```
         SBC  #$37    (convert A-F)
SMALL    CMP  #$10    (result too big?)
         BCS  HEXIN   (yes, try again)
         TAY          (copy value to Y)
         TXA          (restore ASCII)
         JSR  $FFD2   (print digit)
         RTS
```

There are some "tricks" to the above coding. The first subtraction seems to be taking off 47 ($2F), but it really subtracts the correct value of 48 since the carry is clear, which is a "borrow" in subtraction. The carry is set for the second subtraction, so the stated value of $37 (55) is used. All illegal characters are excluded, although it may take a little hand calculation to work out why.

That's the hard part. Now let's do the easy part – the actual hex input of four digits:

```
FOUR JSR  HEXIN  get character
     TYA         move value to A
     ASL  A      mult. by 2..
     ROL  A         ..by 4..
     ROL  A         ..by 8..
     ROL  A         ..by 16
     STA  VALUE  put result somewhere
     JSR  HEXIN  another character
     TYA
     ORA  VALUE  combine with previous
     STA  VALHI  store in high byte
     JSR  HEXIN  get third character
     TYA         move value to A
     ASL  A      mult. by 2..
     ROL  A         ..by 4..
     ROL  A         ..by 8..
     ROL  A         ..by 16
     STA  VALUE  put result somewhere
     JSR  HEXIN  fourth character
     TYA
     ORA  VALUE  combine with previous
     STA  VALLO  store in low byte
```

Not too hard? Multiplying by 16 is performed by four short instructions: a shift and three rotates. The rest involves combining the digits and putting them away.

Next time, we'll discuss decimal number input, which requires a somewhat more difficult multiplication by ten. ©

PROGRAMMING THE TI

C. Regena

Easy Editing

If you use these editing keys and built-in programmers' commands, you'll soon discover how fun and easy-to-use the TI-99/4A can be.

You are typing along writing a program or "keying-in" one from **COMPUTE!** Magazine when – oops! – you make an error. Hold it! Don't type the whole line over! Take advantage of the easy-to-use editing capabilities built in to the TI-99/4A.

Take a look first at the arrow keys (found on letters E,S,D,X). You thought they were just for games? They will probably be the most used editing keys once you get used to them. Suppose you have typed lines 100-150 and look up at the screen and notice you want to change the number in line 130:

```
130 CALL SCREEN(14)
```

Type in 130 then hold the function key (FCTN) down while you press the down arrow ↓. (It might be best to follow through this article as you sit at your TI-99/4A.) You'll notice line 130 comes up at the bottom of the screen with the cursor at the first position. Now press FCTN and the right arrow. The cursor will go toward the right. You may go one space at a time, or hold the key and it will repeat. Go over to the 4 in 14. Stop right over the 4 and type 6. Press ENTER, and the line will now be

```
130 CALL SCREEN (16)
```

Any characters you don't want to change you can just pass over with the arrow key. Change the character you want, then press ENTER – you don't need to go to the end of the line either.

Now suppose you don't like color 16 (white) and decide you want color 6. Type 130 then FCTN ↓. Use FCTN→to get over to the 1 in 16. Stop right on top of the 1. Now press FCTN and 1, which is DEL, for DELete. Now press ENTER and you should have

```
130 CALL SCREEN(6)
```

Try another function key. Type 130 then FCTN↓. Use FCTN→to go on top of the 6 and type 2. Just a second, though. You don't want screen 2; you want 12. Use FCTN←to back up one spot (cursor on 2). Press FCTN 2 for INSert. You won't notice anything right away, but now type 1 – you have color 12. Press ENTER and your line has been changed.

Automatic Repeats

The left arrow, right arrow, and DELete keys have the automatic repeat feature by just holding the key down. The INSert key needs to be pressed just once and characters will keep being inserted as you type until you press ENTER, DELete, or one of the arrow keys. To delete or get rid of a whole line, type the line number and then press ENTER.

Two more handy editing keys are the up arrow and down arrow. Let's assume you have the following lines:

```
200 CALL HCHAR(3,5,42)
210 CALL HCHAR(3,8,42)
220 CALL HCHAR(3,20,33)
```

You RUN your program and discover the graphics needs to be a line lower – the row value needs to be changed from 3 to 4.

