ 8A   Ø36Ø                JMP TOUT
                 Ø37Ø
                 Ø38Ø                .EN
```

A RAE/BASIC LINKER - BY M. A. CUSITER

Take a good look at lines 12Ø - 33Ø in the "PROGRAMME LISTING" below. While the main program is in BASIC, these lines are written in RAE-1 format! The BASIC program actually calls on RAE to assemble object code for it (BASIC) to use.

While we have seen assemblers written in BASIC before, these were usually slow, and much too long to include within a BASIC application program. The USR call in line 2Ø is to the object code stored by the ASS / BAS LINKER EXTENSION ROUTINE which immediately follows the RUN and LISTing of the BASIC program. The USR call in line 35Ø is to the object code which "LINKER" prepared from the "source code" in lines 12Ø - 33Ø inclusive.

A study of "LINKER" will reveal many details of the inner workings of both RAE and BASIC. Be sure to reserve memory space for the USR calls!

```
MEMORY SIZE? 8192
WIDTH? 80

 7679 BYTES FREE

BASIC V1.1
COPYRIGHT 1978 SYNERTEK SYSTEMS CORP.

OK
.LOD LINK3

OK
RUN
                    DEMONSTRATION OF LINKER PROGRAM
The linker expects text to be assembled enclosed in [[ ....]
The linker as it stands is called prior to an assembly routine
but could simply be changed so that it need be called once only.
The linker evapourates after use and does not need any zpage
locations.  It assembles RAE text at BASIC's variables + $100
to make room for zpage storage.  The available space is
divided into 3/4 text, 1/4 labels.  An overflow in text gives
an 'ASSEMBLER TEXT OVERFLOW' error.

The linker tolerates tokens in
the BASIC text by fixing +, -, and =, and converting
the others to letters.  This could give rise to
the rare duplicate label, but this can be completely
avoided by using lower case.

                    PROGRAMME LISTING


 10 PRINTTAB(20)"DEMONSTRATION OF LINKER PROGRAM"
 20 X=USR(&"3000",0)
 30 PRINT"The linker expects text to be assembled enclosed in [[ ....]"
 40 PRINT"The linker as it stands is called prior to an assembly routine"
```

```
 50 PRINT"but could simply be changed so that it need be called once only."
 60 PRINT"The linker evapourates after use and does not need any zpage"
 70 PRINT"locations.  It assembles RAE text at BASIC's variables + $100"
 80 PRINT"to make room for zpage storage.  The available space is"
 90 PRINT"divided into 3/4 text, 1/4 labels.  An overflow in text gives"
 100 PRINT"an 'ASSEMBLER TEXT OVERFLOW' error."
 105 :
 110 REM - START OF ASSEMBLY CODE
 120 [[ .BA $2000 ;the linker inserts a space at the beginning of each
 130 ;line only.: ;this means that labels must always: ;be preceded
 140 ;by colons.: ;more than one statement per line
 150 ;new line, new statement
 160 .OS :TOUT .DE $8AA0 ;linker changes TOut to something else
 170 LDX $0
 180 :MESS LDA MESSAGE,X
 190 BEQ OUT
 200 JSR TOUT ;output character
 270 INX: BNE MESS :OUT JMP $D14C ;return to BASIC
 280 :MESSAGE .by $0a $0d 'The linker tolerates tokens in'
 290 .by $0a $0d 'the BASIC text by fixing +, -, and =, and converting'
 300 .by $0a $0d 'the others to letters.  This could give rise to'
 310 .by $0a $0d 'the rare duplicate label, but this can be completely'
 320 .by $0a $0d 'avoided by using lower case.' $0a $0d $0d $00
 330 .en]
 340 REM - END OF ASSEMBLY CODE
 345 :
 350 X=USR(&"2000",0):REM - CALL OUR ROUTINE!
 360 PRINT:PRINTTAB(20)"PROGRAMME LISTING":PRINT:LIST
OK
                 ØØ1Ø
                 ØØ2Ø                ;****************************************
                 ØØ3Ø                ;* ASS / BAS LINKER EXTENSION ROUTINE   *
                 ØØ4Ø                ;*     WRITTEN BY Dr. M. A. Cusiter     *
                 ØØ5Ø                ;****************************************
                 ØØ6Ø
                 ØØ7Ø                .BA $3ØØØ
                 ØØ8Ø                .OS
                 ØØ9Ø
                 Ø1ØØ                ;VARIOUS STORES FOR POINTERS, REGISTERS
                 Ø11Ø
                 Ø12Ø LINNUM         .DE $1C
                 Ø13Ø STST           .DE $B3
                 Ø14Ø VEND           .DE $81
                 Ø15Ø RTXTPTR        .DE $AD
                 Ø16Ø BLOK.2         .DE $AF
                 Ø17Ø ESTOR          .DE $EF         ;ECHO STOR
                 Ø18Ø VESTOR         .DE $FØ
                 Ø19Ø TXTPTR         .DE $D3
                 Ø2ØØ RETAD          .DE $F4
                 Ø21Ø STSTOR         .DE $F5
                 Ø22Ø
                 Ø23Ø                ;PAGE ONE VECS
                 Ø24Ø
                 Ø25Ø RTXST          .DE $1ØØ
                 Ø26Ø RTXEN          .DE $1Ø2
                 Ø27Ø RLST           .DE $1Ø4
                 Ø28Ø RLEN           .DE $1Ø6
                 Ø29Ø
                 Ø3ØØ                ;MONITOR AND SYS RAM
                 Ø31Ø
                 Ø32Ø ACCESS         .DE $8B86
                 Ø33Ø OUTVEC         .DE $A664
                 Ø34Ø TECHO          .DE $A653
                 Ø35Ø TOUT           .DE $8AAØ
                 Ø36Ø
                 Ø37Ø            ;BASIC
                 Ø38Ø
                 Ø39Ø CHRGET     .DE $CC
                 Ø4ØØ CHRGOT     .DE $D2
                 Ø41Ø
                 Ø42Ø            ;REVECTOR BASOUT
                 Ø43Ø
                 Ø44Ø !!!TV      .MD (OLD NEW) ;TRANSFER VEC
                 Ø45Ø            LDA OLD
                 Ø46Ø            STA NEW
                 Ø47Ø            LDA OLD+1
                 Ø48Ø            STA NEW+1
                 Ø49Ø            .ME
                 Ø5ØØ
                 Ø51Ø !!!CV      .MD (DATA ADDRS) ;CHANGE VEC
                 Ø52Ø            LDA #L,DATA
                 Ø53Ø            STA ADDRS
                 Ø54Ø            LDA #H,DATA
                 Ø55Ø            STA ADDRS+1
                 Ø56Ø            .ME
                 Ø57Ø
                 Ø58Ø            .ES
                 Ø59Ø
3ØØØ- 2Ø 86 8B   Ø6ØØ            JSR ACCESS
                 Ø61Ø            TV (OUTVEC OLDVEC)

3ØØ3- AD 64 A6
3ØØ6- 8D 21 3Ø
3ØØ9- AD 65 A6
3ØØC- 8D 22 3Ø

                 Ø62Ø            CV (TRAPOUT OUTVEC)

3ØØF- A9 1C
3Ø11- 8D 64 A6
3Ø14- A9 3Ø
3Ø16- 8D 65 A6

3Ø19- 4C 4C D1   Ø63Ø            JMP $D14C    ;BACK TO BASIC
                 Ø64Ø
3Ø1C- C9 ØD      Ø65Ø TRAPOUT    CMP #$ØD
3Ø1E- FØ Ø3      Ø66Ø            BEQ ANALYSE
                 Ø67Ø
3Ø2Ø- 4C         Ø68Ø            .BY $4C
3Ø21-            Ø69Ø OLDVEC     .DS 2
                 Ø7ØØ
3Ø23- 2Ø D2 ØØ   Ø71Ø ANALYSE    JSR CHRGOT
3Ø26- C9 5B      Ø72Ø            CMP #'[
3Ø28- FØ Ø4      Ø73Ø            BEQ PROSTAK  ;ASSEMBLY COMING UP
3Ø2A- A9 ØD      Ø74Ø            LDA #$ØD
3Ø2C- DØ F2      Ø75Ø            BNE OLDVEC-1
3Ø2E- A2 ØD      Ø76Ø PROSTAK    LDX #13
3Ø3Ø- 68         Ø77Ø PULL       PLA
3Ø31- CA         Ø78Ø            DEX
3Ø32- 1Ø FC      Ø79Ø            BPL PULL
                 Ø8ØØ
                 Ø81Ø            ;BEGIN MAINLINE
                 Ø82Ø
3Ø34- AE 53 A6   Ø83Ø ASSBAS     LDX TECHO    ;WHATEVER IT IS
3Ø37- 86 EF      Ø84Ø            STX *ESTOR
3Ø39- BA         Ø85Ø            TSX
3Ø3A- 86 F5      Ø86Ø            STX *STSTOR
3Ø3C- A5 81      Ø87Ø            LDA *VEND
3Ø3E- 85 FØ      Ø88Ø            STA *VESTOR
3Ø4Ø- A5 82      Ø89Ø            LDA *VEND+1
```

```
3Ø42- 85 F1      Ø9ØØ            STA *VESTOR+1
3Ø44- AD ØØ Ø1   Ø91Ø            LDA RTXST    ;GET POINTER TO PAGE 1
3Ø47- 85 AF      Ø92Ø            STA *BLOK.2
3Ø49- AD Ø1 Ø1   Ø93Ø            LDA RTXST+1
3Ø4C- 8D BØ ØØ   Ø94Ø            STA BLOK.2+1
3Ø4F- 68         Ø95Ø            PLA
3Ø5Ø- 85 F4      Ø96Ø            STA *RETAD
3Ø52- 68         Ø97Ø            PLA
3Ø53- 85 F5      Ø98Ø            STA *RETAD+1          ;STORE RETURN ADDRS
                 Ø99Ø
                 1ØØØ            ;CALCULATE FILE BOUNDARIES FOR RAE
                 1Ø1Ø
3Ø55- 18         1Ø2Ø            CLC
3Ø56- A5 81      1Ø3Ø            LDA *VEND    ;LEAVE SPACE FOR ZPAGE
3Ø58- 8D ØØ Ø1   1Ø4Ø            STA RTXST
3Ø5B- A5 82      1Ø5Ø            LDA *VEND+1
3Ø5D- 69 Ø1      1Ø6Ø            ADC #1
3Ø5F- 8D Ø1 Ø1   1Ø7Ø            STA RTXST+1
                 1Ø8Ø
                 1Ø9Ø            ;CALCULATE BYTES AVAILABLE
                 11ØØ            ;FOR RAE FILES
                 111Ø
3Ø62- 38         112Ø            SEC  ;CALCULATE RLEN ADDRS
3Ø63- A5 83      113Ø            LDA *STST
3Ø65- E9 Ø4      114Ø            SBC #4
3Ø67- 8D Ø6 Ø1   115Ø            STA RLEN
3Ø6A- A5 84      116Ø            LDA *STST+1
3Ø6C- E9 ØØ      117Ø            SBC #Ø
3Ø6E- 8D Ø7 Ø1   118Ø            STA RLEN+1   ;4 BYTES OFF
3Ø71- 38         119Ø            SEC
3Ø72- AD Ø6 Ø1   12ØØ            LDA RLEN
3Ø75- ED ØØ Ø1   121Ø            SBC RTXST
3Ø78- 8D Ø4 Ø1   122Ø            STA RLST     ;CONTAINS LEN FRE SPACE
3Ø7B- AD Ø7 Ø1   123Ø            LDA RLEN+1
3Ø7E- ED Ø1 Ø1   124Ø            SBC RTXST+1
3Ø81- 8D Ø5 Ø1   125Ø            STA RLST+1
3Ø84- 18         126Ø            CLC  ;FIND 1/4 FRE SPACE
3Ø85- 6E Ø5 Ø1   127Ø            ROR RLST+1
3Ø88- 6E Ø4 Ø1   128Ø            ROR RLST
3Ø8B- 18         129Ø            CLC
3Ø8C- 6E Ø5 Ø1   13ØØ            ROR RLST+1
3Ø8F- 6E Ø4 Ø1   131Ø            ROR RLST
3Ø92- 38         132Ø            SEC  ;SUBTRACT 1/4FS FROM RLEN
3Ø93- AD Ø6 Ø1   133Ø            LDA RLEN
3Ø96- ED Ø4 Ø1   134Ø            SBC RLST
3Ø99- 8D Ø4 Ø1   135Ø            STA RLST
3Ø9C- AD Ø7 Ø1   136Ø            LDA RLEN+1
3Ø9F- ED Ø5 Ø1   137Ø            SBC RLST+1
3ØA2- 8D Ø5 Ø1   138Ø            STA RLST+1
3ØA5- 38         139Ø            SEC  ;SET RTXEN
3ØA6- AD Ø4 Ø1   14ØØ            LDA RLST
3ØA9- E9 Ø4      141Ø            SBC #4
3ØAB- 8D Ø2 Ø1   142Ø            STA RTXEN
3ØAE- AD Ø5 Ø1   143Ø            LDA RLST+1
3ØB1- E9 ØØ      144Ø            SBC #Ø
3ØB3- 8D Ø3 Ø1   145Ø            STA RTXEN+1  ;4 BYTES BELOW
                 146Ø
3ØB6- AØ ØØ      147Ø            LDY #Ø
                 148Ø
                 149Ø            ;GENERATE RAE TXT
                 15ØØ
3ØB8- 2Ø CC ØØ   151Ø ASSTXT     JSR CHRGET   ;GET NXT CHR FROM BAS
3ØBB- DØ Ø6      152Ø            BNE PASS.1   ;END OF LINE?
3ØBD- 2Ø Ø3 32   153Ø            JSR NXTLINE  ;INCREMENT PAST 4 BYTES
3ØCØ- 2Ø CC ØØ   154Ø            JSR CHRGET   ;GET NXT CHR
```

```
3ØC3- C9 5B     155Ø PASS.1     CMP #'[
3ØC5- FØ Ø3     156Ø            BEQ SETUP
3ØC7- 4C B6 CC  157Ø            JMP $CCB6     ;ERRORMSGE
3ØCA- AØ ØØ     158Ø SETUP      LDY #Ø
3ØCC- 84 1C     159Ø            STY $LINNUM
3ØCE- 84 1D     16ØØ            STY $LINNUM+1          ;SET LINE NUMBER TO Ø
3ØDØ- AD ØØ Ø1  161Ø            LDA RTXST
3ØD3- 85 AD     162Ø            STA $RTXTPTR           ;SET START
3ØD5- AD Ø1 Ø1  163Ø            LDA RTXST+1
3ØD8- 85 AE     164Ø            STA $RTXTPTR+1
3ØDA- 2Ø ØC 32  165Ø            JSR INCLN     ;FIRST LINE = 1
                166Ø
                167Ø            ;ASSEMBLE RAE TXT
                168Ø
3ØDD- 2Ø 27 32  169Ø TEXTIN     JSR COMPARE
3ØEØ- 2Ø FA 31  17ØØ            JSR BINCPTR   ;INC BAS PTR
3ØE3- C9 3A     171Ø            CMP #':       ;NEW COMMAND?
3ØE5- DØ ØC     172Ø            BNE CHECKEND
3ØE7- 2Ø 3F 32  173Ø            JSR SETEND    ;SET BIT 7
3ØEA- 2Ø 38 32  174Ø            JSR RINCPTR   ;INC RAE PTR
3ØED- 2Ø ØC 32  175Ø            JSR INCLN
3ØFØ- 4C DD 3Ø  176Ø            JMP TEXTIN
3ØF3- C9 ØØ     177Ø CHECKEND   CMP #Ø        ;END LINE?
3ØF5- DØ 16     178Ø            BNE ASSEND
3ØF7- 2Ø 3F 32  179Ø            JSR SETEND
3ØFA- 2Ø 38 32  18ØØ            JSR RINCPTR
3ØFD- 2Ø ØC 32  181Ø            JSR INCLN
31ØØ- 2Ø 38 32  182Ø            JSR RINCPTR   ;PUT IN SPACE
31Ø3- A9 2Ø     183Ø            LDA #$2Ø      ;AFTER NEW LINE
31Ø5- 91 AD     184Ø            STA (RTXTPTR),Y
31Ø7- 2Ø Ø3 32  185Ø            JSR NXTLINE   ;SKIP 4 BYTES BAS TXT
31ØA- 4C DD 3Ø  186Ø            JMP TEXTIN
31ØD- C9 5D     187Ø ASSEND     CMP #']       ;END OF ASSEMBLY?
31ØF- FØ 26     188Ø            BEQ MARKEND
3111- C9 A4     189Ø            CMP #$A4      ;PLUS TOKEN
3113- DØ Ø4     19ØØ            BNE MINUS
3115- A9 2B     191Ø            LDA #$2B      ;FIX IT
3117- DØ ØE     192Ø            BNE STORCHR
3119- C9 A5     193Ø MINUS      CMP #$A5      ;MINUS TOKEN
311B- DØ Ø4     194Ø            BNE EQUALS
311D- A9 2D     195Ø            LDA #$2D
311F- DØ Ø6     196Ø            BNE STORCHR
3121- C9 AC     197Ø EQUALS     CMP #$AC      ;EQUALS TOKEN
3123- DØ Ø2     198Ø            BNE STORCHR
3125- A9 3D     199Ø            LDA #$3D
3127- C9 7F     2ØØØ STORCHR    CMP #$7F      ;ANY MORE TOKENS?
3129- 9Ø Ø4     2Ø1Ø            BCC STORCHAR
312B- Ø9 41     2Ø2Ø            ORA #$41      ;YES THERE ARE
312D- 29 7F     2Ø3Ø            AND #$7F      ;TRANSFORM IT
312F- 2Ø 38 32  2Ø4Ø STORCHAR   JSR RINCPTR   ;STORE CHAR IN TEXT
3132- 91 AD     2Ø5Ø            STA (RTXTPTR),Y
3134- 4C DD 3Ø  2Ø6Ø            JMP TEXTIN
3137- 2Ø 3F 32  2Ø7Ø MARKEND    JSR SETEND    ;MARK OFF END
313A- 98        2Ø8Ø            TYA
313B- A2 Ø3     2Ø9Ø            LDX #3
313D- 2Ø 38 32  21ØØ ZEND       JSR RINCPTR   ;MARK OFF END
314Ø- 91 AD     211Ø            STA (RTXTPTR),Y      ;OF RAE TXT
3142- CA        212Ø            DEX  ;WITH 3 ZEROS
3143- DØ F8     213Ø            BNE ZEND
                214Ø
                215Ø            ;START SHIFTING Z-PAGE ,ETC
                216Ø
3145- A2 ØØ     217Ø            LDX #Ø
3147- B9 ØØ ØØ  218Ø SHIFTOUT   LDA Ø,Y
314A- 91 FØ     219Ø            STA (VESTOR),Y
```

