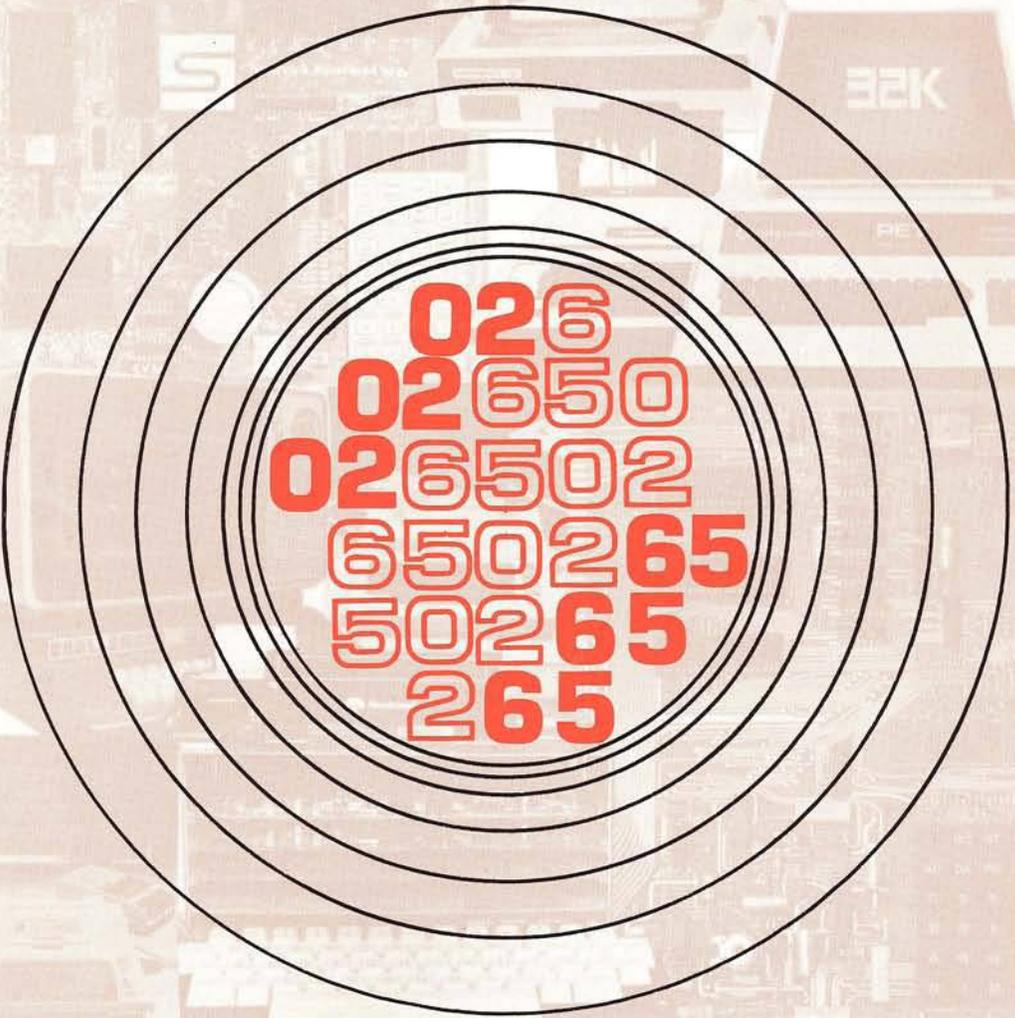


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# MICRO

# THE 6502 JOURNAL



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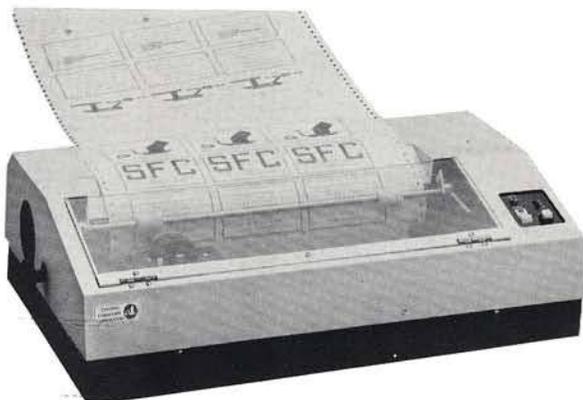
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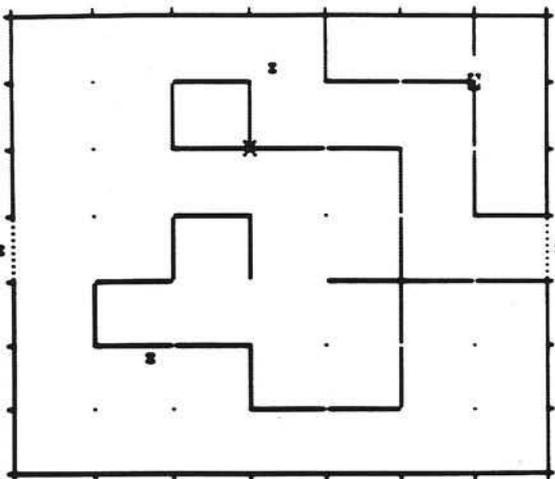
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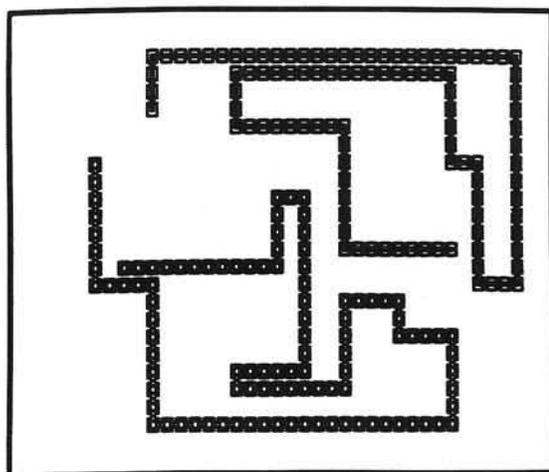
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**Issue Number 24**

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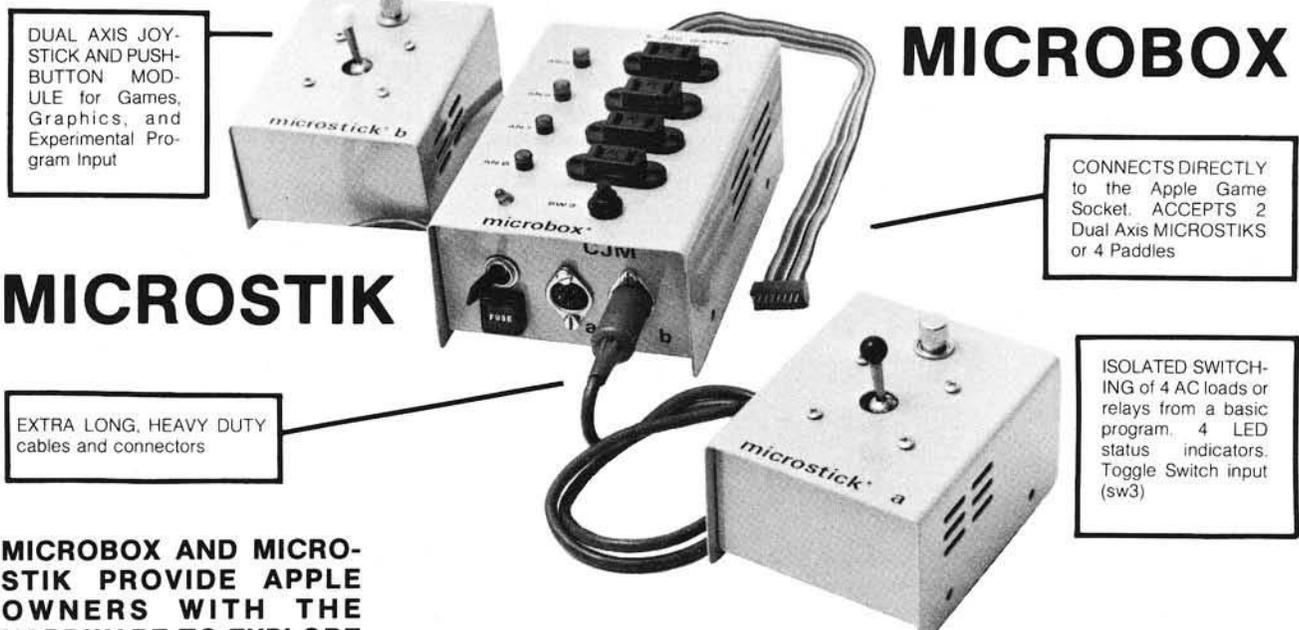
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## More About 16 Bits

Last month's article by Randall Hyde, "The SY6516 Pseudo-16 Bit Processor" [MICRO 23:36] is an interesting combination of a year-old rumor and author fantasy.

More than a year ago, Synertek considered developing a part to be called the SY6516. Several different SY6516's were proposed which significantly differed from each other. It was decided not to develop any of the proposed 6516's. Therefore, it is not "almost ready to ship".

Of course, Synertek does have several other development programs running in both the peripheral and CPU areas. The SY6545 improved CRT controller and the SY6591 floppy disk controller, each with the 6502 bus, will be available later this year.

This letter may not be the action referred to in last month's editorial. A simple phone call to Synertek from Micro to discuss the SY6516 would have forestalled publication of this article which has created so much confusion and annoyance among 6502 enthusiasts.

Michael Smolin  
Strategic Marketing Manager,  
Synertek, Inc.

*Editor's Note: The intent of the above mentioned article, and my editorial "The Value of 16 Bits" [MICRO 23:9], was to spark reader interest in improved versions of our 6502 microprocessor. My intent was **not** to cause anyone "confusion and annoyance" and to the degree that this has occurred, I apologize. I did, by the way, attempt to get some information from my local distributor, but without any success. Now that I have a contact at Synertek who is aware of this type of project, I will certainly check out any Synertek related material in the future.*

*It is heartening to hear that the article and editorial did generate interest in an improved 6502. Several readers have written with their suggestions. If you have any ideas, please send them in. We will present the best ideas in an article in a few months.*

*Robert M. Trapp*

# WHAT'S THE ONE THING NO ONE HAS THOUGHT ABOUT DOING WITH COMPUTERS?



We acknowledge that computers are the most valuable data processing devices ever conceived for business and education, and are the most creative toys on earth. However, the potential of computers has only begun to be explored. Avant-Garde Creations has discovered and developed a way to use computers in the areas of self-transformative experiences, life-awareness, making relationships work, and "getting your act together".

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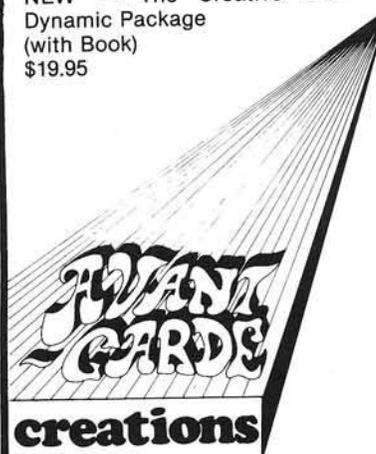
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# ROADRUNNER - A Math Drill for Second - Graders

Remember 'rationalizing' the purchase of your microcomputer on the grounds that 'it would be good for the kids'? Well, here are some suggestions on using your Apple for Computer Assisted Instruction.

Peter A. Cook  
1443 N. 24th Street  
Mesa, AZ 85203

Computer Assisted Instruction (CAI) will spread rapidly in the field of education as the use of small computers becomes more widespread. Children in their earliest school years can enjoy using a keyboard to learn the traditional skills, if programs are prepared with imagination and care. The greatest challenge in designing these programs is the fact that young children too easily become bored and lose interest.

## Making a Game of It

My second-grader was having trouble beating the clock during timed math drills at school, so I devised a program which presents him with 50 practice problems on an Apple II computer. Random addition and subtraction problems such as the following are displayed on the screen.

$$\begin{array}{r} 11 \\ - 2 \\ \hline \end{array} \quad \begin{array}{r} 9 \\ - 5 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ + 4 \\ \hline \end{array} \quad \begin{array}{r} 12 \\ + 0 \\ \hline \end{array}$$

The largest number used is 12, for either operand or result. This can be changed as the needs of the child dictate.

To increase the interest level and heighten the student's motivation, several elements have been added which turn the drill into a game, called "Roadrunner". These added features provide the child with a visible goal, immediate reinforcement, and a certain amount of pressure.

Goal orientation is provided by six animal names which illuminate in sequence as each group of ten problems is completed. The lowest level is the snail, for the beginning problems with a long time interval, progressing to the roadrunner for the last problem with the shortest interval.

The player is informed at the end of each problem whether or not his answer

is correct. If so, the next problem is presented. If not, the problem sequence is stopped, and the player is given as many chances as needed to determine the right answer. The game will not end until the correct answer has been given, so the student isn't left hanging as to what the proper answer should be.

Pressure is applied in the form of a time countdown for each problem. The time interval starts at 20 seconds for the first ten problems, then decreases by two seconds after each set of ten problems is completed.

The game stops running if an answer is not given before the time elapses, or when an answer is incorrect. Once the correct answer is supplied, or when 50 problems are completed, the animal name corresponding to the highest level attained begins flashing. This is accompanied by several beeps from the speaker, to officially announce the end of the game.

## The Program

Coding the Applesoft program was fairly straightforward with the exception of the time countdown. A random number is first selected between 0 and 24. If it is greater than 12, then 12 is subtracted from it, and the problem will be a subtraction problem. A second random number is then selected between 0 and 12. In the case of an addition problem, the sum of the two numbers is checked to be sure it is no higher than 12. For a subtraction problem, the second number is checked to be sure it is less than the first number. The problem is then presented on the screen, and a reply is requested.

The usual method for inputting a reply to a question in Applesoft, using the INPUT or GET statement, will not work in this case because they cause the program to stop and wait indefinitely until a reply is keyed in. Memory location -16384 contains the ASCII value of the last key

depressed, plus 128, provided that the keyboard strobe (-16368) has been reset to zero. (Applesoft BASIC Programming Reference Manual, Apple Computer Inc., 1978) By PEEKing this location repeatedly during a time delay loop, as in program lines 60 through 66, the computer will know whether or not an answer has been keyed in prior to the time interval elapsing. Since a reply could have one or two digits, the return key is used to signify the end of data input and to stop the timer from counting down.

Once the reply is received, it is tested for correctness, and the appropriate message is printed. When ten problems have been completed, the animal name and time delay are changed, and the above process is repeated.

Several changes can be made to the program to make the game more or less challenging, depending on the age and ability of the child. Numbers larger or smaller than 12 can be programmed in by changing H in line 2. The time interval, 20 seconds, is defined by T in line 4, and the decrease after each ten problems, 2 seconds, is subtracted from U in line 84.

One caution needs to be mentioned which could cause some frustration if not explained before using the program. The process of reading the keyboard using PEEK (-16384) depends on the particular time during the cycle that a key is depressed, and for how long. It seems to work about 95 per cent of the time. Watch the screen to be sure each digit is printed before pressing the next key during the time countdown, or an incorrect answer will be accepted. Sometimes the desired key must be pressed one or two additional times. The time interval is purposely long enough to allow for this. Also, if the wrong key is pressed, you cannot back up and correct it.

That completes the description. Type in the program, have your second-grader RUN it, and see if he can answer the problems fast enough to become a ROADRUNNER.

```

LIST0
0 REM "ROADRUNNER", PETE COOK,
  OCT 79
2 H = 12: REM HIGHEST NUMBER
4 T = 20: REM LONGEST TIME, SECON
  DS
6 DIM W$(6): FOR W = 1 TO 6: READ
  W$(W): NEXT
8 DATA SNAIL, TURTLE, CHIPMUNK, RAB
  BIT, COYOTE, ROADRUNNER
10 REM PRINT HEADINGS:
12 HOME : HTAB 11: PRINT "R O A
  D R U N N E R": PRINT : HTAB
  9: PRINT "50 ADD/SUBTRACT PR
  OBLEMS"
14 POKE 34,5: REM TOP MARGIN
16 POKE 33,22: REM WIDTH, ALTERN
  ATES FROM LEFT HALF TO RIGHT
  HALF
18 P = 1: X = 0: Y = 1: Z = 0: U = T:
  REM RESETS VARIABLES FOR NE
  W GAME
20 REM PRINT ANIMALS:
21 VTAB 10: FOR W = 1 TO 6: IF W
  = Y THEN INVERSE : IF Z =
  1 THEN FLASH
22 PRINT W$(W): NORMAL : PRINT :
  NEXT
23 IF Z = 1 THEN FOR C = 1 TO 5
  : FOR D = 1 TO 10: NEXT D: PRINT
  CHR$(7): NEXT C: GOTO 90:
  REM 5 BEEPS
24 REM BLANK LAST PROBLEM, PRIN
  T NEW NUMBER AND TIME REMAIN
  ING:
25 VTAB 6: CALL - 868: REM BLA
  NK LINE
26 POKE 32,17: REM LEFT MARGIN
27 FOR C = 1 TO 20: FOR D = 1 TO
  60: NEXT D: CALL - 912: NEXT
  C: REM SCROLL UP ONE LINE
28 POKE 32,0: VTAB 6: PRINT "NUM
  BER: "; P: POKE 32,17: FOR D =
  1 TO 1000: NEXT : REM DELAY
29 VTAB 6: HTAB 3: PRINT "SECON
  D
  S: "; U
30 REM SELECT NUMBERS:
31 S$ = "+ ": L = H: A = 0
32 M = INT ( RND (1) * 100): IF
  M > 2 * H THEN 32: REM TOP N
  UMBER
34 N = INT ( RND (1) * 100): IF
  N > H THEN 34: REM BOTTOM NU
  MBER
36 IF M > H THEN 42: REM SUBTRAC
  T
38 S = M + N: IF S > H THEN 34
40 GOTO 46
42 L = M - H: IF N > L THEN 34: REM
  TOP NUMBER MUST BE LARGER
44 S = L - N: S$ = "- ": M = L
45 REM PRINT PROBLEM:
46 FOR D = 1 TO 1000: NEXT : REM
  DELAY
50 VTAB 9: HTAB 8: IF M < 10 THEN
  HTAB 9: REM RIGHT JUSTIFY
52 PRINT M: HTAB 6: PRINT S$:
54 IF N < 10 THEN HTAB 9
55 PRINT N: HTAB 6: PRINT "----"

```

## ROADRUNNER

50 ADD/SUBTRACT PROBLEMS

NUMBER: 32	SECONDS: 9
SNAIL	12
TURTLE	<u>4</u>
CHIPMONK	ANSWER? 7
RABBIT	WRONG, TRY AGAIN.
COYOTE	ANSWER? 8
ROADRUNNER	RIGHT!

**Figure 1: End of game, Problem 32 was answered incorrectly. "RABBIT" flashes to show highest level achieved.**

```

56 REM INPUT ANSWER, TEST IT:
57 V = U * 18: REM MULTIPLIER FO
  R ACTUAL SECONDS
58 PRINT : PRINT : HTAB 3: PRINT
  "ANSWER? ": REM NO CURSOR
60 I = PEEK ( - 16384): POKE -
  16368,0: REM READ KEYBOARD,
  RESET KEYBOARD STROBE
62 IF I = 141 THEN VTAB 15: GOTO
  74: REM RETURN KEY INDICATE
  S ALL DIGITS RECEIVED
64 IF I > 127 THEN A = A * 10 +
  VAL ( CHR$( I - 128)): VTAB
  14: HTAB 11: PRINT A: REM
  WEIGHT KEYSTROKES FOR UNITS,
  TENS
66 V = V - 1: IF V > 0 THEN VTAB
  6: HTAB 13: PRINT " "; HTAB
  12: PRINT INT ( V / 18): GOTO
  60: REM BLANK SECOND DIGIT
  OF SECONDS REMAINING
70 Z = 1: VTAB 16: HTAB 5: PRINT
  CHR$(7): "TOO LATE!"
72 PRINT : PRINT : HTAB 3: INPUT
  "ANSWER? "; A
74 IF A = S THEN 78: REM CORRECT
  ANSWER
76 Z = 1: PRINT : HTAB 5: PRINT "
  WRONG, TRY AGAIN!": GOTO 72
78 P = P + 1: IF P = 51 THEN Z =
  1: Y = 6
80 PRINT : HTAB 5: PRINT "RIGHT!
  "
82 POKE 32,0: IF Z = 1 THEN 21: REM
  Z STOPS GAME
84 X = X + 1: IF X > 9 THEN X = 0
  : Y = Y + 1: U = U - 2: REM CH
  ANGE ANIMAL AND TIME INTERVA
  L AFTER 10 PROBLEMS
86 GOTO 21
90 VTAB 24: INPUT "ANOTHER GAME
  (Y/N)? "; I$: IF I$ = "Y" THEN
  POKE 33,40: HOME : GOTO 16
92 POKE 34,0: POKE 33,40: HOME :
  END

```

**Roadrunner  
Variables List**

A	Answer
C	Counter Delay
H	Highest Number
I	Input
I\$	Input
L	Top number for subtraction
M	Top number
N	Bottom number
P	Problem number
S	Sum or difference
S\$	Sign
T	Maximum time interval
U	Decreased time interval
V	Actual seconds remaining
W\$(6)	Winning animal
W	Subscriber
X	Counts ten problems
Y	Level attained
Z	Ends game

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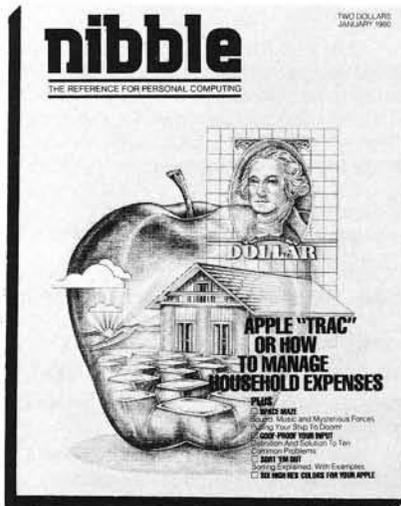
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# Plotting with Special Character Graphics

---

**A primer on, and program for, generating plot mode type graphics with special characters. Applicable to the PET, Challenger, and other micros.**

---

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611 Galen  
San Jose, CA 95106

Microcomputers that support graphics are basically one of two types. One type supports their graphics with a special set of graphics characters that are printed or poked on the screen thereby drawing the picture you were trying to portray. Examples of this type of computer are the Challenger, Sorcerer, and Pet. The second type of graphics support divides the screen into small squares or rectangles which are turned on or off by specifying their address in a matrix system. These points are said to be "plotted" on the screen in the same fashion that you would plot on a piece of graph paper. Examples of this type of machine include the CompuColor, Intecolor and TRS-80.

If you are an owner of the first type of computer and have ever been envious of the people who own the second type or would like to use graphics programs written for the second type then this is the article for you! A program will be presented that allows you to duplicate the plot mode graphics and allows you to create your own expanded graphics mode.

First let us take a minute and ensure that everyone understands plot mode graphics. I will use the TRS-80 for an example. They have divided the screen into 128 points across (horizontally) and 48 points down (vertically). To identify any single point you must specify its location with two numbers; the first will identify how many points over from the left edge of the screen your point is and the second number will identify how many points down from the top edge. To turn a point on you would use the instruction SET (X,Y) where X is the distance across (0-127) and Y is the distance down (0-47). To draw a line across the screen you would have to write a program that would specify a value for Y and included a loop that would increment or decrement X until the line was drawn.

For example, consider the following program:

```
10 Y = 6
20 FOR X = 0 TO 63
30 SET (X,Y)
40 NEXT X
```

This program would plot a line near the top of the screen beginning at the left edge and extending across to the center of the screen.

The TRS-80 has three instructions that support their graphic; one to turn a point on, one to turn a point off, and one to examine a point to see whether it is on or off.

Some people call this graphics mode "high resolution" or simply HIRES graphics since this is the smallest increment of data that the programmer has control of. HIRES graphics capability of the TRS-80 is  $128 \times 48$ . A low resolution graphics capability exists also and is inherent in all computers whether they have graphics capability or not. This LOWRES graphics mode is simply to use a character from the keyboard (such as X) and draw pictures with it. Most people have used this technique when playing around with a typewriter. In this mode the TRS-80 would have a resolution of  $64 \times 16$ . (The number of characters per line by the number of lines.) To use this mode of graphics you would simply use print statements.

Intecolor and CompuColor use a method very much like that used by Radio Shack. They use a sequence of PLOT instructions to accomplish their graphics capability. In addition, they have some subplot modes which allow you to draw lines and bars without the necessity of writing loops like the one I showed you for the TRS-80. This capability gives the programmer a very powerful tool for fan-

cy graphing such as vector mode, point to point lines, bar graphs, etc.

Most home computers display the screen from a memory somewhere in the 64K that a programmer has access to. The BASIC interpreter program simply places the information in the proper address of this memory and the hardware of the computer constantly displays this memory on the TV tube that you look at. For this reason, if you know where this refresh RAM (memory) is located, then you can simply use the BASIC PEEK instruction to find out what is there and the POKE instruction to put anything you choose on the screen, whether it be keyboard characters or graphics characters. Normally each character on the screen occupies one byte of data in the refresh RAM. This means that there are 256 possible characters that can be displayed. The way that each manufacturer uses these 256 characters is one of the major differences between home computers.

The TRS-80 is no exception. They reserve 64 of these characters for the keyboard, 64 of these characters are used for the double width characters and the other 128 are the graphics characters. Mathematically it can be shown that the 128 characters are enough to contain all possible combinations of 6 bits ( $2^6 = 128$ ); therefore what Radio Shack did was divide a character into 6 pieces arranged in a two by three group.

CompuColor and Intecolor devote two bytes of data to each character on the screen since they must also include color information. This also gives them the ability to devote 256 characters to graphics, 8 bits in a two by four group, and thus they have a higher resolution capability than does Radio Shack.

Now that you understand plot mode character graphics let's see how we can duplicate this graphics mode with the special character graphics. The demonstration programs and the special graphics subroutine we'll be looking at will run unmodified on a PET computer but I'll try to include enough notes so that it should be easy to modify these routines for any computer that uses Microsoft BASIC as long as the graphics symbols are available.

The symbols that we are going to use are shown in Figure 1. Since we are going to divide our characters into four bits we will need 2<sup>4</sup> or 16 characters. PET has thoughtfully provided all of these characters on the keyboard, although some will have to be used with the RVS key. Challenger doesn't provide these characters from the keyboard but you should be able to find them listed in the graphics program book. The first one is simply a space.