Type 200, press FCTN ↓, and use the right arrow to change the 3. Instead of pressing the ENTER key, press FCTN ↓. After line 200 has been edited, the very next line, line 210 in this case, will appear for editing. Likewise, the up arrow will give you the line just before the one on which you were working.

Two other editing keys you should be aware of are ERASE (FCTN 3) and CLEAR (FCTN 4). You may already be familiar with CLEAR. If you are running a program and want to stop, FCTN 4 will interrupt the program. (QUIT, FCTN =, will stop the program, erase it from memory, and return to the TI title screen; CLEAR stops the program but it is still in the computer and you may either CONtinue or RUN.)

CLEAR has another function while you are programming. If you start typing a line and decide you don't want that line after all, press CLEAR.

The cursor will go to the next line and the line you were working on is ignored. ERASE will erase the line that you are working on.

The other function keys you see along the top row of your keyboard are used in some of the command modules and are described in the manuals accompanying the modules.

Some helpful commands for programmers are LIST, NUM, and RES. As you are writing a program, each command needs a line number. When the program is RUN, the computer executes each line in numerical order. The command LIST will list your complete program in order. As your program lists, if it is too long for one screen, the lines scroll off the top. If you want to stop the listing, press CLEAR. If you want to list only part of your program, just list the lines you wish:

Command	Lists:
LIST	Whole program
LIST -200	All lines up to and including line 200
LIST 200-300	Lines 200 to 300 inclusive
LIST 300-	Lines 300 to the end

When you're typing in a program, it will save time and reduce the chance for error if you let the computer type the line numbers. Type in the command NUM (for NUMBER). The computer will automatically start with line 100. Now type in CALL CLEAR and press ENTER. The computer enters line 100 and starts you on line 110. The NUM command automatically increments the line numbers by 10.

You may start anywhere – for example, type NUM 3220 and press ENTER. Your program starts with line 3220 and increments by 10.

Yes, you can change the increments also. Type NUM 200,5 and you'll start with line 200 and increment by 5 (line 200, 205, 210, etc.). The general form is: NUM initial line, increment.

If you want the program to start with line 100 but the increments to be 7 instead of 10, you may use NUM ,7.

To get out of the automatic numbering, just press ENTER after the line number or CLEAR. You'll also notice that if you have a program in the computer and type NUM the computer will show you what is on that line. If you want to keep the line as is, just press ENTER.

Complete Renumber

RES is a command that stands for RESEQUENCE. You've been programming and adding lines here and there and want it to look nice again, all numbered by tens. Type RES and press ENTER. As soon as the cursor reappears, your program is resequenced or renumbered, including all line numbers referenced in other lines. Try this sample:

```
1Ø CALL CLEAR
12 CALL SCREEN(14)
2Ø FOR I=1 TO 8
3Ø CALL SOUND(5ØØ,-I,2)
35 GOTO 2Ø
```

Now type RES and press ENTER, then LIST. The lines are resequenced, starting with 100 and incrementing by 10. Like the NUM command, you may specify the starting line number and the increment: RES initial line, increment.

Try RES 10 then LIST.

Try RES 1,1 or RES ,5 and experiment with your own numbers.

Quite often I like to start writing programs with line numbers incrementing by 10. Type in NUM and start programming. If the program has several branches, I may start one branch at 1000 (NUM 1000), another at 2000, etc. Leaving gaps in the line numbers makes it easier to add lines later.

For example, if I have a line 200 and the next line is line 210, I may easily add lines in between by numbering them 202, 204, etc. But what if I have to add 15 lines between lines that are only ten apart? RES ,50 will spread the lines apart and allow more numbers in between. Of course, when I'm through with the program, I RES so the program starts at 100 and increments by 10, and you can't tell where I have planned poorly and had to add lines. ©

PET Quickplot

Matt Ganis

This machine language subroutine, when added to any BASIC program, will perform fast, high-resolution drawing or plotting on PET/CBM's of any memory size, any version of BASIC (see Programs 2 and 3 for the variations). Program 1 checks your memory size and places itself in the correct location at the top of RAM and reports to you the SYS address to use from BASIC programs.