```
314C- 8A        22ØØ            TXA  ;FILL WITH ØØ
314D- 99 ØØ ØØ  221Ø            STA Ø,Y
315Ø- C8        222Ø            INY
3151- CØ FØ     223Ø            CPY #$FØ      ;ONLY UP TO $EF
3153- DØ F2     224Ø            BNE SHIFTOUT
                225Ø
3155- AØ ØØ     226Ø            LDY #Ø        ;NOW PAGE 1
3157- 99 ØØ Ø1  227Ø ZERO.1     STA $1ØØ,Y
315A- C8        228Ø            INY
315B- CØ 2E     229Ø            CPY #$2E
315D- DØ F8     23ØØ            BNE ZERO.1
                231Ø
                232Ø            ;FILL RAE BUFF WITH $2Ø
                233Ø
315F- AØ ØØ     234Ø            LDY #Ø
3161- A9 2Ø     235Ø            LDA #$2Ø      ;SPACE
3163- 99 35 Ø1  236Ø FILLBUF    STA $135,Y
3166- C8        237Ø            INY
3167- CØ 56     238Ø            CPY #$56
3169- DØ F8     239Ø            BNE FILLBUF
                24ØØ
                241Ø            ;STORE OLD OUTVEC, PATCH NEW
                242Ø
316B- 2Ø 86 8B  243Ø            JSR ACCESS
316E- AD 64 A6  244Ø            LDA OUTVEC
                245Ø            CV (ASSEM OUTVEC)

3171- A9 E2
3173- 8D 64 A6
3176- A9 31
3178- 8D 65 A6

                246Ø
317B- 4C Ø3 BØ  247Ø            JMP $BØØ3     ;INITIALISE RAE
                248Ø
317E- 29 7F     249Ø ASSEMBLE   AND #$7F
318Ø- C9 3E     25ØØ            CMP #'>
3182- FØ 2Ø     251Ø            BEQ RESTORE   ;PROMPT?
3184- C9 Ø7     252Ø            CMP #7        ;BEL
3186- FØ Ø1     253Ø            BEQ PRINTERR
3188- 6Ø        254Ø            RTS  ;BACK
3189- 2Ø 86 8B  255Ø PRINTERR   JSR ACCESS
318C- 48        256Ø            PHA
                257Ø            CV (ERROUT OUTVEC)

318D- A9 9B
318F- 8D 64 A6
3192- A9 31
3194- 8D 65 A6

3197- 68        258Ø            PLA
3198- 4C AØ 8A  259Ø            JMP TOUT
319B- 29 7F     26ØØ ERROUT     AND #$7F
319D- C9 3E     261Ø            CMP #'>
319F- FØ Ø3     262Ø            BEQ RESTORE
31A1- 4C AØ 8A  263Ø            JMP TOUT
31A4- 2Ø 86 8B  264Ø RESTORE    JSR ACCESS
                265Ø            TV (OLDVEC OUTVEC)

31A7- AD 21 3Ø
31AA- 8D 64 A6
31AD- AD 22 3Ø
31BØ- 8D 65 A6

                266Ø
```

```
31B3- A0 00     2670          LDY #0         ;SHIFT BACK VECS
31B5- B1 F0     2680 SHIFTIN  LDA (VESTOR),Y
31B7- 99 00 00  2690          STA 0,Y
31BA- C8        2700          INY
31BB- C0 F1     2710          CPY #$F1
31BD- D0 F6     2720          BNE SHIFTIN
31BF- A5 AF     2730          LDA $BLOK.2
31C1- 8D 00 01  2740          STA RTXST
31C4- A5 B0     2750          LDA $BLOK.2+1
31C6- 8D 01 01  2760          STA RTXST+1
31C9- A9 00     2770          LDA #0
31CB- 8D 02 01  2780          STA RTXST+2
31CE- 8D 03 01  2790          STA RTXST+3
                2800
31D1- A6 EF     2810          LDX $ESTOR     ;RESTORE ECHO STATE
31D3- 8E 53 A6  2820          STX TECHO
31D6- A6 F5     2830          LDX $STSTOR
31D8- 9A        2840          TXS
31D9- A5 F5     2850          LDA $RETAD+1
31DB- 48        2860          PHA
31DC- A5 F4     2870          LDA $RETAD
31DE- 48        2880          PHA
31DF- 4C CC 00  2890          JMP CHRGET     ;BACK TO BASIC
                2900
31E2- 20 86 8B  2910 ASSEM    JSR ACCESS
                2920          CV (ASSEMBLE OUTVEC)

31E5- A9 7E
31E7- 8D 64 A6
31EA- A9 31
31EC- 8D 65 A6

31EF- 68        2930          PLA
31F0- 68        2940          PLA  ;REMOVE RET. ADDRS
31F1- A9 20     2950          LDA #$20       ;SET REGS
31F3- A0 00     2960          LDY #0
31F5- A2 00     2970          LDX #0
31F7- 4C FC B0  2980          JMP $B0FC      ;START ASSEMBLY
                2990
                3000          ;SUBROUTINES FOLLOW
                3010
31FA- E6 D3     3020 BINCPTR  INC $TXTPTR
31FC- D0 02     3030          BNE INCP
31FE- E6 D4     3040          INC $TXTPTR+1
3200- B1 D3     3050 INCP     LDA (TXTPTR),Y
3202- 60        3060          RTS
                3070
3203- A2 04     3080 NXTLINE  LDX #4
3205- 20 FA 31  3090 NXTBYT   JSR BINCPTR
3208- CA        3100          DEX
3209- D0 FA     3110          BNE NXTBYT
320B- 60        3120          RTS
                3130
320C- F8        3140 INCLN    SED  ;RAE LINES IN DECIMAL
320D- 18        3150          CLC
320E- A5 1C     3160          LDA $LINNUM
3210- 69 01     3170          ADC #1
3212- 85 1C     3180          STA $LINNUM
3214- A5 1D     3190          LDA $LINNUM+1
3216- 69 00     3200          ADC #0
3218- 85 1D     3210          STA $LINNUM+1
321A- D8        3220          CLD
321B- A5 1C     3230          LDA $LINNUM
321D- 91 AD     3240          STA (RTXTPTR),Y        ;PUT IT IN TXT
321F- 20 38 32  3250          JSR RINCPTR
3222- A5 1D     3260          LDA $LINNUM+1
3224- 91 AD     3270          STA (RTXTPTR),Y
3226- 60        3280          RTS
                3290
3227- 38        3300 COMPARE  SEC
3228- AD 02 01  3310          LDA RTXEN
322B- E5 AD     3320          SBC $RTXTPTR            ;CHECK TO SEE
322D- AD 03 01  3330          LDA RTXEN+1  ;IF ENOUGH SPACE
3230- E5 AE     3340          SBC $RTXTPTR+1
3232- B0 03     3350          BCS CLEAR
3234- 4C 46 32  3360          JMP ATOMESS
3237- 60        3370 CLEAR    RTS
                3380
3238- E6 AD     3390 RINCPTR  INC $RTXTPTR
323A- D0 02     3400          BNE RINCP
323C- E6 AE     3410          INC $RTXTPTR+1
323E- 60        3420 RINCP    RTS
                3430
                3440 SETEND
323F- B1 AD     3450          LDA (RTXTPTR),Y
3241- 09 80     3460          ORA #$80
3243- 91 AD     3470          STA (RTXTPTR),Y
3245- 60        3480          RTS
                3490
3246- A2 00     3500 ATOMESS  LDX #0
3248- BD 56 32  3510 MSG.1    LDA MESS.1,X
324B- F0 06     3520          BEQ FIN.1
324D- 20 A0 8A  3530          JSR TOUT
3250- E8        3540          INX
3251- D0 F5     3550          BNE MSG.1
3253- 4C 7E C2  3560 FIN.1    JMP $C27E     ;BAS WARM
                3570
3256- 41 53 53  3580 MESS.1   .BY 'ASSEMBLER TEXT OVERFLOW' $0D $0A $0
3259- 45 4D 42
325C- 4C 45 52
325F- 20 54 45
3262- 58 54 20
3265- 4F 56 45
3268- 52 46 4C
326B- 4F 57 0D
326E- 0A 00
                3590          .EN
```

A MODEM INTERFACE PROGRAM FOR SYM

The KTM-2/80 (or KTM-2) can be connected directly into any modem which will accept inverted TTL voltage levels (< 0.8 V = logic one, > 2.8 V = logic zero) as well as standard RS-232-C (EIA) levels (+/- 3 V approx). This includes all modems which use the 1488/1489 EIA transceiver chip pair. With some older modems it may be necessary to bring a -5 V supply voltage to the KTM-2 and change the appropriate jumpers. This terminal-modem combination will allow you to communicate with any of the time-share systems to which you arrange access.

Unfortunately, however, the data you receive in this way is evanescent. This problem is easily solved by getting SYM into the system to record the incoming data. How to do this is described in the following paragraphs:

First, the 20 mA current loops (CL interface), both input and output, must be converted to EIA (or inverted TTL) for interfacing SYM to the modem. While this can be done by modifications directly on the SYM board itself, by "rebuilding" the CL interface into a "twin" of the existing EIA interface (spare inverters are available on-board the SYM which may be used for this purpose, as pointed out in an earlier issue), we prefer an alternate approach, for two reasons.

ancient modems around, which we occasionally use; a couple of these put out voltages as high as +/- 25 V, and we don't like the idea of bringing such high voltage levels to the SYM.

We recommend converting CL to and from EIA with a pair of optoisolaters at the modem end of the CL line from the SYM. Placement at the modem end of the line is suggested because if the modem requires bipolar input signals, i.e., +/- 3 V or greater, +/-12 V will be available somewhere around the modem itself for this purpose. Unfortunately, you will need to bring an additional wire from the SYM to the (SYM) receive optoisolater, with +5 V. This is because the SYM is designed to be the "active" element in both the transmit and receive CLs.

The term "active" in CL systems is used to describe the unique element in any CL serial chain which incorporates the "battery", or current source for the entire loop. Two "batteries" are required for full duplex systems, one in each of the two required loops. The SYM provides both.

Anyway, once you have interfaced your SYM to the modem over the CL interface (and with the KTM-2 or other terminal through the EIA interface), the following program, by Jeff Lavin, will enable the SYM to store "incoming" files from the "remote" system. We have not yet actually used the program, but we know it works, since Jeff has provided us with a number of data files he has down-loaded from various "sources" (he also provided us with a long listing of such sources).

One such data file, "SUSAN", is reproduced (partially only, the original was much longer) on pages 13/14-21 through 13/14-27, and the program on page 13/14-28 to print that data file was abstracted from this MODEM COMMUNICATION PROGRAM. The communication protocols involved are easily deduced by studying the comments in the source code.

```
0010 ;  MODEM COMMUNICATION PROGRAM
0015 ;  JEFF LAVIN - 1982
0020
0030 ;  When uploading, it is very IMPORTANT
0040 ;  to be sure an EOT Char ($04 = ^D)
0050 ;  is the last character of the program.
0060
0070 MODFLG     .DE $FA
0080 LODFLG     .DE $FB
0090 WARM       .DE $8003
0100 SAVER      .DE $8188
0110 INCCMP     .DE $82B2
0120 CRLFSZ     .DE $8316
0130 OUTQM      .DE $8320
0140 SPACE      .DE $8342
0150 CRLF       .DE $834D
0160 INSTAT     .DE $8386
0170 OUTCHR     .DE $8A47
0180 INTCHR     .DE $8A58
0190 TIN        .DE $8A6A
0200 ACCESS     .DE $8B86
0210 PBDA       .DE $A402
0220 TECHO      .DE $A653
0230 TOUTFL     .DE $A654
0240 INVEC      .DE $A660
0250 LINK       .DE $F03A     ;PUT YOUR OWN PRINTER LINK HERE
0260
0270            .BA $9000
0280 ; .OS
0290
```

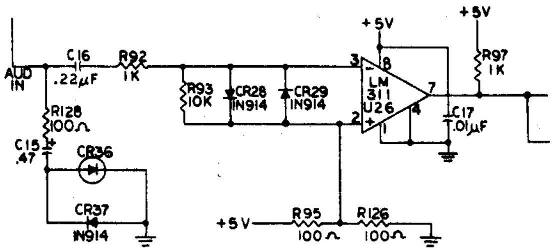
```
9005- 8D 61 A6  0320              STA INVEC+1
9008- A9 90     0330              LDA #H,MODEM
900A- 8D 62 A6  0340              STA INVEC+2
900D- A9 80     0350              LDA #$80
900F- 8D 53 A6  0360              STA TECHO
9012- A2 D0     0370              LDX #$D0
9014- 8E 54 A6  0380              STX TOUTFL
9017- A9 40     0390              LDA #$40
9019- 85 FA     0400              STA $MODFLG
901B- A9 00     0410              LDA #$00
901D- 85 FB     0420              STA $LODFLG
901F- 60        0430              RTS
                0440
9020- 20 6A 91  0450 MODEM        JSR NEWCHR   Get a char & determine source
9023- 29 7F     0460              AND #$7F     Strip possible parity
9025- A2 D0     0470              LDX #$D0
9027- 8E 54 A6  0480              STX TOUTFL   Turn off TTY OUT
902A- 24 FA     0490              BIT $MODFLG  Check mode
902C- 30 5D     0500              BMI TOMON    To MON if bit 7 is set
902E- 24 FB     0510              BIT $LODFLG  Check mode
9030- 30 62     0520              BMI DOWNLD   To download prgrm if bit 7 se
9032- 70 78     0530              BVS UPLOAD   To upload prgrm if bit 6 set
                0540
9034- C9 1B     0550              CMP #$1B     Esc ?  (MONITOR select char)
9036- D0 E8     0560              BNE MODEM    Else, get next char
9038- 20 58 8A  0570              JSR INTCHR   Get next char, do not send
903B- 29 7F     0580              AND #$7F     Strip parity
903D- C9 4D     0590              CMP #'M      M ? (MONITOR select char)
903F- F0 35     0600              BEQ GOMON
9041- C9 51     0610              CMP #'Q      Q ? (Toggle Keybd echo)
9043- F0 28     0620              BEQ TOGGL
9045- C9 50     0630              CMP #'P      P ? (Print select char)
9047- F0 34     0640              BEQ GO.PRNT
9049- C9 44     0650              CMP #'D      D ? (Download select char)
904B- F0 0E     0660              BEQ GO.DNLD
904D- C9 55     0670              CMP #'U      U ? (Upload select char)
904F- D0 CF     0680              BNE MODEM
                0690
9051- A9 40     0700 GO.UPLD      LDA #$40
9053- 85 FB     0710              STA $LODFLG  Set bit 6
9055- 20 58 91  0720              JSR SETPTRS
9058- 4C AC 90  0730              JMP UPLOAD
                0740
905B- 38        0750 GO.DNLD      SEC          Set carry
905C- 66 FB     0760              ROR $LODFLG  Roll carry into bit 7
905E- 20 58 91  0770              JSR SETPTRS
9061- 20 16 83  0780              JSR CRLFSZ
9064- 20 4D 83  0790              JSR CRLF
9067- 20 4D 83  0800              JSR CRLF
906A- 4C 20 90  0810              JMP MODEM
                0820
906D- A9 40     0830 TOGGL        LDA #$40     Mask bit 6
906F- 45 FA     0840              EOR $MODFLG  Invert bit 6
9071- 85 FA     0850              STA $MODFLG
9073- 4C 20 90  0860              JMP MODEM
                0870
9076- A9 C0     0880 GOMON        LDA #$C0     Set echo & go to MON
9078- 85 FA     0890              STA $MODFLG
907A- 4C 03 80  0900              JMP WARM     Go to MON and print prompt.
                0910
907D- 20 3A F0  0920 GO.PRNT      JSR LINK     Link printer
9080- A0 00     0930              LDY #$00
9082- 20 61 91  0940              JSR DELAY
9085- 20 58 91  0950              JSR SETPTRS
```