Since we plan to poke these characters on the screen, we'll need to know the decimal equivalents of all of these characters. The following subroutine will build an array of all the characters shown in figure 1 by using the decimal equivalents of these characters in the data statements.

```

32000 DIM X2 (15) :FOR Y1=0 TO
32010 READ X2(Y1):NEXT:RETURN
32020 DATA 32,126,124,226,123,97,
225,236,108,127,225,251,
98,252,254,160

```

If you don't have a PET, change the DATA statement per your machine documentation. Be sure to enter them in the order shown in figure 1.

My subroutines all use the variables X, Y, plus these variables with numbers. This is done to minimize the impact on variables you may be using in your program. Variable definitions are given in the table below.

X	The horizontal coordinate of the point
Y	The vertical coordinate of the point
X1	The decimal address of the character that the point is in.
X2	The original data at the address X1
X3	A flag to tell the subroutine what kind of plotting is desired (see text)
Y1	The pointer into the array containing our plot character
Y2	A flag indicating which one of the four points in the character that X,Y points to

X2(Y1) The array of possible plot characters

Now let's look at the program in detail. Line 50 gets rid of any ambiguity about the value of X; first by making sure that it is an integer and then by making sure that the point is on the screen. The number 79 is one less than twice the number of characters you have across your screen. A good value to use on the Challenger 1P is 47; Challenger 2 would use 127.

Line 52 does the same thing for Y. The number 49 represents one less than twice the number of lines.

Line 54 generates the address of the character we are interested in and peeks the current value. It then searches to try and match this value with the array that we set up earlier. The number 40 is the number of characters on the Pet line. For a Challenger 1P this must be 32. 32768 is the decimal address of the starting location of the Pet memory map for screen refresh. Your system documentation should tell you where yours is located. For the Challenger 1P this starting location depends on the TV overscan but 53349 should be a good place to start.

Line 56. If the search is unsuccessful and X3 is a zero, we'll assume Y1 = 0, thereby overwriting any data that is already on the screen. Otherwise, we will abort the plot and preserve the data on the screen.

Lines 58 and 60 find the proper quadrant of the character.

Let's skip lines 63, 64 and 66 for now.

Line 68 does the actual plotting by overwriting the old data pointer and the quadrant pointer. If you've gotten this far and you suddenly find that your machine won't, or that there are two numbers together, then please drop me a line and I'll give you a program that does the same thing with logical IF tests. Be sure to tell me what kind of machine you have.

The program we have just discussed will simulate the TRS-80 SET instruction except that we can also have control over what happens should our plot program encounter a normal print character. To demonstrate this, consider the following example:

```

5 GOSUB 32000
10 Y = 6
20 FOR X = 0 TO 39
30 GOSUB 50
40 NEXT X : END

```

If you have entered the two subroutines prior to this, then this program will draw a

line half way across the screen near the top, just like the Radio Shack program did. Now, remove these lines (5 through 40) and enter the following program.

```

10 PRINT CHR$(147):REM CLRS
SCREEN
20 GOSUB 32000
30 GOTO 100
100 FOR X = 0 TO 79
110 Y = 24 + 15 * SIN(X/5)
120 GOSUB 50
130 NEXT X
140 END

```

When you run this you should have a nice sine wave appear on the screen.

Radio Shack has a RESET instruction also that allows them to turn off a bit. Some of the time this is used to simulate a ball or bullet for animation purposes. Since this program is in Basic which is inherently slow for this sort of thing, I have provided for a special feature to allow simulating this kind of action. Please add this one line to your earlier program.

```
115 POKE X1, X2
```

This turns off the bit that was just turned on by poking back the original value. Once you have tried this program, please be sure to remove line 115. This is not the only use of the RESET instruction, however. We should be able to simulate this instruction also. Now we can discuss the rest of the main subroutine.

Line 62 holds the key to the power of this subroutine. By setting X3 to a particular value we can use this subroutine to do many plotting functions. We have already discussed the values of X3 = 0 and X3 = 1.

Line 64 is required since the ON instruction cannot work with X3 = 0.

Line 70 is the place we will jump to if X3 = 2. Add the following lines to your program and try it again.

```

140 IF X3 = 2 THEN END
150 X3 = 2
160 GOTO 100

```

As you can see, X3 = 2 simulates the RESET instruction very well. You should now save your program tape.

This same routine provides more advanced functions as well which are similar to those supplied by Compucolor. For example, if X3 = 3, then a test is made on the bit at the X,Y coordinate. If it is off, we'll turn it on but if it's already on, we'll turn it off. This decision is made with line 66.

Line 72 is the line we will get to if X3 = 4. This will cause us to enter the X-bar graph mode. Consider this program:

```

5 GOSUB 32000
10 PRINT CHR$(147)

```

```

15 Y = 6
20 X3 = 4
25 X = 39
30 GOSUB 50
35 END

```

It draws the same horizontal line we saw earlier but we didn't have to write a loop. It was also a little faster.

Line 74 is where you will end up when X3 = 5. This enters the Y-bar graph mode and vertical lines will be drawn.

Of course several more variations could be derived depending on your application. For example, if X3 = 6 pointed to line 76, then  
76 GOSUB 68: X = X - 1: Y = Y + 1: GOTO 50  
would draw a diagonal line. Or alternately, an adaptation of line 66 could provide a status that would indicate whether one bit was on or off.

### Final Considerations

This routine is intended to reside near the front of your using program since subroutines at the beginning of programs execute faster than those near the end. The initialization subroutine only executes once, so placing it at the end simply gets it out of the way.

### Notes on the Challenger 1P

In addition to the changes described in the text, you will have to make the following changes to run this program on the Challenger 1P. Line 54 will have to be broken into two lines since it is more than 72 characters long. The same is true of line 32020. Although Challenger has a very extensive set of graphics characters, they really blew it when using the sixteen characters described in this article. Four are missing. This prevents not only a clean implementation of this program but also prevents another use for these characters such as that of creating large lettering. The best compromise may be the following statements:

```
32020 DATA 32, 168, 166, 155, 167, 156, 170, 175
```

```
32030 DATA 165, 169, 157, 177, 154, 178, 176, 161
```

Challenger should consider changing their ROM; perhaps changing 171 through 174.

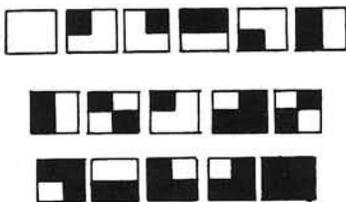


Figure 1

### Main Subroutine

```

50 X = INT(X): IF X 79 OR X 0 THEN RETURN
52 Y = INT(Y): IF Y 49 OR Y 0 THEN RETURN
54 X1 = INT(X/2) + 40*INT(Y/2) + 32768: X2 = PEEK(X1): FOR Y1 = 0 TO 15: IF X2 = X2(Y1) THEN 58
56 NEXT: Y1 = 0: IF X3 THEN RETURN
58 Y2 = 1: IF X/2 - INT(X/2) THEN Y2 = 2*Y2
60 IF Y/2 - INT(Y/2) THEN Y2 = Y2*4
62 ON X3 GOTO 68,70,66,72,74
64 GOTO 68
66 IF X2(Y1 OR Y2) = X2(Y1) THEN 70
68 POKE X1, X2(Y1 OR Y2): RETURN
70 POKE X1, X2(Y1 AND 15 - Y2): RETURN
72 GOSUB 68: X = X - 1: GOTO 50
74 GOSUB 68: Y = Y + 1: GOTO 52

```

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```

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      0100 MOVE TBL 1 TO TBL2
      0110 BA $400
0400 - A8 08 0120 LOOP LDY #00
0402 - B9 08 04 0130 LDA TBL1 Y
0405 - 89 08 05 0140 STA TBL2 Y
0408 - C8 0150 INY
0409 D8 F7 0160 BNE LOOP
      0170
040B 0180 TBL1 DS 256
050B 0190 TBL2 DS 256
      0200
      0210 EN

LABEL FILE 1 - EXTERNAL
START = 0400 LOOP = 0402 TBL1 = 040B
TBL2 = 050B
110000 060B 060B

```

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# SYM - 1 BASIC "GET" Command

---

**Everything you need to know to implement the 'GET' function in SYM - 1 BASIC. The use of the GET function is discussed and several examples are provided.**

---

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The SYM-1 BASIC Interpreter provides for an unused "GET" token which always produces a Function Call error (FC) whenever it is encountered in a program. GET is an alternate form of INPUT except that it only inputs one character for each call and that one character can be any keyboard character including control characters and lower case letters. The first section of this article describes a simple procedure to implement this very useful command. The second section explains in detail how it works and the third section offers some examples of BASIC subroutines utilizing the GET command.

## Section One Implementing the GET Command

Step 1: Deposit and Verify the code in the OBJECT LISTING. If it consistently will not Verify, read Section 2 before proceeding.

Step 2: Enter the following monitor command:

```
.SD A600,A664
```

Step 3: Jump to BASIC:  
.J O

Step 4: Enter and RUN a BASIC program such as:

```
100 PRINT "HIT ANY KEY:"  
110 GET A$  
120 PRINT ASC(A$)  
130 GOTO 100
```

The GET command is always used to input a character string which will normally have a length of one. (A double quote (") or a NULL results in a length of zero which causes an FC error to occur. See Section 2.) Of course, the string variable can be either simple or an element of a matrix, but only one variable is

allowed for each GET and it cannot be used in a Direct Command. When GET is encountered in a running program there is no prompt "?" and prompt strings are not allowed. This is intentional to allow for several characters in a row to be typed in, in response to several GET's or for a loop which examines the characters for errors as they are typed. It is therefore normal to precede GET with a PRINT statement to serve as a prompt.

## Section Two Detailed Explanation of GET Implementation

The assembly language program to implement GET is stored in two sections of RAM that are unused by both the Monitor and BASIC. The first of these is the first 32 bytes of System RAM which are normally allocated as the Scope Buffer but are not changed in any way as long as none of the hex keypad buttons are pushed (except, of course, RST and DEBUG ON and OFF). These 32 bytes are located at \$A600-\$A61F. The second section of RAM is the 16 bytes located on page zero at \$E8-\$F7. The code can be entered into your SYM-1 and verified using the object code listing or if you have Synertek's RAE-1, you can enter the source code as it appears in the assembly listing. After it is assembled the block of code belonging on page zero must be moved there from page \$0F with the monitor command:

```
B E8,FE8-FF7
```

The code can not be assembled directly on page zero since RAE-1 also uses that block of memory. If you happen to have EPROM in your system you can also relocate the code there (delete line 300 JMP GET.COMD.3). In order to activate GET, the System Output Vector (\$A664,5) must be changed from its present value,

assumed to be the Terminal Output routine (TOUT = \$8AA0), to the GET command processor (GET.COMD = \$A600). This vector can be changed at the monitor level with the simple command:

```
.SD A600,A664
```

or it can be done in BASIC with:

```
POKE 42596,0: POKE 42597,166
```

which can be either a Direct Command or part of a program. If you decide to relocate the code to some other address than \$A600 then be sure to use the correct address when changing the System Output Vector. Please be aware of the fact that the System RAM is write protected after a warm start to BASIC (G O) until after a LOAD or SAVE command is attempted (if you have the new Monitor ROM) or until a call to ACCESS is made some other way, for example, with QQ=USR("&"8B86",0) or unless the jumper at 45-MM is removed. Incidentally, since BASIC passes the program size and file ID information to the Tape routines through the System RAM, the first LOAD or SAVE after a warm start won't work.

To understand how the GET command is processed look at the assembly language listing. Each time BASIC attempts to print any character, this routine will be entered. If the character to be printed is a carriage return, which is the case when any error is encountered, then further testing is performed to see if it is a Function Call error and then if it was caused by a GET token. If any of the proper conditions are not met then a jump is made to the Terminal Output routine or to whatever special output routine you might have.

Assuming that all the conditions for the GET command are met, then twelve bytes are taken off the stack to account for the series of JSR's involved in printing the error message. Next, the BASIC Input Buffer is set up as it would be if a single character were entered in response to an INPUT command. However, the routines that normally bring characters into the Input Buffer are bypassed because they ignore all control characters (except BELL) and change lower case letters to upper case. Instead, the Input Buffer is loaded directly by the GET command processor so that all characters will be allowed. In addition, a double-quote is automatically inserted before the typed character so that commas, colons and spaces will also be properly interpreted. After the typed character a zero is inserted which is the End-of-Line token. There remains an ambiguity over two characters which can be typed in, namely, NULL and double-quote ("), both of which will be interpreted as a string of zero length. The NULL looks like the End-of-Line token and the double-quote looks like the End-of-String character. If you are not concerned with this ambiguity in your application, skip the remainder of this section.

There are two ways to avoid the ambiguity between double-quote and NULL. First you can change the assembly language instruction on line 350 from AND #\$7F to ORA #\$80 and then subtract 128 from each character after the GET statement. Example: Change BASIC program line 630 to:

```
630 CHAR$ = CHR$(ASC(CHAR$)-128)
```

The second way to handle this is by inserting three instructions between lines 350 and 360 of the assembly program as follows:

```
CMP #$22
BNE +2
ORA #$80
```

But this will require relocating the code to accommodate the additional bytes of program. (Due to a minor error in RAE-1, the branch must be entered as BNE = +3.) In this case, only a double-quote has its most significant bit set. It is not necessary to subtract 128 as long as you treat the ASCII code for double-quote as 162 instead of 34. Also, line 630 of the BASIC program should be deleted.

### Section Three Examples of Using GET

The remainder of this article will describe several BASIC subroutines which can be used to simulate the INPUT function for integer, numeric and string variables. Also described is a means to disable the BREAK key to make it possible to write programs that are incapable of being clobbered by the operator. This is an especially important feature when

## OBJECT LISTING

```
.V E8-F7
00E8 20 58 8A 29 7F 85 1F A2,F0
00F0 1D A0 00 84 20 4C EA C9,50
0650
.V A600-A61F
A600 C9 0D D0 08 E0 08 D0 04,6A
A608 C0 36 F0 03 4C A0 8A BA,83
A610 8A 69 0B AA 9A A9 2C 85,1F
A618 1D A9 22 85 1E 4C E8 00,DE
0DDE
```

running programs for the novice. If you've had the frustrating experience of trying to leave your computer in the hands of the kids to play games only to have them forget to press RETURN after every input and not press RETURN without some in-

put, then you know what a boon this can be. It can save you from having to reload a program because the kids have unknowingly deleted lines of program by typing in numbers while in Command Level.

### LIST

```
10 PROMPT$ = "INPUT A STRING: "
11 GOSUB 600
12 PRINT PHRASE$
13 GOTO 10
20 PROMPT$ = "INPUT A NUMBER: "
21 GOSUB 500
22 PRINT NUMBER
23 GOTO 20
30 PROMPT$ = "INPUT AN INTEGER: "
31 GOSUB 400
32 PRINT NUMBER%
33 GOTO 30
35 :
95 REM *** SUBROUTINE TO ACTIVATE "GET" ROUTINE ***
100 QQ = USR("&8886",0): REM ALLOW ACCESS TO SYSTEM RAM
110 POKE 42596,0: POKE 42597,166: REM CHANGE OUTPUT VECTOR TO "GET"
120 RETURN
185 REM *** SUBROUTINE TO DISABLE "BREAK" KEY ***
195 REM SIMULATE MONITOR COMMAND: .SD 862D,A667
200 QQ = USR("&8886",0): REM ALLOW ACCESS TO SYSTEM RAM
210 POKE 42570,103: POKE 42571,166: REM STORE INSVEC+1 IN P3
220 POKE 42572,45: POKE 42573,134: REM STORE $862D (CLC-RTS) IN P2
230 QQ = USR("&861D",0): REM EXECUTE STORE DOUBLE BYTE COMMAND
240 RETURN
285 REM *** SUBROUTINE TO ENABLE "BREAK" KEY ***
295 REM SIMULATE MONITOR COMMAND: .SD 8B3C,A667
300 QQ = USR("&8886",0): REM ALLOW ACCESS TO SYSTEM RAM
310 POKE 42570,103: POKE 42571,166: REM STORE INSVEC+1 IN P3
320 POKE 42572,60: POKE 42573,139: REM STORE $8B3C (TSTAT) IN P2
330 QQ = USR("&861D",0): REM EXECUTE STORE DOUBLE BYTE COMMAND
340 RETURN
395 REM *** SUBROUTINE TO INPUT AN INTEGER ***
400 GOSUB 500: REM INPUT A NUMBER
410 IF ABS(NUMBER) > 32767 THEN 400: REM REPEAT IF OUT OF RANGE
420 NUMBER% = INT(ABS(NUMBER))*SGN(NUMBER): REM DROP FRACTIONAL PART
430 RETURN
495 REM *** SUBROUTINE TO INPUT A NUMBER ***
500 GOSUB 600: REM INPUT A STRING
510 NUMBER = VAL(PHRASE$): REM CONVERT STRING TO NUMBER
520 RETURN
595 REM *** SUBROUTINE TO INPUT A STRING ***
600 PRINT: PRINT PROMPT$: REM PRINT PROMPT ON NEW LINE
610 PHRASE$ = "": REM DELETE PHRASE
620 GET CHAR$
630 IF LEN(CHAR$) = 0 THEN CHAR$ = CHR$(34): REM CHANGE NULL STRING TO "
640 IF ASC(CHAR$) <> 8 THEN 680: REM BRANCH IF NOT BACK-SPACE
650 IF LEN(PHRASE$) = 0 THEN PRINT RIGHT$(PROMPT$,1): GOTO 620
660 PHRASE$ = LEFT$(PHRASE$,LEN(PHRASE$)-1): REM DELETE LAST CHARACTER
670 PRINT " "; CHR$(8): GOTO 620
680 IF ASC(CHAR$) = 10 THEN 600: REM START OVER IF LINE-FEED
690 IF ASC(CHAR$) = 13 THEN PRINT: RETURN: REM DONE IF CARRIAGE RETURN
700 PHRASE$ = PHRASE$ + CHAR$
710 GOTO 620
795 REM *** SUBROUTINE TO DE-ACTIVATE "GET" ROUTINE ***
800 QQ = USR("&8886",0): REM ALLOW ACCESS TO SYSTEM RAM
810 POKE 42596,160: POKE 42597,138: REM CHANGE OUTPUT VECTOR TO "TOUT"
820 RETURN
DK
```

The BASIC program listing contains two parts. The first part (lines 10-35) contains sample drivers for the three types of INPUT's and the second part (lines 95-820) contains the actual subroutines. The first subroutine (GOSUB 100) changes the output vector to point to the assembly language program which of course must be loaded prior to entering BASIC. The last subroutine (GOSUB 800) can be used to switch the output vector back to its normal state. The second and third subroutines can be used to disable and enable the BREAK key. These routines use part of the Monitor Store Double Byte Command to change the Input Status Vector because it is impossible to do the same thing in pure BASIC since the status would be checked between the two POKE's and would result in the program going to an undesired place. The BREAK is disabled by simply pointing it to a routine that always returns a status clear.

The subroutine beginning at line 600 simulates the INPUT command for a character string. The first thing it does is print a prompt string which should be defined prior to calling the subroutine.

The name of the prompt string is PROMPT\$ (or PR\$). Next, the string which will contain the typed characters is cleared. Its name is PHRASE\$ (or PH\$). Then a loop is entered which GETs the typed characters one at a time and examines them before it puts them into the PHRASE\$ string to see if they are any of the following special characters:

1. NULL (same as double-quote) is changed to " .
2. Back Space deletes previous character.
3. Line Feed deletes entire line.
4. Carriage Return ends the input.

No test is made to limit the number of characters to 255. Therefore, typing in 256 characters is a way to "BREAK" a program that has the BREAK key disabled since it will cause a Long String Error (LS).

The subroutine beginning at line 500 simulates the INPUT command for a number. It does this by calling the string

input subroutine and using the BASIC VAL function to put the string into the variable called NUMBER (or NU). If the string does not convert correctly into a number, no error is generated, instead that portion of the string up to the error is used (or zero if it is completely wrong). However, if the magnitude of the number is too large for BASIC an Overflow Error(OV) results. This is another way to "BREAK" a program even with the BREAK key disabled.

The subroutine beginning at line 400 simulates the INPUT command for an integer. It does this by calling the number input subroutine and using the BASIC INT function to convert it to an integer called NUMBER\* (or NU\*). If the number is too large to be an integer, the prompt is repeated to avoid an error. Also, the fractional part of a negative number is dropped instead of rounding up to the next larger integer (absolute value).

Obviously, similar sorts of routines can be written to accommodate any particular requirements you might have. One word of caution: at the lower baud rates BASIC can't keep up with a fast typist. Using the BREAK disable subroutine will keep the program from aborting but might result in incorrect characters being read. However, if they are read incorrectly they will also be echoed incorrectly, so backspace over any errors and retype. At 4800 baud, BASIC can easily keep up with all but the fastest typist. At 110 baud it isn't hard to get incorrect reads, but even then it's not likely to be a problem with a novice operator. However, if you are running at 110 baud it is probably because you are running on a teletype in which case you will have to handle the character deletes with something other than a back-space.

#### >ASSEMBLY LISTING

```

0010 GET.TOKEN .DE $9B BASIC "GET" TOKEN
0020 FC.ERRORR .DE $08 BASIC "FC ERROR" TOKEN
0030 INPUT.COMD .DE $C9B9 BASIC INPUT COMMAND INTERPRETER
0040 INP.BUFFER .DE $1E BASIC INPUT BUFFER
0050 TOUT .DE $8AA0 MONITOR TERMINAL OUTPUT ROUTINE
0060 INTCHR .DE $8A58 MONITOR INPUT TERMINAL CHARACTER
0070
0080 .DS
0090 .BA $A600
0100
0110 ; *** PROGRAM TO IMPLEMENT SYM-1 BASIC "GET" COMMAND ***
0120
A600- C9 0D 0130 GET.COMD CMP #$0D TEST FOR CARRIAGE RETURN
A602- D0 08 0140 BNE GET.COMD.1 AND BRANCH IF NOT.
A604- E0 08 0150 CPX #FC.ERRORR TEST FOR FC ERROR AND
A606- D0 04 0160 BNE GET.COMD.1 BRANCH IF NOT.
A608- C0 36 0170 CPY #L,GET.TOKEN+GET.TOKEN TEST FOR GET AND
A60A- F0 03 0180 BEQ GET.COMD.2 BRANCH IF $0.
A60C- 4C A0 8A 0190 GET.COMD.1 JMP TOUT IF NOT, CONTINUE OUTPUT.
0200
A60F- BA 0210 GET.COMD.2 TSX TAKE 12 BYTES OFF STACK.
A610- 8A 0220 TXA ALREADY IN BINARY MODE AND
A611- 69 0B 0230 ADC #12-1 CARRY SET, SO ADD 11.
A613- AA 0240 TAX
A614- 9A 0250 TXS
A615- A9 2C 0260 LDA #'
A617- 85 1D 0270 STA #INP.BUFFER-1 STORE COMMA IN FRONT OF
A619- A9 22 0280 LDA #' STORE QUOTE IN BUFFER TO
A61B- 85 1E 0290 STA #INP.BUFFER ALLOW AUTO STRING INPUT.
A61D- 4C E8 00 0300 JMP GET.COMD.3 CONTINUE ON PAGE ZERO.
0310
0320 .BA $E8 STORE $E8 CODE AT $E8,
0330 .MC $FEB MOVE WITH: B E8,$E8-FF7
00E8- 20 58 8A 0340 GET.COMD.3 JSR INTCHR INPUT A CHARACTER.
00EB- 29 7F 0350 AND #$7F CLEAR PARITY BIT.
00ED- 85 1F 0360 STA #INP.BUFFER+1 PUT IT IN BUFFER.
00EF- A2 1D 0370 LDX #INP.BUFFER-1 X NEEDED BY BASIC.
00F1- A0 00 0380 LDY #0 Y=0 NEEDED BY BASIC.
00F3- 84 20 0390 STY #INP.BUFFER+2 END-OF-LINE TOKEN.
00F5- 4C EA C9 0400 JMP INPUT.COMD+49 CONT INTO BASIC.
0410 .EN

```

LABEL FILE: [ / = EXTERNAL ]