Program 1, the BASIC loader for "Quickplot," can be RUN and then, to get an idea of its graphics capabilities, try Programs 4 and 5 for demonstrations. When you give a value for X and Y, that point on the PET screen is illuminated with the appropriate character from the table. This series of characters effectively creates an 80 x 40 resolution for the screen. In order to plot a point, say (20,10), just execute SYS (address given by loader), 20,10 and there it appears.

The program is set up to avoid any negative values. The lower left-hand corner of the screen is 0,0 (line zero, column zero). The way the value of X and Y is given to the machine language plotting routine is the most interesting feature of Quickplot. There is a short subroutine, three machine language JSR's long, which is contained in line 500 of Program 1. It jumps to three PET ROM routines in a row.

The first jump is to a ROM routine called "checkcom," which looks through the line in BASIC for a comma. Then we jump to "evaexp" which evaluates expressions. It can handle both numbers and variables. Finally, "fltfix" gives a numerical value expressed as an integer, anything to the right of the decimal point is dropped, and the number can be found divided between its high byte in the accumulator and low byte in the Y register.

After the program thus recovers the coordinates, it decides which of the characters (see the table) is appropriate and then figures out the screen address.

The method used here to pass values from a SYS to a machine language subroutine could easily be adapted to other machine language work. Just disassemble the three JSR's in line 500 which apply to your computer. Jot them down if you ever need to send numbers conveniently from BASIC to machine language.

The plot characters

Character	Index	Binary Representation
□	0	0000
▗	1	0001
▝	2	0010
▐	3	0011
▖	4	0100
▄	5	0101
▞	6	0110
▟	7	0111
▘	8	1000
▚	9	1001
▀	10	1010
▜	11	1011
▌	12	1100
▙	13	1101
▛	14	1110
█	15	1111

Program 1: BASIC Loader

```
100 TP=PEEK(53)-1
110 FOR T=0 TO 220
120 READ A$
130 IF A$="*" THEN A=TP:GOTO 150
140 A=VAL(A$)
150 POKE T+TP*256,A
160 NEXT T
170 POKE 53,TP:PRINT"{CLEAR}USE    SYS"TP*256:N
    EW
180 DATA 32,185,*,140,211,*,141,212,*,32
190 DATA 185,*,140,213,*,141,214,*,173,212
200 DATA *,208,11,173,214,*,208,6,32,35
210 DATA *,32,60,*,96,24,78,211,*,144
220 DATA 4,169,1,208,2,169,4,141,215,*
230 DATA 24,78,213,*,144,3,14,215,*,96
240 DATA 56,169,24,237,213,*,141,216,*,169
250 DATA 40,141,218,*,169,0,141,217,*,32
260 DATA 133,*,173,219,*,24,109,211,*,144
270 DATA 3,238,220,*,133,1,173,220,*,24
280 DATA 105,128,133,2,160,0,162,0,177,1
```

```
290 DATA 221,195,*,240,7,232,224,16,208,244
300 DATA 162,0,138,13,215,*,170,189,195,*
310 DATA 145,1,96,169,0,141,219,*,141,220
320 DATA *,24,78,216,*,144,25,24,173,219
330 DATA *,109,218,*,141,219,*,144,3,238
340 DATA 220,*,24,173,220,*,109,217,*,141
350 DATA 220,*,24,14,218,*,46,217,*,173
360 DATA 216,*,208,213,96
500 DATA 32,245,190,32,152,189,32,45,201,96
510 DATA 32,108,124,225,123,98,255,254,126,127
520 DATA 226,251,97,252,236,160,0,0,0,0
530 DATA 0,0,0,0,0,0
```

Program 2: Use this line for Upgrade BASIC.

```
500 DATA 32,248,205,32,159,204,32,210,214,96
```

Program 3: Use this line for Original BASIC.

```
500 DATA 32,17,206,32,184,204,32,208,214,96
```

Program 4: Example Sine Wave

```
10 FORX=0TO79
20 Y%=24*SIN(6.28*X/80)+24
30 SYS32512,X,Y%
40 NEXTX
```

Program 5: Example plot of a circle centered at (40,24) and radius 10

```
10 X=40:Y=24:R=10
20 FORT=1TO360
30 X%=X+R*COS(T*3.14/180)
40 Y%=Y+R*SIN(T*3.14/180)
50 SYS 32512,X%,Y%
60 NEXTT
```

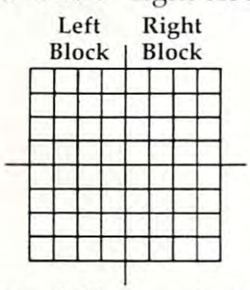
©

TI Graphics Made Easy

Lyle O. Haga

There is a better way of figuring out pattern-identifier code than that presented in the TI manual.