```
9088- 4C 1D 91  0960           JMP PRINT
                0970
908B- C9 04     0980 TOMON     CMP #$04      ^D ?  (EOT Char)
908D- D0 04     0990           BNE =+5       No, pass it on
908F- A9 40     1000           LDA #$40
9091- 85 FA     1010           STA $MODFLG   Yes, clear MON mode
9093- 60        1020           RTS
                1030
9094- C9 04     1040 DOWNLD    CMP #$04      ^D ?  (EOT Char)
9096- D0 0A     1050           BNE =+11      No, pass it on
9098- 48        1060           PHA
9099- 06 FB     1070           ASL $LODFLG   Clear download mode
909B- 20 16 83  1080           JSR CRLFSZ
909E- 20 4D 83  1090           JSR CRLF
90A1- 68        1100           PLA
90A2- A0 00     1110 LD>MEM    LDY #$00      Y is index
90A4- 91 FE     1120           STA ($FE),Y   Store ASCII in sequential
90A6- 20 B2 82  1130           JSR INCCMP    memory locations beqinning
90A9- 4C 20 90  1140           JMP MODEM     at $200
                1150
90AC- A2 B0     1160 UPLOAD    LDX #$B0      Enable CRT & TTY out
90AE- 8E 54 A6  1170           STX TOUTFL    CRT only in
90B1- A0 00     1180           LDY #$00
90B3- 20 61 91  1190           JSR DELAY
90B6- 20 61 91  1200           JSR DELAY
90B9- A0 04     1210           LDY #$04
90BB- A9 00     1220           LDA #$00
90BD- 20 47 8A  1230 NULLS     JSR OUTCHR    Send null
90C0- 88        1240           DEY
90C1- D0 FA     1250           BNE NULLS
90C3- A0 00     1260 MEM>OUT   LDY #$00      Y is index
90C5- B1 FE     1270           LDA ($FE),Y   Get char at memory loc
90C7- C9 0D     1280           CMP #$0D      CR ? (End of line?)
90C9- D0 2B     1290           BNE ^D.CHECK
90CB- 48        1300           PHA           Save char
90CC- A9 20     1310           LDA #$20      Space
90CE- 20 47 8A  1320           JSR OUTCHR    Print it
90D1- 68        1330           PLA           Retrieve char
90D2- 20 47 8A  1340           JSR OUTCHR    Send & print char
90D5- 20 B2 82  1350           JSR INCCMP
90D8- B1 FE     1360           LDA ($FE),Y;  Get next char
90DA- C9 0A     1370           CMP #$0A      LF ?
90DC- D0 0B     1380           BNE GETPRMPT
90DE- A2 90     1390           LDX #$90
90E0- 8E 54 A6  1400           STX TOUTFL    Only CRT in & out
90E3- 20 47 8A  1410           JSR OUTCHR    Print LF
90E6- 20 B2 82  1420           JSR INCCMP
90E9- A2 D0     1430 GETPRMPT  LDX #$D0
90EB- 8E 54 A6  1440           STX TOUTFL    Restore TTY in
90EE- A0 40     1450           LDY #$40
90F0- 20 61 91  1460           JSR DELAY
90F3- 4C 20 90  1470           JMP MODEM     Wait for response
90F6- C9 04     1480 ^D.CHECK  CMP #$04      ^D ?  (EOT Char)
90F8- F0 0B     1490           BEQ =+12
90FA- 20 47 8A  1500           JSR OUTCHR    Send & print char
90FD- 20 B2 82  1510           JSR INCCMP
9100- 20 86 83  1520           JSR INSTAT    Brk if key down
9103- 90 BE     1530           BCC MEM>OUT
9105- 20 42 83  1540           JSR SPACE
9108- 20 16 83  1550           JSR CRLFSZ
910B- 20 4D 83  1560           JSR CRLF
910E- 20 4D 83  1570           JSR CRLF
```

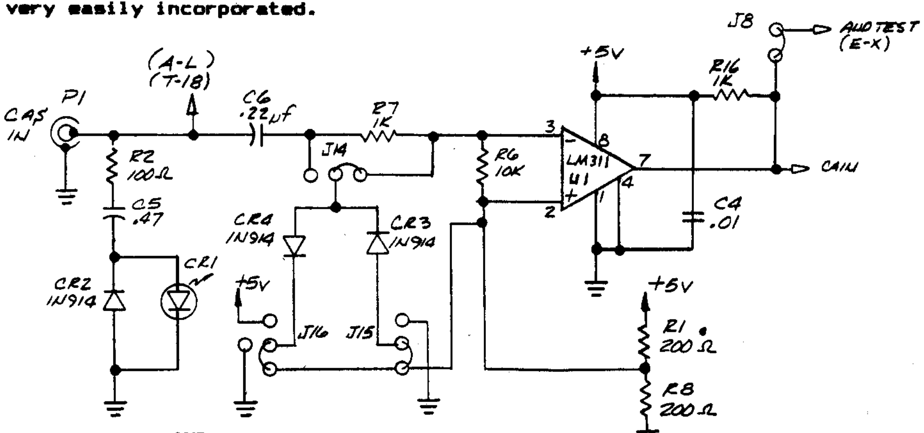
```
9111- A9 D0     1580           LDA #$D0      Restore previous setting
9113- 8D 54 A6  1590           STA TOUTFL
9116- A9 00     1600           LDA #$00
9118- 85 FB     1610           STA $LODFLG   Clear upload mode
911A- 4C 20 90  1620           JMP MODEM
                1630
911D- A2 B0     1640 PRINT     LDX #$B0
911F- 8E 54 A6  1650           STX TOUTFL
9122- A0 00     1660 MEM>PRNT  LDY #$00
9124- B1 FE     1670           LDA ($FE),Y
9126- C9 04     1680           CMP #$04
9128- F0 0B     1690           BEQ =+12
912A- 20 47 8A  1700           JSR OUTCHR
912D- 20 B2 82  1710           JSR INCCMP
9130- 20 86 83  1720           JSR INSTAT
9133- 90 ED     1730           BCC MEM>PRNT
9135- 20 4D 83  1740           JSR CRLF
9138- 20 20 83  1750           JSR OUTQM     Print "?"
913B- 20 42 83  1760           JSR SPACE
913E- 20 58 8A  1770           JSR INTCHR    Get a char
9141- 29 7F     1780           AND #$7F
9143- C9 59     1790           CMP #'Y       Is it Yes?
9145- D0 03     1800           BNE =+4
9147- 20 16 83  1810           JSR CRLFSZ    If so, print addr
914A- 20 4D 83  1820           JSR CRLF
914D- 20 4D 83  1822           JSR CRLF
9150- A9 D0     1830           LDA #$D0
9152- 8D 54 A6  1840           STA TOUTFL
9155- 4C 20 90  1850           JMP MODEM
                1860
9158- A9 02     1870 SETPTRS   LDA #$02
915A- 85 FF     1880           STA $$FF      ADH Store memory
915C- A9 00     1890           LDA #$00
915E- 85 FE     1900           STA $$FE      ADL Store memory
9160- 60        1910           RTS
                1920
9161- A2 00     1930 DELAY     LDX #$00
9163- CA        1940 DELOOP    DEX
9164- D0 FD     1950           BNE DELOOP
9166- 88        1960           DEY
9167- D0 FA     1970           BNE DELOOP
9169- 60        1980           RTS
                1990
                2000 ; THIS ROUTINE ONLY WORKS AT 300 BAUD
                2010
916A- 20 88 81  2020 NEWCHR    JSR SAVER     Copy part of INTCHR here
916D- A9 00     2030           LDA #$00
916F- 85 F9     2040           STA $$F9
9171- A9 C0     2050 LOOK      LDA #$C0      Mask all but bits 6 & 7
9173- 2C 02 A4  2060           BIT PBDA      Is there input & where?
9176- F0 F9     2070           BEQ LOOK      Loop if no input
9178- 70 0D     2080           BVS TTYIN     Branch if TTY is input source
917A- 24 FA     2090           BIT $MODFLG Input is from kybd; echo desire
917C- 70 04     2100           BVS ECHO      Yes
917E- A0 E0     2110           LDY #$E0      No keybd echo to CRT
9180- D0 02     2120           BNE ECHO+2
9182- A0 F0     2130 ECHO      LDY #$F0      Echo keybd to modem
9184- 8C 54 A6  2140           STY TOUTFL
9187- 4C 6A 8A  2150 TTYIN     JMP TIN       Do the rest of INTCHR in MON
                2160
                2180           .EN
```

MORE ON THE CASSETTE INTERFACE

Readers of SYM-PHYSIS will, no doubt, remember the number of suggestions on improving the performance of the cassette interface which have been published during the past several years. To the right is a copy of the schematic of the SYM-1 cassette interface, from the Reference Manual.



Below, for information only, is a copy of the schematic for the SYM-2 cassette interface, which is essentially identical to that of the SYM-1. Note, however, the provision of rather extensive modifiable jumper capabilities, so that the suggestions published in SYM-PHYSIS may be very easily incorporated.



AUDIO CASSETTE INTERFACE SCHEMATIC

FDC-1 TECHNICAL NOTES - ISSUE 1

Because of the large number of SYM owners who have installed FDC-1 Disk Systems, FDC-1 Technical Notes will become a regular feature of the newsletter. Here is the first set of notes:

Number 1.1

About 10% of the FDC-1 boards seem to behave in a very erratic manner. A serendipitous fix was discovered by Jeff Lavin, who wired his board in such a way as to bring the +5V in from the SYM-1 instead of through the turret pin.

By adding the jumper shown in the figure below to the inoperative boards sent to him for trouble-shooting, Jeff got all of these boards to operate properly. The +5V can still be brought in at the turret pin as well as through pin 21.

We are not yet certain why the fix works and are discussing the problem and fix with a Synertek engineer who has been assigned to the problem.

Number 1.2

The timeout routines provided in the FDC-1 software do not set the timer correctly, and must be rewritten. This will be done in the near future. Meanwhile, it does not matter anyway, inasmuch as the IRQ output of the 6532 has not even been connected on the SYM-1! You may wish to jumper pin 25 of the 6532 (U27) to pin 4 of the 6502 (U5) to enable the interrupt capability of the 6532.

Number 1.3

With some single-sided 5 1/4" drives, in particular those from BASF, the .L7 operation is unusually long because of the second-side search. While this may be fixed in the software, a quick hardware "fix" is as follows:

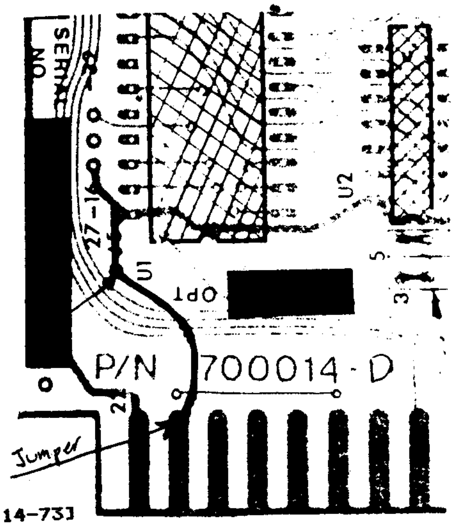
Bend up pins 9 and 10 of U14 so that they will not go into the socket. Tie them to pin 7 (GND), then replace the chip.

We can't remember who first gave us this fix, but we thank him for it.

Number 1.4

Correct the FDC-1 schematic as follows:

Pin 8 of RP1 is left unconnected.



[SEE ALSO "MORE ON FDC-1 FIX" ON PAGE 13/14-73]

```
0010 ;   Handshake through KTM 2/80
0020 ;   By V.I.Pancuska
0030 ;
0040 ;   In the following is a wiring diagram and output patch
0050 ;to enable handshake on SYM-1 when auxiliary port on
0060 ;KTM 2/80 is active
0070 ;
0080 ;   Pin 12 of U3 is enable auxiliary port
0090 ;   New IC 7400 is mounted similar way as Mr.Blalok's
0100 ;RAE 1/2
0110 ;
0120 ;
0130 ;       To pin 10 of Terminal                From pin 4 of
0140 ;       conector on SYM - 1                  printer
0150 ;               !                                 !
0160 ;               !                                 >
0170 ;               !                                 > 3.3K
0180 ;               !                                 >
0190 ;               !                                 !
0200 ;               !      ,--------------------------!
0210 ;               !      !                !         !
0220 ;         ,------------------------,    ´-!<!-,   >
0230 ;  -----  !     !      !    -----  !          !   > 2K
0240 ;  !   !--´14   !   --------!1  !--´14        !   >
0250 ;  !   !        !   !  ´----!27 !             ----!
0260 ;  ! 12!-------------     ,-!34 !                 -
0270 ;  ! U !        !         !-!40 !                 -
0280 ;  !   !        !         ´-!50 !                 -
0290 ;  ! 3 !        ------------!6  !
0300 ;,-!7  !                  ,-!7  !
0310 ;! -----                  ! -----
0320 ;´------------------------!
0330 ;                         -
0340 ;                         -
0350 ;                         -
```

```
                0360 ;
                0370 ;   PIN 6 ON PBDA ($A402)    0=CONTINUE
                0380 ;                            1=BUSSY. WAIT
                0390 ;   TO ENABLE PATCH DO: SD F000.A664
                0400 ;
                0410 PBDA       .DE $A402
                0420 TOUT       .DE $8AA0
                0430            .BA $F000
                0440 ;
F000- AA        0450            TAX
F001- 2C 02 A4  0460 LOOP       BIT PBDA
F004- 50 FB     0470            BVC LOOP
F006- 8A        0480            TXA
F007- 4C A0 8A  0490            JMP TOUT
                0500            .EN
```

A 'LEARNING' GAME FOR SYM

The following is an interesting little BASIC game for the SYM. It arrived too close to publication time for us to try out, but knowing Phillip Rinard as we do, we are pretty sure it should work as described.

Dear Lux: Nov. 1, 1982

I am submitting a program, NIM-WIT, for your consideration. If you would like to publish it in SYM-PHYSIS, go right ahead. Without having done anything in the field of artificial intelligence, I have found it fascinating and have been looking for a program that would be simple but show some amount of "intelligence".

The game of NIM has been around a long while and probably put into half the computers in the world. But this one has a twist: the computer is kept in the dark on one vital piece of information. The REM statements in the program review the rules and what the computer doesn't know, and therefore has to "learn". It's fun to watch it "catch on", especially when someone is playing it who doesn't know anything about computers beyond the keyboard.

Sincerely,

Phillip M Rinard

Phillip M. Rinard

```
 10 REM         *************
 20 REM         *************
 30 REM         ** NIM-WIT **
 35 REM         *************
 40 REM         *************
 42 REM
 43 REM
 44 REM   A GAME OF "NIM" IN WHICH THE COMPUTER
 45 REM   IS AT A DISADVANTAGE UNTIL IT "LEARNS"
 46 REM   HOW BEST TO PLAY BY "WATCHING" ITS
 47 REM   HUMAN OPPONENT -- YOU!
 48 REM
 50 REM
 51 REM   ASSUMED EQUIPMENT:
 52 REM     SYM-1 WITH SUPERMON MONITOR
 53 REM     KTM-2 TERMINAL (40 OR 80 COLUMN)
 54 REM     SYNERTEK'S BASIC, OR EQUIVALENT
 60 REM
 65 REM
 70 REM       PHILLIP M. RINARD
 80 REM        1872 CAMINO UVA
 90 REM      LOS ALAMOS, NM 87544
100 REM
110 REM         OCTOBER, 1982
```

```
150 REM  RULES:
160 REM    1. HUMAN CHOOSES MAXIMUM NUMBER OF TOKENS
170 REM       THAT CAN BE REMOVED AT ONE TIME.
180 REM    2. HUMAN TELLS COMPUTER HOW MANY TOKENS
190 REM       EXIST AT THE BEGINNING.
200 REM    3. COMPUTER TAKES AWAY A NUMBER OF
210 REM       TOKENS (NO MORE THAN THE MAXIMUM).
220 REM    4. HUMAN TAKES AWAY A NUMBER OF
230 REM       TOKENS (NO MORE THAN THE MAXIMUM).
240 REM    5. COMPUTER AND HUMAN TAKE TURNS UNTIL
250 REM       NO TOKENS REMAIN.  WHOEVER TAKES
260 REM       THE LAST TOKEN IS THE WINNER.
262 REM    6. START ANOTHER GAME WITH STEP 2.
264 REM    7. TERMINATE GRACEFULLY WITH NULL ENTRY
265 REM       FOR INPUT.
270 REM
280 REM   THE COMPUTER MUST "LEARN" HOW MANY TOKENS
290 REM   CAN BE TAKEN AWAY AT ONE TIME.  AFTER
300 REM   IT DOES SO, ITS WINNING PERCENTAGE
310 REM   WILL INCREASE DRAMATICALLY.

400 PRINT CHR$(12) : REM--CLEAR THE SCREEN THROUGH KTM-2
410 PRINT : PRINT
420 PRINT"       WELCOME TO THE GAME OF "
430 PRINT : PRINT"              NIM-WIT"
440 PRINT : PRINT"<><><><><><><><><><><><><><><><><><><><>"
450 PRINT : PRINT"I ALWAYS PLAY FIRST,"
460 PRINT"BUT ONLY YOU KNOW THE BEST STRATEGY!"
470 PRINT : PRINT
480 PRINT"CHOOSE THE MAXIMUM NUMBER OF TOKENS"
490 PRINT"THAT CAN BE TAKEN AWAY AT ONE TIME."
495 PRINT
500 PRINT"NEVER TELL ME WHAT THAT NUMBER IS!"
510 PRINT : PRINT"IT'S NOT FAIR TO CHANGE IT ON ME!"
520 PRINT : PRINT
530 REM
540 REM
550 MAX = 0 : REM--NO MAXIMUM ESTIMATED YET
560 REM
570 REM  <<< START A NEW GAME >>>
580 REM
600 PRINT
610 PRINT "WHAT NUMBER OF TOKENS DO WE START WITH?"
620 INPUT NUMBER
630 GOSUB 2000 : REM--DISPLAY TOKENS
640 REM
650 REM   <<< COMPUTER PLAYS >>>
660 REM
670 IF MAX > 0 THEN 700 : REM--FIRST TIME THROUGH?
680 MAX = 1 : TAKE = 1 : REM--FOR FIRST TIME ONLY
690 GOTO 760
695 REM
700 P=1 : REM--MULTIPLIER OF (MAX+1)
710 IF P*(MAX+1) > NUMBER THEN 730
720 P=P+1 : GOTO 710
725 REM
730 P=P-1 : REM--BEST P, BASED ON MAX
740 TAKE = NUMBER -P*(MAX+1)
750 IF TAKE = 0 THEN TAKE = INT((MAX+1)*RND(1))
760 A$="ARE" : IF NUMBER = 1 THEN A$="IS"
770 PRINT : PRINT"THERE ";A$;NUMBER;"LEFT."
780 NUMBER = NUMBER - TAKE
785 REM
790 GOSUB 5000 : REM--TIME DELAY
795 REM
```

```
800 PRINT "I'LL TAKE";TAKE;"."
805 REM
810 GOSUB 5000 : REM--TIME DELAYS
820 GOSUB 5000
825 REM
830 GOSUB 2000 : REM--DISPLAY TOKENS
840 REM
850 REM   <<< CHECK FOR COMPUTER VICTORY >>>
860 REM
870 PLAYER = 1 : REM--I.D. FOR COMPUTER
880 GOSUB 3000 : REM--VICTORY?
890 IF PLAYER = 0 THEN 600 : REM--ZERO FOR VICTORY
892 REM
893 REM   <<< HUMAN PLAYS >>>
894 REM
900 PRINT
910 PRINT"THERE ARE";NUMBER;"LEFT."
920 PRINT"HOW MANY DO YOU WANT?"
930 INPUT TAKE
940 NUMBER = NUMBER - TAKE
950 IF TAKE > MAX THEN MAX = TAKE : REM--NEW MAX ESTIMATE
960 REM
970 REM   <<< CHECK FOR HUMAN VICTORY >>>
980 REM
990 PLAYER = 2 : REM--I.D. FOR HUMAN
1000 GOSUB 3000 : REM--HUMAN VICTORY?
1010 IF PLAYER = 0 THEN 600 : REM--ZERO FOR VICTORY
1020 GOSUB 2000 : REM--DISPLAY TOKENS
1030 GOTO 700 : REM--COMPUTER'S TURN AGAIN
1040 REM
1060 REM         <<< END OF MAIN PROGRAM >>>
1070 REM
1970 REM
1980 REM  <<< SUBROUTINE TO DISPLAY TOKENS >>>
1990 REM
2000 IF NUMBER > 0 THEN 2030 : REM--THERE ARE SOME LEFT
2010 PRINT : PRINT"NONE LEFT."
2020 RETURN
2030 PRINT : PRINT : PRINT
2040 RESTORE
2045 REM
2050 DATA 6912, 18176, 6912, 20992
2060 REM   ESC   UC-G   ESC   UC-R
2070 REM--PUT KTM-2 INTO GRAPHICS MODE
2080 REM
2090 FOR I = 1 TO 4
2100 READ V : X=USR(&"8A47",V) : REM--SYM MONITOR'S OUTCHR
2110 NEXT I
2120 REM
2130 FOR I = 1 TO NUMBER
2140 PRINT "("; : REM--THAT'S A SHIFT-ESC
2150 NEXT I
2160 REM
2170 DATA 6912, 26368, 6912, 29184
2180 REM   ESC   LC-G   ESC   LC-R
2190 REM--PUT KTM-2 INTO ALPHANUMERICS MODE
2200 REM
2210 FOR I = 1 TO 4
2220 READ V : X=USR(&"8A47",V)
2230 NEXT I
2250 PRINT
2260 RETURN
2270 REM
2280 REM  <<< SUBROUTINE TO CHECK FOR VICTORY >>>
2290 REM
```

NOTE BY LUX:

SHIFT ESC is
+/- on the
KTM-2, but
in standard
ASCII is "{"
HEX $7B, DEC 123