```

/GET.TOKEN=009B /FC.ERRORR=0008 /INPUT.COMD=C9B9
/INP.BUFFER=001E /TOUT=8AA0 /INTCHR=8A58
GET.COMD=A600 GET.COMD.1=A60C GET.COMD.2=A60F
GET.COMD.3=00EB //0000,00F8,0FF8
>

```

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# A Simple Temperature Measurement Program and Interface

Using a micro for temperature measurement demonstrates some of the problems and some of the solutions involved in interfacing to the real world.

Marvin L. DeJong  
Dept. of Math & Physics  
The School of the Ozarks  
Point Lookout, MO 65726

Temperature measurements at least as precise as  $+1^{\circ}\text{C}$  can be made with the circuit shown in Figure 1 and the program listed in Table 1. The 555 timer integrated circuit operates in conjunction with a FENWAL GB41P2 thermistor as a temperature-to-frequency converter. The pulses from the circuit in Figure 1 are counted with the T2 counter/timer on the 6522 Versatile Interface Adapter. A machine language subroutine measures the number of pulses in one second, while a BASIC program converts the frequency to temperature.

The relationship of the temperature of the thermistor to the frequency of the pulses at PB6 is non-linear. A temperature vs. frequency curve for our system is shown in Figure 2. You must make such a calibration curve for the system to work. A calibration curve is obtained by immersing the thermistor and a previously calibrated thermometer in some fluid and making measurements of the frequency as the temperature of the fluid is changed. We used water, heat, and ice cubes to produce our calibration curve. The frequency measurement program in Table 2 is used to measure the pulse frequency as a function of temperature. If you want to use this system as an air thermometer, then the fluid should be air. You will have to wait for nature to provide the necessary temperature changes. Temperatures below and above those shown on our calibration curve (Figure 2) may be included, depending on your intended application. Provided components with low temperature coefficients are used in the 555 timer circuit, the precision of the temperature measurements made by the program will depend largely on the quality of the calibration data you obtain for your circuit. The thermistor may be located in some remote location and connected to the 555 timer circuit by a twisted wire pair.

The program listed in Table 1 requires the user to input 20 frequency-temperature points from the calibration curve. The program can be easily modified to input more or less data. With the calibration data in memory, it calls the machine language subroutine to measure the frequency of the pulses from the interface circuit in Figure 1. Using the measured frequency and the calibration data, it performs a quadratic interpola-

tion calculation to convert the frequency measurement to a temperature. It also converts the Celsius temperature to a Fahrenheit temperature and outputs both. In the BASIC program, statements number 50, 60 and 70 serve to get the frequency using the machine language subroutine. We are using AIM 65 BASIC, and the techniques necessary to call the machine language subroutine may vary from machine to machine. In any case,

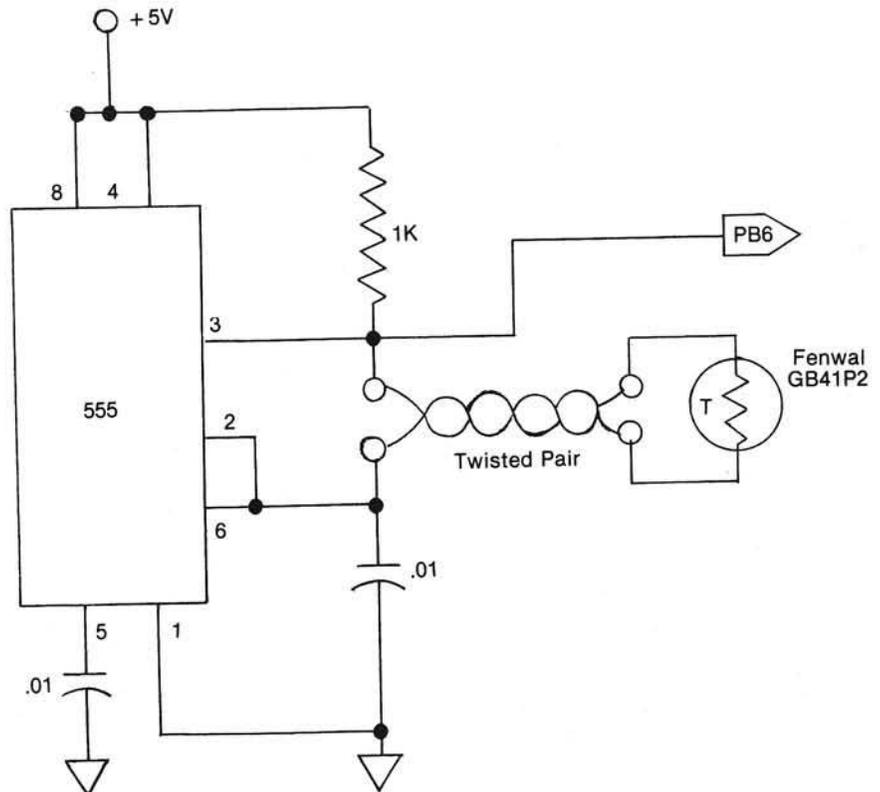


Figure 1: Using the 555 Timer as a Temperature-to-Frequency Converter

statement number 50 pokes the starting address of the machine language subroutine into a location where AIM 65 BASIC can find it. Statement number 60 actually produces the subroutine jump. The variable Y means nothing in statement 60. In statement 70 the BASIC program obtains the frequency from the two bytes in memory where the machine language subroutine stored it, namely 49 = \$31 and 50 = \$32 in zero page.

Because of the way the quadratic interpolation formula is applied to the incoming frequency data, it is a good idea to make the first calibration point entered into the BASIC program be  $F = 0$ ,  $T = -100$  or some other low temperature below the range where you wish to operate. The other calibration points, from your calibration curve, are entered in order from low frequency-low temperature to high frequency-high temperature. For example, our first few data points entered were:

0, -40  
1000, -10  
2550, 0.5  
3000, 5.0

A close inspection of our calibration curve in Figure 2 shows that the first two sets of points are a dummy point (0, -40) and an extrapolated point (1000, -10). Note that the data are entered in pairs, frequency first, temperature second.

For reference purposes, let's review very briefly the quadratic interpolation formula that is used. Given a function  $T(F)$  defined at three points,  $(F_i, T_i)$ ,  $(F_j, T_j)$ , and  $(F_k, T_k)$ , we must find the value of the function at an arbitrary point  $F$ , assuming that the curve through the three points is a second degree equation (quadratic) in  $F$ . The equation is:

$$T = T_j + U \left[ -R^2 T_i + (R^2 - L^2) T_j + L^2 T_k \right]$$

$$+ U^2 \frac{(R+L)}{RL} [RT_i - (R+L)T_j + LT_k]$$

where,  $R = F_j - F_i$ ,  $L = F_k - F_j$ , and  $U = (F - F_j)/(R + L)$ .

Refer to Figure 3 for a graphical interpretation of quadratic interpolation. In the program, the value of  $j$  (J in BASIC) that is chosen is such that  $F$  exceeds  $F_j$  but is less than  $F_k$ . Then  $i = j - 1$  and  $k = j + 1$ . Thus the points  $F_j$  and  $F_k$  always bracket  $F$ .

Now a few comments on the machine language subroutines used in the programs in Tables 1 and 2. These routines are identical. They allow the T2 counter/timer on the 6522 to count pulses for a number of 50,000 clock cycle intervals. The number of such intervals is determined by the byte of data in location \$OFO7 in the program. \$14 = 20 such intervals give a total counting period of one second. Clearly this number may be changed to count pulses for either 0.1 s, 10.0 s, or some other time interval if

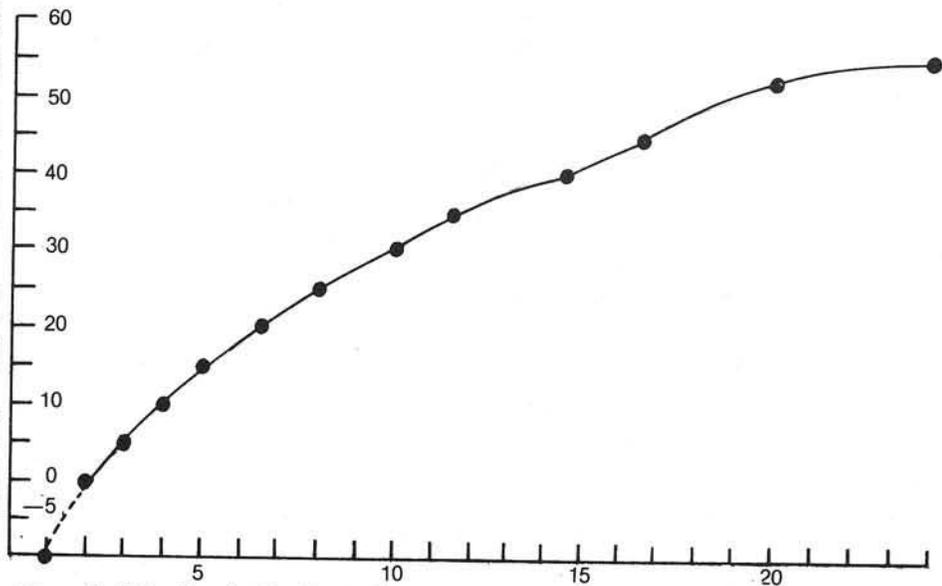


Figure 2: Using the Analog Devices 537J as a T/F Converter. Resistances are in Ohms and Capacitances are in Microfarads.

Table 1 . A simple frequency-to-temperature conversion program.

```

10 DIM F(20), T(20)
20 FOR J = 1 TO 20
30 INPUT F(J),T(J)
40 NEXT J
50 POKE $4, $5: POKE $5, 15
60 Y=USR($ )
70 Y=PEEK(49): Z=PEEK(50)
80 FRQ=256*Z+Y
90 FOR J = 1 TO 20
100 IF FRQ < F(J) THEN 120
110 NEXT J
120 I=J-1: K=J+1
130 L=F(J) - F(I)
140 R=F(K) - F(J)
150 U=(FRQ - F(J))/(R + L)
160 TC=T(J) + U/(R*L)*(-R*R*T(I)+(R*R-L*L)*T(J)+L*L*T(K))
170 TC=TC+U*U*(R+L)/(L*R)*(R*T(I)-(R+L)*T(J)+L*T(K))
180 TF = 9/5*TC + 32
190 TC = INT(TC + .5): TF = INT(TF + .5)
200 PRINT " ";TF;"F ";TC;"C"
210 GO TO 60
220 END

```

\$OFOO D8	START	CLD	\$OF1C 2C 0D A0	TEST	BIT IFR
OF01 A9 60		LDA \$60	OF1F 50 FB		BVC TEST
OF03 8D 0B A0		STA ACR	OF21 AD 04 A0		LDA T1CL
OF06 A9 4D		LDA \$4D	OF24 C6 30		DEC CNTR
OF08 8D 06 A0		STA T1LL	OF26 D0 F4		BNE TEST
OF0B A9 14		LDA \$14	OF28 38		SEC
OF0D 85 30		STA CNTR	OF29 A9 FF		LDA \$FF
OF0F A9 C3		LDA \$C3	OF2B ED 08 A0		SBC T2CL
OF11 8D 05 A0		STA T1LH	OF2E 85 31		STA PLSLO
OF14 A9 FF		LDA \$FF	OF30 A9 FF		LDA \$FF
OF16 8D 08 A0		STA T2LL	OF32 ED 09 A0		SBC T2CH
OF19 8D 09 A0		STA T2CH	OF35 85 32		STA PLSHI
			OF37 4C D1 C0		JMP BASIC*

\*Used in AIM 65 BASIC. Other BASICs may use a different return-from-subroutine technique.

Table 2. A program to measure frequency using BASIC and machine language.

```

10 POKE 4,4: POKE 5, 15
20 Y = USR(4)
30 FRQ = 256*PEEK(5) + PEEK(49)
40 PRINT FRQ
50 GO TO 20

```

\$OFOO D8	START	CLD	Clear decimal mode.
OFO1 A9 60		LDA \$60	Set up ACR so T1 runs free and
OFO3 8D 0B A0		STA ACR	T2 counts pulses.
OFO6 A9 14		LDA \$14	The program will count pulses for
OFO8 85 30		STA COUNT	\$14 = 20 intervals of 50,000 clock
OFOA A9 4D		LDA \$4D	cycles. T1 is loaded with \$C34D,
OFOC 8D 06 A0		STA T1LL	since \$C34D + 2 = 50,000. IFR6 will
OFOF A9 C3		LDA \$C3	be set every 50,000 clock cycles.
OF11 8D 05 A0		STA T1LH	Clear IFR6 and start T1 running.
OF14 A9 FF		LDA \$FF	Set up T2 to start counting down
OF16 8D 08 A0		STA T2LL	from \$FFFF.
OF19 8D 09 A0		STA T2CH	Start counting pulses on PB6.
OF1C 2C 0D A0	LOAF	BIT IFR	Has T1 timed out yet?
OF1F 50 FB		BVC LOAF	No, then wait in this loop.
OF21 AD 04 A0		LDA T1CL	Read T1CL simply to clear IFR6.
OF24 C6 30		DEC COUNT	Decrement interval counter.
OF26 D0 F4		BNE LOAF	Count pulses for another interval if
OF28 38		SEC	interval counter has not reached zero.
OF29 A9 FF		LDA \$FF	If it has reached zero, obtain the
OF2B ED 08 A0		SBC T2CL	number of pulses from T2 by subtracting
OF2E 85 31		STA PULSLO	the number in T2 from \$FFFF.
OF30 A9 FF		LDA \$FF	Result into locations \$0031 and \$0032.
OF32 ED 09 A0		SBC T2CH	
OF35 85 32		STA PULSHI	
OF37 4C D1 C0		JMP BASIC	AIM 65 return to BASIC command.

necessary. The programs in Tables 1 and 2 will count to a maximum of 65535 pulses in one one-second interval at a maximum rate of 500,000 Hz, the limit of the 6522. Note that the total counting interval may be more or less than one second by say ten microseconds. This error amounts to less than one count if the incoming pulse rate is less than 65,535 Hz, and is of no consequence for this application. The listing in Table 2 is useful as a frequency counter with no regard to our frequency-to-temperature conversion program listed in Table 1. That is, the program in Table 2 is a stand-alone frequency counting program which may be used to count the frequency of pulses arriving at PB6, provided these are TTL level pulses similar to those provided by the 555 temperature-to-frequency circuit. A clever programmer will note that if IFR5, the T2 interrupt flag, is read, the T2 counter becomes a 17 bit counter, extending the range listed above by a factor of two. We did not program this feature into the programs in Tables 1 and 2.

Now that you can measure temperature, let's see what interesting applications you can come up with, and

please let us hear from you. Of course, the first thing you will want to do is put the thermistor under your tongue and measure your body temperature. Analog Devices sells a T/F converter (AS537) that provides a linear relationship between T and F. We now describe how to interface it to your computer.

The connection diagram for the AD537 is shown in Figure 4. Again, the T2 timer/counter on the 6522 is used to measure the frequency of the pulses coming from

#### A Program to Measure Temperature with the AD537 Interface

```

10 POKE 4,4: POKE 5,15
20 Y = USR(4)
30 FRQ = 256*PEEK(5) + PEEK(49)
40 TC = (FRQ - 2731)/10
50 TF = TC*9/5 + 32
60 TF = INT(TF + .5)
70 PRINT " "; TF; "F"; TC; "C"
80 GO TO 20

```

```

20 60 OF JSR DCML
20 ?? ?? JSR DISPLAY
4C 00 OF JMP START

```

the AD537. With the values shown, the AD537 will produce a linear relationship between frequency and absolute temperature (Kelvin degrees) of 10Hz/K. At room temperature (about 300°K) the frequency will be 3000 Hz. The 15 k potentiometer in Figure 4 is adjusted to give the correct temperature. The adjustments are easier if the 15 k potentiometer is replaced by a 9.1 k resistor in series with a 2 k potentiometer to trim the total resistance to about 10 k ohms.

To convert from absolute temperature (°K) to Celsius temperature, we make use of the formula [°C = °K - 273.1]. Then we can convert to Fahrenheit with the formula [°F = (°C)(9/5) + 32]. The entire process is handled with the BASIC program listed in Table 3. This program also calls the machine subroutine listed in Tables 1 and 2.

The AD537 is a versatile device. It can also be used as a very fine voltage-to-frequency converter with only a few external components. Analog Devices appears to share my philosophy that the fewer external components around, the less likely it is for me to have problems. In any case, with the same integrated circuit you can make yourself a voltmeter. The same machine language subroutine will provide the necessary software, and a simple BASIC calling program will place the decimal point and output the answer. You should be sure to obtain the specification sheets on the AD537 if you get one. They contain a lot of useful and vital information. For example, the AD537 can be operated in a remote location with a two-wire connection. Several of them can be multiplexed because the pulse output pin is an open-collector connection. The AD537 is much more expensive than a 555 timer, and Analog Devices may require a minimum order. Perhaps the members of your computer club can get together and place an order. Write: Analog Devices, 1 Industrial Park, P.O. Box 280, Norwood, Ma. 02062.

If you do not have a BASIC interpreter on your computer, then the machine language output subroutines given in Tables 4, 5, and 6 may be used with the programs in Tables 2 and 3 to output the frequency and temperature information. (Note that in order to measure temperature with the 555 timer circuit, a BASIC interpreter is an absolute essential.) SYM-1 and KIM-1 users can use the binary-to-BCD conversion routine in Table 4, together with their own subroutine that displays six numbers on the 7-segment LEDs, to display the frequency of the pulses measured by the machine language program in Table 2. The JMP BASIC instruction at \$0F37 would be replaced by the following instructions:

where DISPLAY is the user's routine to display six digits. AIM 65 owners will want to use all the subroutines in Tables 4, 5, and 6 to output the BCD digits representing the frequency to the AIM 65 twenty character display. To use the subroutines with the AD537 interface and the program in Table 3, you must first subtract \$0AAB (2731) from the measured pulse rate to convert it to Celsius, and then output the BCD digits, remembering for yourself where the decimal place is. Good luck.

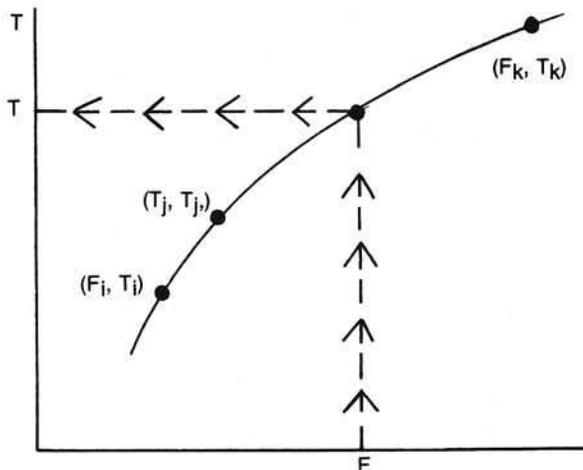


Figure 3: Graphical Interpretation of Quadratic Interpolation

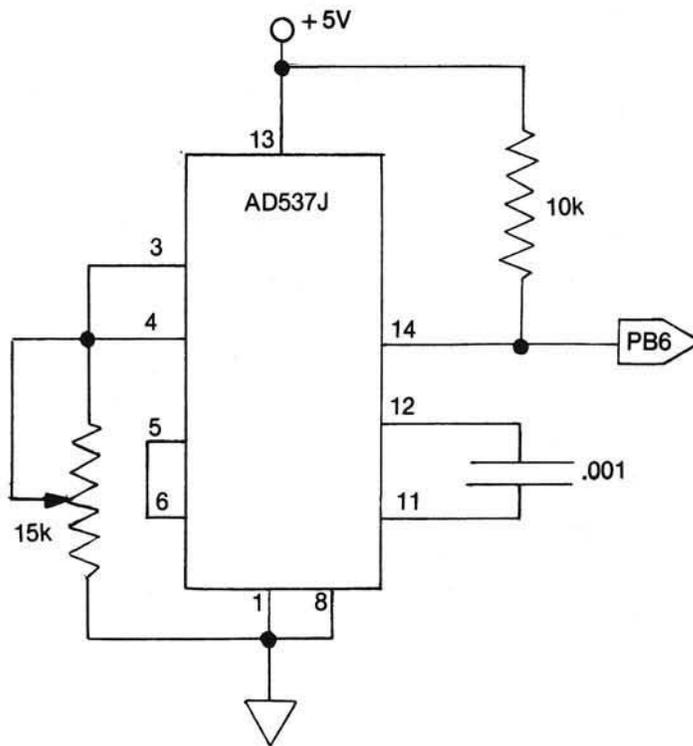


Figure 4: Frequency-to-Temperature Conversion Curve for the 555 Circuit.

Table 4. A subroutine to convert a 16-bit binary number to six BCD digits.

\$0031 = PLSLO;	contains low-order byte of 16-bit number to be converted.
\$0032 = PLSHI;	contains high-order byte of 16-bit number to be converted.
\$0F60 A9 00	DCML LDA \$00 Clear memory locations for the BCD number
0F62 85 01	STA BCDLO
0F64 85 02	STA BCDMI
0F66 85 03	STA BCDHI
0F68 F8	SED Set decimal mode for subsequent additions. Y contains number of bits to be converted. One bit of the number is shifted into the carry bit at a time. X serves as a counter for a triple-precision addition.
0F69 A0 10	LDY \$10
0F6B 06 31	THERE ASL PLSMO
0F6D 26 32	ROL PLSMI
0F6F A2 FD	LDX \$FD
0F71 B5 04	MORE LDA BYT,X
0F73 75 04	ADC BYT,X
0F75 95 04	STA BYT,X
0F77 E8	INX
0F78 D0 F7	BNE MORE
0F7A 88	DEY Get the next bit.
0F7B D0 EE	BNE THERE When Y = 0, the conversion is complete.
0F7D D8	CLD
0F7E 60	RTS Return to calling program.

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Table 5. A subroutine to convert six BCD digits to ASCII and call an output subroutine.

\$OF80 A2 06	ASCII	LDX \$06	X contains the number of BCD digits.
OF82 A9 00		LDA \$00	Our out-character (OUTCH) subroutine requires LOC to start at \$00.
OF84 85 04		STA LOC	
OF86 A5 03	NEXT	LDA BCDHI	Get the most-significant nibble
OF88 29 F0		AND \$FO	of the BCD number. The BCD digits
OF8A 4A		LSR A	will be output from the most-
OF8B 4A		LSR A	significant to the least significant.
OF8C 4A		LSR A	Move high-order nibble to the low-
OF8D 4A		LSR A	order nibble.
OF8E 18		CLC	
OF8F 69 30		ADC \$30	Adding \$30 to a BCD digit converts
OF91 20 A5 0F		JSR OUTCH	it to ASCII. Output the character.
OF94 A0 04		LDY \$04	Get another nibble.
OF96 06 01	AGN	ASL BCDLO	
OF98 26 02		ROL BCDMI	
OF9A 26 03		ROL BCDHI	
OF9C 88		DEY	
OF9D D0 F7		BNE AGN	
OF9F CA		DEX	Get another digit?
OFA0 D0 E4		BNE NEXT	Yes.
OFA2 60		RTS	No.

Table 6. A subroutine to display six digits on the AIM 65 display.

\$0FA5 09 80	OUTCH	ORA \$00	ASCII character is in the accumulator.
\$0FA7 85 05		STA TEMP	Set bit seven and store temporarily.
\$0FA9 8A		TXA	Save X.
\$0FAA 48		PHA	
\$0FAB A6 04		LDX LOC	LOC contains location of the digit
\$0FAD A5 05		LDA TEMP	on the 20 character display
\$0FAF 20 7B EF		JSR OUTDDI	Use AIM 65 monitor routine.
\$0FB2 E6 04		INC LOC	
\$0FB4 A5 04		LDA LOC	
\$0FB6 C9 06		CMP \$06	Have all six characters been output?
\$0FB8 07 04		BCC AHEAD	Yes. Clear LOC.
\$0FBA A9 07		LDA \$00	
\$0FBC 85 04		STA LOC	Get X back.
\$0FBE 68	AHEAD	PLA	
\$0FBF AA		TAX	
\$0FC0 60		RTS	Return to the calling routine.

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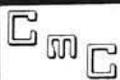
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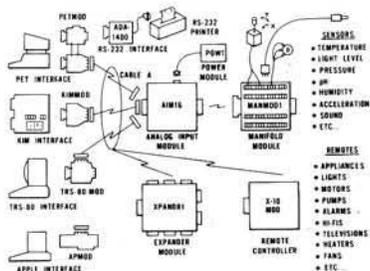
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# Shorthand Commands for Superboard II and Challenger C1P BASICS

---

**This article shows how to intercept the BASIC's input routine and how to implement a shorthand notation.**

---

Henk J. Wevers  
Cloeckendaal 38  
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The Netherlands

As a superboard or Challenger IP owner, you surely have noticed the large amount of adds for extra software for the Apple, PET and TRS 80 machines and you hoped for just some of these goodies to show up for your own computer.

Well, no such luck, so far. So, now we have to do the job ourselves. One of the advertised options for the TRS 80, single stroke instructions, looked nice and I started to program something like that for the OSI machine. The result is presented here, and the shorthand routine is almost always present in my machine during program development.

Before describing how the job was done, let's first have a look at what this routine does exactly. After loading the program, type