The TI screen is divided up into a giant grid of 24 rows and 32 columns for graphics. This grid, shown in your TI manual in the CALL CHAR section, makes 768 positions or spaces for you to put your graphics in. Each square of the grid is divided up into an 8x8 grid consisting of 64 dots to be turned on or off. Each 8x8 grid is divided up into a "left block" and a "right block."

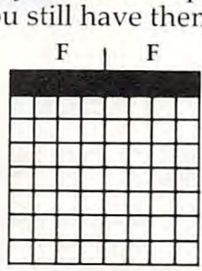


Each time you define a pattern-identifier, you use all 64 dots whether or not you so stipulate. Thus, the statement CALL CHAR(100,"FF") covers all 64 dots even though you stipulated only the top row of eight dots to be turned off; the remaining dots stay turned on. This can be seen by a simple little exercise. Make a box outline, 4x4.

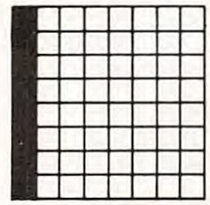
On the surface this sounds like a pretty simple exercise, and it is. The problem is that many people probably won't think it through, and will come up with the following:

```
10 CALL CLEAR
20 CALL CHAR(100,"FF")
30 CALL CHAR(101,"8080808080808080")
40 CALL HCHAR(12,8,100,4)
50 CALL HCHAR(16,8,100,4)
60 CALL HCHAR(12,8,101,4)
70 CALL HCHAR(12,12,101,4)
80 GOTO 80
```

No matter what you do, this won't work; there will always be a gap somewhere. Remember that even though you didn't stipulate all 64 dots in CHAR 100, you still have them to deal with.



On top of this you put the following:



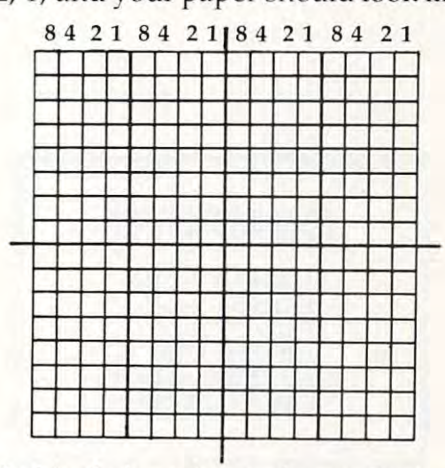
You should be able to see where the gap comes in now. When you put CHAR 101 on top of CHAR 100, the dots you left turned on cover the dots you turned off, thus the gap.

Here's one solution to the problem:

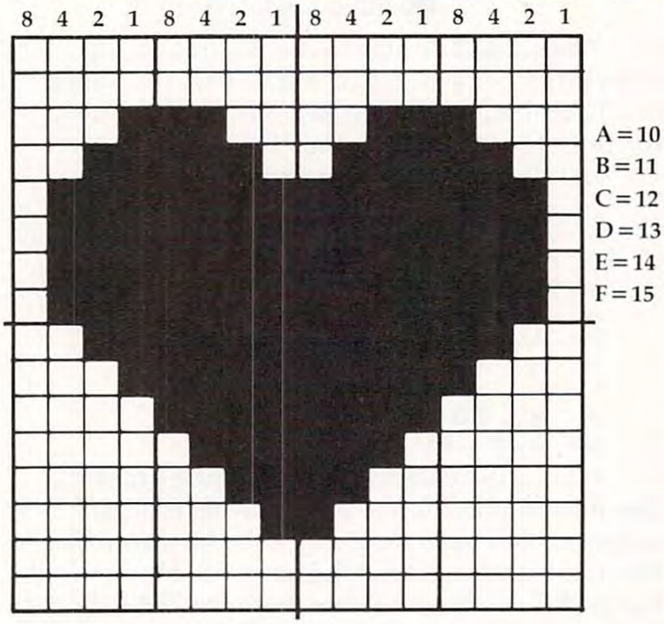
```
10 CALL CLEAR
20 CALL CHAR(100,"00000000000000FF")
30 CALL CHAR(101,"FF")
40 CALL CHAR(102,"8080808080808080")
50 CALL CHAR(103,"0101010101010101")
60 CALL VCHAR(12,8,102,4)
70 CALL VCHAR(12,11,103,4)
80 CALL HCHAR(11,8,100,4)
90 CALL HCHAR(16,8,101,4)
100 GOTO 100
```