```
3000 IF NUMBER > 0 THEN RETURN : REM--NO VICTORY
3010 PRINT : PRINT
3020 IF PLAYER = 1 THEN 3070 : REM--COMPUTER VICTORY
3030 PLAYER = 0 : REM--VICTORY
3040 PRINT"YOU DID IT...WISH I COULD!"
3050 RETURN
3060 REM
3070 PLAYER = 0
3080 PRINT"GOSH...I GOT LUCKY!"
3090 PRINT"  LET'S TRY IT AGAIN."
3100 RETURN
3110 REM
4970 REM
4980 REM   <<< SUBROUTINE FOR TIME DELAY >>>
4990 REM
5000 FOR I=1 TO 500 : NEXT I
5010 RETURN
5030 END
5040 REM
5050 REM           <<< END OF NIM-WIT >>>
```

RAM-BLINGS (continued from page 13/14-1)

recognized by the Franchise Tax Board as a bona fide periodical, so we must ask California resident subscribers for an additional 6% sales tax!

Incidentally, we used a rather clumsy word above, "thriceannually", to indicate three times per annum. According to our dictionary, the prefix "tri-" could mean either thrice, i.e., three times per, or every third; rather ambiguous, to say the least! We once thought that triannually meant three times per year, and triennially every third year, but now we're not too sure. Just what is the correct word for three times per year, or, equivalently, every fourth month? Help!!!

There is a lot of work involved in publishing the newsletter, but, very, very, fortunately, it is definitely NOT a thankless job. The many phone calls and letters of commendation we keep getting do make it all seem worth the effort. How could we even consider quitting, when so many of you tell us, in effect, "Keep up the good work!" We appreciate such "carrots", and only twice in three years have we received what we considered to be unfair criticism. Thus, it's far more ego-gratifying to continue than to stop.

We wish to thank all of you who have sent in disks, cassettes, listings, Xeroxed reference materials, notes for publication, useful components, samples, etc. It is our firm intention, each time we sit down to open our mail, to send, immediately, a thank-you card or note, to inform the sender that the material did arrive safely, and was much appreciated. We get so entranced in going over the materials, transcribing the cassettes to diskettes, and in reading all the materials, either on-screen, or hard-copy, that the time zips by, and we're by then much too tired to do the polite thing. So please accept our apologies and thanks in this form, for now. Things will be different in the future!

Now that we are going thriceannually, we will be able to get better organized. We will ask Jean, who pre-screens our mail, and answers immediately whatever requests for help she can, to prepare a "pre-addressed" card on which we can express our thanks for the material received, immediately on opening the package.

And now for a personal note: Thanks to those who expressed their concern over the Intraocular Lens (IOL) Implant surgery, which was quite succesful. Although the operation is still considered "experimental" in the USA, and my surgeon has never before implanted two IOLs in the same patient less than six months apart, he will implant another IOL in the other eye right after this issue goes to press (19 November).

The hospital stay is only about two days, and during our Thanksgiving holiday. Will be able to work with both eyes within a week, and with no more newsletters due out for nearly a whole semester, should be able to get caught up on correspondence and all of the interesting, long-deferred projects.

Vision in the "bionic" eye is now 20/20 (can't remember it ever being better than 20/40, corrected, before). Binocular vision is now near spectacular, and the sky looks ever so much bluer. The only problem with the new lens that I have found, so far, is at night, when the pupil is wide open. Then small bright lights tend to create diffraction patterns due, I think, to the two small "struts" which support the lens in place.

My natural lens was very foggy, and quite yellow. The new one is diamond-clear, and colorless. As a consequence, the new eye is about one "stop" brighter, and has a color temperature differential of 4000K (daylight blue photoflood) to 3200K (indoor photolamp). Made the measurements with a collection of neutral density and color balance filters left over from my photograph engineering days, using my two eyes as a comparison "flicker" photometer and colorimeter. Just can't help making these quantitative comparisons!

When I noticed that an old argon lamp I had lying around looked much more vividly blue and very much brighter with my new eye, I examined the spectrum of the lamp and found that the plastic lens had extended my color vision from its previous cutoff point in the blue-violet region way down into the near UV region. I like my new eye, and want a matched pair. When the state of the art of IOLs improves, I'd like one wide-angle and one telephoto lens, please!

INTRODUCING THE SYM-2

First the "pluses":

1) It is smaller than SYM-1, measuring 8.8" x 7.8".
2) It comes with a plug-in transformer which provides 10 VAC at 16 VA.
3) It has a row of 8 LEDs and 8 DIP switches for "experiments".
4) It has a pair of RCA phono jacks for easier cassette I/O connections.
5) Jumpers are provided for easier cassette interface modifications.

Now some "minuses":

1) Contains only 1 K RAM space; piggy-backing to 2 K worthless.
2) Valuable space taken up by filter caps and large voltage regulator.
3) Only one VIA (no AA connector).
4) No edge-fingers, instead holes for installing 44-contact sockets.
5) Only one 24-pin socket for ROM/EPROM expansion.
6) Priced slightly higher than SYM-1.

General comments:

The SYM-2 is a "different" kind of SYM-1, with much less on-board expansion capability, but is "ready-to-use", right out of the box, with no scrounging around or added cost for power supply, or LEDs or switches for I/O control experiments. This makes it particularly attractive for classroom use.

Synertek is planning an extensive advertising campaign, aimed at the large educational market which is certainly out there, if properly exploited. The market is not computer users, but rather computer system design students. We have seen proofs of some of the ads, and think they are very well done. We are especially pleased to see that the advertising copy includes the phrase "A subsidiary of Honeywell", since the Honeywell name provides a larger degree of customer recognition.

We have had an evaluation SYM-2 for many months now, with the revised SUPERMON (SYM 2.0) in a 2532 EPROM. At that time we received only a preliminary copy of the manual, with no Reference Card, and no listing of 2.0. We hope to get the additional documentation very soon, so that we can help SYM-2 owners with their problems and/or questions, also.

If you look closely at the masthead of this issue, you will notice a slight name change; we dropped the -1 from our name, and are now the "SYM Users' Group". We intend to support the -2, as well as the -1, since we are obviously deeply into education, ourselves.

MORE ON "RADAR" AND A CQ FOR HAMS

Here are some extracts from a recent letter from Ian Dilworth about the program "RADAR", which appeared in Issue 12. We were curious about where the data came from, and how to get more data for ourselves. Ian provides several interesting suggestions in his letter, some of which we would like to try, particularly the Speak & Spell one. He is also doing more with his Visible Memory than anyone else we know of!

Dear Lux:

The data supplied with RADAR was just test stuff. We actually have radar inputing data via a VIA and A/D converter. One nice use would be to have an A/D converter on a VIA and connect this to the AGC line on a receiver or spectrum analyser and sweep the local oscillator frequency in synchronism with the Visible Memory axis -- you have then made a cheap spectrum analyser with 3-D display and storage screen. I could supply megabytes of data but I don't really think it would be worthwhile.

Changing the aspect ratio of RADAR and the hidden line is OK, but the 1 MHz 6502 is too slow to do it in real time (unfortunately). Try a microphone into a VIA to get a data bank and use RADAR.

Instead of a microphone, you could use T I's Speak & Spell and the phoneme (very good, by the way!) package, triggered off the S & S, and look at spectra vs time of utterances . Great for seeing and hearing phoneme effects. Also pulse rate monitor and storage screen on Vis Mem very easy to do even without an A/D converter. There are 64 bytes in one horizontal scan in "RADAR".

I was interested to read recently of an Apple II based light pen that can draw (in high definitions) in real time -- apparently the screen is scanned at 60 Hz!! I'd really like to know the algorithm for doing that -- with 255 x 255 pixels to select from!

I'm using a joystick to draw on the Vis Mem at present. Also, I have a VIA pin connected to the video modulator (via series R) to give me z-axis modulation, i.e., a grey scale of 8.

Can you put a request in the next issue please? I'd like to get in touch with any radio hams who use the SYM and particulary has anyone got a Morse code and RTTY program going? I'd rather not reinvent the wheel unless necessary. My call is G3WRT (W3 until December). Also how about slow-scan TV (SSTV) using the Vis Mem?

I am working at COMSAT for 3 months during my sabbatical. I may introduce a SYM or two here. But until I get home I probably won't do much with the system which I have actually brought with me.

Regards,

Ian Dilworth
COMSAT Labs
223Ø Comsat Drive
Clarksburg, MD 2Ø871

Ian's permanent address is: Dr. I. J. Dilworth, Department of Electrical Engineering Science, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, England.

We should note that it is not essential to have a Visible Memory installed to do the RADAR type printouts on a printer with point-graphics capability; the Vis Mem just saves you time and paper by showing you the image before printing.

All that is required is a 4K RAM block to store a block of 64 "Y-slices" for 64 "X-values" of an eight-bit variable "Z", which is computed (or sampled) as a function Z(X,Y). The points to be printed are then stored, temporarily, in a less than 8K RAM block (4Ø x 2ØØ bytes), for the 32Ø x 2ØØ pixel image.

This type of graphics data processing is a natural for FORTH, since the data can easily be handled in its 16 bit integer format and the fixed-point arithmetic is inherently much faster than software-implemented floating-point arithmetic (note that the Apple's high speed graphics are usually handled in the Integer, rather than the Applesoft BASIC).

Unfortunately, most "programmers" these days are not familiar with techniques for "scaling" away the decimal points to permit the use of fixed-point arithmetic trigonometric packages, for example. While floating-point packages can be added to FORTH, most FORTH programmers prefer to use the much faster double precision (32 bit integer) arithmetic instead. Jack Brown sent us some very dynamic FORTH programmed Vis Mem graphics which would have been much less impressive when run at BASIC speed.

Incidentally, the word to SAVE the 8-bit Z value computed for any pair of X,Y values into a block of RAM starting at CONSTANT ORIGIN would be, simply:

```
      : SAVE   Z @ ORIGIN X @ 64 Y @ * + + C! ;
      ( @ means fetch value of; C! means store only single-byte)
```

The rest of the program would involve writing a defining word, ZCOMPUTE, for the value of VARIABLE Z in terms of VARIABLE X and VARIABLE Y, and using a pair of nested Ø 64 DO ..... LOOP structures to do the work of filling in the 4K array of DATA.

EPSON RIBBONS AND ROLLERS

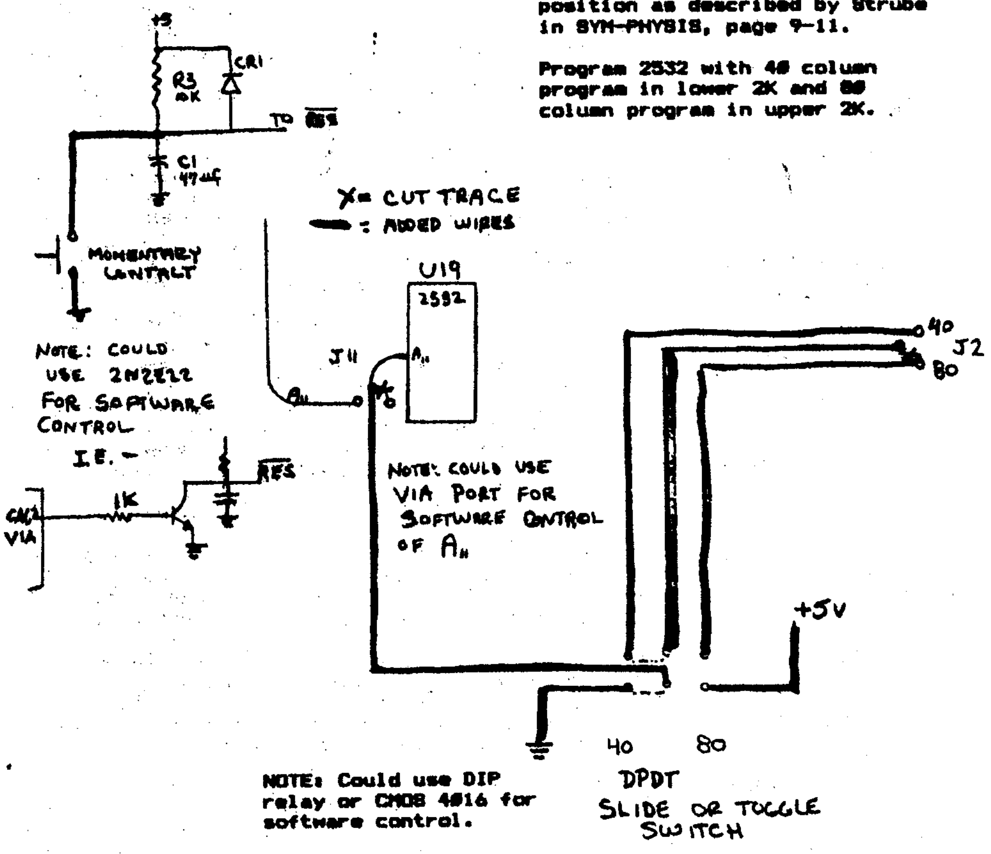
We have been using WD-4Ø to "rejuvenate" our Epson printer ribbons, as reported earlier, to keep the costs down. It works very well; we use it two or three times on each ribbon. We found only one problem, and a fix for same. If you are using the FT model, the one with the friction drive, and don't allow the ribbon enough time to dry properly, the ink strikes through the paper and onto the rubber platen roller, causing it to "gum" up. The tackiness causes paper misalignment when using tractor feed paper. The cure? Clean the roller with alcohol, and apply talcum powder to its surface until any tendency to "grab" the paper is gone.

"DUALIZING" THE KTM-2

The KTM-2 (4Ø columns) can be used with an RF modulator and any TV set, and its character aspect ratio makes for nicer looking graphics than those provided by the KTM-2/8Ø. The -2/8Ø is much better for word processing, however, and many purchasers of the -2 have upgraded to the -2/8Ø, by replacing the ROM and adding the necessary support chips. We have done so with one of our -2 versions and reconvert by depowering, exchanging ROMs, and switching the jumper between -4Ø and -8Ø manually.

The sketch and the accompanying notes, below, by Steve Starre, Enfield, Connecticut, show how this may be done without depowering, and even under software control, if desired. Those owners of -8Øs who wish to follow Steve's example may order the KTM-2 ROM (Ø2-ØØ16B) from the Users's Group to copy into a 2532 as he describes (or just replace it manually, as we have been doing).

KTM-2 RESET needed to restart 65Ø2 when ROM is switched (sometimes).



Change J18 & J19 to alternate position as described by Strube in SYM-PHYSIS, page 9-11.

Program 2532 with 4Ø column program in lower 2K and 8Ø column program in upper 2K.

NOTE: Could use DIP relay or CMOS 4Ø16 for software control.

600 6TH AVENUE WEST
OWEN SOUND, ONTARIO
N4K 5E7 OCT 18 1982

SYM-1 USER'S GROUP
P.O. BOX 319
CHICO, CA 95927

Dear Jean & Lux:-

This is the latest, and, I hope, last edition of my rearrangement of SWP-2. I discovered some bugs in the last tape I sent you, and these have now been eliminated. Additionally, some extra goodies have been added. The new features of SWP-2.5 (from SWP-2) are as follows:

(1) Using command (period) I R will indent all lines in the paragraph AFTER the first line by R spaces. This could be done before by using the S command in the following lines, but then the first

line was not right justified. Anyway, this way is much easier.

(2) After setting the R parameter as in (1) above, the command I without parameters will continue doing the same thing.

(3) The command (period)X will indent ALL lines in the paragraph, including the first, by R spaces. This is used for additional paragraphs under the same heading.

(4) Page numbering is now justified over the right columns of text, with the number only being printed. I have tested it and it works up to page 9999, which should be enough for the average literary effort. Also, the page number for Page 1 is suppressed.

(5) If the final work will be in book form (or Xeroxed on both sides of the page) then use TB instead of T#. This will justify the odd page numbers over the right columns of text and the even numbers over the left columns, just like in a book.

(6) The FOOT command now works as before, except that if you use FOOT# with no other parameter, the page numbers will be centered at the bottom of the page, as, for example, in the CODOS manual.

(7) Formerly, if the command P appeared at the top of a new page, additional blank lines would be output. This is eliminated in this version for P. I and X.

The I R, I and X commands are used where P was used formerly. To make them work, the line immediately preceeding the FIRST I R must be (period)L 2. Then, the line immediately following any I R or I command must contain exactly R characters, of which at least the last MUST be an up arrow. Up arrows may also be used between characters as required. For example, in the indented paragraph above, I set R at 6 and used (7) followed by three up arrows in the line following the I command.

This program has been changed in so many places (from SWP-2) that it is almost a new program. I have left in your FODS linkages, even though I don't have FODS, but this is easily changed for any system.

The cassette is recorded at double speed. There are two copies of the object code (L2 01) which occupies from $200 to $0ACA, and two copies of the source code (GE F1) which occupies from $0B00 to $62AB. For convenience, there are two CT's, at lines 2229 and 4489.

As I said earlier, this now does everything I want, so I don't expect to alter it any further. I hope you try it - I think you'll like it.

Best wishes.

/s/ A. M. Mackay.

P.S. This letter is in RAE format on the tape, after the source code - GE F2.

```
>PR
 0010   .M 0 73 24 1
 0020   .NOFILL
 0030   .S 53
 0040   .TB > > > NEW SWP-2.5 < < <
 0050   .FOOT#
 0060   600 6TH AVENUE WEST
 0070   .S 53
 0080   OWEN SOUND, ONTARIO
 0090   .S 53
 0100   N4K 5E7  OCT 18 1982
 0110   SYM-1 USER'S GROUP
 0120   P.O. BOX 319
 0130   CHICO, CA 95927
 0140   .L3
 0150   Dear Jean & Lux:-
 0160   .JU
 0170   .L2
 0180   .P
 0190   This is the latest, and, I hope, last edition of my
 0200   rearrangement of SWP-2. I discovered some bugs in the
 0210   last tape I sent you, and these have now been eliminated.
 0220   Additionally, some extra goodies have been added.
 0230   The new features of SWP-2.5 (from SWP-2) are as follows:
 0240   .L2
 0250   .I 6
 0260   (1)^^^
 0270   Using command (period) I R will indent all lines in the
 0280   paragraph AFTER the first line by R spaces. This could be
 0290   done before by using the S command in the following lines,
 0300   but then the first line was not right justified. Anyway,
 0310   this way is much easier.
 0320   .I
```

SWP 2.5

The previous two pages contain an abridged copy of a letter received, on cassette, from Sandy Mackay, describing extensions he has added to SWP-2. We appended a portion of his text file to illustrate how the SWP editing commands are inserted into the manuscript, as and where required.

We have been using SWP-1 for a long time now, and have been slowly modifying it into a SWP-2. We have various modified versions on our master disk for special purposes, one of which is called %PUB (for PUBlish), for editing SYM-PHYSIS. We sent Sandy a copy of %PUB, calling it SWP-2, and he has added quite a few enhancements.

We read in his source code, changed the .BA to coreside with %PUB, reinserted the FODS linkage, and added SWP 2.5 to our master disk as %MAK (for MAcKay). We'll use it for the rest of this issue, since it is upward compatible with SWP-1.

During the next several months we'll give SWP-2.5 a good workout, and arrange to provide purchasers of SWP-1 an upgrade cassette to SWP-2.5 at a reasonable price.

HARDWARE RECOMMENDATION - REAL TIME (HARDWARE) CLOCK

Jeff Lavin, of Alternative Energy Products, sent us the first prototype of his Real Time Clock card for testing. We tried it, returned it to him with one or two software suggestions, and placed an order with him for several of them. The clock card is designed to be mounted on the AEP-2 I/O board, which was described in an earlier issue.

[The AEP-2 I/O Board installs into the VIA #2 socket, and provides for up to four additional VIAs for the SYM-1. We plan to use our AEP-2s as follows: The Epson on the AA-connector, and the Hardware Clock, Speak & Spell, EPROM Burner, and ACIA Interface on flat 20 wire cables to the AEP-2. No more depowering and exchanging cables for us! (The EPROM burner and ACIA Interface are forthcoming AEP products which are in the development and early prototype stages at this writing, and will not be formally announced and available till early Spring 1983.)]

The Clock Card has provision for battery backup (NOTE: Batteries not supplied; must be user furnished and mounted to the board with tape, glue, double-sided sticky-stuff, Velcro, rubberbands, chewing gum, or whatever), and the clock may be removed and reinstalled without disturbing the set time. The Clock Card will be available through the Users' Group.

Here is a portion of the software provided to set and read the clock, to give you some idea of how it works. The software could be placed in EPROM, if desired, or could be downloaded from mass storage to RAM as needed.