```
POKE 536,34:POKE 537,2
```

and instead of typing the instruction letter by letter, you can enter it by hitting the ESCAPE KEY and another key after that. The last key determines which instruction is entered. For instance, if you want to enter RIGHT\$, hit the ESCAPE key first. On the display the cursor will change to an arrow to warn you that the next entry will be an instruction instead of a single character. Now hit C and you have just entered RIGHT\$ as the display shows you.

All instructions are accessible in this way, and by altering the table in memory locations 0280 through 02C3 you may even choose your own shorthand codes.

There are a few things about the Microsoft Basic for the OSI machines that should be known before you can fully understand the program.

First, if Basic asks for an input, the input routine is accessed by a vector located in memory locations 0218 and 0219 (hex) or 536 and 537 decimal. You can intercept the input by changing these locations and so routing the input

through your own routines, and that is the way I did the job.

Secondly, to use the token system in their Basic, Microsoft put a table containing all possible instruction in their program starting at location A084 hex. The instructions are separated in the table by the last character of every instruction having bit 7 set. If you strip off bit 7 of the token, you have the relative position of the instruction in the table. If we look at the instruction END with token 80, then this one has the first position in the table (actually position 0, since we count from zero). RIGHT\$ with Token C3 (hex) has the hex position of 43 in the table.

Third to consider is that the input buffer is located at hex location 13 and up in page zero. X serves as the buffer pointer during input.

And lastly, location 0200 is used as the relative cursor location. The routine WRCHAR at BFC2 puts the character in location 0201 on the screen, at location D300 + the contents of 0200. You can use this in your own programs; I found it very handy. Now to the program. Most of it will be clear to you now.

First a character from the keyboard or cassetteport is input, and if it is not 'ESCAPE' we return it to the A register. Basic can't tell the difference between this routine and the original one. If the character is 'ESCAPE', the cursor is changed from underline to right arrow and another character is input. The shorthand table (0280 through 02C3) is scanned for a match, and if a match is found, the X register will contain the token for that command with bit 7 stripped off. If no match is found another (shorthand) character is input. The start of the instruction is searched for in the Basic table and then the instruction is output to the screen and stored in the input buffer, character by character. If bit 7 of a character is set, (signaling the end of the instruction) this process is stopped, bit 7 stripped off and the last character pro-

cessed. Another character or shorthand command can then be input.

By now you have noticed the strange BIT \$07A9 instruction around locations 0263 and 0274. It is a short way of entering a routine with different contents of the accumulator. For instance, if you enter the OUTCH routine via locations 0262 - 0263 - 0266, you have the character in A output, but entering the routine via 0264-0266 you have the 'BELL' character in A and so output. 025E and 026F switch between the two, depending on the input buffer being full.

Now let's look at the shorthand table starting at location 0280. The last two characters of the addresses also give the token for the instruction. I have programmed this table for you in a way that I have found convenient for the location of the shorthand commands on the keyboard. If you want to program this layout yourself, just enter the ASCII value in the table for the shorthand key you want. For example, if you want the Q-key to be shorthand for 'THEN', only put 51, the ASCII code for Q, in location 02A0, the location for 'THEN'.

The last thing to explain is the choice of where to put this routine in memory. I used locations 0222 and up, because these locations are unused by BASIC and the monitor, and they are not affected by either a cold or a warm start. If you have hit the BREAK key you have to change the input vector again by proper POKING as described earlier.

I hope this little routine will make programming a little easier for you as it did for me. Imagine being able to RUN, LIST, SAVE, and LOAD with one simple keystroke! Most likely, you have exceeded the maximum line length by using a ? instead of PRINT, so you had to type the line all over again after a list, because the program wouldn't load. This routine shows PRINT on the screen after 'ESCAPE' and ? so you will always see what you are doing. Good luck!

Second part of Memloc is taken for command in that location.

MEMLOC	COMMAND	SHORTHAND	CODE(HEX)	02A2	STEP	E	45
0280	END	H	48	02A3	+	+	2B
0281	FOR	Q	51	02A4	-	-	2D
0282	NEXT	G	47	02A5	≠	≠	2A
0283	DATA	O	4F	02A6	/	/	2F
0284	INPUT	I	49	02A7	^	^	5E
0285	DIM	J	4A	02A8	AND	5	35
0286	READ	U	55	02A9	OR	6	25
0287	LET	:	21	02AA	>	>	3E
0288	GOTO	R	52	02AB	=	=	3D
0289	RUN	'CR'	0D	02AC	<	<	3C
028A	IF	D	44	02AD	SGN	(	28
028C	GOSUB	T	54	02AE	INT	6	36
028D	RETURN	Y	59	02AF	ABS	&	26
028E	REM	"	22	02B0	USR	'	27
028F	STOP	^G	07	02B1	FRE	7	37
0290	ON	:	3A	02B2	POS	8	38
0291	NULL	^E	05	02B3	SQR	9	39
0292	WAIT	^A	01	02B4	RND	∅	30
0293	LOAD	L	4C	02B5	LOG	\$	24
0294	SAVE	K	4B	02B6	EXP	4	34
0295	DEF	^D	04	02B7	COS	2	32
0296	POKE	A	41	02B8	SIN	1	31
0297	PRINT	?	3F	02B9	TAN	3	33
0298	CONT	^B	02	02BA	ATN	<del>7</del>	23
0299	LIST	'RUBOUT'	7F	02BB	PEEK	S	53
029A	CLEAR	^C	03	02BC	LEN	M	40
029B	NEW	'LF'	0A	02BD	STR\$	B	42
029C	TAB(	.	2E	02BE	VAL	,	2C
029D	TO	W	53	02BF	ASC	N	4E
029E	FN	^F	06	02B0	CHR\$	V	56
029F	SPC(	;	3B	02C1	LEFT\$	Z	5A
02A0	THEN	F	46	02C2	RIGHT\$	C	43
02A1	NOT	)	29	02C3	MID\$	X	58

SHORTHAND COMMAND FOR OSI CHALLENGER IP and SUPERBOARD

0222	20 BA FF	SHORT1	JSR IN	INPUT CHAR FROM KEYB. OR TAPE
0225	C9 1B		CMPIM \$1B	IS IT 'ESCAPE' ?
0227	FO 01		BEQ SHORT2	YES? BRANCH
0229	60		RTS	NO, RETURN TO BASIC WITH ECHAR
022A	98	SHORT2	TYA	SAVE Y
022B	48		PHA	AND
022C	8A		TXA	X REGISTERS
022D	48		PHA	
022E	A9 12		LDAM \$12	LOAD 'ARROW' TO
0230	8D 01 02		STA CURSOR	CHANGE CURSOR
0233	20 C2 BF		JSR WRCHAR	DO IT
0236	A2 43	SHORT3	LDXIM \$43	LOAD MAX TABLE INDEX
0238	20 BA FF		JSR IN	INPUT SHORTHANDCOMMAND
023B	DD 80 02	SHORT4	CMPX TABLE	COMPARE WITH TABLE
023E	FO 06		BEQ SHORT5	FOUND IT? BRANCH
0240	CA		DEX	DECREMENT INDEX FOR NEXT TRY
0241	10 F8		BPL SHORT4	IF NOT DONE? LOOP BACK
0243	4C 36 02		JMP SHORT3	NO MATCH? IGNORE AND LOOP BACK
0246	EB	SHORT5	INX	COME HERE WITH TABLE INDEX IN X
0247	AO FF		LDYIM \$FF	PREPARE FOR LOOKUP IN COMMAND 1
0249	CA	SHORT6	DEX	COMMAND FOUND?
024A	FO 08		BEQ SHORT8	YES? BRANCH
024C	C8	SHORT7	INY	NO SKIP CURRENT COMMAND IN TABL
024D	B9 84 AO		LDAY \$A084,Y	DONE YET?
0250	10 FA		RPL SHORT7	NO, LOOP BACK
0252	30 F5		BMI SHORT6	YES? GO AND TRY NEXT ITEM
0254	68	SHORT8	PLA	GET INPUTBUFFER INDEX BACK
0255	AA		TAX	AND STORE IT IN X REG
0256	C8	SHORT9	INY	GET READY TO STORE COMMAND IN B
0257	B9 84 AO		LDA \$A084,Y	GET COMMAND CHAR
025A	30 0F		BMI SHORT10	IF LAST CHAR OF COMM, BRANCH
025C	EO 47		CPXIM \$47	INPUTBUFFER FULL?
025E	BO 04		BCS +04	YES? BRANCH TO SHORT9A + 1
0260	95 13		STAX \$13	STORE CHAR IN INPUTBUFFER
0262	E8		INX	INCR. BUFFERPOINTER
0263	2C A9 07	SHORT9A	BIT \$07A9	SKIP OR LOAD 'BELL' IN A
0266	20 E5 A8		JSR OUTCH	OUTPUT CHAR
0269	DO EB		BNE SHORT9	BRANCH ALWAYS
026B	29 7F	SHORT10	ANDIM \$7F	LAST CHAR. STRIP OF HIGH BIT
026D	EO 47		CPXIM \$47	INPUTBUFFER FULL?
026F	BO 04		BCS + 04	YES, BRANCH
0271	95 13		STAX \$13	STORE CHAR IN INPUTBUFFER
0273	E8		INX	INCR BUFFERPOINTER
0274	2C A9 07		BIT \$07A9	SKIP OR LOAD 'BELL' IN A
0277	20 E5 A8		JSR OUTCH	OUTPUT CHAR
027A	68		PLA	RESTORE
027B	A8		TAY	Y REGISTER AND
027C	4C 22 02		JMP SHORT1	LOOP BACK
0280 - 02C3		TABLE		

POKE 536,34:POKE 537,2 PUTS SHORTHAND ON AND  
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Patent Applied For

# A Formatted Dump Routine for the AIM 65

This HEX dump utility permits the user to control the formatting of the dump to conform to his printer's capabilities.

W.E. Wilson  
Washington State U.  
Pullman, WA 99164

The Dump routine in the AIM 65 Monitor produces a continuous character string and thus is not very readable. The dump format is essentially not fit for human consumption. The serious AIM 65 user who needs a memory dump is thus limited to using the Monitor "M" command, which only dumps four locations at a time. A more useful and efficient dump routine with a variable output format was needed by the author and thus the following program was written.

The Formatted Dump routine will dump memory over the range specified in response to the "FROM=" and "TO=" parameters. The number of bytes in each line of the dump is specified in response to "I". All input and output is in hexadecimal. Each line of the dump gives the starting address of the first byte in the line, a space, 1st byte, space, 2nd byte, etc. The standard AIM-65 printer will handle \$05 bytes per line and an 80 column TTY type unit will handle up to \$16 (22) bytes per line.

The dump routine makes extensive use of the routines in the AIM-65 Monitor as well as RAM locations reserved for the Monitor. No locations outside of the Monitor area, except for the dump routine itself, are used by the dump routine. Thus the dump routine may be located at any convenient place in RAM and will not affect any other software. The following dumps demonstrate the use of the routine.

## AIM-65 MONITOR ROUTINES USED IN DUMP PROGRAM

E7A3 = Print "FROM=" and get address in \$A41C/D.

E83E = Print " " (blank).

E910 = Move address from \$A41C/D to \$A41AB.

E7A7 = Print "TO=" and get address in A41C/D.

E837 = Print "!".

E785 = Get two hex digits and store in A419.

EA13 = Print "CRLF".

EA46 = Print one hex byte = Two ASCII characters.

EB58 = LDAY - Simulates LDA (N), Y without page 0.

E182 = AIM-65 Monitor Re-entry.

## A Formatted Dump Routine for the AIM-65 List 1

0112 4C JMP 0F90

0F90 20 JSR E7A3  
0F93 B0 BCS 0F90  
0F95 20 JSR E83E  
0F98 20 JSR F910  
0F9B 20 JSR E7A7  
0F9E B0 BCS 0F9B  
0FA0 20 JSR E83E  
0FA3 20 JSR E837

0FA6 20 JSR E785  
0FA9 20 JSR EA13  
0FAC AD LDA A41C  
0FAF 38 SEC  
0FB0 ED SBC A41A  
0FB3 48 PHA  
0FB4 AD LDA A41D  
0FB7 ED SBC A41B  
0FBA 30 BMI 0FF6  
0FBC D0 BNE 0FC1  
0FBE 68 PLA  
0FBF F0 BEQ 0FF6  
0FC1 AD LDA A41B  
0FC4 20 JSR EA46  
0FC7 AD LDA A41A  
0FCA 20 JSR EA46  
0FCD AE LDX A419  
0FD0 A0 LDY #00  
0FD2 20 JSR E83E  
0FD5 A9 LDA #1A  
0FD7 20 JSR E858  
0FDA 20 JSR EA46  
0FDD C8 INY  
0FDE CA DEX  
0FDF D0 BNE 0FD2  
0FE1 20 JSR EA13  
0FE4 AD LDA A419  
0FE7 18 CLC  
0FE8 6D ADC A41A  
0FEB 8D STA A41A  
0FEE 90 BCC 0FF3  
0FF0 EE INC A41B  
0FF3 4C JMP 0FAC  
0FF6 4C JMP E182

RUN  
 FORMATTED DUMP ROUTINE FOR THE AIM-65  
 ENTER VIA F3 FUNCTION KEY =↑  
 SPECIFY : FROM=, TO=, /=(CHRS/LINE)  
 CHRS/LINE=TWO HEX DIGITS

<↑>FROM=B000 TO=B020 /05

B000 4C A3 CE 4C 7F  
 B005 B2 FE BE D1 C0  
 B00A 5D B6 5B B5 FF  
 B00F BA 66 B7 BB B9  
 B014 D9 BD EF B9 13  
 B019 B8 13 B7 EB B6  
 B01E 96 B7 30 B6 F6

<↑>FROM=B000 TO=B020 /08

B000 4C A3 CE 4C 7F B2 FE BE  
 B008 D1 C0 5D B6 5B B5 FF BA  
 B010 66 B7 BB B9 D9 BD EF B9  
 B018 13 B8 13 B7 EB B6 96 B7

<↑>FROM=B000 TO=B020 /10

B000 4C A3 CE 4C 7F B2 FE BE D1 C0 5D B6 5B B5 FF BA  
 B010 66 B7 BB B9 D9 BD EF B9 13 B8 13 B7 EB B6 96 B7

# AIM 65 Software



\* DISCOVER 6502 POWER \*

## HELP!!

9 Super utility programs for all AIM 65 programmers. **HEX INPUT:** Long and short versions, used for entering hex bytes into memory. **DUMP & HEXOUT:** Print out your memory in two formats for easy checking or location of individual bytes. **FIELD SORT:** A field sorting routine that finds usage in many tasks including helping you organize your programming. **RESTORE:** A program which automatically restores your editor after you've re-entered it improperly. This has been a real time saver for us. **ONE STEP:** Allows you to step thru the disassembly (K listing) one line at a time. **SYMBOL TABLE:** Is for use with the assembler ROM (How can you do without one?). It prints the beginning and ending addresses of your symbol table along with each label in your program and its address, all in a handy format. **RELOCATE:** Is a powerful program which allows you to move or relocate programs or data in memory. All who write, adapt or pirate programs or subroutines will appreciate this. It allows you to place them wherever you'd like. You can even open up spaces right in the middle of a program for inserting missing, new, or additional data or instructions. A programmers dream.

## GAIMS PAK I

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6 Programs dealing with numbers & math & the AIM 65. **ADD & SUBTRACT:** This powerful utility program turns your AIM 65 into a multiple precision calculator. **TOTAL:** Adds up to four decimal or hexadecimal numbers at a time. **TEST MEMORY:** Lets you really check out your RAM memory. **FIBONACCI:** You learn about these important numbers as your AIM generates them in a series. **DEC TO HEX:** A multi-use program and algorithm for changing decimal numbers into their hex equivalents. **TIMER:** Makes your AIM 65 into a timer or a 12 or 24 hour clock, displaying or printing hours, minutes and seconds. A super demo of the power of the AIM 65.

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## SHOW OFF

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**EPROM Programmer:** The VIA's are used in conjunction with some additional circuitry on the DRAM board to program all four types of EPROM. A separate programming socket is provided, a regulator circuit provides the programming voltage from a +27 volt input, and voltage to the EPROM is controlled by the program to prevent accidental damage to the EPROM.

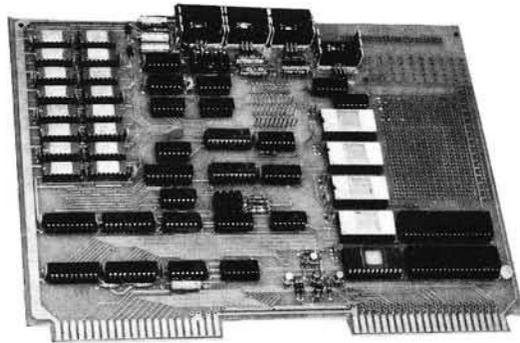
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DRAM PLUS [16K RAM]: TCB-101-16  
DRAM PLUS [32K RAM]: TCB-101-32



**RAM Memory Addressing:** Although the RAM is packaged as one or two 16K segments, provision has been made on DRAM PLUS for the memory to be addressed at four separately defined 4K boundaries per 16K segment. There are some restrictions on the set of boundaries that may be used within any 16K segment. Address bits A12 and A13 must not be the same for any of the 4K segments within a 16K segment. This results in a type of "Chinese Menu" selection. One 4K segment may be selected from each column of the following table, which lists the starting address of the 4K boundaries in hexadecimal:

0000	1000	2000	3000
4000	5000	6000	7000
8000	9000	A000	B000
C000	D000	E000	F000

An examination of the table will show that any four contiguous blocks will automatically come from different columns. If blocks were selected at 1000, 2000, and 3000, then the fourth block would have to be 0000 (which is highly unlikely on an AIM/SYM/KIM), 4000, 8000, or C000, for that 16K segment of memory.

**Prototype Area:** A prototyping area provides space and support for the addition of special circuits. The actual prototyping grid is approximately 2" by 2-3/4" and consists of a matrix of 13 by 28 holes spaced for standard sockets and IC's. The area is designed so that wirewrap or solder sockets may be used. The address and data lines are readily accessible to this area and convenient +5V and ground runs are provided. Connections to this area may be made through a separate connector facility which can support a standard connector with up to 50 pins.

**MICRO Bus Compatible:** The connections between the DRAM PLUS and the AIM/SYM/KIM follow the same conventions used by the original KIM-4 mother board. DRAM PLUS may be interfaced via a simple cable or the MOTHER PLUS.

**General Information:** The board is high quality, double sided with two sets of gold plated fingers with the same positioning as the connectors on the AIM/SYM/KIM. The board is the same size and shape as the SYM and KIM: 7-7/8" wide (excluding the edge connectors) by 10-3/4" long. All IC's are socketted to make field repair and servicing simple. Full documentation consists of instructions, schematics, program listings, data sheets and application notes. A Memory Test and an EPROM Programming Program are provided on a cassette tape which loads and works on the AIM/SYM/KIM. The DRAM PLUS Manual is available separately for \$10.00, and this cost may be applied towards the purchase price.

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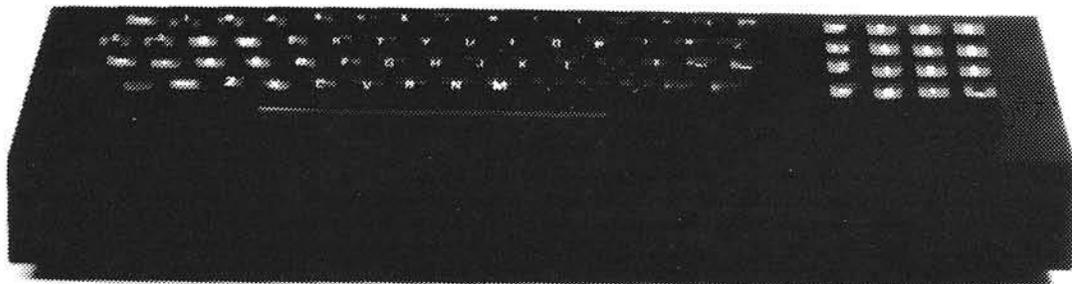
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# New and Better PET User Port Printer Routines

A series of programs are presented which drive any TTL, parallel, or ASCII printer from the PET's user port.

Michael Tulloch  
103 White Cr.  
Niceville, FL 32578

This article describes three programs which drive a printer from PET's user port. Any TTL, parallel, ASCII, printer can be driven. Two of the programs are in machine language and one is in BASIC.

Although there are several IEEE to serial and IEEE to parallel adaptors available for the Pet, the user's port is often needed to drive an ASCII device. In my case I saved \$100 dollars by using the user port to drive my Trendcom printer. No hardware (except a cable and two connectors) is required. The software is equally simple: A printer driver with hand shake and a screen reader.

There are several reasons to drive your printer or other ASCII device from the user port. First, it is quick and easy. Second, some of the IEEE to ASCII adaptors respond to any and all device addresses. Third, if you already have an adaptor, the user port allows a temporary installation without interfering with existing devices. Another reason is that it allows you to have better and more direct control over the output. Both data and hand shaking can be done explicitly with software. Finally, and for me most importantly, it saves money. Just \$2.19 for a ribbon cable and two junkbox connectors, had me printing

In general the following two programs comprise a screen printer. Two parameters can be adjusted by the calling program (or as direct commands): Start point, and  $\pm$  of rows (if implemented in RAM), Thus a specific area, or window, of the screen can be printed. The two programs are named: 1. Printer Driver and 2. Screen Reader. For timing reasons Printer Driver is implemented only in machine language. Screen Reader, however, can be implemented either in machine language (Version A) or BASIC (Version B).

```
10000 POKE850,13:SYS849:
      FORR=0TO23:FORC=0TO35
10010 A=PEEK(32768+C+R*40)
10015 IF A=18 AND C=0 THEN STOP
10020 IF A<=31 THEN A=A+64::GOTO10060
10030 IF A<=63 THEN 10060
10040 IF A>127 THEN A=A-127:GOTO10060
10045 A=A+32
10060 POKE850,A:SYS826
10070 NEXT C:POKE850,13:SYS826
10080 NEXT R
10090 RETURN
READY.
```

Figure 1

Let's start with the easy one first—the BASIC Screen Reader. Figure 1 is a listing of this routine. Line 1000 clears the small printer buffer by making a carriage return and calling Printer Driver (located at 826 in this example). Line 10005 forms the screen reading loops with R the Row counter and C the Column counter. Here only eleven lines are printed. The Screen Value is placed into A by line 10010. Lines 10020 through 10045 convert the screen value to its equivalent ASCII code. Notice that graphic characters are printed as lowercase letters if they are on letter keys. Reversed letters are printed as not reversed letters, and not all graphic characters are printed. Figure 2 gives a sample of print out for the PET character set. The equivalent screen values are though 255. Version A is the machine language equivalent of Screen Reader. It's principle advantage is that it runs hundreds of times faster. In fact, on my Trendcom 100, which prints bidirectionally, you can't even see it hesitate between lines. At the Trendcom's 40 char/sec rate, a full screen of 1000 characters is printed in 30 seconds. Not Bad!

Another advantage is that you can hide it in the second cassette buffer and load it in only once. The BASIC version has to be attached to your program somehow.

A flow chart is shown in figure 3. It is annotated for the machine language version. Figure 4 shows the disassembled code. Figure 5 gives the HEX code as output by the PET monitor program.

Block I initializes all registers. The screen read address is initialized to 32767. This is one less than the upper left screen start address value. Memory location 995 (03E3) is the number of Rows to be printed. It's used as the Row counter. A column counter is stored in 992 (03E0). It is initialized with 40 and 40 is held in the X register for later use.

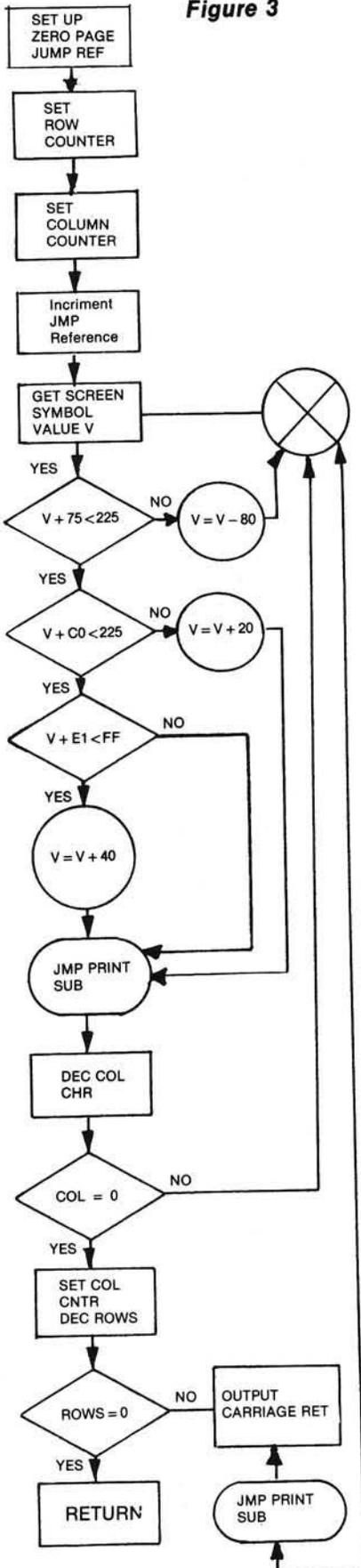
Block II increments the screen read address. Block III gets the screen value occupying the screen read address. This value is stored in location 996. Block IV is the adjustment routine. This is different from the scheme used in the BASIC program. Instead of using subtraction, addition is used. Although the logic is inverted from the BASIC program, the value



BLOCK I

ENTRY

Figure 3



BLOCK II

GET

BLOCK III

BLOCK V

BLOCK VI

BLOCK VII

BLOCK VIII BLOCK IX

BLOCK X

END

SCREEN READER

START 28848

END 28985

TIME 160238

DATE 091779

Figure 4: Machine Language Listing of Version A Screen Reader. Note that the listing is for a high memory location. Addresses found at the following hex lines must be changed to relocate the program: \$70f9, \$70fc, \$7108, \$7113, \$7129, \$7134, \$7137.

28848	709E	A0 00	LDYIM	00	0
28848	7090	A2 FF	LDXIM	FF	255
28850	70B2	8E 01	00STX	0001	1
28853	70B5	A2 7F	LDXIM	7F	127
28855	70B7	8E 02	00STX	0002	2
28858	70BA	AE E3	03LDX	03E3	995
28861	70BD	8E E1	03STX	03E1	993
28864	70D0	A2 28	LDXIM	28	40
28866	70D2	5A	NOP		
28867	70D7	8E 50	03STX	03E0	992
28870	70D8	18	CLC		
28871	70D7	AD 01	00LDA	0001	1
28874	70DA	69 01	ADCIH	01	1
28875	70DC	ED 01	00STA	0001	1
28878	70DF	AD 02	00LDA	0002	2
28882	70D2	69 00	ADCIH	00	0
28884	70D4	8D 02	00STA	0002	2
28897	70D7	18	CLC		
28898	70D8	B1 01	LDARI	01	1
28899	70D8	8D E4	00STA	03E4	998
28903	70D0	69 7F	ADCIH	7F	127
28905	70DF	B0 1F	BDS	1F	31
28907	70E1	AD E4	03LDA	03E4	996
28909	70E4	69 00	ADCIH	00	132
28912	70E6	B0 25	BDS	25	37
28914	70E8	AD E4	03LDA	03E4	998
28917	70EB	69 E1	ADCIH	E1	225
28919	70ED	B0 37	BDS	37	50
28911	70FF	AD E4	03LDA	03E4	996
28914	70F2	69 40	ADCIH	40	64
28916	70F4	EA	NOP		
28917	70F5	EA	NOP		
28918	70F6	8D 54	035IA	0354	952
28921	70F8	20 3A	71JSR	713A	28988
28924	70FC	4C 18	71JMP	7118	28952
28927	70FF	EA	NOP		
28928	7100	EA	NOP		
28929	7101	AD E4	03LDA	03E4	936
28932	7104	38	SEC		
28933	7105	E9 80	SBC	80	128
28935	7107	18	CLC		
28936	7108	4C 0A	70JMP	700A	28980

```

28939 710B EP      NOP
28940 710C EP      NOP
28941 710D A0 E4 03LDA 03E4 996
28944 7110 18      CLC
28945 7111 69 20  ADCIM 20 32
28947 7113 4C F6 70JMP 70F6 28918  START 28986      END 29051
28950 7116 EA      NOP
28951 7117 EA      NOP

```

PRINTER DRIVER

TIME 160614 DATE 09/17/79

```

28952 7118 0E E0 03DEC 03E0 990
28955 711B 00 A0  BNE  A0 170
28957 711D 8E E0 03STX 03E0 990
28960 7120 0E E1 03DEC 03E1 990
28963 7123 00 09  BNE  09 9
28965 7125 60      RTS
28966 7126 AD E4 03LDA 03E4 996
28969 7129 4C F6 70JMP 70F6 28918
28972 712C EA      NOP
28973 712D EA      NOP
28974 712E EA      NOP
28975 712F A9 00  LDRAIN 00 13
28977 7131 80 54 03STA 0354 852
28980 7134 20 3A 71JSR 713A 28936
28983 7137 4C 06 70JMP 7006 28870

```

Figure 5

READY.