```
0010  ; CLOCK/CALENDAR DRIVER PROGRAM
0020  ; for OKI MSM5832 MICROPROCESSOR
0030  ;    Real-Time Clock/Calendar
0040
0050  ;        Copyright  1982
0060  ; ALTERNATIVE ENERGY PRODUCTS
0070
0080  ; The Registers are:
0090
0100  ; REGISTERS:     1M 10M  1H 10H  W   D1 D10  M1 M10  Y1 Y10
0110
0120  ; EXAMPLE:     $6X $2X $9X $8X $2X $5X $0X $0X $1X $2X $8X
0130
```

```
0140  ; This example would print out as:
0150
0160  ;          "09:26:00 TUESDAY OCT 05 1982"
0170
0180  ; The program inserts the century "19"; may be changed
0190  ; when the 21st century arrives.
0200
0210  ; (Bit 7 of 10H is set (high) for 24 hour format; this bit
0220  ; is inserted by the program below)
0230
0240  ; Only the most significant nibbles above are meaningful,
0250  ; since this is a four bit wide micro.  Note that a total
0260  ; of 16 registers can be accessed since the address bus is
0270  ; also four bits wide.  Only 11 registers are shown above.
0280  ; Two other registers, 1S and 10S are "read only", since
0290  ; they can only be written to as $0.  Two other "possible"
0300  ; registers are not implemented, and the final register,
0310  ; not used here, is also read only.  It generates a 1024
0320  ; Hz square wave on one of the data lines and pulses each
0330  ; second, minute, and hour on the other three data lines.
0340
0350  ; The clock/calendar is driven by a VIA
0360  ; The port assignments are as follows:
0370
0380  ;     PORT  A                PORT B
0390  ; 7 6 5 4 3 2 1 0      7 6 5 4 3 2 1 0
0400  ;---------------------------------------
0410  ; D D D D A A A A              T A R W H
0420  ; 3 2 1 0 3 2 1 0              E D E R O
0430  ;                              S J A I L
0440  ;                              T   D T D
0450  ;                                    E
0460
0470
0480  ; N.B. The actual program has been omitted here.
0490  ;      Only the tables for "SET" prompting
0500  ;      and "READ" formatting are reproduced here.
0510
0520  SET.PRMPT  .BY 'Set time:' $D $A $A
0530  SET.MSG    .BY 'Y10' $A0 'Y01' $A0 'M10' $A0 'M01' $A0
0540             .BY 'D10' $A0 'D01' $A0 'DAY' $A0
0550             .BY '10H' $A0 '01H' $A0 '10M' $A0 '01M' $A0
0560             .BY $FF
0570
0580  DAY.TABL   .BY 'SUNDAY' $80 $80
0590             .BY 'MONDAY' $80 $80
0600             .BY 'TUESDAY' $80
0610             .BY 'WED' $27 'SDA' $D9
0620             .BY 'THURSDA' $D9
0630             .BY 'FRIDAY' $80 $80
0640             .BY 'SATURDA' $D9
0650
0660  MONTH.TABL .BY 0 0 0 $80
0670             .BY 'JAN' $A0
0680             .BY 'FEB' $A0
0690             .BY 'MAR' $A0
0700             .BY 'APR' $A0
0710             .BY 'MAY' $A0
0720             .BY 'JUN' $A0
0730             .BY 'JUL' $A0
0740             .BY 'AUG' $A0
0750             .BY 'SEP' $A0
0760             .BY 'OCT' $A0
0770             .BY 'NOV' $A0
0780             .BY 'DEC' $A0
                 .EN
```

HARDWARE RECOMMENDATION - SYM/KTM ENCLOSURE

We have installed one of our SYM/KTM systems in a very elegant case made by KEN-WAY PRODUCTS, 831 Patton Road, New Brighton, Minnesota 55112.

To quote from the descriptive brochure: "The (aluminum) enclosure features a low profile design with durable textured baked charcoal finish that matches the KTM keys. Solid birch side panels are walnut stained. The SYM is mounted in the hinged top panel which also provides direct access to the SYM keypad."

Our system includes the SYM-1, a KTM-2, a 32K Beta DRAM Board, an FDC-1 Disk Controller, and an HDE FODS Disk Controller. There is still lots o space left over, into which we plan to build a compact 4 A power supply, using the case as the heat sink for the regulator (no fan for us!).

We power up on this system to the FODS DOS, then download the FDC-1 operating system into RAM at $9ØØØ. This is the system on which we will be evaluating and debugging any new DOSes developed for the FDC-1. We have two pairs of BASF 5 1/4 " drives on this system, one dual system for FODS, one dual system for FDC-1. We even have an extra cable coming off the FDC-1 controller card for a pair of 8" drives, for testing the software with 8" systems. We have only one pair of 8" drives around and these are installed on our MTU CODOS system, but can be switched over for testing.

We like the case very much and highly recommend it as a good value. Contact Ken Schaufler (KEN-WAY PRODUCTS), (612) 633-3Ø35 for prices and any additional information.

Ken sent us a copy of one of Sylvia Porter's newspaper columns which pointed out that, this year only (1982), business equipment expenses up to $5ØØØ may be written-off in full, rather than being depreciated! So, buy it this year, if you can manage it.

FORCED TAPE READ

S. G. Knox (we think that's who it was!) sent us this little program he got from Bob Peck to force a cassette read. Might be worth trying if you are having difficulty reading a cassette.

```
                   ØØ1Ø ; ******************************************
                   ØØ2Ø ; *                                        *
                   ØØ3Ø ; *    BOB PECK'S SYM MON 1.1 FORCED       *
                   ØØ4Ø ; *      CASSETTE TAPE READ ROUTINE        *
                   ØØ5Ø ; *              2 MAY 1982                *
                   ØØ6Ø ; *                                        *
                   ØØ7Ø ; ******************************************
                   ØØ8Ø
                   ØØ9Ø ; .OS
                   Ø1ØØ            .BA $ØØ1Ø    ;OR WHEREVER DESIRED
                   Ø11Ø
                   Ø12Ø PLACE      .DE $Ø2ØØ    ;OR WHEREVER
                   Ø13Ø
                   Ø14Ø
ØØ1Ø- 2Ø 86 8B     Ø15Ø START      JSR $8B86    ;ACCESS
ØØ13- A9 Ø2        Ø16Ø            LDA #H,PLACE
ØØ15- 8D 4D A6     Ø17Ø            STA $A64D    ;P2H
ØØ18- A9 ØØ        Ø18Ø            LDA #L,PLACE
ØØ1A- 8D 4C A6     Ø19Ø            STA $A64C    ;P2L
ØØ1D- AØ 8Ø        Ø2ØØ            LDY #$8Ø     ;MODE
ØØ1F- 2Ø A9 8D     Ø21Ø            JSR $8DA9    ;START TAPE ROUTINE
ØØ22- 2Ø 52 8D     Ø22Ø            JSR $8D52    ;READ HIGH SPEED BYTE - SYNC FIND
ØØ25- 2Ø E5 8D     Ø23Ø LOOP       JSR $8DE5    ;READ A BYTE
ØØ28- AØ ØØ        Ø24Ø            LDY #$ØØ
```

```
ØØ2A- 91 FE        Ø25Ø            STA ($FE),Y  ;PUT IT AWAY
ØØ2C- E6 FE        Ø26Ø            INC *$FE     ;BUMP THE POINTER
ØØ2E- E6 FF        Ø27Ø            INC *$FF
ØØ3Ø- 2Ø 3C 8B     Ø28Ø INCDUN     JSR $8B3C    ;TSTAT - STOP IF KEY DOWN
ØØ33- 9Ø FØ        Ø29Ø            BCC LOOP
ØØ35- ØØ           Ø3ØØ            BRK
ØØ36- EA           Ø31Ø            NOP
                   Ø32Ø
                   Ø33Ø
                   Ø34Ø            .EN
```

C/O School of Optometry
University of NSW
P.O. Box 1
Kensington
NSW 2Ø33
Australia

Dr. H. R. Luxenberg
SYM Users' Group
P.O. Box 319
Chico, CA 95927
USA

Dear Dr. Luxenberg:

I have been meaning to write to you for some time now, ever since first reading a copy of SYM-PHYSIS. I have not seen any copies dated later than 198Ø, and so I hope your excellent newsletter is still alive and well. I am writing for two reasons:

1. Is the Users' Group still active? If so I would like to join. Please send me all the details.

2. I thought you may like some details of my system. It was put together in a hurry (are'nt they all?) for data acquisition in the field of neurophysiology. The system supports a 16 input A/D and 2 output D/A, a BCD event counter and external switch register input. There is also an extra 4K RAM. All extras are built into standard 'Radio Shack' 44 pin proto boards. The SYM, memory, extras and KTM-2 all fit into an aluminium box a little bigger than an Apple. I also have an Apple 2+. This is not treason. The Apple communicates with the SYM via the VIAs (if you see what I mean). At present I am not using the full capacity of the SYM. However it is an indispensible part of a piece of apparatus providing timing signals to control stimuli for experiments in vision physiology.

This is not an original idea. The SYM program enclosed is based on a similar program written for a KIM by the Vision Research Labs at the NIH in Washington D.C. The program was whipped up in an afternoon (testimony to the quality of RAE-1). It works, but I'm sure you could find ways of improving the software.

NOTES ON SYM TIMER PROGRAM

The program enables four lines (Port A of 6522#1) to be used as outputs for pulses of precisely controlled length. The states of the lines and the times at which they change are determined by a table located at $3Ø. When triggered, the program loads a 6522 timer with data for 1mS, and enables IRQ interrupts to IRQINT. At IRQINT, a 16 bit count location is decremented. If zeroed, then the count location is updated from the next two bytes of the table (ready for next time interval) and the third byte is output to Port A of 6522 #1. In this way the program makes its way down the table until either $FF or $FE are encountered. If $FE, then pulse train repeats indefinitely. If $FF then program disables IRQ and waits for another 'trig' pulse before

[ED NOTE: line(s) missing from manuscript here]

The enclosed version is not as general in application as was the original. It includes a facility where one line (bit 1) is only enabled during the first pulse train following a DELY pulse (that is what BGFLG is for).

Also, the annotation is a bit skimpy due to my having only 8K for the RAE - 1 files.

The important I/O bits are:

PORT A 6522#1
 Outputs
 Bit 0 - Trig output (e.g. to CRO)
 Bit 1 - Line 1 output (e.g. conditioning stimulus)
 Bit 2 - Line 2 output (e.g. test stimulus)
 Bit 3 - SYM BUSY output (handshake to Apple)
 Inputs
 Bit 6 - Change sixth byte in table to next byte in DLIST
 Bit 7 - Trig in (initialise a pulse sequence)

The function served by bit 6 is peculiar to the type of experiment in which I am presently engaged. This line, when pulsed low, causes the location DELY to be replaced with the next element in a list of delay values at DLIST.

You may guess that the equipment is controlled by an Apple program which calls up the various responses by pulsing bits 7 and 6 low when required.

I am enclosing a circuit diagram of the System as it now stands. I have not written any software for it, though I have written a waveform averaging progam for an Apple with the appropriate hardware. Members of the group are welcome to copies of this. I'm sure it could be adapted easily to any SYM system.

I hope this is of some use to you. If you want more information on my 6502 activities, please write. However I'm only an amateur, and I'm sure I would learn a lot more from the group than I could put into it.

Regards,

/s/ Philip J. Anderton

Here is Mr. Anderton's TIMER program, which we reprint, slightly edited, without having had the time to test it. Following the program we reproduce several of Mr. Anderton's sketches to show the very effective use he has made of the SYM's VIAs.

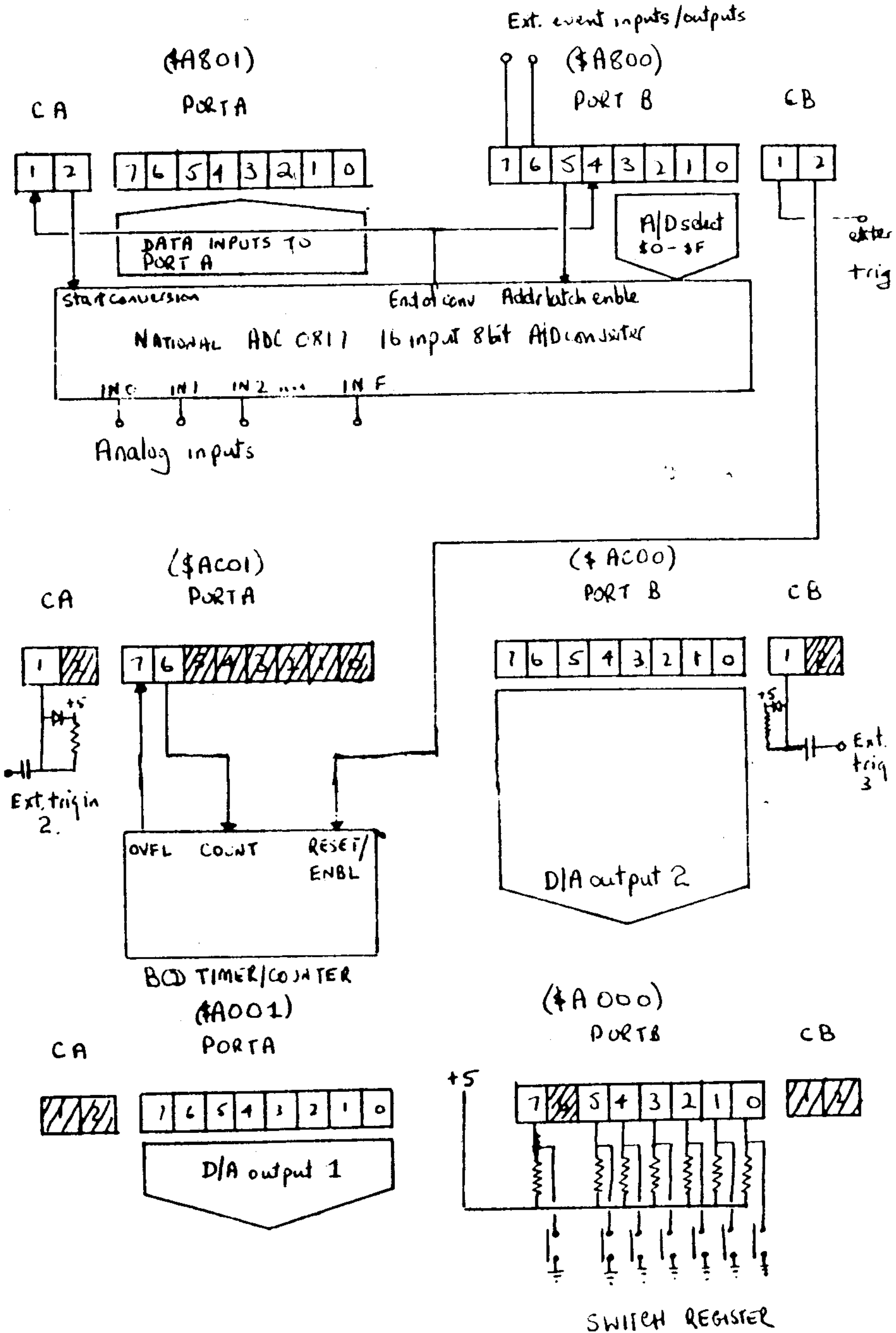
```
0010 ;PROGRAM TO USE SYM AS TIMER
0020
0030             .BA $1800 or wherever
0040 ; .OS
0050
0060 ;6522 ADDRESS DEFINITIONS
0070
0080 ;6522#1
0090
0100 PRTA1       .DE $A001
0110 DDRA1       .DE $A003
0120 T11LO       .DE $A004
0130 T11HI       .DE $A005
0140 ACR1        .DE $A00B
0150 IFR1        .DE $A00D
0160 IER1        .DE $A00E
```

```
                0170  -
                0180 ;6522#2
                0190
                0200 PCR2        .DE $A80C
                0210
                0220 ;6522#3
                0230
                0240 PRTA3       .DE $AC01
                0250 DDRA3       .DE $AC03
                0260
                0270 ;INITIALIZATION DATA
                0280
                0290 ENBT1       .DE $C0
                0300 DIST1       .DE $40
                0310 BUSY        .DE $08 bit 3
                0320
                0330 ;MONITOR ROUTINES
                0340
                0350 USRENT      .DE $8035
                0360 TSTAT       .DE $8B3C
                0370 OUTCHR      .DE $8A47
                0380 UIRQVC      .DE $A678
                0390 SAVER       .DE $8188
                0400 RESALL      .DE $81C4
                0410 GETKEY      .DE $88AF
                0420 OUTBYT      .DE $82FA
                0430 CRLF        .DE $834D
                0440 INTCHR      .DE $8A58
                0450 SCR0        .DE $A630
                0460 ACCESS      .DE $8B86
                0470 OBCRLF      .DE $834A
                0480
                0490 ;PROGRAM LOCATIONS
                0500
                0510 POINTR      .DE $2E 2 bytes
                0520 TABLE       .DE $30 <256 bytes
                0530 TCOUNT      .DE $2C 2 bytes
                0540 DELY        .DE TABLE+6
                0550 DELPTR      .DE $2A
                0560 ENDFL       .DE $29
                0570 BGFLG       .DE 28 mask to disable bit 1
                0580
                0590 ;PROGRAM STARTS HERE
                0600
1800- 20 86 8B  0610 MAIN        JSR ACCESS
1803- 20 7F 18  0620             JSR INIT
1806- 20 0F 19  0630 MAIN1       JSR BUSYLO
1809- AD 01 A0  0640             LDA PRTA1 test for pulse inputs
180C- 09 0F     0650             ORA #$0F
180E- 2A        0660             ROL A
180F- 90 3B     0670             BCC TRIG tigger input low?
1811- 2A        0680             ROL A
1812- 90 07     0690             BCC NDLY new delay input low?
1814- 20 3C 8B  0700             JSR TSTAT key pressed?
1817- 90 ED     0710             BCC MAIN1
1819- 78        0720             SEI
181A- 60        0730             RTS
181B- 20 75 18  0740 NDLY        JSR WAIT
181E- 20 06 19  0750             JSR BUSYHI set bit 3 hi
1821- A9 FF     0760             LDA #$FF
1823- 85 1C     0770             STA $BGFLG enable one pulse only for bit 1
1825- A0 00     0780             LDY #$00 and update dely value
1827- E6 2A     0790             INC $DELPTR
1829- B1 2A     0800             LDA (DELPTR),Y
182B- C9 FF     0810             CMP #$FF
```

```
182D- DØ Ø3      Ø82Ø               BNE ND1
182F- 2Ø C3 18   Ø83Ø               JSR INITPRD
1832- B1 2A      Ø84Ø ND1           LDA (DELPTR),Y
1834- 85 36      Ø85Ø               STA $DELY
1836- 2Ø FA 82   Ø86Ø               JSR OUTBYT
1839- E6 2A      Ø87Ø               INC $DELPTR
183B- B1 2A      Ø88Ø               LDA (DELPTR),Y
183D- 85 37      Ø89Ø               STA $DELY+1
183F- 2Ø FA 82   Ø9ØØ               JSR OUTBYT print it for debugging
1842- 2Ø 4D 83   Ø91Ø               JSR CRLF
1845- 2Ø ØF 19   Ø92Ø               JSR BUSYLO
1848- DØ BC      Ø93Ø               BNE MAIN1
184A- FØ BA      Ø94Ø               BEQ MAIN1
184C- 2Ø 75 18   Ø95Ø TRIG          JSR WAIT new pulse train
184F- A9 ØØ      Ø96Ø               LDA #$ØØ
1851- 85 29      Ø97Ø               STA $ENDFL
1853- 2Ø Ø6 19   Ø98Ø               JSR BUSYHI
1856- 2Ø FB 18   Ø99Ø               JSR LDSTRT load and start clk
1859- A9 CØ      1ØØØ               LDA #ENBT1
185B- 8D ØE AØ   1Ø1Ø               STA IER1 enable
185E- 58         1Ø2Ø               CLI interrupts from clk
185F- A5 29      1Ø3Ø TR1           LDA $ENDFL if either endflag or
1861- DØ Ø5      1Ø4Ø               BNE TR2
1863- 2Ø 3C 8B   1Ø5Ø               JSR TSTAT
1866- 9Ø F7      1Ø6Ø               BCC TR1 keypressed then stop
1868- A9 4Ø      1Ø7Ø TR2           LDA #DIST1
186A- 8D ØE AØ   1Ø8Ø               STA IER1
186D- A9 ØØ      1Ø9Ø               LDA #$ØØ
186F- 8D 29 ØØ   11ØØ               STA ENDFL
1872- 78         111Ø               SEI
1873- FØ 91      112Ø               BEQ MAIN1 ALWAYS
                 113Ø
1875- AD Ø1 AØ   114Ø WAIT          LDA PRTA1 wait for all switched 2B cleared
1878- Ø9 ØF      115Ø               ORA #$ØF
187A- 49 FF      116Ø               EOR #$FF
187C- DØ F7      117Ø               BNE WAIT
187E- 6Ø         118Ø               RTS
                 119Ø
                 12ØØ ;INIT ROUTINE
                 121Ø
187F- 2Ø E5 18   122Ø INIT          JSR LTBL initialise vectors and pointers
1882- 2Ø AF 18   123Ø               JSR INITPR
1885- A9 1A      124Ø               LDA #L,IRQINT
1887- 8D 78 A6   125Ø               STA UIRQVC
188A- A9 19      126Ø               LDA #H,IRQINT
188C- 8D 79 A6   127Ø               STA UIRQVC+1
188F- A9 ØF      128Ø               LDA #$ØF
1891- 8D Ø3 AØ   129Ø               STA DDRA1
1894- A9 CØ      13ØØ               LDA #$CØ
1896- 8D ØC A8   131Ø               STA PCR2 ENBL TIMER
1899- 8D ØB AØ   132Ø               STA ACR1
189C- 8D Ø1 AC   133Ø               STA PRTA3
189F- 8D Ø3 AC   134Ø               STA DDRA3
18A2- A9 8Ø      135Ø               LDA #$8Ø
18A4- 8D Ø1 AC   136Ø               STA PRTA3
18A7- 2Ø CC 18   137Ø               JSR INITCNT
18AA- A9 FD      138Ø               LDA #$FD
18AC- 85 1C      139Ø               STA $BGFLG
18AE- 6Ø         14ØØ               RTS
                 141Ø
18AF- 2Ø BA 18   142Ø INITPR        JSR INITPRT initialise both pointers
18B2- 2Ø C3 18   143Ø               JSR INITPRD
18B5- A9 A6      144Ø               LDA #L,DLIST+9 pnt to 2nd last byte on initial
18B7- 85 2A      145Ø               STA $DELPTR
18B9- 6Ø         146Ø               RTS
                 147Ø
```

```
18BA- A9 3Ø      148Ø INITPRT       LDA #L,TABLE
18BC- 85 2E      149Ø               STA $POINTR
18BE- A9 ØØ      15ØØ               LDA #H,TABLE
18CØ- 85 2F      151Ø               STA $POINTR+1
18C2- 6Ø         152Ø               RTS
                 153Ø
18C3- A9 9D      154Ø INITPRD       LDA #L,DLIST
18C5- 85 2A      155Ø               STA $DELPTR
18C7- A9 19      156Ø               LDA #H,DLIST
18C9- 85 2B      157Ø               STA $DELPTR+1
18CB- 6Ø         158Ø               RTS
                 159Ø
18CC- A9 Ø1      16ØØ INITCNT       LDA #$Ø1 initialise 16 bit counter
18CE- 85 2C      161Ø               STA $TCOUNT
18DØ- A9 ØØ      162Ø               LDA #$ØØ
18D2- 85 2D      163Ø               STA $TCOUNT+1
18D4- 6Ø         164Ø               RTS
                 165Ø
18D5- A9 8Ø      166Ø COUNT         LDA #$8Ø send a pulse to BCD counter
                 167Ø ;                      (port A 6522#3, bit 7)
18D7- 8D Ø1 AC   168Ø               STA PRTA3
18DA- A9 ØØ      169Ø               LDA #$ØØ
18DC- 8D Ø1 AC   17ØØ               STA PRTA3
18DF- A9 8Ø      171Ø               LDA #$8Ø
18E1- 8D Ø1 AC   172Ø               STA PRTA3
18E4- 6Ø         173Ø               RTS
                 174Ø
18E5- 2Ø BA 18   175Ø LTBL          JSR INITPRT load TABLE at zero page
18E8- AØ FF      176Ø               LDY #$FF
18EA- C8         177Ø LT1           INY
18EB- B9 8A 19   178Ø               LDA DATA,Y
18EE- 91 2E      179Ø               STA (POINTR),Y
18FØ- C9 FF      18ØØ               CMP #$FF
18F2- FØ Ø6      181Ø               BEQ LT2
18F4- C9 FE      182Ø               CMP #$FE
18F6- FØ Ø2      183Ø               BEQ LT2
18F8- DØ FØ      184Ø               BNE LT1
18FA- 6Ø         185Ø LT2           RTS
                 186Ø
18FB- A9 E8      187Ø LDSTRT        LDA #$E8 load and start clock
18FD- 8D Ø4 AØ   188Ø               STA T11LO
19ØØ- A9 Ø3      189Ø               LDA #$Ø3
19Ø2- 8D Ø5 AØ   19ØØ               STA T11HI
19Ø5- 6Ø         191Ø               RTS
                 192Ø
19Ø6- AD Ø1 AØ   193Ø BUSYHI        LDA PRTA1 set bit 4 hi (anytime)
19Ø9- Ø9 Ø8      194Ø               ORA #BUSY
19ØB- 8D Ø1 AØ   195Ø               STA PRTA1
19ØE- 6Ø         196Ø               RTS
                 197Ø
19ØF- A9 Ø8      198Ø BUSYLO        LDA #BUSY set bit 4 lo (anytime)
1911- 49 FF      199Ø               EOR #$FF (BUSYHI and BUSYLO can be corrupted
                 2ØØØ ;                      by interrupt routine)
1913- 2D Ø1 AØ   2Ø1Ø               AND PRTA1
1916- 8D Ø1 AØ   2Ø2Ø               STA PRTA1
1919- 6Ø         2Ø3Ø               RTS
                 2Ø4Ø
191A- 48         2Ø5Ø IRQINT        PHA  ;interrupt routine does it all
191B- 98         2Ø6Ø               TYA
191C- 48         2Ø7Ø               PHA
191D- AD ØD AØ   2Ø8Ø               LDA IFR1
192Ø- 8D ØD AØ   2Ø9Ø               STA IFR1
1923- 8D 3Ø A6   21ØØ               STA SCRØ
1926- AD ØE AØ   211Ø               LDA IER1
1929- 2D 3Ø A6   212Ø               AND SCRØ
```

```
192C- DØ Ø8     213Ø          BNE IQ1
192E- A9 ØØ     214Ø          LDA #$ØØ
193Ø- 8D ØB AØ  215Ø          STA ACR1
1933- 2Ø 35 8Ø  216Ø          JSR USRENT if wrong source of int goes to mon
1936- F8        217Ø IQ1      SED DECIMAL MODE
1937- 38        218Ø          SEC prepare to subtract
1938- A5 2C     219Ø          LDA *TCOUNT decrement 16 bit counter
193A- E9 Ø1     22ØØ          SBC #$Ø1
193C- 85 2C     221Ø          STA *TCOUNT
193E- A5 2D     222Ø          LDA *TCOUNT+1
194Ø- E9 ØØ     223Ø          SBC #$ØØ
1942- 85 2D     224Ø          STA *TCOUNT+1
1944- A5 2C     225Ø          LDA *TCOUNT
1946- DØ 3D     226Ø          BNE ENDINT end interrupt if not zero
1948- A5 2D     227Ø          LDA *TCOUNT+1
194A- DØ 39     228Ø          BNE ENDINT "        "
194C- AØ ØØ     229Ø          LDY #$ØØ
194E- B1 2E     23ØØ          LDA (POINTR),Y get next byte in table
195Ø- C9 FE     231Ø          CMP #$FE if $FE or $FF do appropriate things
1952- FØ 12     232Ø          BEQ IQ2
1954- C9 FF     233Ø          CMP #$FF
1956- DØ 1A     234Ø          BNE IQ3
1958- A9 Ø1     235Ø          LDA #$Ø1 if $FF then disable and end interrupts
195A- 8D 29 ØØ  236Ø          STA ENDFL
195D- A9 4Ø     237Ø          LDA #DIST1
195F- 8D ØE AØ  238Ø          STA IER1
1962- A9 FD     239Ø          LDA #$FD
1964- 85 1C     24ØØ          STA *BGFLG
1966- 2Ø D5 18  241Ø IQ2      JSR COUNT if $FE count one and reinit pointers
                242Ø ;                  without disable
1969- 2Ø BA 18  243Ø          JSR INITPRT
196C- 2Ø CC 18  244Ø          JSR INITCNT
196F- 4C 85 19  245Ø          JMP ENDINT
1972- 85 2D     246Ø IQ3      STA *TCOUNT+1 if not $FF or $FE then must be
                247Ø ;                      new time/port info
1974- E6 2E     248Ø          INC *POINTR load new timer
1976- B1 2E     249Ø          LDA (POINTR),Y and port data (masked by BGFLG)
1978- 85 2C     25ØØ          STA *TCOUNT
197A- E6 2E     251Ø          INC *POINTR
197C- B1 2E     252Ø          LDA (POINTR),Y
197E- 25 1C     253Ø          AND *BGFLG
198Ø- 8D Ø1 AØ  254Ø          STA PRTA1
1983- E6 2E     255Ø          INC *POINTR dont forget update TABLE pntr and
1985- D8        256Ø ENDINT   CLD NORMAL exit interrupt
1986- 68        257Ø          PLA
1987- A8        258Ø          TAY
1988- 68        259Ø          PLA
1989- 4Ø        26ØØ          RTI
                261Ø
198A- ØØ 1Ø Ø9  262Ø DATA     .BY $ØØ $1Ø $Ø9
198D- Ø1 ØØ Ø8  263Ø DELY1    .BY $Ø1 $ØØ $Ø8
199Ø- Ø1 ØØ ØA  264Ø DELY2    .BY $Ø1 $ØØ $ØA
1993- Ø1 ØØ ØE  265Ø TEST1    .BY $Ø1 $ØØ $ØE
1996- Ø1 ØØ ØA  266Ø TAIL1    .BY $Ø1 $ØØ $ØA
1999- Ø1 ØØ ØØ  267Ø TAIL2    .BY $Ø1 $ØØ $ØØ $FF
199C- FF
199D- Ø1 ØØ Ø2  268Ø DLIST    .BY Ø1 ØØ Ø2 ØØ Ø3 ØØ Ø4 ØØ Ø5 ØØ $FF
19AØ- ØØ Ø3 ØØ
19A3- Ø4 ØØ Ø5
19A6- ØØ FF
19A8- FF FF FF  269Ø          .BY $FF $FF $FF $FF
19AB- FF
                27ØØ
                271Ø          .EN
```



MR. PACMAN, MEET MR. SYMMAN!

We reproduce below extracts from a very recent letter sent us by Daniel Wuethrich (you may recognize his letterhead from a previous issue!). This is followed by an edited copy of the Instruction Manual he provided on FDC-1 format diskette and three Epson MX-8Ø printouts showing the appearance of the Visible Memory screen at various stages of the game. And, finally, some additional comments by us on SYMMAN . . . .

ibw

INGENIEURBÜRO WÜTHRICH BRUGG
Hardware Mikroprozessor-Software Prozesssteuerungen Prototyp-Entwicklungen Kleinserien

Dear Lux and Jean,

I like to send to You a computer game I made for my visible memory. It is similar to the well known arcade-game PACMAN. For copyright reason I call my game SYMMAN. If You like this game, I would be glad if You can sell it to other SYM-users. I let You select a resonable price. If You can sell the game please don't send any money to me, just keep it for my future orders.

Enclosed is a disk with the following files (in SYMDOS):
- T.SYMMAN = Manual for the game
- M.SYMMAN = Machine-Code of the game (Ready to start)
- S.SYMM.P1 = Source-Code Part 1
- S.SYMM.P2 = Source-Code Part 2

For the game You need a joystick with 4 switches for the 4 directions. The analog joystick (with variable resistors) You gave to me can not be used for this game. For Your information: I made the hard- and software for this analog joystick, but the precision was not good enough to draw nice figures on the screen.

I look forward to see You in Switzerland. Are You already planning Your Europe-trip ?

SYM-cerly Yours

Daniel

Daniel A. Wüthrich
Ing.büro Wüthrich

SYMMAN MANUAL

1.HARDWARE

You need a joystick with 4 switches for the directions UP, DOWN, LEFT and RIGHT plus an additional button for ACTION.
You can buy such a joystick as a spare part from a computer game distributor (e.g., Commodore, Atari, etc.). With a little skill you can build your own.
Connect the joystick to any free 8-bit port as follows:

```
GROUND : all switches
bit Ø  : UP-switch
bit 1  : DOWN-switch
bit 2  : ACTION-switch
bit 3  : -
bit 4  : -
bit 5  : -
bit 6  : LEFT-switch
bit 7  : RIGHT-switch
```

(text continued to page 13/14-67)

```
>RUN $4ØØØ
```

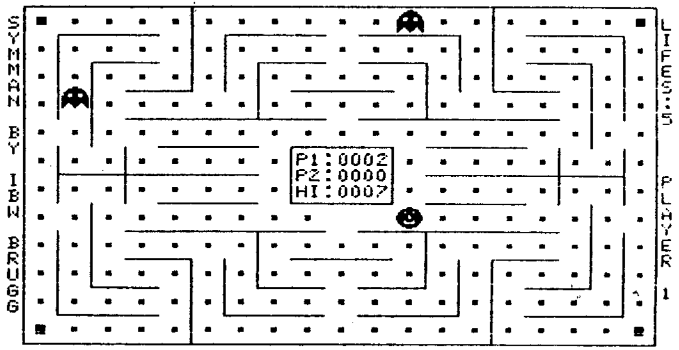


FIGURE 1: The game has just started, with Player 1. SYMman has 5 lives (forgive the mis-spelling) left. SYMman started at the center of the screen, just below the score display, and has gobbled up 2 of the dots, on his trip to the right. Since we had not added the joystick control, SYMman continued moving right, picking up 5 more dots, until he was trapped by the wall of the maze. The HI score of 7 was from previous "runs".

```
>RUN $4ØØØ
```

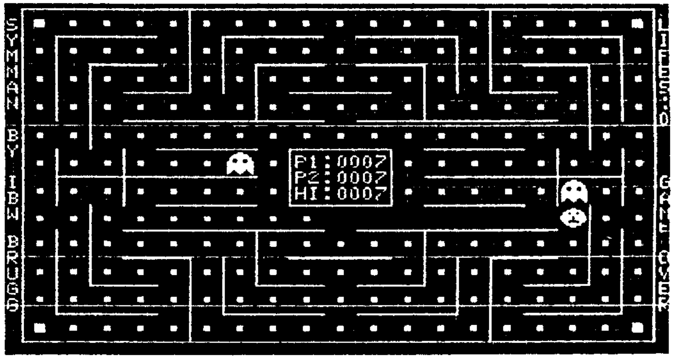


FIGURE 2: (Printed as a "negative" for variety) We watched, helplessly, as SYMman lost all five lives to the octopi, then watched the same sequence occur with Player 2. Here Player 2 has Ø lives left, and SYMman is just about to be devoured by the octopus just above him, ending the game.

(Yes, we will be adding a joystick, as soon as we can. We think we owe it to ourself, to play a game once in a while, and we do want to help SYMman rise above the measly 7 point score!!!)

TYPICAL OF ONE INPUT:

```
                   o +5 Volts
                   !
                  ---
                  ! !   Resistor 1 Kohm
                  ! !
                  ---
                   !
       o-----------o-------------->  to port
      /
     / o-----------o
                   !
    switch         !
                  ---  GROUND
```

Memory needed: 8 K MTU Visible Memory
                8 K to play the game
               32 K to assemble

2. SOFTWARE

Load the programm M.SYMMAN (from $2ØØ-$1AFF). Set the following memory locations:

$2Ø3 : e.g., $2Ø   Visible Memory origin (e.g., VM from $2ØØØ to $3FFF)

$2Ø4 : e.g., $ØØ   Low byte address of joystickport

$2Ø5 : e.g., $A8   High byte address of joystickport (e.g., $A8ØØ

Then type G 2ØØ <CR>

3. THE GAME

Try to catch all dots in the maze by moving Your SYMMAN (smiling sun) with the joystick. Your enemies are the octopi (2 at the beginning up to 5). They follow you and try to catch you. Normally you have 5 lives, after that Player 2 can play. If you want to change the lives per game, then change memory location $2Ø8 (1...9). Catching one of the 4 large dots at the corners make the octopi black for a few seconds. When the octopi are black you can eat then and they are sent to the other end of the maze.

POINTS: small dot = 1 point
         large dot = 5 points
         black oct = 1Ø to 9Ø points depending on the number of octopi in the maze and on the number of octopi already eaten

After catching all dots the game starts automatically again with one octopus more (up to 5).

DISPLAY: In the middle of the maze you see the points of Players 1 and 2 and the high score. The high score is in memory $2Ø6 and $2Ø7. If you want to save the high score after the game, then simply save the whole programm back to disk or cassette.
At the right border of the maze you see the number of lives and which Player has to play.
After Player 2 loses his last life GAME OVER is displayed.

RESTART: After GAME OVER press the ACTION button briefly to restart the game. If you press the ACTION button longer than 1 second a jump to SYM-MONITOR is executed.

>RUB $4ØØØ

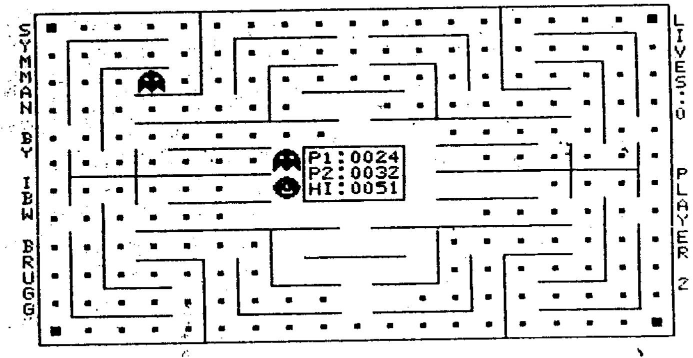


FIGURE 3: We gave SYMMAN a sporting chance by allotting him 9 lives and giving him the opportunity to take a "quasi-random walk", actually more nearly a drunken stagger. We did this by letting the program sample the free-running timer at $A8Ø4, rather than the nonexistent joystick at $A8ØØ. We inhibited the jump to SUPERMON after GAMEOVER so that the game would always restart, and left it running overnight. We stopped the game with RST just as Player 2 had lost his last life, and was about to be devoured, triggering GAMEOVER. We also corrected the spelling of "lives".

MORE ON SYMMAN

Dan Wuethrich was the second to send us material for review and publication on an FDC-1 diskette (Jeff Lavin was the first, but he also sent backup on cassette, since our FDC-1/FODS Dual-Dual Disk Drive System (F/F D-D DDS) was not yet ready). We read Dan's FDC-1 diskette and transcribed the material to a FODS diskette on our newly completed F/F D-D DDS.

We transfered the diskette to our main development system (the only one interfaced to the Epson for graphics printout; all others use the decwriter II on the 2Ø mA loop at 6ØØ baud for printout, or, if the printer patch is not resident, we log-on with the decwriter as a TTY-type terminal at 11Ø baud whenever we need hard copy), so that we would, eventually, be able to make hard copy images of the Visible Memory display(s).

As of now, our only Visible Memory (which is an MTU product) is on another system at $2ØØØ-$3FFF, built into an MTU Card-File, with the MTU

CODOS (Channel Oriented Disk Operating System) resident at $4ØØØ-$7FFF, hence no FODS or FDC-1 available. Thus, we transfered material between the MTU/Vis Mem/CODOS system and our main development system over the cassette interface loop(s) so that we could see the dynamic interactive graphics on one, and print out the static "snapshot" type images on the other.

In the near future (see following article on SUPER-SYM) we hope to have another system going where we'll be able to interrupt a dynamic display during a transition period, so that the printout will show some "blur", thereby creating a feeling of motion in the image (there we go, thinking like a still photographer).

Incidentally, while SYMMAN is black/white only, and does not have the full audio capabilities of the arcade game which it resembles, the visual resolution is excellent, and Dan calls very effectively on JSR BEEP to provide very nice sound effects.

SUPER-SYM

Our SYMs are used rather heavily, by both ourselves and students, so we need to have a large number of them running on a multi-tasking basis. Each of our SYM's has its own personality and capabilities, sort of like siblings in a large family.

For many years we lived comfortably with SYM's built-in limitation of a maximum of 32 K contiguous RAM with a spare utility 4 K at $9ØØØ-$9FFF. We didn't like the fact that the 16 K RAM requirement of CODOS forced us to locate our 8 K Visible Memory at $2ØØØ-$3FFF, right in the middle of our SYM-FORTH, however, and we were looking for a way out of this dilemma.

It wasn't until we started disassembling and reassembling our newest FORTH (see elsewhere in this issue) that we really felt the 32 K limitation. We didn't mind the .CT assembly so much; what did bother us was trying to use KWOK's Cross Referencer to get the "oh, so elegant!" Label File Listings it provides. Now FORTH source code, by virtue of its threaded nature, is essentially a listing of label addresses, and many of the labels are called dozens, or even scores, of times. While each of the two source files could be cross-referenced individually, there was no way to get a complete cross reference label file for both source files into the contiguous 32 K!

We had bought for our own use the complete prototype run, some five or six boards, of Jeff Lavin's AEP-1 32 K RAM boards (the final production boards have additional jumper capabilities not present on the prototypes). We liked the capability of being able to interchange 2 K RAMs and 2 K EPROMs (2716s) so freely, anywhere on the board. We also had a spare Visible Memory, and of course a SYM. We ordered another MTU Card Cage, and shipped the whole collection of boards and stuff to Jeff Lavin, telling him, in a rather vague way, that we needed more contiguous RAM, and the Visible Memory as far up in the memory address space as he could get it.

What he came up with surpassed our wildest dreams. Here, in highly condensed form, are but a few of the details of the SUPER-SYM he built for us:

1) All I/O, etc., relocated and "compacted" as follows:

```
VIA #1 from $AØØØ-$A3FF to $F8ØØ-$F87F
VIA #2 from $A8ØØ-$ABFF to $F88Ø-$F8FF
VIA #3 from $ACØØ-$AFFF to $F9ØØ-$F97F
SYSI/O from $A4ØØ+echo  to $FFØØ-$FF7F
SYSRAM from $A6ØØ+echo  to $FF8Ø-$FFFF
```

2) SUPERMON relocated to $EØØØ-$EFFF in 2 2716s on the SYM-1

3) RAE-1 relocated to $CØØØ-$DFFF in 2 2716s on an AEP-1 (HI-Ø)

4) BAS-1 still at $CØØØ-$DFFF in 2 2716s on an AEP-1 (HI-1)

5) POR circuit modified, and all external addresses changed in the EPROMs for self-consistency

6) Write protect circuitry and .W command modified to provide for bank-switching between two AEP-1 boards at $0000-$7FFF, LO-Ø, LO-1 and between two additional AEP-1 boards at $8000-$FFFF, HI-Ø, HI-1

7) Visible Memory (8 K RAM) is located at $AØØØ-$BFFF

Bank-switch default at POR is to LO-Ø, HI-Ø (with RAE-1). In the command .W wxyz, where wxyz are the four bits corresponding to a single hex byte, "w" and "z" are not used (future expansion for "z"), "x" selects between LO-Ø and LO-1, and "y" between HI-Ø and HI-1.

The MTU Card Cage holds "cards" on five levels. The SYM is at the top level (Level 1), covered with "smokey" lucite, with cutouts for "rare" access to the keypad, and to an AEP-2 I/O board which provides for four additional VIAs in the space assigned to VIA #2 (the AEP-2 plugs into socket U 28 in place of VIA #2).

The Visible Memory is at Level 5. Level 2 holds LO-Ø on the "right" and HI-Ø (with RAE-1) on the "left" (the default AEP-1s), while Level 3 holds LO-1 and HI-1 (with BAS-1).

That leaves Level 4 . . . .

We haven't decided what goes on the left side (we're sure Jeff will come up with several suggestions), but an FDC-1, with custom EPROM and with a modified addressing PROM goes on the right (the Expansion Connector side). Note that we have well over 1 1/4 K available at $F98Ø-$FEFF. We'll put a 2716 in there, using the PROM to give it all address space in the 2 K block $F8ØØ-$FFFF not otherwise spoken for in 1) above (allowing also for the five addresses needed by the FDC-1 I/O registers).

This 2716 will hold a BOOTstrap program to download into RAM whatever DOS we decide to use. Since BOOTs are almost trivially short, typically at most one page or so, we'll still have over 1 K for all sorts of utility "goodies", as well.

With a disk system available we'll remove the BASIC and RAE EPROMs from the AEP-1 HI boards and replace them with RAM, downloading BASIC and RAE (and FORTH, naturally) as needed. We will then have contiguous RAM from $ØØØØ-$BFFF! That is 56 K, friends, not counting the bank-switching!! And there is still an isolated 2 K of RAM at $FØØØ-$F7FF. What about the DOS? The latest word from Steve Cole, of the UK SYMmers Group, is that Arthur Richards estimates that he is about 8Ø% of the way towards completion, and that we should be getting a copy for testing right around the first of the year. It should be ready to announce with our next issue.

We saw the tremendous amount of enhancements Arthur added to FODS, while at the same time compacting the object code more than we would ever have believed possible. Knowing Arthur's work as we do, we believe that his new FDC-1 DOS will be among the very best we have seen. We estimate it will occupy perhaps 6 K or so. Since it will be able to use the 2 K of RAM at $FØØØ-$F7FF for overlays and buffer space, it will not take up too much of the contiguous 56 K of RAM.

Incidentally, Steve has begun to devote most of his time to the BBC computer. We can't blame him; we tried one out when we were in Australia this spring (our spring, that is; their fall). The cost advantage of the single-board computer, e.g., the SYM, over the appliance-type computer, e.g., Atari 8ØØ, Commodore 64, BBC Acorn, Timex-Sinclair, etc., is long since gone. The only remaining two advantages of the single board computer are: 1) you are required to understand more of its "inner workings", and, 2) the single board computer is much more truly a personal sort of thing. The best example we can give for both of these points is the "dream system" we have been describing above.

Jeff did his usual great job on this custom system for us, and provided us with complete documentation for all modifications made to the software, and to the hardware for the SYM-1 itself, the Card Cage, and all other (memory) boards used. He gave us an annotated SYM-1 schematic showing all POR changes and a schematic of the added logic to do the more extensive I/O decoding required. Since this was a custom job, and since space is limited, we cannot reproduce the details here. Contact Jeff directly if you wish more information, especially if you would like similar services. He can provide customized and/or relocated EPROMS for MON, BAS-1, RAE-1, etc., on request. We are now referring all requests for customized and OEM systems to him, since he has a faster response time than we do, with Dick Albers available for support and backup as needed.

Note that, except for the relocations, all software developed on this system will be fully compatible with standard SYMs. We'll borrow an idea from Jack Brown, and use conditionals in our source code, i.e., there will be lines like the following:

```
          MYSIM     .DE  1     ;OR Ø IF NOT MYSIM

                    IFE MYSIM

          ;NORMAL CODE AND/OR DEFINITIONS FOR STANDARD SYM GO HERE

                    ***

                    IFN MYSIM

          ;SPECIAL CODE AND/OR DEFINITIONS FOR MYSIM GO HERE

                    ***
```

We are doing this now with many of the programs we distribute for cassette based systems, in that we define FODS .DE Ø, and include lines with FODS .DE Ø, IFE FODS, and IFN FODS, so that the user with FODS can redefine FODS .DE 1 to get the FODS linkages inserted. We hope soon to be able to do the same for FDC1.

COMPUTER SPEECH

We have long been using the SP-1 SPEAK & SPELL (TM) INTERFACE, marketed as a kit by David P. Kemp, for voice output from our SYM. We have made our SYM into a talking clock, as a novelty demonstration, but have used the SP-1 for a more practical purpose, with the .V (Verify) command, to read back to us, for code checking purposes, a hex dump of long tables which we have entered "by hand".

We understand that the kit is no longer available, and we thought we understood why. At the time we bought the SP-1 it was just about the only way to add, inexpensively, at least, speech capabilities to the SYM (the excellent manual, Release 1.1, bears a copyright date way back in 1979, almost prehistoric, by now).

Since that time a number of alternate approaches have become available, and a casual examination of their specifications and prices led us to believe that some of these approaches might be cheaper and better than the SP-1 approach, especially since the price of the Speak & Spell seemed to be inflating. Dave must have felt that the SP-1 was "obsolete", and that the market for it was dead, and we would have agreed with him.

We have since reexamined the matter, and changed our opinion. First, as to cost: With TI's very active rebate policy (currently $15.ØØ) the S & S is available for as little as $34.97. While the kit is no longer available, except for the PC board, and a special socket to fit the Expansion ROM connector on the S & S, all other parts are obtainable locally at a very nominal cost.

Here is the COMPLETE parts list:

1 ea	4.7 ufd Tantalum Capacitor
1 ea	1Ø K 1/4 W Resistor
1 ea	2N229Ø7 Transistor
1 ea	74175 Quad D Flipflop
1 ea	74368 Hex Tri-state Inverter
2 ea	74395 Four Bit Tri-state Shift Registers

(plus sundry sockets and 16 wire flat cables)

These parts can't be too expensive, anywhere. If the PC board is no longer available, a prototype board of some type could be substituted. Also, we did not really like the makeshift socket provided for interfacing to the S & S PC board, which is much thinner than standard. We would just as soon solder flat cable wires directly to the edge connector traces of the TI board, ourselves.

So much for cost. We think that this approach has got to be the least expensive way to go. And now for the effectiveness: First of all, Kemp's manual provides an educational experience in itself, on the general theory of LPC, and the specifics of the S & S implementation thereof. He provides fully commented source code listings of all required software. Second, additional theory and software listings are available in several manuals written by John P. Cater, "65Ø2 Experimenter Package", and "65Ø2 Phonetic Generator Software".

While we do not fully agree with his specific selection and implementation of phonemes, enough information is provided to add additional phonemes, and to include as many allophones (variants of phonemes, with differing pitches, lengths, levels, and inflections) as desired, to produce very, very, natural sounding speech, even regional dialects, if you wish.

The information provided by Kemp and Cater make the S & S approach one of the most versatile computer speech systems we have seen, at the lowest cost we know of. The price of the manuals should not really be considered only as part of the hardware cost, but rather as supplementary reading, or "required texts", if you like. With this in mind, we now feel that the S & S/SP-1 approach is the most cost/effective way to get 65Ø2 voice I/O, bar none (unless you get the chips, etc., as a gift, or donation, of course).

If any of you are interested in following this approach further, please let us know of your interest. We will then contact Cater and Kemp for resale or reprint rights to their manuals, and ask Kemp if he wishes to provide the PC boards (not complete kits, as in the past), or license us to have them made. We could also obtain the TI interface connectors, as well. We think Dave would certainly be agreeable, especially if we provide the customer support, rather than he having to do it. Customer support can be difficult if you have moved on to other projects, but if you are still actively interested it is kind of fun.

We could also provide RAE source code on cassette, to save you many hours of keying time. Our source code includes conditionals for Kemp's various subprograms, so that any combination(s) of them can be co-resident (we have eliminated duplicated labels), and all sections, including the extensive packed tables (and for Cater's software, the phoneme tables) are fully relocatable and easily extensible.

To end on a humorous note, we have been listening to Victor Borge's, by now "classical", comedy albums, one of which contains a monolog called "Phonetic Punctuation", in which he maintains that spoken speech would be less error-prone if the punctuation marks of written speech were also "soundable". He then assigns various noises and funny sounds to ".", "!", "?", ",", ";", ":", etc., and then "reads" a short story, with the voiced punctuation. We'd like to emulate that with our SYM!

P.S. The Speak & Spell (t/m) is also endorsed by E.T.(c)! E.T. THE EXTRA-TERRESTRIAL

P.P.S. We'd sure like to find a way to use that very nice eight character full alphanumeric fluorescent display to supplement the SYM's six seven-segment LED displays. We do like the green color, too.

MORE ON FDC-1 FIX

To ensure greater stability (?) on the +5 V line, tie more of the +5 V points together. We tied the hole marked "+" between RP1 and pin 14 on U8 to the +5 V turret pin with #22 hookup wire. We don't think that problem is due to lack of decoupling capacitors; rather we feel that there is too much ohmic resistance in the traces, or plated-through holes. The suggested fixes work, although just why is still uncertain.

EDITING BASIC FILES WITH RAE

Here are some of the explanatory notes and comment lines from a RAE program sent us by Rudolf Karg, a Swiss SYMmer, for review and marketing, if we found it to be useful. We tried it, we liked it, and are pleased to offer it as a new product.

After the program is assembled and the object code is stored in high RAM, BASIC is entered as usual, with the usual memory reserve. After you have tested your BASIC program, if you wish to do major editing on any of the program lines, call on this program as instructed. You will then find yourself in RAE with appropriate >SEt limits, where you will be able to use all of RAE's editing features to do such things as finding and/or renaming variables, etc. RAE's >PRint command, if preceded by a CTRL Y will send the program (and you) back into BASIC. It is very interesting to watch the program at work.

Naturally we disobeyed M. Karg's injunction to use the cold entry only once; we wanted to see what would happen with multiple use. Well, each cold entry cut BASIC's memory limit in half till there was no more left to use. The program can be very helpful for "polishing" up your BASIC programs.

```
ØØ1Ø ;***********************************************
ØØ2Ø ;*                                             *
ØØ3Ø ;*  LINK PROGRAM BASIC - RAE/TED FOR SYM-1     *
ØØ4Ø ;*                                             *
ØØ5Ø ;*  COPYRIGHT 198Ø      R. KARG                *
ØØ6Ø ;*                      WILENSTR.27            *
ØØ7Ø ;*                      CH-95ØØ WIL            *
ØØ8Ø ;*                      SWITZERLAND            *
```

```
ØØ9Ø ;*                                                     *
Ø1ØØ ;*  TAPE FILE Ø1  8.JAN.81                             *
Ø11Ø ;*  TAPE Ø46 SIDE A                                    *
Ø12Ø ;*                                                     *
Ø13Ø ;*  ENTER BASIC AND ALLOCATE MEMORYSIZE OR             *
Ø14Ø ;*  TYPE RETURN IF THIS PROGRAM IS STORED              *
Ø15Ø ;*  IN EPROM.                                          *
Ø16Ø ;*  ADD THE FOLLOWING LINES TO YOUR BAS-FILE           *
Ø17Ø ;*                                                     *
Ø18Ø ;*  9997 END                                           *
Ø19Ø ;*  9998 X=USR(&"XXXX",Ø):LIST                         *
Ø2ØØ ;*  9999 X=USR(&"YYYY",Ø):LIST                         *
Ø21Ø ;*                                                     *
Ø22Ø ;*        XXXX  =  COLD.ENTRY                          *
Ø23Ø ;*        YYYY  =  WARM.ENTRY                          *
Ø24Ø ;*                                                     *
Ø25Ø ;*  START CONVERSION FROM BASIC TO RAE/TED             *
Ø26Ø ;*  WITH GOTO 9998 (COLD ENTRY POINT)                  *
Ø27Ø ;*  RETURN TO BASIC WITH CTRL Y  PR  RETURN.           *
Ø28Ø ;*  START EACH FURTHER CONVERSION TO RAE/TED           *
Ø29Ø ;*  WITH GOTO 9999 (WARM ENTRY POINT).                 *
Ø3ØØ ;*                                                     *
Ø31Ø ;*******************************************************
Ø32Ø               .BA $5ØØØ
Ø33Ø               .OS
Ø34Ø ACCESS      .DE $8B86     ;UNWRITE PROT SYST RAM
Ø35Ø EXECUTE     .DE $8855     ;MON EXECUTE ROUTINE
Ø36Ø PARNR       .DE $A649     ;NUMBER OF PARMS
Ø37Ø PAR.3       .DE $A64A     ;POINTER FOR EXECUTE ROUTINE
Ø38Ø OUTVEC      .DE $A663     ;OUTPUT DRIVER VECTOR
Ø39Ø POINTER     .DE $7Ø       ;ASCII TRANSFERBUFFER-POINTER
Ø4ØØ LASTMEMORY  .DE $FD       ;LAST STORED CHARACTER
Ø41Ø MEMORYSIZE  .DE $87       ;BASIC MEMORY SIZE
Ø42Ø TERM.WIDTH  .DE $1A       ;BASIC TERMINAL WIDTH
Ø43Ø BUFF.END    .DE $6E       ;TRANSFERBUFFER-END
Ø44Ø BUFF.START  .DE $6C       ;TRANSFERBUFFER-START
Ø45Ø TOUT        .DE $8AAØ     ;TERMINAL CHR OUT
Ø46Ø RAE.WARM    .DE $BØØ3     ;RAE WARM ENTRY
Ø47Ø CTRL.Y      .DE $ØØ       ;RAE CTRL.Y VECTOR
Ø48Ø SHIFT       .DE $76       ;SCRATCH PAD MEMORY
Ø49Ø ADDM        .DE $77       ;SCRATCH PAD MEMORY
Ø5ØØ DECIMAL     .DE $F9       ;SCRATCH PAD MEMORY
Ø51Ø ;
```