```

CS  S  PC  SR  AC  XR  YR  SP
..  USED 30 38 7E 31 FE
..  H 70AE,7137
..  0 1 2 3 4 5 6 7
..  70FE 00 00 02 FF 0E 01 00 A2
..  7085 7F 8E 02 00 HE E3 03 8E
..  708E E1 03 A2 28 EA 8E E0 00
..  7008 18 AD 01 00 69 01 80 01
..  70CE 00 AD 02 00 69 00 80 02
..  7005 00 18 B1 01 80 E4 03 69
..  702E 7F 80 1F AD E4 03 69 00
..  705B 80 25 AD E4 03 69 E1 80
..  70EE 37 AD E4 03 69 40 E9 6A
..  70F6 80 54 03 20 3A 71 4C
..  70FE 71 EA EA AD E4 03 38
..  7105 80 18 4C DA 70 EA EA AD
..  710E E4 03 18 69 20 4C F6 70
..  7116 EA EA 0E E0 03 00 A9 8E
..  711E E0 03 0E E1 03 00 09 60
..  7126 AD E4 03 4C F6 70 EA EA
..  712E EA A9 00 80 54 03 20 3A
..  7135 71 4C 06 70 A9 FF 80 43
..  X
..  PS

```

Figure 6

```

28986 713A A9 FF  LDRAIN FF 255
28988 713C 80 43 E8STA E843 5945
28991 713F AD 4C E8LDA E84C 59468
28994 7142 48      PHA
28995 7143 A9 FE  LDRAIN FE 254
28997 7145 80 4C E8STA E84C 5946
29000 7148 AD 49 E8LDA E84B 59467
29003 714B 29 E3  ANDIM E3 227
29005 714D 80 4B E8STA E84B 59467
29008 7150 EA      NOP
29009 7151 E0      NOP
29010 7152 78      SEI
29011 7153 AD 54 03LDA 0354 652
29014 7156 80 41 E8STA E841 59457
29017 7159 AD 4C E8LDA E84C 59468
29020 715C 29 1F  ANDIM 1F 31
29022 715E 09 00  ORAIM 09 192
29024 7160 80 4C E8STA E84C 59468
29027 7163 EA      NOP
29028 7164 EA      NOP
29029 7165 EA      NOP
29030 7166 EP      NOP
29031 7167 AD 4C E8LDA E84C 59468
29034 716A 09 E0  ORAIM E0 224
29036 716C 80 4C E8STA E84C 59468
29039 716F EA      NOP
29040 7170 18      CLC
29041 7171 EA      NOP
29042 7172 AD 40 E8LDA E840 59469
29045 7175 29 02  ANDIM 02 2
29047 7177 FD F9  BEB  F9 249
29049 7179 68      PLA
29050 717A 58      CLC
29051 717B 60      RTS
29052 717C EA      NOP
29053 717D EA      NOP
29054 717E EA      NOP
29055 717F 00      BRK
29056 7180 00      BRK

```

READY.  
RUN

```

D*  PC  SR  AC  XR  YR  SP
.  CSED 30 38 7E 31 FE
.  H 713A,7180
      0  1  2  3  4  5  6  7

```

FsUsD MONITOR  
LOADING  
READY.  
RUN

```

D*  PC  SR  AC  XR  YR  SP
.  CSED 30 38 7E 31 FE
.  H 713A,7180
      0  1  2  3  4  5  6  7
.  713A 09 FF 8D 43 E8 FD 4C E8
.  7142 48 09 FE 8D 4C E8 AD 4B
.  714A E8 29 E3 8D 4B E8 EA EA
.  7152 78 AD 54 03 8D 41 E8 AD
.  715A 4C E8 29 1F 09 D0 8D 4C
.  7162 E8 EA EA EA EA AD 4C E8
.  716A 09 E8 8D 4C E8 EA 18 EA
.  7172 AD 4D E8 29 02 F0 F9 68
.  717A 58 60 EA EA EA 00 00 24
.  X
READY.
>8

```

Figure 7

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**Symbol-Table Sorter/Printer for the AIM Assembler**  
by Mel Evans  
[MICRO 20:43]

"After more extended use of the program, I have found the following pair of bugs.

The first can be cured by replacing the code shown in Figure 1A (occurring at the end of subroutine SORT) by that in Figure 1B. The old code works often, but not always. The new code always works.

The second bug won't show until you start getting fancy with your source code. I was mistaken in thinking that memory locations 003C, 003D contain the address of the last symbol found during assembly. Instead, they contain the address of the last active symbol. With straightforward code, these will be one and the same. But suppose you have written your last subroutine (let's call it SUBZ) and then decide to initialize a couple of zero-page addresses (starting at ZP1) as in Figure 2A. After assembly, the last symbol will be SUBZ, but the last active symbol will be ZP1. And with this stored in 003C, 003D, you will get a very short listing!

The problem could be solved by re-writing the program to avoid using 003C, 003D. But, there's a simpler solution, as shown in Figure 2B. Add a new symbol, LAST, as the last byte of the program. (This is a good practice anyway. After assembly, the address of LAST tells you precisely how much memory the program needs.) The, after initialization and any other housekeeping, add the line "\*" = LAST". This makes "last active" equal "LAST", and the listing comes out complete."

Submitted by: Mel Evans  
ERIM, P.O. Box 8618  
Ann Arbor, MI 48107

```
JSR CRCK
JSR INCADR
BMI PRNT1
BEQ PRNT1
JSR GAP
RTS
```

Figure 1A: Old SORT Code

```
SUBZ
.
.
RTS
:
*=ZP1
.DBY $0A0B
;
.END
```

Figure 2A: Wrong "Last Active"

```
JSR CRCK
TXA
BNE FIN
JSR INCADR
BNE PRNT1
DEX
BNE PRNT1
FIN JSR GAP
RTS
```

Figure 1B: New SORT Code

```
SUBZ
.
.
LAST RTS
;
*=ZP1
.DBY $0A0B
;
*=LAST
;
.END
```

Figure 2B: Right "Last Active"

# Microbes

## and

# Updates

**Expanding the SYM - 1 ... Adding an ASCII Keyboard**  
by Robert A. Peck  
[MICRO 21:5]

"As we discussed, here is a corrected version of my program listing. Somehow the hex locations column of this listing was not used for the article. [Sorry about that - MICRO] Typos corrected on final version including label "DISP" change to WAIT2 at location 206 (minor), incorrect object code fixed at line 222 to 20 47 8A .... Last was pointer to KSTAT at line 240 which should be 39."

Submitted by: Robert A. Peck  
P.O. Box 2231  
Sunnyvale, CA 94087

```
0200 20 88 B1 GKEY JSR SAVER SAVE REGISTERS
0203 AD 01 A8 LDA A801 GET PARALLEL ASCII
0206 F0 24 BEQ WAIT2 UNLESS NONE, THEN BRANCH
0208 85 F1 STA 00F1 STORE IT A WHILE
020A A9 10 LDA #810 DEBOUNCE CONSTANT
020C 85 EF STA 00EF DEBOUNCE
020E C6 F0 WAIT1 DEC 00F0 SMALL LOOP
0210 D0 FC BNE WAIT1
0212 C6 EF DEC 00EF LARGE LOOP
0214 D0 F8 BNE WAIT1
0216 20 03 89 SCANA JSR IJSCNV SCAN DISPLAY(USE SCANVEC)
0219 2C 01 A8 BIT A801 IS KEY STILL DOWN?
021C 30 F8 BMI SCANA WAIT FOR KEY RELEASE
021E A5 F1 LDA 00F1 KEY UP, PROCESS KEY
0220 29 7F AND #87F STRIP KEY STROBE BIT
0222 20 47 8A JSR OUTCHR SEND INTO DISBUF
0225 A5 F1 LDA 00F1 GET IT AGAIN
0227 29 7F AND #87F STRIP IT AGAIN
022A 4C B8 81 JMP RESXAF RETURN WITH ASCII IN A
022C A9 10 WAIT2 LDA #810 IF NO KEY,
022E 85 EF STA 00EF SCAN DISPLAY
0230 20 03 89 SCANB JSR IJSCNV THRU SCANVEC
0233 C6 EF DEC 00EF A NUMBER OF TIMES
0235 D0 F9 BNE SCANB THEN GO BACK
0237 F0 CA BEQ GKEY AND LOOK AGAIN
0239 AD 01 A8 KSTAT LDA A801 READ ASCII INPORT
023C 0A ASLA SHIFT MSB INTO CARRY
023D 60 RTS RET, CFLAG=1 IF KEY DN.

0240 20 86 8B INIT JSR ACCESS UNPROTECT SYSRAM
0243 A9 00 LDA #00 MODIFY
0245 BD 61 A6 STA A661 KEYBOARD
0248 A9 02 LDA #02 INPUT
024A 8D 62 A6 STA A662 VECTOR
024D A9 39 LDA #39
024F 8D 67 A6 STA A667 KEYPRESS
0252 A9 02 LDA #02 STATUS
0254 8D 68 A6 STA A668 VECTOR
0257 4C 03 80 JMP WARM WARM ENTRY, MONITOR
```

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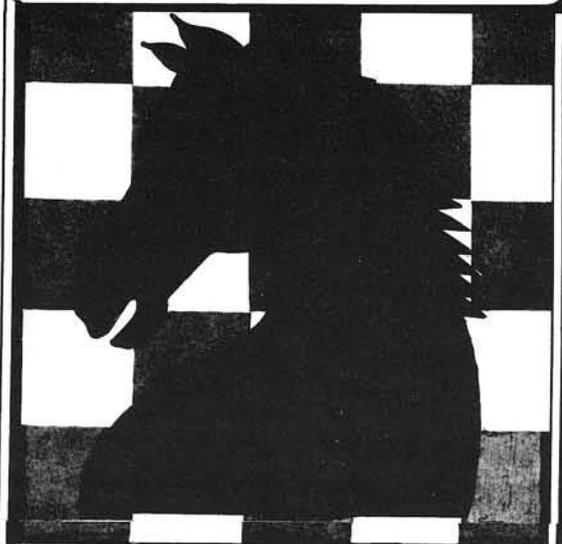
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# Graphics and the Challenger C1P, Part 5

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**This final installment in the series discusses plotting techniques and moving characters.**

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The ability to have characters and have them move in our game programs is a must. How do we accomplish this task? It is a simple task to implement. We do it with a technique called plotting.

## C1P Plotting Technique

In order to have any character move on our C1P's Monitor screen, we must first know where we wish our character to start, the angular directions in which it is to move, and where the character's movement will end. If you will examine the example of the plotting diagram in Figure 1, you can see the angular directions in which the character can be made to move on the monitor screen. These angular directions are relative to any point on the screen, i.e., relative to a certain position on the Video RAM. If, for example, the starting location were 54000 decimal, the zero point would be 54000 decimal and all movement would be relative to that point.

As stated in an earlier part of this series, we can cause a character to be placed on the screen of our C1P with a BASIC POKE statement. We move the character that has been placed on the screen with a BASIC FOR/NEXT loop. In the explanation of plotting and how to develop animated characters we will use the functions of BASIC to develop our programs and to describe animation methods.

To begin our explanation, let's use decimal location 54000 as an example again as a starting point. A BASIC program would use this decimal location as a variable content. For example,  $10 A = 54000$ . Now that we have a starting point, we can move the graphics character in any direction shown in the diagram in Figure 1. For example, if you wish the character to move in a vertical direction, with a BASIC subroutine we can get the character displayed and moved. In order to explain how this procedure works,

please refer to the BASIC program subroutines in Listing 1, along with Figure 1.

If we wish to have an animated character (one that moves) we must first know the start, end, and path of the character, as stated before. The character must be made to appear at a point along the path of angular movement. The character is then displayed for some duration of time. Next it is erased from its present position and then displayed at a new position on the monitor screen. This process must be continued for the desired distance along the plotted path that we have chosen. These criteria can be executed with BASIC or Machine Language programs. Since we are primarily programming in BASIC, we will develop some BASIC routines to show how the character can be produced and moved on the C1P's

monitor screen.

The BASIC routine in section one of Listing 1 will be used to generate an animated character that will primarily move from near center screen downward to near the bottom of the screen. This subroutine begins at BASIC program line 5. Here the REM statement tells the user that this is a routine to generate the movement of a character downward. Line 10 is the real beginning of the subroutine. At line 10 the A variable is loaded with the decimal beginning of the memory location where the character will first be displayed. Notice that this line forms part of a FOR/NEXT loop. Also notice that this loop will be incremented by a total of 32 counts for every pass through the program. This is done with the STEP function of BASIC. The FOR/NEXT loop at line 10 actually sets the limits of movement of the character. These limits are in the



For an angular movement in any direction, use the value in the chart to cause movement in that direction. It must be understood that the decimal beginning and ending must be calculated because for each pass through the loop with a step function, the variable will be incremented by the amount in the step value.

Study the remainder of the modules in Listing 1, from our discussion you should be able to see just how these subroutines work. Load the programs into your C1P and watch the action on the screen. This will show you the results. The diagram in Figure 2 gives the complete memory map for a C1P. This is for a 25 by 25 character format. Use this diagram for all your plotting to find any location on the C1P monitor screen.

Now that we have seen some examples of how a moving character is made to move on the C1P's screen, let's use some of these techniques to develop a program that has some moving character elements that form a game. Listing 2 shows a game program that uses moving elements. These are: a starship and laser cannon shots directed at the starship. All the techniques that we have discussed, that give the sensation of motion, are used in Listing 2. Please refer to this listing as we discuss the inner workings of the program's operation.

The program is presented, as I have said, as a game. The starship moves across mid-screen and the cannons are placed at each bottom corner, and at mid-bottom of the screen. The keyboard keys 5, 6, and 7 are used to fire the cannons. A hit score total is printed out at the top of the monitor screen for the player.

This program is straight-forward and each module is identified by REM statements. This discussion will deal mainly with graphics and the keyboard routines, so please continue to refer to Listing 2. The remainder of the program should be self-explanatory.

The program from line 300 through 347 forms the main line BASIC module. It is used to draw and move the starship across the screen. The polling routine for the keyboard is located from line 335 to line 344. If a 5, 6, or 7 key is pressed, a GOSUB to a cannon shot routine will result in a shot at the starship. Key 5 causes a shot from bottom right upward diagonally to top left of the screen. A 7 key results in a shot from bottom left to top right. A 6 key results in a true vertical shot.

The position of the starship is always contained in the K variable. This location is always checked in each shot routine at lines 415, 462, and 525. If a hit occurs, the program jumps to line 600 where an ex-

plosion of the starship will be displayed at the screen location contained in variable K. Next a hit score will be placed on the screen. The hit count will be checked for 10 hits. If so the player will be informed that he has completed the exact number of hits and has won the game. If the player has less than 10 hits, the program returns through RETURNS to the exact main-line program at line 300.

This program uses more of the elements contained in the Character Generator ROM. These elements are the elements that are used to draw the starship. Their decimal equivalents are 9 and 12, and are written into video memory with the POKE statement at line 310. After a delay at line 320, the starship is erased and placed at the next location in the FRO/NEXT loop from line 300. The cannon shots are primarily POKED to screen memory, displayed for some duration of time and then erased. This process continues until the FOR/NEXT loop has been incremented to its maximum value.

#### Conclusion

If you have followed all five parts of this series, I believe that you should now have sufficient knowledge of your C1P's graphics capabilities. I hope that you now also have a better understanding of the polled keyboard, and how to use these capabilities with BASIC programming to produce real working programs that will be enjoyable to use. Hopefully you have learned with me through these efforts and I will see some of your programs published in the pages of MICRO in the near future. With that, I will conclude this series of articles and I hope that these programs and ideas will be as much fun for you as you read and experiment, as they have been for me in the writing. Good luck with your programming and with your writing.

#### SECTION 1)

```
5 REM MOVE CHARACTER DOWN
10 FOR A = 53776 TO 54160 STEP 32
20 POKE A, 161
30 FOR B = 1 TO 50 : NEXT B
40 POKE A, 32
50 NEXT A
```

#### SECTION 2)

```
60 REM MOVE CHARACTER UP
70 FOR A = 54160 TO 53763 STEP -32
80 POKE A, 161
90 FOR B = 1 TO 50 : NEXT B
100 POKE A, 32
110 NEXT A
```

#### SECTION 3)

```
120 REM MOVE CHARACTER RIGHT
130 FOR A = 53776 TO 53787
140 POKE A, 161
150 FOR B = 1 TO 50 : NEXT B
160 POKE B, 32
170 NEXT A
```

#### SECTION 4)

```
180 REM MOVE CHARACTER LEFT
190 FOR A = 53776 TO 53763 STEP -1
200 POKE A, 161
210 FOR B = 1 TO 50 : NEXT B
220 POKE A, 32
230 NEXT A
```

#### List 1

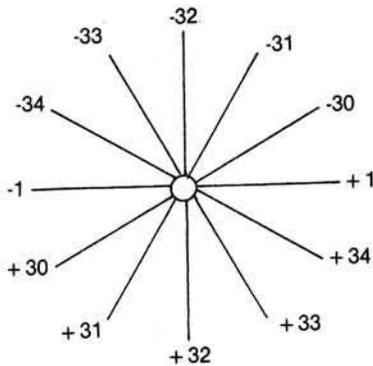
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*Photographs for this series were provided by William L. Taylor, Jr.*

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**Figure 1: Plotting Directions for the C1P**

LIST1-500

```

1 REM DEMONSTRATION PROGRAM FOR ANIMATED ELEMENTS ON
2 REM BY WILLIAM L. TAYLOR 12/3/1979      OSI C1P
3 PRINT"STAR SHIP ATTACK"
4 PRINT:PRINT" DESTROY THE STARSHIPS WITH KEYS 5,6,7"
5 PRINT" YOU GET 10 SHOTS":PRINT
8 FOR S=1 TO 10000:NEXT S
10 L=2:GOTO350
299 REM DRAW STARSHIP AND KEYBOARD POLLING ROUTINE
300 FOR K=53763 TO 53767
310 POKE K,9:POKE K+1,12
320 FOR J=1 TO 50:NEXT J
330 POKE K,32:POKE K+1,32
335 POKE 530,1:POKE 57088,127
337 C=C+1
342 IF PEEK(57088)=253 THEN GOSUB 400
343 IF PEEK(57088)=251 THEN GOSUB 500
344 IF PEEK(57088)=247 THEN GOSUB450
345 NEXT K
347 GOTO 300
349 REM CLEAR SCREEN
350 FOR T=-3 TO 32:PRINT:NEXT T
360 GOTO 300
399 REM DRAW RIGHT VERTICAL SHOT
400 FOR T1=54147 TO 53403 STEP -31
410 POKE T1,249
415 IF T1=K THEN GOSUB 600
420 FOR T2=1 TO 5:NEXT T2
425 POKE T1,32
430 NEXT T1
438 RETURN
449 REM DRAW LEFT VERTICAL SHOT
450 FOR T3=54171 TO 53379 STEP -33
460 POKE T3,255
462 IF T3=K THEN GOSUB 600
463 FOR T4=1 TO 5:NEXT T4
464 POKE T3,32
465 NEXT T3
470 RETURN
475 POKE T4,32
499 REM DRAW VERTICAL SHOT
500 FOR T5=54158 TO 53390 STEP-32

```

OK

LIST4L500-800

```

500 FOR T5=54158 TO 53390 STEP-32
520 POKE T5,248
525 IF T5=K THEN GOSUB 600
530 FOR T7=1 TO 5:NEXT T7
540 POKE T5,32
550 NEXT T5
580 C=0:RETURN
599 REM CHECK SHOT HIT DRAW EXPLOSION AND DISPLAY HITS
600 E=0:U=53731
610 POKE U+E,32
620 FOR A=1 TO 10:POKE K,A:NEXT A
630 E=E+1:IF E<20 THEN 610
640 IF E=20 THEN POKE 53455,72:POKE 53456,73:POKE 53457,84
650 POKE 53458,32:POKE 53459,L+47
660 L=L+1
662 IF L<10 THEN RETURN
665 IF L=10 THEN PRINT" ALL TARGETS DESTROYED"
670 PRINT" YOU HAVE SAVED THE UNIVERSE"
680 PRINT" WANT TO PLAY AGAIN YES OR NO"
690 INPUT A1$
700 IF A1$="YES" THEN 1
710 IF A1$="NO" THEN END

```

OK

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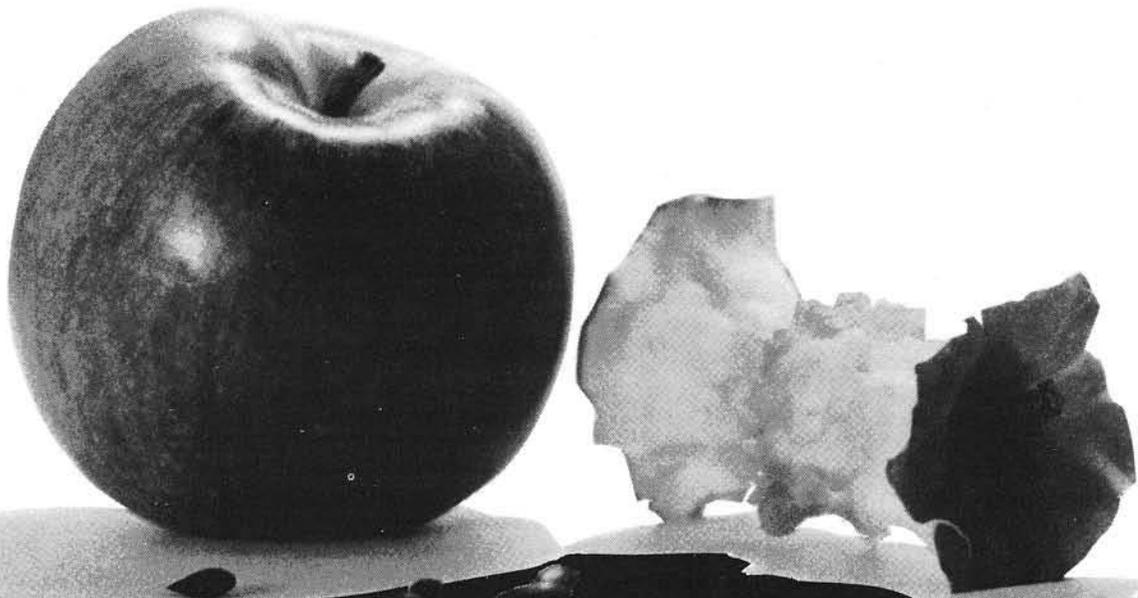
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# Lower Case and Punctuation in APPLESOFT

---

**Do you need to get lower case and punctuation into your BASIC strings? Then, try these programs.**

---

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## Introduction

While computer people may adapt to all caps, the general public still uses, and apparently likes, lower case. Printing with lower case is more familiar, more readable and more acceptable. Thus, we who work with computers should provide lower case in any printout that we expect or hope laymen to read. After all, computers should adapt to people; people should not have to adapt to computers.

Also, who is there among us who hasn't wondered at how the APPLE handles punctuations in strings? In INPUT's, we have found to our dismay that a "JONES, JOHN" results in an error message saying "?EXTRA IGNORED" and later finding the string variable as only "JONES" with nothing to tell us which Jones that may be. What wouldn't we give to get quotation marks and commas in the places we want?

So much for what should be or what we want. The APPLE doesn't have lower case and seems rather whimsical about punctuation. Well, face it; there were a number of compromises made in the design of the APPLE and Applesoft. Of course, some of these deficiencies can be conquered by money. We can buy one of the lower-case boards and live more or less happily ever after. Unfortunately, we do not all or always have the option of buying a solution to a problem; most of us have more problems than money. And there are not always solutions for sale.

An alternative approach is an Applesoft program to produce the desired lower case and punctuation. I have looked for such a program and I found two possibilities (there likely are others but I am not acquainted with them):

1. Val J. Golding in "Lower Case Routine for Integral Data

Printer," *Call-Apple*, v.2, p. 11 (April/May 1979) gave a program to poke lower case characters into strings in the string array memory space.

2. Another program was published in *Contact*, v.1, p.5 (May 1978); this program pokes lower case into the beginning of program memory space.

Both of these are quite limited. Note: both should work for punctuation problems within the same limitations.

Neither of these enables one to enter lower case or problem punctuations conveniently into string variables, nor to print statement strings in an Applesoft program as desired. The program given in the listing in Figure 1 does the job for string variables and the one given in Figure 2, for strings in print statements.

## Use and Operation

The heart of these programs is the same as in the cited programs: use of the GET command to sneak things around the interpreter. The GET command handles input character by character so that each can be manipulated.

(The identical GET routine is used for both programs—lines 63010 to 63120 in the first and lines 63140 to 63150 in the second. Only one typing needs be done, a hint not to be ignored.)

The first program is intended for use as a subroutine. For example, a statement such as

```
30 INPUT "ACCOUNT NAME";NAME$(1)
can be replaced directly by
```

```
30 PRINT "ACCOUNT NAME"; GOSUB
63000:NAME$(1)=BB$
```

In a run, the program would appear to behave normally except that there would be no ?EXTRA IGNORED's and NAME(1) would look quite strange on the CRT monitor (" ,7%2 #!3%" for "lower case") and as lower case only on the printer.

In both programs, capitals are entered in a manner similar to the operation of MUSE's word processor program Dr. Memory. A ctrl-A makes the next letter only capital; an ctrl-C makes all the following letters capital until either a ctrl-S or the end of the string. Unlike Dr. Memory, the control characters are not displayed. Instead, the capitalized letters are shown in inverse video. I like this way of doing things. If you would prefer the opposite video, just interchange the words NORMAL and INVERSE in lines 63020-63040 and 63080 and add an INVERSE to line 63000 in Figure 1. You could do even more to tailor to your personal tastes; change the control characters, change the default operation from lower case to capitals, etc. These custom fittings are left as an exercise.

Another feature common to both programs is the motion of the cursor. The backspace works but that is all. And it will move the cursor back no further than the initial position. However, therein lurks a minor nuisance; if you try to backspace beyond that limit, the immediately preceding character will be wiped out or replaced by a white block. This is of no consequence; ignore it.

Since the string variables subroutine runs as a part of your program, you have to keep labels straight. This subroutine uses only AA\$, AZ\$, BB\$, BB, BZ\$, and ZZ and has no FOR loops. Also note that only the usual limitation applies for the length of strings.

In the use of the second program, you append it to the program in which you

want to put lower case. A RUN 63000 initiates things; you simply give the line number in which lower case is wanted. The first string in that line is printed, terminated by ## to indicate the length limit. The cursor below this line indicates the place for the change. You can insert anything but we assume that a mixed capital and lower case rendition of the line above is what you will want. In any case, the length cannot be exceeded. If you go over the limit, the excess will be ignored. If you put in less, the remainder will be filled with spaces. If you don't want to change that particular string, simply hit RETURN.

Figure 1

```

63000 BB$ = "" : BZ$ = "" : BB = 0 : ZZ
      = 0
63010 GET AA$ : AZ$ = AA$ : IF ASC
      (AA$) = 13 THEN NORMAL : GOTO
      63130
63020 IF ASC (AA$) = 1 THEN ZZ =
      1 : INVERSE : BB = 0 : GOTO 630
      10
63030 IF ASC (AA$) = 3 THEN BB =
      1 : INVERSE : GOTO 63010
63040 IF ASC (AA$) = 19 THEN BB
      = 0 : NORMAL : GOTO 63010
63050 IF ZZ = 1 OR BB = 1 THEN Z
      Z = 0 : GOTO 63080
63060 IF ASC (AA$) < 65 OR ASC
      (AA$) > 90 THEN 63080
63070 AA$ = CHR$ ( ASC (AA$) + 3
      2)
63080 BZ$ = BZ$ + AZ$ : PRINT AZ$ ;
      : IF BB = 0 THEN NORMAL
63090 BB$ = BB$ + AA$ : IF ASC (B
      B$) = 8 AND ASC (AA$) = 8 THEN
      PRINT " " ;
63100 IF LEN (BB$) < = 2 AND ASC
      (AA$) = 8 THEN BB$ = "" : BZ$ =
      "" : GOTO 63010
63110 IF ASC (AA$) = 8 THEN BB$
      = LEFT$ (BB$, LEN (BB$) -
      2)
63120 GOTO 63010
63130 PRINT : RETURN
63140 END

```

Figure 2