```
Ø85Ø ;********** BASIC TO RAE TEXT EDITOR **********
Ø86Ø ;THIS PROGRAM DIRECTS THE ASCII OUTPUT STREAM, CAUSED BY
Ø87Ø ;THE BASIC "LIST" COMMAND, TO A TRANSFERBUFFER LOCATED
Ø88Ø ;ABOVE THE BASIC FILE.
Ø89Ø ;AS SOON AS THE BASIC "OK" MESSAGE IS DETECTED (END OF
Ø9ØØ ;LISTING) A $ØØ IS PLACED AT THE END OF THE STREAM WORKING
Ø91Ø ;AS LIMITER FOR THE MONITOR EXECUTE COMMAND. THEN THE
Ø92Ø ;BASIC USER COMMAND FOR THE RAE-1 COLD ENTRY IS PLACED
Ø93Ø ;AT THE BEGIN OF THE TRANSFERBUFFER, FOLLOWED BY SOME
Ø94Ø ;RAE SET UP PARAMETERS. AFTERWARDS THE OUTVEC IS CHANGED
Ø95Ø ;BACK TO TOUT AND UNDER MON EXECUTE COMMAND (STARTING
Ø96Ø ;AT THE BEGIN OF THE TRANSFERBUFFER) THE RAE IS ENTERED
Ø97Ø ;AND THE RAE TEXTFILE IS FILLED UP UNTIL A $ØØ TERMINATES
Ø98Ø ;THE EXECUTE COMMAND, HANDING OVER CONTROL TO THE RAE TEXT
Ø99Ø ;EDITOR.
1ØØØ ;IN CASE OF TRANSFERBUFFER OVERFLOW DURING TRANSFER BEFORE
1Ø1Ø ;RECEIVING THE END OF LISTING MESSAGE, THE REMAINING BASIC
1Ø2Ø ;LINES WILL BE OUTPUTTED AND CONTROL REMAINS UNDER BASIC.
1Ø3Ø ;**********
```

```
217Ø ;********** RAE TEXT EDITOR TO BASIC **********
218Ø ;THIS PROGRAM DIRECTS THE ASCII OUTPUT STREAM, CAUSED BY
219Ø ;RAE COMMAND CTRL Y FOLLOWED BY "PR" RETURN, TO TRANSFER-
22ØØ ;BUFFER LOCATED ABOVE THE RAE TEXT FILE.
221Ø ;NOTE THAT THE "PR" COMMAND IS NOT ECHOED AND THAT THERE-
222Ø ;FORE IS A DELAY UNTIL THE TRANSFER IS VISIBLE ON THE CRT.
223Ø ;AS SOON AS THE END OF PRINT MESSAGE "//" IS DETECTED
224Ø ;A $ØØ IS PLACED INSTEAD OF "//" AT THE END OF THE STREAM.
225Ø ;THEN THE BASIC COLD ENTRY TEXT IS GENERATED AND PLACED AT
226Ø ;THE BEGIN OF THE TRANSFERBUFFER. THE OUTVEC IS CHANGED
227Ø ;TO TOUT AND UNDER MON EXECUTE COMMAND BASIC IS ENTERED
228Ø ;AND THE BASIC TEXT FILE IS FILLED UP UNTIL A $ØØ
229Ø ;TERMINATES THE RETRANSFER.
23ØØ ;**********
231Ø ;
```

SOME QUESTIONS AND SOME ANSWERS

We reprint below a letter with some interesting questions, plus some interesting suggestions. We'll also answer his questions, following the letter.

Dear Lux,

As per our conversation concerning the problem with the Basic "PRINT" statement when printing exponential numbers, I have enclosed a listing and tape of a program that demonstrates the problem. The tape is in H.S. format and uses standard default values. Jerry Larsen of SSC said the problem is at address $C92B in the BAS-1 chip. The stored value is $0E and would have to be changed to allow for a larger field. This change would require burning a new chip or putting BAS-1 in RAM. A "PRINT USING" statement as an enhancement to BAS-1 would remove this bug. Do you have one that could be patched to the BAS-1 command list?

Speaking of enhancements to BAS-1, has anyone written an enhancement package to allow disk operations (OPEN, CLOSE, GET, PUT, FIELD), for creating and using Record I/O Files. Virtual files would also be nice. But, while I believe in miracles, this is probably beyond the capability of the Sym-1 and FDC-1. The CHAIN command would allow us to use programs larger than will presently fit in the 32K contiguous memory available on the Sym.

The reason why this letter is so late (I spoke with you two weeks ago) is that I fried the power supply to my Sym. I piggy-backed 4K of static memory chips on the existing 4K of memory on board (see attached article "Beat the High Cost of H-88/89 Memory Expansion; Steve Howard; Microcomputing, August, 1982, pg. 80) and added 16K of static RAM using a board I designed and built. It was a great feeling to see 24K come up on the screen as I signed on to BAS-1, until I noticed smoke coming off the transformer on my power supply. I have since built a new supply using two LM323 chips as regulators - 6 amps. should be enough for a while.

I have added a 2Mhz crystal to my Sym. I can switch select either the 1 or 2Mhz crystal with the Sym under power. My printer is attached to my video terminal through a parallel bus and therefore both must run at the same speed with the printer speed (30 CPS) being the limiting factor. I must therefore run my terminal at 300 baud. This causes problems when I try to connect to my Sym with 2Mhz clock speed. Typing in a "Q" to set the baud rate does not work because doubling the clock on the Sym causes only the follwing baud rates to be recognized: 220, 600, 1200, 2400, 4800, 9600. I got around the problem as follows:

1) Set Sym clock at 1Mhz
2) Turn on system
3) Type in "Q"
4) Sign on to Basic
5) Type in the following:
   X=USR(-29818,0)b̸:b̸POKE 42580,144b̸:b̸POKE 42577,156
   return (the spaces (b̸) are important)(taken from
   Sym Physics 7:4)
6) Set Sym clock at 2Mhz
   Double the H.S. tape format default values if you
   want to read tapes created at 1Mhz clock rate or
   read in the tape at 1Mhz before you perform step
   5 above.

The 2Mhz crystal change was made necessary by a program I use to have the Sym create mazes for my 4 year old son to solve. A 24 block by 50 block maze takes about 20 minutes to compute and 1.5 minutes to print. Gregory got so good at solving them that the Sym could not create them fast enough. The 2Mhz clock rate solved the problem. Now the Sym creates a 24 by 100 maze in the same 20 minutes. I am still trying to solve one of those!

In designing the 16K memory board that I mentioned before, I found an error on page 8-3 of the Sym-1 Reference Manual. I have included a copy of the page with corrections noted.

I am working on a hardware method (no fancy programing) to transfer programs from the PDP-11/70 at work direct to my Sym over a telephone line. I sometimes have to do computation work at home and using the Sym will save money on the phone bills. Some of the programs are over 12K long and not worth the time to key in by hand. The Basic enhancements mentioned before would eliminate the need to rewrite sections of the program to make them compatable with BAS-1.

That's it for now. Waiting to hear from you concerning the enhancements.

Sincerely,

Dennis Kochansky

Dennis Kochansky
118 Hidden Trail
North Plainfield, N.J. 07060

Dennis' problem is that he is attempting to "PRINT" a nicely formatted tabular display of results, depending on the use of ";" in his PRINT statements to do the tabbing for him. Whenever the numbers are too small and have too many significant figures, e.g., Ø.ØØ987654321, which BASIC prints out as 9.87654321E-Ø3, his numbers spill over the tab positions (the $ØE gives a FIXED field of 13 positions, which doubles to 26 for long exponentials).

The simplest solution is to use "," between variables, not ";", and use TAB(N) to do the tabbing. Actually, you may not even need the ",", we think (we leave this as an exercise for the reader!). There is no problem in transfering BAS-1 into EPROMS, modifying it along the way, as desired, except for perhaps not having enough sockets.

Jack Brown's newest BASIC enhancements do have PRINT USING and CHAIN. And, please do continue to believe in miracles, since what you ask is NOT beyond the capabilities of the SYM-1/FDC-1 combo; just wait till next spring for SUPERDOS for FDC-1!

ANOTHER FDC-1 NOTE

We thought we had a real problem with our FDC-1 system, and spent several weeks thinking about a solution. It seems that 25-50% of the times that we powered on, the disk drives started spinning, often with heads loaded and LEDs on; resetting the SYM would not turn them off.

The problem is that the signals to the (read-only) Drive Control Register at $F1XX (or $AFXX on special order) are actually generated by the Hex D-Type Flip-Flop 74LS174 at U13 (MOTOR-ON, SIDE-SELECT, DS-1, and DS-2 go directly to the drives, HLT and DDEN* go to the SY1791-02). The power-on state of these flip-flops is, of course, indeterminate.

Writing $FF or, at least, $04, to $F1XX, will turn off the drives. You will get a "?" when you write, naturally, as the read-back of these addresses will always read $00. Entering $00 will give no "?", but will leave the drives running.

MISCELLANIA

DICK ALBERS and JEFF LAVIN of Alternative Energy Products advise that their next two products for the SYM-1 (and, incidentally, also for AIM 65), are now entering the final development stages, that we should have early prototype units for our evaluation before the end of the year, and that announcement of price and availability can be made in the next issue of SYM-PHYSIS.

These are: 1) an ACIA card permitting asynchronous communication at rates up to 9600 baud, and, 2) an EPROM Burner capable of handling ALL EPROMs from 2516 up, with simple header changes and software options. Jeff, with his hardware know-how, and Dick, with his software and analytic skills, form a truly SYM-biotic pair!

# # #

JACK BROWN, of Saturn Software, sent us five diskettes with review copies of new SYM software. Among the collection is a new DOS, called RAE-DOS, which adds a whole bunch of new commands to RAE, extending its capabilities tremendously. RAE-DOS is usable only with FODS systems.

One of the disks is used with the FODS system to reBOOT to RAE-DOS; the other four disks are then accessed with RAE-DOS. We briefly tested the system and examined many of the utilities and other goodies supplied; it would take many long hours to learn how to exploit all of the treasures there. Jack also supplied us with the RAE-DOS Manual, and the manual for Ralph Deane's MEAN14 (which adds Floating Point Arithmetic to RAE). That is one we will find useful for very fast scientific computations in machine language, such as FFT, etc.

While we are dealers for all of his earlier software, Jack wishes to have all orders for his newer software items to be placed directly through Saturn Software. Thus, we suggest that you contact him directly, and get on the Saturn Softnews mailing list for announcements of his new products.

On the other hand, Jack realizes that preparing and distributing Cassette, FODS, and CODOS versions take up so much of time and energy, that he is hesitant to also support FDC-1 versions. Since we have the ONLY Dual/Dual FODS/FDC-1 SYM that we know of, we have the equipment to do the conversion, testing, and distribution of FDC-1 versions of certain selected software items. We are currently discussing with Jack the possibility of becoming the distributor for FDC-1 SUPERDOS versions. Incidentally, there are already far more FDC-1 SYMs out there than FODS and CODOS combined.

# # #

SERGE MATOVICK, of Incon Electronics Inc., 782 Damien Way, Mississauga, Ontario, Canada L5C 3H2, (416) 273-4499, sent us photographs and spec sheets for three products he helped design. These are a Programmable Controller, a Programmer-Emulator, and a Simulator. These look OK, and the prices seem reasonable, but we have NOT tried them personally. If you wish additional information on these items, contact Serge directly.

# # #

Thanks to everyone whose contributed programs and/or articles were deferred to future issues. Space is at a premium, of course, so not every item submitted can be published. We "referee" the articles for "quality", of course, whatever that means, but our choice is based mainly on getting sufficient variety into each issue so that each reader, hopefully, will find at least one article per issue which justifies his subscription costs.

We try to "validate" each program by actual test, and each hardware suggestion by going over the theory involved. We now have enough voluntary reviewers to speed up the process as follows: We will transcribe all received cassettes to disk, or make copies of received diskettes, and Xerox all accompanying manuscript material. We will then send the original materials to the reviewers, notifying the authors of the status.

Several readers have been kind enough to have sent "Computerized Indexes" to partial volumes of SYM-PHYSIS, but these are not in a form which permits easy cumulative updating. "SANDY" MACKAY has sent us a copy of his DATA MANAGEMENT SYSTEM (DMS), which runs under Brown's Extended Disk BASIC (EDB-FODS version), but up to now we have been memory limited. When we get our FDC-1 SUPERDOS going on the SUPERSYM, with all that RAM available, we'll write our own DMS in FORTH. If all goes well, we'll mark up a complete set of back issues with appropriate KEYWORDs, and have the data entered in page number sequence, then sorted by KEYWORDs. This is a long-range project, and our plan is to include an Index to Issues 0 through 17 in Issue 17.

Here's a CONTEST ANNOUNCEMENT: We'll award a complimentary "Lifetime" Subscription to whoever submits the best new masthead to be used in Volume 4. We'd prefer something which uses the graphics capabilities of the Epson, but will accept camera-ready copy, otherwise. Entries due by 1 March 1983.

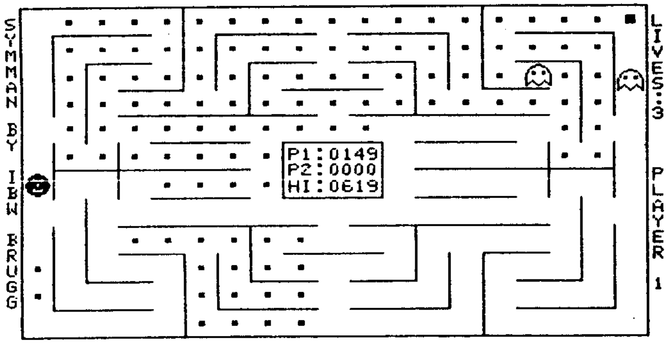
VIC-20 & COMMODORE 64

We had long been thinking that the VIC-20 would be a far better buy than the RCA VP3301 Data Terminal which we have been using as an output peripheral for our SYM, mainly for video titles. We were also thinking that the VIC-20, with its better keyboard than the Timex-Sinclair (plus color), was bringing closer the day when college students would be required to have their own computers, just as once they provided their own slide-rules (remember?), and we were "evaluating" the VIC-20 with that possibility in mind.

We still think the VIC-20 would provide a good beginners' introduction to computers, but the Commodore 64 is a much more value-packed item, one we want to learn more about. We therefore visited a local computer store to study the manuals on the Commodore 64. We skimmed through the User's Manual and plan to return when the Programmer's Manual is in stock to read that, too.

While there, we bought a Commodore 64 Joystick, and soon as we can get a DB-9 male connector, we'll be playing SYMMAN!

SYMMAN, REVISITED



We added the joystick (we just couldn't wait) and played a few (we'd rather not say how long we were at it!) games. Notice the HI score of 619, made by our oldest son, visiting, with his wife and our first grandchild, for Thanksgiving Day. He interfaced the joystick, so he got to play first.

We stopped the game after taking out a corner square so that we could make a printout for you. Note the change in "color" of the octopi; they are now vulnerable to Mr. SYMMAN. After cleaning out all of the dots additional octopi appear to make the game even more challenging.

LOGOUT

Issue 13/14 was fun to put together, with so many readers' contributions to chose from. The hardest part was not having room for all of them, and having to omit so many good items. Now we can turn our energies to personal studies in Voice I/O, and becoming thoroughly proficient in FORTH. We also will be "producing" several half-hour demo videotapes for classroom and lecture use. And, now that the pressure is off, for a while, at least, we'll try to answer the backlog of letters. Also, we'll try to acknowledge future contributions immediately on receipt.

This issue should reach you just before Christmas Day, so let us wish each of you the Season's Best, and a Very Happy New Year. The next three issues are scheduled for mailing at the end of March, July, and November of 1983. Look for us then.

PRODUCT ANNOUCEMENTS

HARDWARE

CLK-1

A new product from Alternative Energy Products (Jeff Lavin). Described in Issue No. 13/14. Ready to install and use, with software on cassette in RAE-1 source code. The card mounts directly on the AEP-2 I/O Board, or it may be "cabled" directly to either of the Application Edge Connectors. Price is $60.00 US/Canada, $63.00 elsewhere, postpaid first-class or airmail. Backup batteries not included!

CUSTOM PROMS FOR FDC-1

We have a few 256x4 N82S129 Bipolar PROMs with "pages" $F0 and $F1 relocated to $AE and $AF, respectively, available at $12.00, postpaid first-class or airmail anywhere.

SOFTWARE

KARG'S BASIC TO RAE EDITOR

Described in Issue No. 13/14. Cassette; complete RAE-1 source code, full instructions, $36.00 postpaid first-class or airmail anywhere.

WUETHRICH'S SYMMAN

Described in Issue No. 13/14. Cassette; complete RAE-1 source code, full instructions, $36.00 postpaid first-class or airmail anywhere.

CARL MOSER'S ASSM/TED (6800) FOR SYM-1

This is just a reminder to those of you using 6800 systems as well as SYMs that this outstanding 6502 to 6800 Cross Assembler (works just like RAE, except for the 6800 mnemonics) is still available at $75.00, first-class or airmail anywhere. Object code on cassettte, resident at $2000-$416A.

PUBLICATIONS

Elcomp's "MICROCOMPUTER HARDWARE HANDBOOK", an 846 page collection of off-prints of spec sheets of lots of TTL, FAST TTL, CMOS, Voltage Regulator, RAM, EPROM, EEPROM, ROM, CPU, Support Circuit, and Interfacing Circuit Chips is available at $17.00 US/Canada, and $18.00 overseas, surface mail only. While it does not cover the very newest, state-of-the-art chips, it is reasonably complete on the "classical" chips, and is handy to have around when you need it.

PRICE INCREASES

We regret that we must pass on publishers' price increases for the following two books:

> Leventhal and Seville's "6502 ASSEMBLY LANGUAGE SUBROUTINES", now $15.50 US/Canada, book-rate, and $18.00 overseas, surface mail.
>
> Zumchak's "MICROCOMPUTER DESIGN AND TROUBLESHOOTING", now $17.50 US/Canada, book-rate, and $18.50 overseas, surface mail.

The AEP-2 I/O Board is now $60.00 US/Canada, $63.00 elsewhere, postpaid first-class or airmail. The AEP-2 I/O Board plugs directly into the VIA #2 socket (U28). If your SYM has been built into an enclosure which does not include sufficient space for direct installation, a special model with an 8" extension cable is available for an additional $12.00.

ATTENTION - OVERSEAS SUBSCRIBERS

We can no longer accept checks from overseas customers which do not bear MICR coding because of the $5.00 to $10.00 surcharge required to cash them. Paying $10.00 to cash a $14.00 check is not a sound business practice. Please switch to a bank using MICR coding.

Here is a sample of MICR encoding: ⑈0034397⑈ ⑆063104972⑆

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