```

62999 END
63000 HOME : VTAB (3) : PRINT "LO
      WER CASE INSERTION PROGRAM" :
      PRINT : PRINT
63010 LMAX = 62999 : PRINT "NUMBER
      OF FIRST LINE TO BE RE-" : INPUT
      "WRITTEN " : LT : PRINT
63020 PRINT : M = 256 * PEEK (10
      4) + PEEK (103) + 2
63030 LN = 256 * PEEK (M + 1) +
      PEEK (M) : IF LN > = LMAX OR
      LN > LT THEN 63320
63040 IF LN < > LT THEN M = 256

```

```

* PEEK (M - 1) + PEEK (M -
      2) + 2 : GOTO 63030
63050 K = 0 : LL = 0 : UL = 0
63060 FOR J = M + 2 TO M + 255 : T
      ST = PEEK (J) : IF TST = 0 THEN
      M = J + 3 : GOTO 63030
63070 IF TST = 58 THEN K = 0
63080 IF TST = 186 OR TST = 132 THEN
      K = 1
63090 IF K = 1 AND LL > 0 AND TS
      T = 34 THEN UL = J - 1 : GOTO
      63120
63100 IF K = 1 AND LL = 0 AND TS
      T = 34 THEN LL = J + 1
63110 NEXT
63120 BB$ = "" : BZ$ = "" : BB = 0 : ZZ
      = 0
63130 FOR I = LL TO UL : PRINT CHR$
      ( PEEK (I)) ; : NEXT : PRINT "
      ##"
63140 GET AA$ : AZ$ = AA$ : IF ASC
      (AA$) = 13 THEN NORMAL : GOTO
      63260
63150 IF ASC (AA$) = 1 THEN ZZ =
      1 : INVERSE : BB = 0 : GOTO 631
      40
63160 IF ASC (AA$) = 3 THEN BB =
      1 : INVERSE : GOTO 63140
63170 IF ASC (AA$) = 19 THEN BB
      = 0 : NORMAL : GOTO 63140
63180 IF ZZ = 1 OR BB = 1 THEN Z
      Z = 0 : GOTO 63210
63190 IF ASC (AA$) < 65 OR ASC
      (AA$) > 90 THEN 63210
63200 AA$ = CHR$ ( ASC (AA$) + 3
      2)
63210 BZ$ = BZ$ + AZ$ : PRINT AZ$ ;
      : IF BB = 0 THEN NORMAL
63220 BB$ = BB$ + AA$ : IF ASC (B
      B$) = 8 AND ASC (AA$) = 8 THEN
      PRINT " " ;
63230 IF LEN (BB$) < = 2 AND ASC
      (AA$) = 8 THEN BB$ = "" : BZ$ =
      "" : GOTO 63140
63240 IF ASC (AA$) = 8 THEN BB$
      = LEFT$ (BB$, LEN (BB$) -
      2)
63250 GOTO 63140
63260 IF BB$ = "" THEN 63310
63270 PRINT : FOR I = LL TO UL
63280 DD$ = MID$ (BB$, I - LL + 1
      , 1) : MM = ASC (DD$)
63290 POKE I, MM
63300 NEXT
63310 UL = 0 : LL = 0 : PRINT : GOTO
      63110
63320 PRINT : PRINT "NUMBER OF N
      EXT LINE TO BE REWRITTEN" : INPUT
      "(ENTER 0 TO END PROGRAM) "
      ; LT
63330 IF LT = 0 THEN END
63340 GOTO 63020

```

After a RETURN, the next string in the same line will appear, ready to be changed. When all the strings of that one line have been dealt with, you are asked for the number of the next line.

As mentioned above, lower case if displayed by the APPLE ad keyboard symbols other than letters. These print properly as lower case on a printer that prints lowercase. If you want to display, say, a table so that you can check data prior to printing, you need to program the display table and the printout table separately. For convenience in doing this, both programs provide an all-caps string BZ\$ as well as the corresponding string BB\$ with lowercase.

#### Program Design

The GET routine, essentially the whole of Figure 1, has already been mentioned. The GET command is followed by a series of IF's to implement the control character, backspace and RETURN functions. These are straight-forward and self-explanatory.

The second program, Figure 2, consists of three parts. The first, lines 63020-63300, pokes the new string into the program into the program memory space.

#### Concluding Remarks

Although written for Applesoft, these programs can be adapted to other BASIC's. The first presents no problems. However, the program memory space search routine in the second will require modification for other computers. This modification should not be too difficult to implement for other Microsoft BASIC's.

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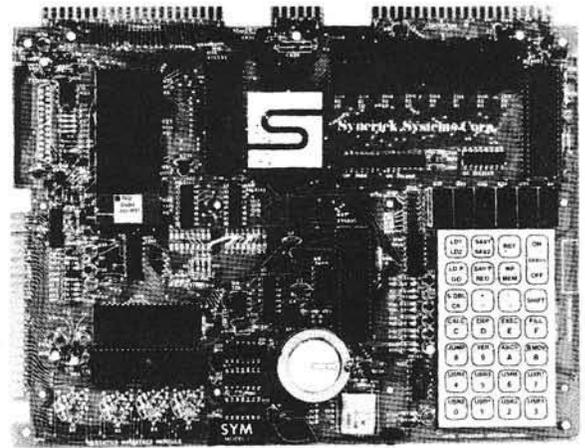
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# SYM - 1 Sends Morse Code

**Now you can use your SYM as a Morse Code teaching tool, automatic I.D'er or 'canned' message sender.**

Ralph R. Orton  
16015 San Fernando Mission Blvd.  
Granada Hills, CA 91344

Although many Morse Code oriented programs have been written ranging from simple message loops to quite flexible code reading routines, I have not yet seen any written specifically for the SYM-1. The following will fill this gap with a sending program that could be used as a teaching tool, automatic I.D'er or as a short cut for sending often sent messages. About 25 words can be stored with the 1K memory that comes with the SYM-1. An additional 50 words can be stored for each additional 1K memory added; thus, the 4K board R/W memory capability could store a total of about 175 words. This may not seem like a lot yet; teaching code at 5 wpm (words per minute), one would have over one half hour of steady material. Even at 13 wpm, you would have over 10 minutes of practice; no easy task for a learner! Figure 1 is a simple circuit for interfacing to the SYM-1 to provide an audio code indicator. Headphone jacks for several people could possibly be paralleled instead of the loud speaker. Other interfaces are left to the needs of the reader.

Pressing an 'O' on the keyboard enters a 'DIT' into memory. A '1' enters a 'dah' and a '2' enters a 'space' (enter 1 between letters and 3 between words). Spaces between parts of a letter need not be entered as they are provided by the program. Entering a '3' ends a message segment. This is only required if a series of messages are being entered. (See list of key memory locations.) As dits, dahs and spaces are entered from the keyboard on the SYM-1's, 1's and 2's appear on the display, indicating the data entered. Entry errors can be corrected by entering an 'E' for each entry to be erased. For example, if two erroneous entries had just been made, pressing 'E' twice would cause 'E' to be displayed twice. This indicates that the two prior entries had been erased (see figure 2). Upon completion of data entry, press the 'GO' key and your message will be sent.

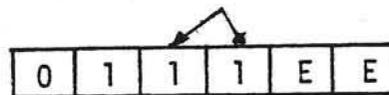
A popular method of teaching code is to send letters at a fast rate but leaving larger than normal spaces between letters until the learner has reached the desired plateau of proficiency.

The rate modification table can be used to determine data to be entered for desired combination of letter speed versus words per minute. Dit delay factor is entered at 0091 and the space factor is entered at 0076.

If continuous loop has been programmed at 004A through 004C, then code will be sent until such time reset is accomplished. If multiple message has been programmed, then a "GO" "CR" at the end of each segment will cause the next segment to be sent.

It should be noted that a GO command at 002D will cause a new start to occur regardless of the mode selected. Thus, it is not necessary to reprogram old data unless it has been lost due to a newer entry.

## These Characters Have Been Erased



04A thru 004C: These locations control the mode of operation.

4C 35 00 Gives continuous loop message. Be sure to put enough spaces at the beginning or end to identify the start of each loop through.

4C A2 00 Gives single or multiple message as desired. For multiple messages, key-in 'GO' 'CR' to start next message.

- 0053: Data at this location determines times Dit delay will be executed per 'Dit'.
- 0067: Data at this location determines times Dit delay will be executed per 'DAH'.
- 0076: Data at this location determines times Dit delay will be executed per 'Space'.
- 007D: Data at this location determines times Dit delay will be executed per silence between parts of a letter of spaces.
- 0091: Data at this location determines times delay programmed by "DIVFAC" (Division Factor) will be executed. (e.g. if 'Divfac' = 1024 then 1 loop = 1.024 ms disregarding instruction time error. Part of "Ditdly" routine.
- 0093: Data at this location determines division factor to be used by internal timer. 1C = + 1; 1D = + 8; 1E = + 64; 1F = + 1024. Part of "Ditdly routine."

	13	17	21	25	29
	Standard word rate				
5	0E	14	1A	20	27
8	06	0A	0E	11	15
11	02	05	08	0B	0D
14		03	05	07	00
17		01	03	05	06
20				03	04
23				02	03
26					02
	Dit delay factor				
	5A	45	38	2F	28

### RATE MODIFICATION TABLE

The timing in the table is based on the following relationships for standard code:

1. A dit is a reference unit of time.
2. A dah = 3 dits
3. Average letters = 6.2 dits
4. Spaces in a letter = 1 dit
5. Spaces between letters = 3 dits
6. Words = 5 letters & appropriate spaces

"Space" multiplication factor =

$$\frac{60 + d - d(43W_m - 3)}{d(7W - 3)}$$

Where d = dit time of standard words per minute rate

W<sub>m</sub> = words per minute of the desired modified rate.

"dit time" =

$$\frac{60}{50W_s - 7}$$

Where W<sub>s</sub> = words per minute of the desired standard rate.

The above formulas neglect the operation times of the SYM-1 but for practical purposes are quite accurate. The results must be converted to Hex for use in the program, introducing a rounding error which is also normally inconsequential. Greater accuracy is obtainable of course, but the author leaves it to those with the desire to make the needed changes.

Address	Code	Operation	Comments
0090:		EQUATE LIST	
0100:			
0110:	00A6	WORDS *	\$000A
0120:	00A6	INCHR *	\$8A1B
0130:	00A6	ACCESS *	\$8B86
0140:	0000	ORG	\$0000
0150:			
0160:	0000 A0 00	LOAD LDYIM	\$00
0170:	0002 20 86 8B	JSR ACCESS	
0180:	0005 20 1B 8A	SHOKEY JSR INCHR	
0190:	0008 99 00 02	STAY	\$0200 WORDS ARE STORED STARTING AT \$0200
0200:	000B C9 47	CMPIM	\$47 WAS 'GO' KEY PRESSED ?
0210:	000D F0 1E	BEQ START	IF YES - START SENDING CODE
0220:	000F C9 45	CMPIM	\$45 WAS 'E' PRESSED ?
0230:	0011 F0 0D	BEQ ERASE	IF YES - DO ERASE ROUTINE
0240:	0013 C8	INY	
0250:	0014 C0 00	CPYIM	\$00 256 WORDS COMPLETED ?
0260:	0016 F0 03	BEQ BASELD	IF SO, INCREMENT HI BYTE OF BASE
0270:	0018 4C 05 00	JMP SHOKEY	
0280:			
0290:	001B E6 0A	BASELD INCZ	WORDS
0300:	001D 4C 05 00	JMP SHOKEY	
0310:			
0320:	0020 88	ERASE DEY	
0330:	0021 C0 FF	CPYIM	\$FF PAGE CROSSING ?
0340:	0023 F0 03	BEQ SUBASE	IF YES - DECREMENT HIGH BYTE OF BASE

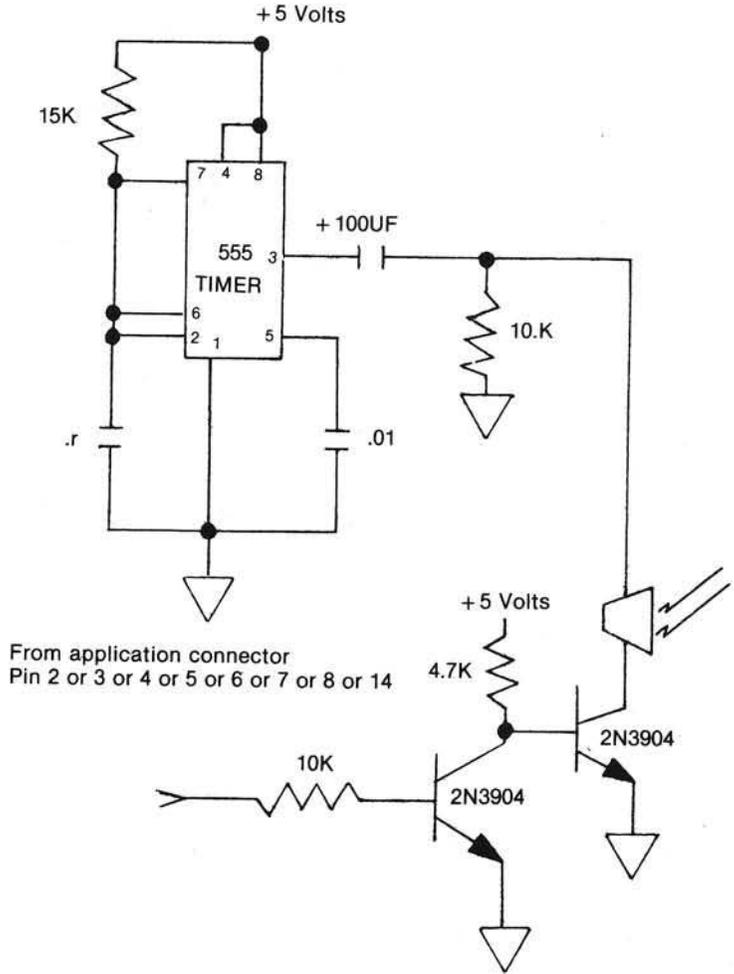


Figure 1

```

0350: 0025 4C 05 00          JMP   SHOKEY
0360:
0370: 0028 C6 0A          SUBASE DEC  WORDS
0380: 002A 4C 05 00          JMP   SHOKEY
0390:
0400: 002D A9 FF          START LDAIM $FF  START OF SENDING CODE
0410: 002F 8D 01 A0        STA   $A001
0420: 0032 8D 03 A0        STA   $A003
0430: 0035 A9 02          KEEPON LDAIM $02  'MODE' JUMPS HERE FOR LOOP
0440: 0037 85 3D          STAZ  $3D
0450: 0039 A0 00          LDYIM $00
0460: 003B B9 00 02       CODE LDAY $0200  CODE WAS STORED STARTING AT $0200
0470: 003E C9 30          CMPIM $30  IS IT A DIT ?
0480: 0040 F0 0B          BEQ   DIT   IF SO - GO TO DIT ROUTINE
0490: 0042 C9 31          CMPIM $31  IS IT A DAH ?
0500: 0044 F0 1B          BEQ   DAH   IF SO - GO TO DAH ROUTINE
0510: 0046 C9 32          CMPIM $32  IS IT A SPACE CHARACTER ?
0520: 0048 F0 2B          BEQ   SPACE IF SO - GO TO SPACE ROUTINE
0530: 004A 4C A2 00       MODE JMP   SEGMNT NONE OF ABOVE , DECIDE MODE
0540:
0550: 004D A9 00          DIT   LDAIM $00
0560: 004F 8D 01 A0        STA   $A001  SET OUTPUT LOW
0570: 0052 A9 01          LDAIM $01  LOAD 1 FOR DIT DELAY
0580: 0054 85 FF          STA   $00FF  STORE FOR USE BY 'DITDLY'
0590: 0056 20 90 00        JSR   DITDLY
0600: 0059 A9 FF          LDAIM $FF
0610: 005B 8D 01 A0        STA   $A001  SET OUTPUT HIGH AGAIN
0620: 005E 4C 7C 00        JMP   SILENT
0630:
0640: 0061 A9 00          DAH   LDAIM $00
0650: 0063 8D 01 A0        STA   $A001  SET OUTPUT LOW
0660: 0066 A9 03          LDAIM $03  LOAD FOR 3 DIT DELAYS
0670: 0068 85 FF          STA   $00FF  STORE FOR USE BY 'DITDLY'
0680: 006A 20 90 00        JSR   DITDLY
0690: 006D A9 FF          LDAIM $FF
0700: 006F 8D 01 A0        STA   $A001  SET OUTPUT HIGH AGAIN
0710: 0072 4C 7C 00        JMP   SILENT  QUIET BETWEEN CHARACTERS
0720:
0730: 0075 A9 01          SPACE LDAIM $01  LOAD $0076 FOR DESIRED SPACE
0740: 0077 85 FF          STA   $00FF  LENGTH AND STORE FOR USE BY 'DITDLY'
0750: 0079 20 90 00        JSR   DITDLY
0760:
0770: 007C A9 01          SILENT LDAIM $01  LOAD FOR 1 DIT DELAY
0780: 007E 85 FF          STA   $00FF  STORE FOR USE BY 'DITDLY'
0790: 0080 20 90 00        JSR   DITDLY
0800: 0083 C8          INCMEM INY          MOVE POINTER TO NEXT CHARACTER
0810: 0084 C0 00          CPYIM $00  PAGE CROSSING ?
0820: 0086 F0 03          BEQ   BASEGO IF YES - INCREMENT HIGH BYTE BASE
0830: 0088 4C 3B 00        JMP   CODE
0840:
0850: 008B E6 3D          BASEGO INC  CODE  +02
0860: 008D 4C 3B 00        JMP   CODE  GET NEXT CHARACTER
0870:
0880: 0090 A9 47          DITDLY LDAIM $47  LOAD $0091 WITH DESIRED DIT TIME
0890: 0092 8D 1F A4        DIVFAC STA  $A41F
0900: 0095 2C 05 A4        TIMER  BIT   $A405
0910: 0098 10 FB          BPL   TIMER  KEEP CHECKING FOR DELAY COMPLETED
0920: 009A E8          INX          DONE - INCREMENT DIT COUNTER
0930: 009B E4 FF          CPX   $00FF  SHOULD WE DITDLY AGAIN ?
0940: 009D D0 F1          BNE   DITDLY
0950: 009F A2 00          LDXIM $00  RESET 'X' REGISTER
0960: 00A1 60          RTS         BACK TO WHERE YOU CAME FROM
0970:
0980: 00A2 00          SEGMNT BRK          STOP UNTIL "GO" "CARRIAGE RETURN
0990: 00A3 4C 83 00        JMP   INCMEM  NOW SEND NEXT MESSAGE
1000:
ID=

```

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# An EDIT Mask Routine in Applesoft BASIC

---

**This article describes some techniques for producing formatted output using Edit Masks. The programs permit you to produce professional looking output.**

---

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My work as a professional programmer in business applications has often called for the use of what are called "edit masks", in such languages as COBOL, DIBOL, and the Commercial Subroutine Package of Data General FORTRAN. I have found the edit mask capability in these languages quite useful, and so I decided to write a routine in Applesoft Basic that I could use at home on my Apple II.

I should begin by first giving a brief explanation of what an edit mask is, for those readers who have never encountered the term before. An edit mask might be defined as a string of characters which specify operations on a number so as to produce an output string that contains the number's digits re-formatted for printing in certain specific ways. Some of the most common operations that can be carried out on any given number by means of edit masks are the following: (1) "suppressing" of zeroes, by replacing them with blanks in the output string, (2) inserting of a decimal point in a fixed position of the output string, (3) inserting of comma in the string to express thousands, million, etc., (4) placing a dollar sign before the leftmost digit of the number string, and (5) appending a minus sign to the end of the string if the input number is negative.

The edit mask is used as a sort of "picture" of what the output string should be like after carrying out operations such as the above on the number to be edited. In order to achieve this, there are definite rules for the edit routine's interpretation of the characters that make up the mask. Perhaps the best way of explaining this is to give some examples of my routine's use.

The routine itself, on the following listing, is contained between line numbers 100 to 580. The statements preceding 100 are a "driver" routine you

can use to input your edit mask and number to be edited in order to experiment with various types of editing.

The editing routine is called by means of a GOSUB 100. There are two arguments that must be passed to it: NUM is the number to be edited, and MASK\$ is the edit mask string. NUM can contain any number of digits up to 9. I have made no provision for editing numbers that must be expressed in "scientific notation" with an Exponent field.

The result of the masking will be passed back to the calling program in the string OUT\$, whose length is the same as MASK\$.

There are six special characters which can appear in MASK\$ that are treated in a distinctive way: these are the digit 9, the digit 0, the period, the comma, the minus sign, and the dollar sign. The mask can contain other characters also, but more about this later.

The digit 9 is the "numeric replacement" character. This means, wherever a 9 is present in the mask, it will be replaced in the result field (OUT\$) by the corresponding digit of NUM, if any, in that position.

Thus, suppose we define MASK\$ = "99999", and assume the number to be edited is NUM = 352. Then the result, after calling the edit routine, will be OUT\$ = "352". (Note the two blanks preceding the ASCII digit 3. This is because the length of the mask exceeds the length of the number to edit by two.)

Next, the digit 0 is the "zero-suppress" character. This means wherever a 0 appears in the mask, it will be replaced in the result field by the corresponding digit of NUM only if that digit is not a zero; if the digit is a zero, then the corresponding

position in the result field will be a blank.

To give an example, suppose MASK\$ = "990990" and the number to be edited is NUM = 120563. Then the result will be OUT\$ = "12 563". The zero in NUM was suppressed.

The most common usage of the zero-suppress character in a mask is to suppress leading zeroes of a number. Thus a mask of "00099" would suppress the first three digits of any five-digit number if they were zeroes, but would print them if they were not. Due to the way my routine operates, it turns out that leading zeroes are always suppressed, anyway. If you would rather change this feature of the routine, I will describe later how you could go about doing so.

The period in a mask is usually used as the decimal point position. It is what is called an "insertion character" in the mask because it is always inserted in the result field exactly in its corresponding position in the mask.

Let's consider some examples of masks containing a period, and what the result will be. Suppose our mask is "999.99", and our number to be edited is 312.44; then, as you would expect, the result will be OUT\$ = "312.44". Next suppose we use the same mask but NUM = 33.6. The result is OUT\$ = " 33.60". There is a blank in position one and a zero in the last position. (If the last character of the mask had been a 0 instead of a 9, then the last character in the result would have been a blank.) Now, let's suppose that NUM = 124.556. In this case there is one more digit to the right of the decimal point in the number to edit than there is in the decimal part of the mask. When this, or something similar happens, my routine will truncate the extra digit(s), and replace it (them) by an asterisk to signal

field overflow. The result then is OUT\$ = "124.5\*\*".

My routine follows a similar rule in case the number of digits to the left of the decimal point in NUM exceeds the number allowed in MASK\$. For example, if NUM = 1256.7, then the result will be OUT\$ = ""56.70".

By the way, since it is conceivable that you might, either by mistake or by design, include two or more periods in your mask, the routine will treat only the rightmost period in the mask as the decimal point position. All other periods will be treated as insertion characters, and so will appear in the corresponding positions of the result field as they expected.

Next, let's consider the comma in an edit mask. An example of a mask containing two commas is the following: MASK\$ = "99,999,999". If your number to edit contains either 7 or 8 digits, then the result field will contain both commas in the appropriate places, as you would expect. However, with 6 or fewer digits in NUM, either the first or both commas will be suppressed and replaced by blanks. Examples: if NUM = 1234567, the OUT\$ = " 1,234,567"; and if NUM = 1234, then OUT\$ = " 1,234" (note the five blank characters preceding the digit 1); and lastly, if NUM = 123, then there will appear seven blanks preceding the digit 1: OUT\$ = " 123".

Thus we see that the comma is a special sort of insertion character which is suppressed if there are no preceding digits of the number to be edited.

Now consider the dollar sign used as an edit mask character. I have defined this character's usage in a special way. If the dollar sign is the very first character in the mask, then it is treated as what is called a "floating dollar sign". That means that the dollar sign in the result field will "float" to the right, far enough so as to immediately precede the leftmost digit of NUM. Some examples: if MASK\$ = "\$99,999.99" and NUM = 11.45, then the result of editing is OUT\$ = " \$11.45" (note that there are four blanks preceding the dollar sign in the result field). And if NUM = 2321, then we have this result: OUT\$ = " \$2,321.00" (one blank preceding the dollar sign).

Please note that I have defined this usage of the dollar sign as a "floating" dollar sign only when it is the first character in the mask. If it occurs elsewhere in the mask, then it becomes an insertion character.

The last special usage character in a mask is the trailing minus sign. If the mask contains a minus sign as the very last character, then the rightmost position of the result field will be a minus sign

when the number to edit is negative, or will be blank if the number is positive. Examples: if MASK\$ = "99,999.99" and NUM = -1453.62, then the resultant OUT\$ = " 1,453.62-". While if NUM = 2246.7, then we have OUT\$ = " 2,246.70".

If a minus sign appears in a mask in any other position, it is treated as an insertion character. Thus, for example, you could format a date, MMDDYY = month, day, and year with the following mask: MASK\$ = "09-99-99". If NUM = 101479, then OUT\$ = "10-14-79".

You might be wondering what will happen if you edit a negative number using a mask which does not contain a trailing minus sign. It depends upon whether you have allotted enough digit positions in the mask to accommodate a leading minus sign. If you have then the minus sign will take the place of the first position containing a nine, zero, or comma that immediately precedes the leftmost digit of NUM. If you have not allotted enough digit positions in the mask, then my routine will print the asterisk signaling field overflow.

Now, any character other than the six special cases discussed above may also appear in a mask. In that case the character becomes an insertion character. Suppose you define

```
MASK$ = "$BAL. DUE AS OF SEP/78:
          '99,999.99"
```

If NUM = 1324.57, then the result of masking will be:

```
OUT$ = "BAL. DUE AS OF SEP/78:
         $1,324.57"
```

From the above example, you can see that you are only restricted in using edit masks by your imagination, perhaps after making modifications to my routine. For example, you will note that the year in the above mask is '78 not '79. It could not be '79 because the 9 is a numeric replacement character and in this case would have been blanked out. However, if you change the numeric replacement character to some other more convenient character (perhaps an ampersand?) then this difficulty could be avoided.

As already mentioned, another modification you might wish to make is to allow outputting of leading zeroes in a numeric field if the corresponding edit characters are 9's. To do this, you need to make three changes to the routine.

```
455 IF I-1 > = II AND MID$
      (MASK$,I-1,1) =
      "9" THEN 480
500 IF N$ = "" THEN N$ = "0"
525 IF N$ = "" THEN 460
```

When you incorporate this routine into your own programs, you may wish to change the names of some of the local

variables used by it in order not to conflict with your own use of the same names. So here is a list of all variables used by my routine.

#### Variables

MASK\$	the string containing the edit mask.
NUM	the input number to edit
NUM\$	NUM converted to a string
LM	length of MASK\$
LN	length of NUM\$
PM	position of rightmost decimal point in MASK\$ (or zero if none)
PN	position of decimal point in NUM\$ (zero if none)
RM	number of digit positions right of decimal point in MASK\$
RN	number of digits right of decimal point in NUM\$
QM	number of digit positions left of decimal point in MASK\$
QN	number of digits left of decimal point in NUM\$
FD%	flag telling whether mask has floating dollar sign (1 if yes, 0 if no)
MF%	flag telling whether mask has trailing minus sign (1 if yes, 0 if no)
NF%	flag telling whether NUM is negative (1) or positive (0)
M\$	current character of MASK\$ being processed
N\$	current character of NUM\$ being processed
I	loop variable and temporary variable
J	pointer to current digit in NUM\$
II	first position in MASK\$ to process
I2	last position in MASK\$ to process

One final note: in using the driver routine to experiment with various edit masks, you should remember that if your mask will contain commas or colons, then you must enclose the entire mask by quotation marks, or else Applesoft will drop part of your mask when it executes the INPUT statement.

#### Notes on Converting to other Basics

I am not familiar with any other Basics for microcomputers. I do, however, have some acquaintance with the Basic languages for two mini-computers—the DEC PDP-11 and the Data General Nova 3. With this as background, I have compiled the following list of possible modifications you might have to make to my routine to get it to work on other 6502 machines other than the Apple.

1.) Applesoft allows variables to have names with more than two characters,

although only the first two are used to distinguish between different names. If your Basic does not allow this, you will have to change some of the names that my routine uses.

2.) Some Basics don't allow multiple statements per line, or if they do, the statement separator might not be the colon; two common alternatives are the back slash or the exclamation point.

3.) If your Basic does not have the "ON...GO TO" statement, then line number 85 will have to be replaced with something else, perhaps a couple of "IF...THEN GOTO..." statements.

4.) Not all Basics allow "NEXT" statements which do not specify the loop variable to end "FOR" loops. There are several lines in my program that may necessitate this type of change: 160, 190, 240, 280, 340, and 550. In all of these cases the implied FOR loop variable is "I".

5.) You may have to DIMension your strings in your Basic program, as is true in Apple's Integer Basic, but not Applesoft.

6.) String concatenation in Applesoft is accomplished with string expressions joined by means of the plus (+) sign; your Basic may use the ampersand (&).

7.) In comparing strings, Applesoft uses the combination of less than and greater than signs (<>); perhaps, as in Integer Basic on the Apple, you are only allowed to test inequality with the number sign (#).

8.) Please note that I have several statements in my program of the following general form: IF X THEN... This is "shorthand" for the equivalent IF X <> 0 THEN... I also have a number of statements like the following: IF...THEN 100 (where 100 can be any statement number). This is a "shorthand" for IF...THEN GOTO 100. I don't know whether all Basics allow the abbreviated forms that I use.

9.) I have made use of the following string functions: STR\$, LEFT\$, RIGHT\$, MID\$, and LEN. Your Basic might call these by different names, or have different syntax rules about their arguments. Here are the Applesoft syntactic definitions for these functions, which you should keep in mind if you have to convert to different usages on your computer:

STR\$(X)  
converts the number X to a string

LEFT\$(A\$,N)  
returns the leftmost N characters of string A\$

RIGHT\$(A\$,N)  
returns the rightmost N characters of string A\$

MID\$(A\$,M,N)  
returns the N consecutive characters of string A\$, starting at position M

LEN(A\$)  
returns the number of characters in string A\$

These are all the differences between Applesoft and other Basics that I am aware of, although there may be more. At any rate, it should not be difficult to convert my program to any other machine's Basic.

## LIST

```

10 REM ROUTINE TO EDIT A NUMBER
   , NUM, WITH AN EDIT MASK, MA
   SK$
20 HOME : PRINT "EDIT MASK ROUTI
   NE": PRINT : PRINT " THE E
   DIT MASK CAN CONTAIN ANY INS
   ER-": PRINT "TION CHARACTERS
   , PLUS FOLLOWING SPECIAL"
30 PRINT "CHARACTERS:" : PRINT "
   IF $ IS FIRST CHAR., IT IS
   TREATED AS": PRINT "A FLOATI
   NG DOLLAR SIGN"
40 PRINT " IF - IS LAST CHAR.,
   IT WILL BE OUTPUT": PRINT "I
   F NUMBER TO EDIT IS NEGATIVE
   , OR RE-": PRINT "PLACED BY
   BLANK IF POSITIVE"
50 PRINT " 9 CORRESPONDS TO A D
   IGIT TO PLACE IN": PRINT "TH
   AT POSITION OF THE MASK": PRINT
   " 0 CORRESPONDS TO A NONZER
   O DIGIT TO"
60 PRINT "PLACE IN THAT POSITION
   , IF YOU WANT A": PRINT "COM
   MA OR COLON IN THE MASK, ENC
   LOSE THE"
65 PRINT "ENTIRE MASK IN QUOTES
   TO INPUT IT.": PRINT
70 INPUT "EDIT MASK? ";MASK$
75 INPUT "NUMBER TO EDIT? ";NUM:
   GOSUB 100: PRINT "EDITED NU
   MBER:";OUT$
80 PRINT : INPUT "1=NEW NUMBER,
   2=NEW MASK AND NUMBER?";N
85 ON N GOTO 75,70
90 GOTO 80
100 NUM$ = STR$(NUM):LN = LEN
   (NUM$):LM = LEN(MASK$):QM =
   0:QN = 0:RM = 0:RN = 0:PN =
   0:PM = 0:NFX = 0:MFZ = 0:FDZ
   = 0:DFZ = 0
110 OUT$ = "": IF NUM < 0 THEN NF
   X = 1: REM SET FLAG TELLING
   WHETHER INPUT NUMBER IS NEG
   ATIVE
120 IF RIGHT$(MASK$,1) = "-" THEN
   MFZ = 1: REM SET FLAG TELLI

```

```

NG WHETHER INPUT MASK HAS TR
AILING MINUS SIGN
130 IF LEFT$(MASK$,1) = "$" THEN
FDZ = 1: REM SET FLAG TELLI
NG WHETHER INPUT MASK HAS FL
OATING DOLLAR SIGN
140 FOR I = 1 TO LM: REM FIND P
OSITION OF DECIMAL POINT IN
MASK
150 IF MID$(MASK$,I,1) = "." THEN
PM = I
160 NEXT I: IF FDZ = 0 THEN DFZ =
1: REM IF NO FLOATING DOLLA
R SIGN IN MASK, SET FLAG SAY
ING "$" ALREADY OUTPUT TO ED
ITED FIELD
170 FOR I = 1 TO LN: REM FIND P
OSITION OF DECIMAL POINT IN
NUMBER TO EDIT
180 IF MID$(NUM$,I,1) = "." THEN
PN = I
190 NEXT I
200 IF PN THEN RN = LN - PN: REM
IF DECIMAL POINT IN NUMBER,
COMPUTE # DIGITS RIGHT OF D
ECIMAL PT.
210 IF PM = 0 THEN 250: REM IF
DEC. PT. IN MASK, FIND # DIG
IT POSITIONS RIGHT OF IT
220 FOR I = LM TO PM STEP - 1
230 IF MID$(MASK$,I,1) = "0" OR
MID$(MASK$,I,1) = "9" THEN
RM = RM + 1
240 NEXT I
250 IF PN = 0 AND PM = 0 THEN 30
0
260 IF RM = RN THEN 300
270 IF RM < RN THEN 290
280 FOR I = RN TO RM - 1: NUM$ =
NUM$ + "0": NEXT I: GOTO 300:
REM ZERO-FILL RIGHTMOST DE
CIMAL POSITIONS OF NUM$
290 I = LN - RN + RM - 1: NUM$ = LEFT$
(NUM$,I) + "*": REM TRUNCAT
E NUM$ TO MATCH MASK, PUT "*"
" IN RIGHTMOST DIGIT
300 QN = LEN(NUM$) - RM: IF PN THEN
QN = QN - 1: REM GET # DIGI
TS LEFT OF DEC. PT. IN NUMBE
R, IGNORING DEC. PT., IF ANY
310 IF NF% AND MF% THEN QN = QN -
1: REM IGNORE MINUS SIGN IN
NUMBER IF TRAILING MINUS IN
MASK
320 FOR I = 1 TO LM: IF I = PM THEN
350: REM FIND # DIGITS IN M
ASK LEFT OF DEC. PT.
330 IF MID$(MASK$,I,1) = "0" OR
MID$(MASK$,I,1) = "9" THEN
QM = QM + 1
340 NEXT I
350 IF QM > = QN THEN 370: REM
TRUNCATE NUMBER ON LEFT, MA
KING LEFTMOST DIGIT "*"
360 I = LEN(NUM$) - QN + QM - 1
: IF NF% AND MF% THEN I = I -
1: REM DROP MINUS SIGN ALSO
IF IGNORED BEFORE
365 NUM$ = "*" + RIGHT$(NUM$,I)
: QN = QM
370 I1 = 1: IF DF% THEN I1 = 2: REM
WILL IGNORE ANY FLOATING DO
LLAR SIGN IN MASK
380 I2 = LM: IF MF% THEN I2 = LM -
1: REM WILL IGNORE ANY TRAI
LING MINUS IN MASK
385 IF NF% AND MF% AND LEFT$(N
UM$,1) = "-" THEN QN = QN +
1: REM IF NUMBER'S MINUS SI
GN WAS IGNORED BEFORE, PUT I
T BACK IN
390 IF PN THEN NUM$ = LEFT$(NU
M$,QN) + RIGHT$(NUM$,RM): REM
DROP DEC. PT. FROM NUMBER S
TRING
400 IF NF% AND MF% AND LEFT$(N
UM$,1) = "-" THEN NUM$ = RIGHT$
(NUM$, LEN(NUM$) - 1): REM
DROP MINUS SIGN IF TRAILING
MINUS IN MASK
410 J = LEN(NUM$): FOR I = I2 TO
I1 STEP - 1: M$ = MID$(MAS
K$,I,1): N$ = " ": IF J > 0 THEN
N$ = MID$(NUM$,J,1)
420 IF M$ < > "," THEN 490
430 IF N$ < > "-" THEN 450
440 OUT$ = N$ + OUT$: J = J - 1: GOTO
550
450 IF N$ < > " " THEN 480
460 IF DF% THEN 440: REM IF FLO
ATING DOLLAR SIGN ALREADY OU
TPUT, GO INSERT BLANK
470 DF% = 1: OUT$ = "$" + OUT$: GOTO
550
480 OUT$ = M$ + OUT$: GOTO 550
490 IF M$ < > "9" THEN 520
500 IF N$ = " " THEN 460: REM I
F ALL DIGITS OF NUMBER OUTPU
T, GO OUTPUT FLOATING DOLLAR

```

```

SIGN OR BLANK
510 GOTO 440: REM GO OUTPUT THE
    DIGIT
520 IF M$ < > "0" THEN 480: REM
    GO OUTPUT CURRENT CHARACTER
    IN MASK
530 IF N$ < > "0" THEN 500: REM
    GO OUTPUT BLANK OR DIGIT
540 N$ = " ": GOTO 440: REM OUTP
    UT BLANK
550 NEXT : IF DF% = 0 THEN OUT$ =
    "$" + OUT$: REM IF FLOATING
    DOLLAR NOT OUTPUT, APPEND I
    T ON LEFT
555 IF DF% AND FD% THEN OUT$ = "
    " + OUT$: REM IF DOLLAR SI
    GN ALREADY OUTPUT, PUT BLANK
    IN PLACE OF MASK'S DOLLAR S
    IGN
560 IF MF% = 0 THEN RETURN : REM
    ALL DONE IF NO TRAILING MIN
    US IN MASK
570 N$ = " ": IF NF% THEN N$ = "-
    " : REM BLANK IF POSITIVE, M
    INUS SIGN IF NEGATIVE
580 OUT$ = OUT$ + N$: RETURN

```

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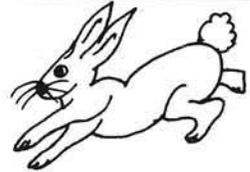
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# PET Keysort Update

## Two changes are presented to improve the PET Keysort.

Rev. James Strasma  
120 West King Street  
Decatur, IL 62521

After further use and testing, I decided to make two changes to my program KEYSORT as printed in MICRO:23. First, I've added to the intelligence of the himem setter in lines 550-630 of the source listing. Previously, my copy wasted about 100 bytes of memory by setting himem lower than it needs to be. Now it is set just at the start of the sort. The new source listing would read:

```
.550     lda *him + 1;cut himem?
.560     seo
.570     sbo #h,sart
.580     boo sav     dont lower himem
.590     bne cut     ;do lower it
.600     lda *him     depend on lo byte
.605     sbo #L,sart
.610     boo sav     ;if already lower
.615cut  lda #L,sart ;out lo, then hi
.620     sta *him
.625     lda #h,sart
.630     sta *him + 1
```

This is an addition of 3 lines and 5 bytes.

```
./ 7050 00 00 00 00 A5 35 38 E9
./ 7058 70 90 10 D0 06 A5 34 E9
./ 7060 54 90 08 A9 54 85 34 A9
./ 7068 70 85 35 20 98 7D A5 20
./ 7070 85 15 A5 2D 85 16 A5 02
./ 7078 09 24 F0 06 A9 80 85 00
./ 7080 85 01 A0 00 B1 15 05 00
./ 7088 F0 06 A9 80 05 00 D0 08
./ 7090 08 B1 15 05 01 30 01 08
./ 7098 98 AA A5 03 09 25 F0 04
./ 70A0 A9 09 85 04 A5 05 09 23
./ 70A8 F0 04 A9 00 85 06 A0 02
./ 70B0 B1 15 18 65 15 85 18 08
./ 70B8 B1 15 65 16 85 19 A5 2F
./ 70C0 05 19 F0 02 B0 0E A5 2E
./ 70C8 05 18 F0 02 B0 06 E0 02
./ 70D0 B0 11 90 17 E0 02 B0 0B
./ 70D8 A5 18 85 15 A5 19 85 16
./ 70E0 18 90 9F A0 04 B1 15 09
./ 70E8 01 F0 08 20 98 7D A2 80
```

The other change is in the way KEYSORT handles nulls. Logically, they should have a value below any other character. The original KEYSORT treats them this way. However, that leads to a problem with partially filled Basic arrays. All the undefined array elements start out as nulls, and end up after a sort at the 'bottom' of the array, where the significant elements were before. I elected to redefine nulls as larger than 'Z', so they stay at the 'top' of the array, where they were before the sort. The necessary changes are made in lines 5180-5220 of the source listing. The label 'null' is deleted from line 5180. A new label, 'same' is added to line 5220. Then 4 new lines are added after line 5420. These are like lines 5180-5200, except that the destinations are opposite. The new lines read:

```
.5422nullcpx#1 ;put nulls @top of$$
.5424     beq two(( ;to keep them out
```

```
.5426     bpL one(( ;of the way of prgm
.5428     bmi same ;jump
```

This change adds 4 lines and 8 bytes to the program. Unfortunately it also alters many other parts of the object code in order to stay just below himem, so you'll need to check the enclosed new object listing carefully against your copy of the former version.

After these changes are made, the system call address for the sort is lowered, to sys (31828). The option setting addresses are unchanged. If you'd rather not make these changes yourself, updated copies for any loation in memory, or for old ROMs are available directly from the author for \$5.00. Please specify the address and ROM set you prefer to use.

```
./ 70F0 40 57 03 A0 06 B1 15 85
./ 70F8 12 88 B1 15 85 13 18 6A
./ 7D00 85 0E A5 12 6A 18 69 01
./ 7D08 85 0D A5 0E 69 00 85 0E
./ 7D10 A5 15 18 69 04 85 23 A5
./ 7D18 16 69 00 85 24 A5 12 85
./ 7D20 0B A5 13 85 0C A5 0E F0
./ 7D28 03 4C AA 7D A5 0D 09 01
./ 7D30 D0 F7 A5 08 85 1B A5 0C
./ 7D38 85 1C 20 B3 7F A0 00 B1
./ 7D40 15 85 20 08 B1 15 85 21
./ 7D48 08 B1 15 85 22 A5 23 18
./ 7D50 69 03 85 18 A5 24 69 00
./ 7D58 85 19 B1 18 91 15 88 B1
./ 7D60 18 91 15 88 B1 18 91 15
./ 7D68 38 A5 0B E9 01 85 0B A5
./ 7D70 0C E9 00 85 0C 09 00 D0
./ 7D78 57 A5 0B D0 53 A5 07 85
./ 7D80 1B A5 08 85 1C 20 B3 7F
./ 7D88 A5 20 A0 00 91 15 08 A5
```



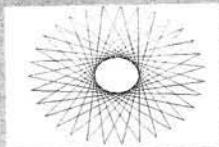
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Manchester, N.H. 03108  
603-627-1464



**Graphic Text Software Drivers** To allow you to easily use this graphic display and print power, MTU has also designed the K-1008-5C software package which gives you point plotting, line drawing, character generation and a host of other subroutines. Written in assembly language, these routines may be executed from BASIC or assembly language — your choice. Text output from BASIC or the AIM monitor may also be shown on the Visible Memory display as up to 22 lines by 53 characters per line significantly enhancing the use of the AIM-65 as a computer with a CRT display.

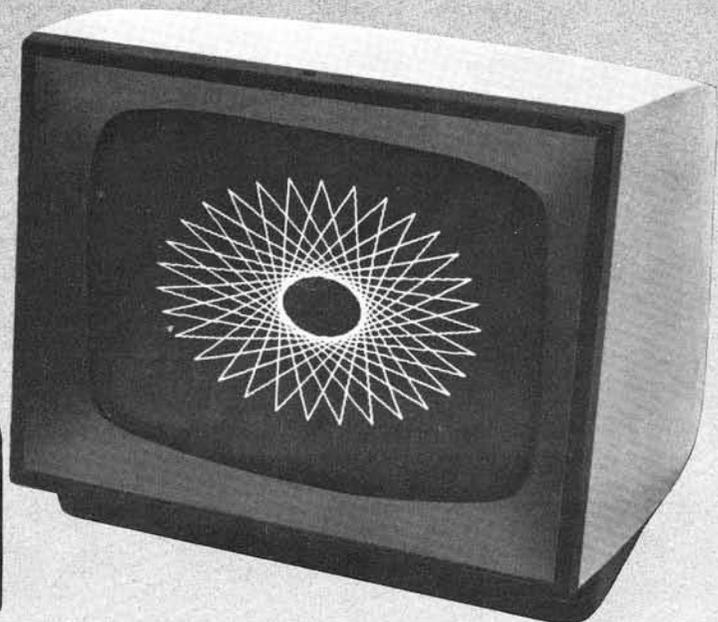
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# Expand KIM - 1 Versatility in Systems Applications

Techniques and programs are presented which permit the simple addition of six sense switches or an ASCII keyboard to the KIM.

Ralph Tenny  
P.O. Box 545  
Richardson, TX 75080

The KIM-1 microcomputer, produced by MOS Technology, Commodore and Rockwell International, is a single-board computer which gained early popularity with hobbyists. It also was adopted by industry for small controller applications. Some of these computers have been expanded into fairly large systems, in colleges as well as industry. One reason for the easy acceptance of the KIM-1 was the on-board keypad and six digit display. These features, along with a slow but extremely reliable audio cassette interface for program storage, made KIM-1 one of the first microcomputers which did not require an operator interface more expensive than itself.

The on-board keyboard and seven-segment display, which permits system operation without an teletype of terminal, is implemented in a way which permits addition of both an ASCII external keyboard and sense switches. Fig. 1 shows the key-pad implementation where U24 enables one of three banks of seven keys, and U2 (an MCS6530 programmable interface device detects a key closure in any one of the seven switch columns.

The keyboard encoding scheme works as follows: U2 is programmed for output on lines PB1-PB4 to drive U24, a four line-to-ten-line decoder which has active-low outputs. Note that the least significant bit of U2's B port (PBO) is not used in the keyboard drive, so values written to Port B are incremented by two to select the next higher keybank. For example, writing 0016 to Port B selects Row keys, 0216 enables Row 1 and 0416 selects Row 2.

On Port A of U2 (lines PA0-PA6), which are programmed as inputs, a closure of (for example) key 8 will cause a logic zero to be input on PA5 whenever key Row 1 is active (low). KIM's operating system software then decodes Row 1/PA5 as key 8 and returns the value 0816 in the accumulator.

A fourth keybank (Row 3) is also implemented by this matrix, but the standard KIM-1 has only the TTY/KYBD switch installed on this row. FIG. 1 shows six additional switches implemented on Row 3; with proper programming, these can be used as sense switches or input lines for address vec-

tors in an expanded interrupt scheme. Listing 1 gives an example of the programming required to detect activity on Row 3 inputs.

The programming strategy required for any such inputs is to enable PA0-PA6 lines for input and sequentially activate the driving lines (outputs of U24 in this case) to their on (low) state. The program then reads all input lines, masks and inverts the data and returns to the calling program which tests the accumulator for any "one" bits. It is then the programmer's responsibility to repeat the scan periodically and test to see if the same data is present (a noise spike would be gone on a second scan) or has changed after some period of time. This testing allows for switch bounce—multiple closures of the contacts—a characteristic of all switches. Very good switches will bounce for a minimum of one or two milliseconds, while worn or cheap switches may bounce for up to 25 milliseconds. On the other hand, any operator who is trying to make a very short switch closure will find it difficult to release a switch earlier than 50 milliseconds after closure. Consequently, reading keys with software is a fine art!

## LISTING I

```
A9 00          LDA # $00          SET PADD (KEY INPUT LINES)
8D 41 17       STA PADD          FOR INPUT
A9 3F          LDA # $3F          SET PBDD (ROW DEFINITION)
8D 43 17       STA PBDD          FOR OUTPUT
A9 06          LDA # $06          ENABLE KEYBOARD
8D 42 17       STA PBD           ON ROW 3
AD 40 17       LDA PAD           READ SENSE SWITCHES
29 7E          AND # $7E          MASK OFF TTY/KYBD SWITCH
49 7E          EOR # $7E          INVERT SWITCH DATA
A2 00          LDA # $00          DISABLE
8E 42 17       STX SBD          KEYBOARD
60             RTS           RETURN TO CALLING PROGRAM
```

Any keyboard with ASCII outputs is likely to have both a debounced output and a strobe which becomes active when there is a key pressed and the data has been debounced. Typically, the key data is active high (positive logic), but the strobe can be either active high or active low. The ASCII keyboard input described here does not use the strobe; instead, the key matrix is scanned in the same manner as is the normal KIM keypad. Fig. 2 shows the necessary connections—a pull-down transistor for each output bit of

the keyboard. Any logic "one" data from the keyboard will input a low on the same lines as the KIM keypad. Note that some keyboards output only six bits, so the strobe can be implemented on Column G.

Listing 2 shows a "bare bones" scan program which will return to the calling program as did Listing 1. The basic scheme here is to initialize the accumulator to FF<sub>16</sub> and get the input data by a logic AND with the input port. The data is then inverted (Exclusive OR) and

tested for any logic one bits. Note that the calling program could also permanently set the port for input and somewhat abbreviate the program segment shown. If the strobe is implemented on Column G as mentioned above, the 6502 BIT instruction followed by a test of the overflow status bit (BVC or BVS) will identify strobe activity. Note that the on-board keypad must not be active when the ASCII keyboard is being used, and that the normal KIM keypad scan routines will not properly interpret the ASCII input.

### LISTING II

A9 80	LDA #\$80	ENABLE KEYBOARD
8D 41 17	STA PADD	INPUT LINES
A9 FF	LDA #\$FF	INITIALIZE ACCUMULATOR
2D 40 17	AND SAD	INPUT POSSIBLE KEYBOARD BITS
49 7F	EOR #\$7F	INVERT ANY BITS PRESENT
F0 02	BEQ OUT	TEST FOR DATA PRESENT
A9 80	LDA #\$80	SET FLAG FOR NO INPUT
60	OUT	RETURN TO CALLING PROGRAM
	RTS	

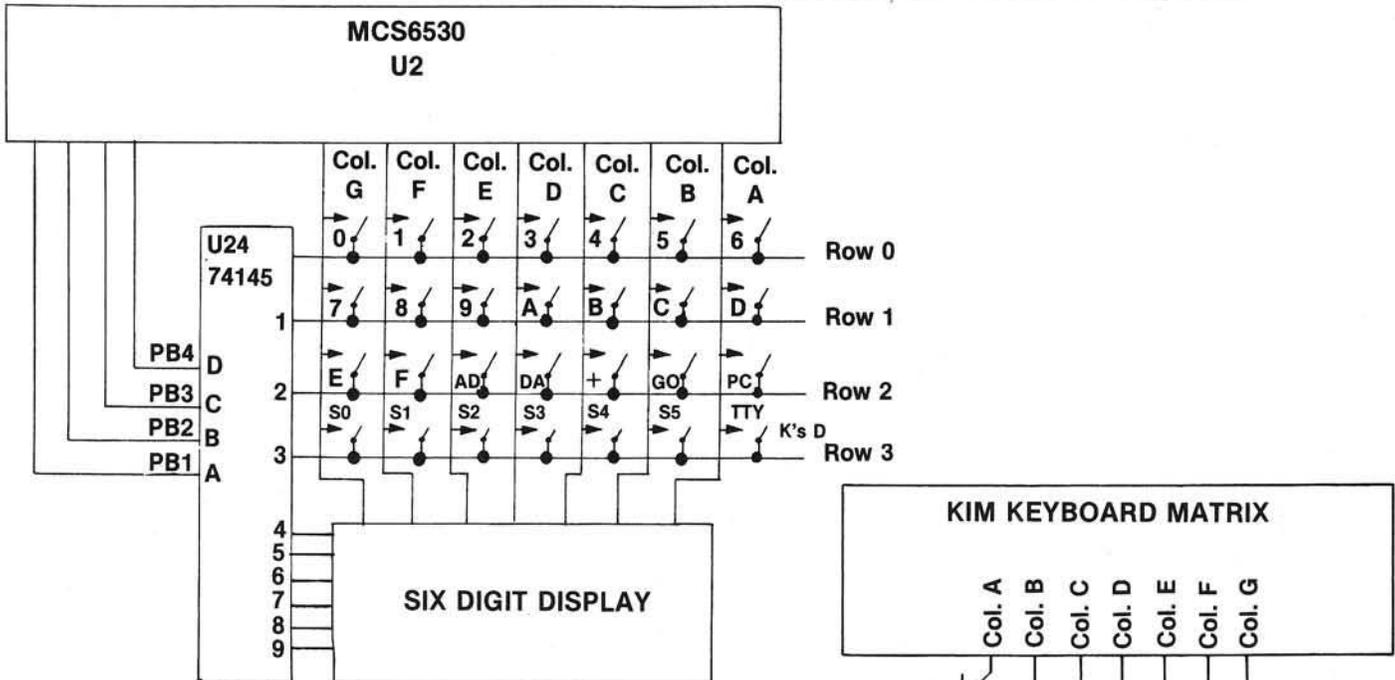


Figure 1: KIM-1 Keyboard allows six sense switches to be added.

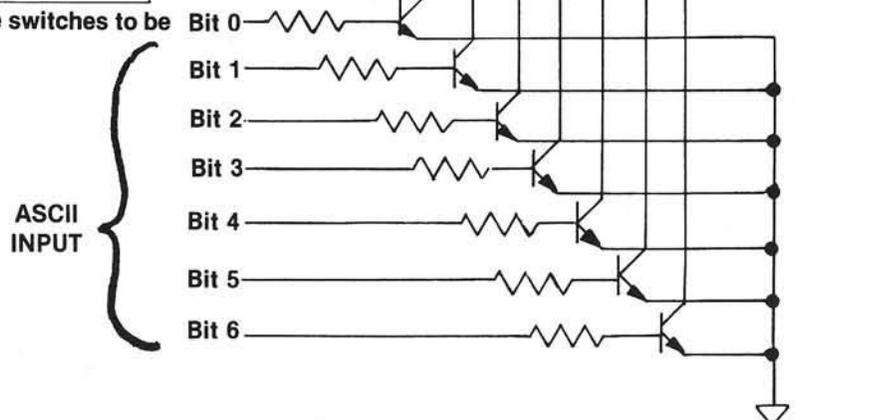


Figure 2: Simple interface allows addition of ASCII keyboard to basic KIM-1.

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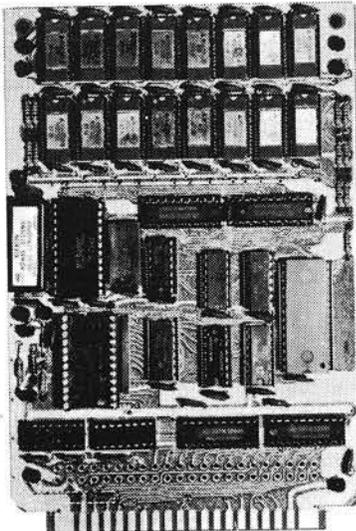
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# MICRO Club Circuit

MICRO continues its soon to be monthly feature on 6502-related clubs. We are continuing to publish the names, locations, and activities of groups that could be of interest to our readers.

If you are involved in such a club have your representative register your group with us. In return for this registration we will send a free one year subscription of MICRO to your club's library. Include information regarding the club's name, location, algorithm, publications, purpose, officers, number of members, contact person, etc. Your club will then automatically appear in any club updates. If you are already registered please be sure to keep us current on your club's activities.

We would like this feature to be as helpful to our readers as possible. We welcome any information that will be of interest to other clubs: ie. what your club does, how it got started, what is published, your meeting format, purpose, etc.

We are publishing a complete list as of March. Please keep the updates coming! Start increasing your membership and give your group new exposure by telling others about yourselves.

If any of the following information is in error or outdated, please notify us. Address any questions or information to:

**MICRO CLUB CIRCUIT**  
P.O. Box 6502  
Chelmsford, MA 01824

## OSI User's Group

Meets at Aristocraft on the first Thursday of the month (7-9:00 p.m.):  
314 5th Avenue  
New York, New York.

David Gillette, President. "Mutual aid and sharing of information."

## The Big Apple User's Group

Meets on the last Tuesday of each month, at:  
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## Apple Pi Computer User's Group

Meets first Thursday of each month at:  
Colorado School of Mines  
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Room 280  
Boulder, CO.

Scott Knaster, President. "Spread information, use of documentation library and a software library for research and trading."

## Apple User's Group

Meets on the third Thursday of each month (7:30 p.m.) at:  
Computerland of Walnut Creek  
1815 Ygnacio Valley Road  
Walnut Creek, CA.

Hank Couden, President. "Foster knowledge and use of the Apple Computer."

## Original Apple Corps

Meets second Sunday of the month (12:00 Noon) at:  
Cal State University at Long Beach  
Lecture Hall 151

Contact:  
Kip J. Reiner,  
19041-2 Hamlin Street  
Reseda, CA 91335

"Expand the knowledge of Apple Computers. Software and Hardware."

## Greater Lafayette Apple User's Group

Meets on the second Wednesday of each month (7:00 p.m.) at:  
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Jon W. Backstrom, President. "Library of public domain software. Exchange program. Want to educate members on successful programming skills. Workshops."

## Salem (Oregon) Area Computer Club

Meets on the first Monday of each month.

On odd numbered months, meetings are held at:

McKinley Community School  
461 McGilchrist Street SE  
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and on even numbered months at:  
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Contact:  
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Meets first Tuesday and third Wednesday of the month (7:00 p.m.) at:  
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For further information contact:  
Bill Norris, President  
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## Ohio Scientific Users NW

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**The Santa Barbara Apple User's Group**

Meets at:

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Santa Barbara, CA 93105

**Las Cruces Computer Club**

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SouthWest Computer Center  
Suite 7  
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Las Cruces, N.M. 88001

John Martellaro, President. Contact him at:

2929 Los Amigos, Apt.B  
Las Cruces, New Mexico 88001

**Apple-Siders of Cincinnati**

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**Denmark 6502 Club**

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**Carolina Apple Core**

Meets third Tuesday (7:30 p.m.) of the month for general meeting. Other meetings are held on specific topics. Contact Joe Budge, President at:

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**North London Hobby Computer Club**

For more information contact:

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The Polytechnic of North London  
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DeVlaamse Minicomputerclub  
Lambrechtschoekenlaan 171b6  
2060 Merksem, Belgium

**Apple Group - New Jersey**

Meets the fourth Friday of every month (7:00 p.m.) at:

Union County Tech. Institute  
1776 Raritan Road  
Scotch Plains, N.J.

**PACS PET User Group**

Meets the third Saturday (11:00 a.m.) every month at:  
Science Building  
LaSalle College  
20th and Onley Avenue  
Philadelphia, PA 19191

**Washington Apple Pi**

Meets the fourth Saturday (9:30 a.m.) every month at:

George Washington University  
Rm. 206, Tompkins Hall  
23rd and H streets NW  
Washington, DC

You may write to this club at:

Washington Apple Pi  
P.O.Box 34511  
Washington, DC 20034

"Publishes a monthly newsletter."

**South Carolina Apple**

Meets second Tuesday of the month (7:30 p.m.) at:

The Byte Shop  
1920 Blossom Street  
Columbia, SC

You may address your inquiries to:

P.O.Box 70278  
Charleston Heights, SC 29405

**WAKE--**

(Washington Area Kim Enthusiasts) Meets the third Wednesday (7:30 p.m.) of every month at:

McGraw-Hill Continuing Education Center in Washington DC.

Contact Ted Beach at

5112 Williamsburg Boulevard  
Arlington, VA 22207

for further information.

**Miami Apple User's Group**Contact David Hall, Secretary at:  
2300 NW 135th Street  
Miami, FL 33167**Sun Coast Apple Tree**

Meets the first and third Thursday of the month (7:00 p.m.) at:

The Computer Store  
21 Clearwater Mall  
Clearwater, FL 33516

**Central Ohio Apple Computer Hobbyists**

(COACH) Meets the third Saturday of each month (1:00 - 5:00). Contact:

Tom Mimplitch  
1547 Cunard Road  
Columbus, Ohio 43227

**Apple Dayton**

Meets the second Wednesday of odd numbered months and the second Thursday of even numbered months (7:30 p.m.) at:

Computer Solutions  
Contact: Robert W. Rennard at  
2281 Cobble Stone Court  
Dayton, OH 45431

**Madison Pet User's Club**

Meets monthly at:  
Washington Square Building  
1400 East Washington Avenue  
Madison, WI 53913

Contact: Ben A. Stewart  
501 Willow  
West Baraboo, WI 53913

**Micro and Personal Computer Club of St. Louis**

Meets monthly at:

Futureworld, Inc.  
12304 Manchester Road  
St. Louis, MO 63131

Contact: Mr. Kunihiro Tanaka

**Tulsa Computer Society**

Meets the last Tuesday of each month (7:30 p.m.) at:

Tulso Vo-Tech School  
Seminar Center  
3420 S. Memorial Drive  
Tulsa, OK

This society also has an Apple User Group. For more information please write to:

The Tulsa Computer Society  
P.O.Box 1133  
Tulsa, OK 74101

**The Apple Corps**

Meets the second Saturday of each month (2-5:00 p.m.) at:

Greenhill School  
14255 Midway Road  
Dallas, TX

**Appleseed**

Meets monthly at:

The Computer Shop  
6812 San Pedro  
San Antonio, TX 78216

**Apples Brit.Columbia Computer Society**

Meets the first Wednesday of each month. Contact:

Gary B. Litte  
101-2044 West Third Avenue  
Vancouver, British Columbia  
Canada V6J 1L5

**Honolulu Apple User's Society**

Meets the first Monday of each month at the Computerland Store in Honolulu. Contact:

Bill Mark  
98-1451-A Kaahumanu Street  
Aiea, Hawaii 96701

*Has anyone heard from the following clubs? Are they still active? Any current information would be appreciated!*

The MicroComputer Investor's Assoc.  
The New England Apple Tree  
Apple User Group of Europe

**Applelist**

Meets the second Wednesday of the month (7:30 p.m.) at:

Computerland  
Skiff Street  
Hamden, Conn.

Contact:

Marc B. Goldfarb  
55 Pardee Place  
New Haven, Conn. 06515

"Promote greater literacy on Apple II, Publish Newslad (ASAP) and aid new users."

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Mike Rowe  
Box 6502  
Chelmsford, MA 01824

Name: **The Designer System**  
System: **Apple II or Apple II + 48K**  
Memory: **ROM APPLESOFT**  
Language: **Apple II w/DISK II**  
Hardware: **Apple II w/DISK II**

Description: The Designer is a HIRES graphics macro-operating system that provides the user with line and curve creation with game paddles (or Joysticks) and single keystroke ease. Lines, circles, arcs, ellipses, rectangles, areas, etc. may be quickly drawn, modified, and saved to Disk as completed or unfinished drawings. Both HIRES pages are used to provide 2 position animations. Typical uses are computer art, graphic game setups, visual presentations, and showing off. Sometimes called "the poor man's graphics tablet" this program does your complex hplotting for you. ERROR-FREE-GUARANTEED

Price: **\$24.95**  
Includes: **Disk with DEMOS and Manual, guarantee**  
Author: **Jeff Johnson, Apple Jack**  
Available: **Your dealer or Apple Jack 12 Monterey Drive Cherry Valley, MA 01611**

Name: **ACTS**  
System: **Apple II**  
Memory: **32K RAM with ROM Sp-plesoft**  
Language: **Applesoft and Machine Language**  
Hardware: **Apple II, Disk II, D C Hayes Micromodem.**

Description: The Apple Communication Transfer System (ACTS) and an Apple (equipped with a disk drive, ROM Applesoft, and a C C Hayes micromodem) will transfer over the telephone Apple programs in all three languages. Exchange programs with others without leaving your home. No program modifications, self adapting and easy to use.

Automatically stores the transferred program on the receiving Apple's disk, ready for use. The entire ACTS system, on a disketter with complete documentation, retails for only \$14.50. All proceeds derived from the sale of ACTS will go toward the procurement of micro hardware for the Northeast Ohio Apple Bulletin Board System.

Copies: **30 plus**  
Price: **\$14.50 on disk**  
Includes: **System diskette and full documentation**  
Author: **Northeast Ohio Bulletin Board System**  
Available: **The NEO/ABBS P.O. Box 4731 Cleveland, Ohio 44126**

Name: **Road Race**  
System: **Apple II**  
Memory: **16K min**  
Language: **Integer Basic and Machine Language**  
Hardware: **Game paddles or joysticks**

Description: Real-time simulation of Grand Prix Road Racing. Two players race around a 2.25 mile course, or one player races against a computer driven car. HIRES display shows through-windshield view of race course.

Price: **Cassette \$15.00, disk \$20**  
Author: **Stan Erwin**  
Available: **Stan Erwin 5410 W. 20th Street Indianapolis, IN 46224**

Name: **Space Shuttle Landing Simulator**  
System: **Apple II**  
Memory: **48K**  
Language: **Machine language and Applesoft**

Description: Slightly improved version of program advertised in November 1979 of MICRO. Give system config.

Copies: **250 plus**  
Price: **Applesoft RAM \$15.00 on cassette, Applesoft ROM \$17.00 on cassette, Diskette version \$21.00. State which.**  
Author: **John Martellaro**  
Available: **Harvey's Space Ship Repair P.O.Box 3478 Univ. Park Las Cruces, NM 88003**

Name: **Restaurant Evaluation**  
System: **Apple II**  
Memory: **16K**  
Language: **Applesoft II**  
Hardware: **Disk II, Printer (both optional)**

Description: Evaluates potential restaurant/night club sites and thereby reduces the margin of risk involved in purchasing a new or existing business. All the necessary percentages and formulas are programmed to evaluate whether a potential site will be profitable or not. The program is also structured for use by present restaurateurs to evaluate whether or not their present business is operating at cost and profit efficiency. Calculates monthly gross, computes monthly loan rates (or mortgage), and reports weekly, monthly and annual net profit/loss in dollar amounts and percentages.

Copies: **25 +**  
Price: **\$19.95 Diskette plus \$1.95 P&H First Class Mail, Check or Money Order.**  
Includes: **Diskette and full documentation**  
Author: **M. Goldstein**  
Available: **Mind Machine, Inc. 31 Woodhollow Lane Huntington, N.Y. 11743**

Name: **Trace/Debug-Monext**  
System: **SYM-1**  
Memory: **2K (for cassette version)**  
Language: **Assembler**  
Hardware: **Standard SYM (w/CRT)**

Description: This program adds 15 commands to SYM's monitor including: Trace, Disassemble, Relocate, Find, ASCII dump, Stack dump, etc. The "T" command sets up its own operating environment supporting commands such as, Go, Skip, Continue, Single Step, Memory/Register examine/modify, ect. As SYM executes each instruction of the user program, an NMI is generated. IF the address of the instruction is "valid" — neither in SYM's monitor nor the extension — and if it is not a "skip" range, a disassembly/register listing is printed. This program as a whole is clean and operates transparently under SYM's OS. SASE for complete specs and examples.

Copies: **Just released**  
Price: **Object listing**  
**\$14.95**  
**Cassette**  
**\$15.95 @ \$3800 or specify**  
**EPROM (2716)**  
**\$49.95 @ \$F000 or specify**  
**Commented Source**  
**\$9.95**

Author: **Jeff Holtzman**  
Available: **Jeff Holtzman**  
**6820 Delmar-203**  
**St. Louis, MO 63130**

Name: **LEM LANDER**  
System: **Apple II**  
Memory: **32K**  
Language: **Applesoft**  
Hardware: **Disk II**

Description: Lem Lander is a real-time version of the popular lunar lander game. This disk-based game includes nine landscapes to try your hand at landing on. Your high-resolution LEM is controlled through space via the paddle knob (thrust) and the buttons (rotation).

Copies: **One for you**  
Price: **\$14.95**  
Author: **Barry Cox**  
Available: **Barry Cox**  
**444 Myers Avenue**  
**Harrisonburg, VA 22801**

Name: **UTIL-DS**  
System: **Apple II**  
Language: **Machine language and Applesoft**  
Hardware: **Apple II**

Description: UTIL-DS is a collection of several machine language utility routines and one Applesoft utility routine. The Applesoft utility is a sophisticated formatting routine for numeric output. The routine converts numeric values into a character string for printing. The user of

the routine specifies the maximum length of the resulting string and the number of decimal places to appear in the result. Positive and negative numbers can be converted by the routine. Comma are inserted in the integer portion of the number. The machine language utilities consist of several routines to improve the error handling capabilities of Applesoft programs (e.g. resume execution at the statement following the one in error), a machine language to Applesoft interface utility, a routine to selectively clear arrays and a routine for loading machine language programs into RAM along with an Applesoft program.

Copies: **Just released**  
Price: **\$35.00 (Texas residents add 5% sales tax)**

Includes: **Routines on diskette, a sample program to demonstrate numeric formatting and documentation.**

Author: **Robert F. Zant**  
Available: **Decision Systems**  
**P.O.Box 13006**  
**Denton, TX 76203**

Name: **Dynatext Editor**  
System: **PET/CBM, ROM**  
Memory: **16K or more**  
Language: **Basic, plus machine-language repeat key**  
Hardware: **Commodore 2022 or 2023 Printer (optional)**

Description: Authorized PET version of "Context Editor", as printed in Kilobaud Magazine 5/79. Enhanced and changed in many ways for the PET. Uses cassette or disk. Has all the desirable features of most good word processors, such as global search and replace, right justification, cursor editing, etc. Plus dynamic formatting, the ability to print in any desired shape. Holds 7 pages of text at once in a 32K PET.

Copies: **5, Just Authorized**  
Price: **\$5.00 for cassette, program and instructions.**

Author: **James Strasma, based on work by Law & Mitchell**

Available: **Rev. James Strasma**  
**120 West King Street**  
**Decatur, IL 62521**

Name: **Higher Graphics II**  
System: **Apple**  
Memory: **32K and disk drive**  
Hardware: **Apple I**

Description: A collection of programs and shape tables that lets any programmer create detailed and beautiful high resolu-

tion displays and animation effects. Make your programs come alive by utilizing the full graphical capabilities of the Apple II. The package contains:

Shape Maker - create shapes with this easy to use shape table generator. Start new shape tables or add to existing ones. Correct shapes as they are being produced. Delete unwanted shapes from the table. Display any/all shapes with any scale or rotation at any time.

Table Combiner - pull shapes from existing general purpose tables and add the ones you want into a new special purpose table. May combine shapes from any number of tables. All shapes can be viewed or deleted.

Screen Creator - place your shapes on the high-res screen. Add areas of color and text to make detailed displays or game boards for high resolution games. A screen can be created in minutes with this easy to use program. Utilizes any number of shape tables and allows screen to be saved at any time.

Shapes - four shape tables with over 100 shapes are provided. Included are alphanumerics, chess figures, card symbols (club, spade, etc), tanks, planes, spaceships, ships, cars, trees, mountains, buildings, etc. Add the shapes you like to your own table.

High Res Text - how to use high resolution graphics in your program. Animation effects and display techniques.

Price: **\$24.00 Retail**  
Available: **Synergistic Software**  
**5221 120th Avenue SE**  
**Bellevue, WA 98006**

Name: **HYPNOSIS**  
System: **Apple-1 disk drive**  
Memory: **32K**  
Language: **Integer Basic**

Description: Hypnosis is a program that uses Apple's video and sound capabilities to aid in suggestive relaxation, behavior modification and trance induction. Visual and auditory patterns are fully variable for shape, color and frequency matching of the subject's alpha brain wave rhythm. Designed for health professionals and students of the medical, psychological and social sciences.

Copies: **250 plus**  
Price: **\$20.00**  
Includes: **Diskette, program and manual**

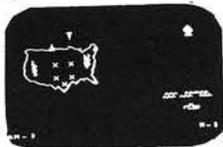
Author: **E.J. Neiburger**  
Available: **Andent Inc.**  
**1000 North Avenue**  
**Waukegan, IL 60085**

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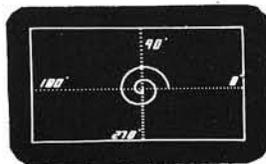
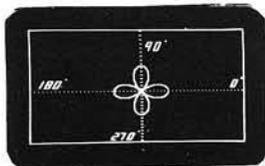
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Akron, OH 44320

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- Yob, Gregory, "Personal Electronic Transactions," pgs. 183-185.  
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The American Heritage Dictionary defines a limerick as: "A light humorous or nonsensical verse of five lines with the rhyme scheme *aabba*". For those of you who may not have been English majors, here is an example:

*There was a young princess  
from Niger,  
Who smiled as she rode on a  
tiger.*

*They returned from the ride  
With the princess inside  
And the smile on the face of  
the tiger.*

To win our limerick contest, all you have to do is come up with an original 5-line verse about MICRO.

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The winning limerick will be published in the September issue, along with some honorable mention runners-up.

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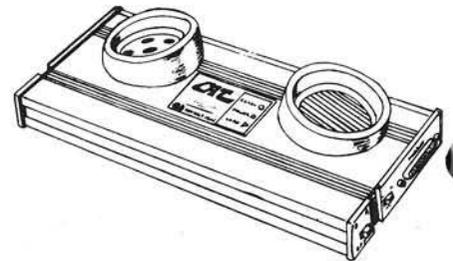
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Bob Bishop			
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Lee Reynolds			

**Editor's Note:** Use this index as a guide to material which is of interest to you. Remember that most of the articles and features under the 'General' heading apply to 6502 systems in general. Also, many articles and programs which are classified for one system may be readily modified and/or adapted to another system.

## Missing MICRO Information?

MICRO is devoted exclusively to the 6502. In addition, it is aimed at useful, reference type material, not just "fun and games". Each month MICRO publishes application notes, hardware and software tutorials, a continuing bibliography, software catalog, and so forth. Since MICRO contains lots of reference material and many useful program, most readers want to get the entire collection of MICRO. Since MICRO grew very rapidly, it quickly became impractical to reprint back issues for new subscribers. In order to make the older material available, collections of the reprints have been published.

[A limited number of back issues are still available from number 7 to 18 and 20 to current. There are no 19's left. Use the order form in this issue.]

For a free copy of the Index for Volumes 1 and 2, please send a self-addressed, stamped envelope to:  
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**The BEST of MICRO Volume 1** contains all of the significant material from the first six issues of MICRO, covering October/November 1977 through August/September 1978. This book form is 176 pages long, plus five removeable reference cards. The material is organized by microcomputer and almost every article is included. Only the ads and a few 'dated' articles have been omitted. **Surface . . . \$7.00**  
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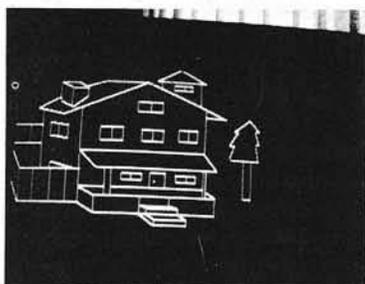
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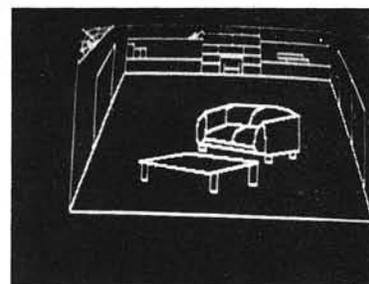
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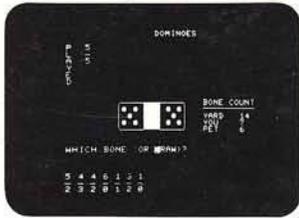
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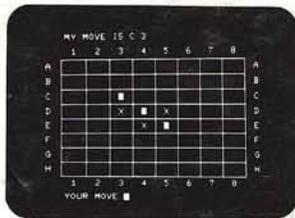
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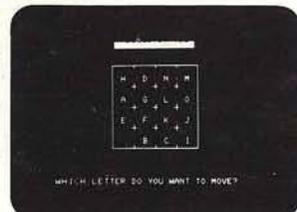
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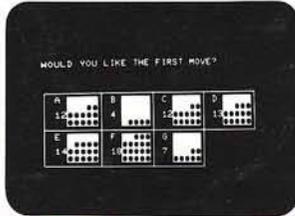
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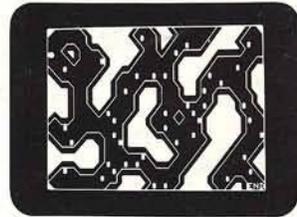
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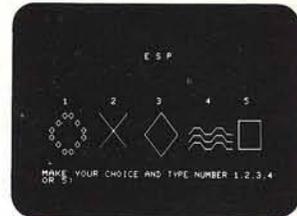
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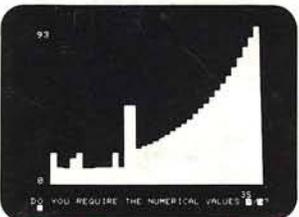
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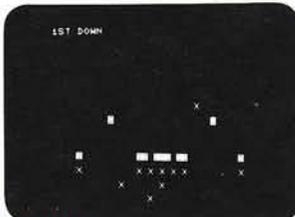
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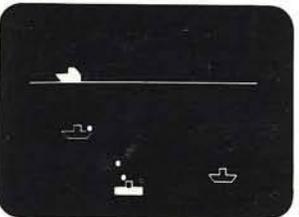
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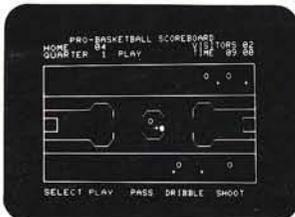
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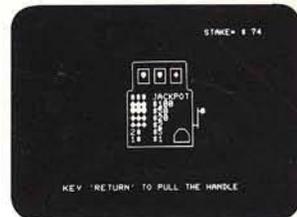
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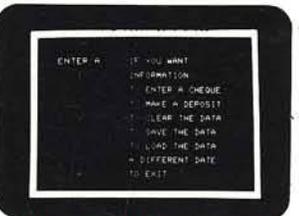
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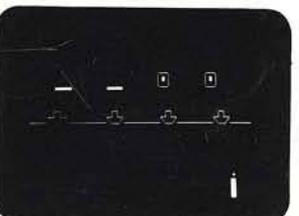
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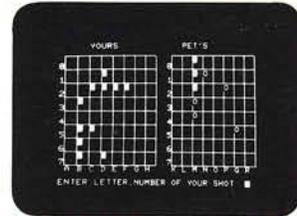
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