What's the easier way of defining graphics? The new method is one your kids learned in school, called base 16. Using base 16, you write the numbers 8,4,2,1,8,4,2,1 across the top of each 8x8 grid. Let's see how this works in defining the heart; we will make it two positions high and two wide.

If you are planning to do many graphics, you should get some graph paper – this will make it easier. Let each square on the graph paper represent one dot; this gives you 16 squares wide and 16 squares high. Make the outline with a heavy line. Count horizontally from the left 4, 8, and 12 lines; make these heavier than the other lines, and make the eighth line even heavier and have it extend beyond the outline. This will mark off your left and right blocks and one position from another. Now, counting vertically, go down eight and darken this line, going beyond the outline. Across the top, put your base 16 numbers 8, 4, 2, 1, 8, 4, 2, 1, and your paper should look like this:



With this, let's make our heart. First, color in all the squares marking your heart. Then, starting at the top row, add up the numbers over the squares you darkened. If the total is under ten, your pattern code will be that number, and if it is over nine, you use the letters A-F. You do the one complete grid and then move to the right; when you are through, move down to the next line. You should come up with the following results:



Row one has no darkened squares, so the code is zero for both left and right blocks. You get the same results with row two. In row three, a square under the number one is darkened in the left block of grid one, so the code is one. In the right block, squares under the 8 and 4 are darkened, so the code is C. In row four, the squares under the 2 and 1 are darkened; the code is 3. Row four of the right block has darkened squares under 8, 4, and 2, so the code is E. Just keep this up, and you will come up with the following:

```
CALL CHAR(1ØØ,"ØØØØ1C3E7F7F7F7F")
CALL CHAR(1Ø1,"ØØØØ387CFEFEFEFE")
CALL CHAR(1Ø2,"3F1FØFØ7Ø3Ø1ØØØØ")
CALL CHAR(1Ø3,"FCF8FØEØCØ8ØØØØØ")
```

Using base 16 is easier. ©

A SuperPET Monitor You Can Bank On

Gary L. Ratliff

How to add and easily relocate Micromon to the SuperPET. When this powerful monitor is paired with that powerful computer – you can explore the languages, the operating system, and maybe construct a 6809 disassembler.

Have you acquired the SuperPET computer and found that resident monitors lack several features found in extended monitors such as Supermon and Micromon? (Both of these monitors were made available to **COMPUTE!** readers: Supermon, December 1981 and Micromon, January 1982.) Have you considered adding additional memory or buying one of the newer Commodore units with the 6508 or 6509 chips? Since both these devices can use bank switching to extend the address range to several megabytes, it's likely that you will soon need a monitor which adds bank switching to an already powerful set of commands.

Or, have you wished to add a user feature to one of these monitors and wondered how it was done? If so, then the methods which I've used to add a Bank command to Micromon Plus will be of interest to you. We will examine more closely the structure of the command and jump tables so that any code which you may wish to add to the monitor will also be easy to relocate with the T and N commands of Micromon.

The first step necessary for the addition of a command to Micromon Plus which will allow bank switching is that you have correct versions of Micromon and Plus which have not been run. When Micromon Plus is executed, several changes are made to the Micromon portion of the code which make relocating the code difficult. [*After the code first appeared in the January 1982 issue of* **COMPUTE!**, *several readers found relocating the code difficult. Consequently, several comments and suggestions appeared in the "CAPUTE!" section of later issues (April 1982 and June 1982).*] If you are entering this on a SuperPET, be certain to make the changes for converting the code for the 8032 screen format to your correct version of Micromon. The assumed starting point is Micromon located at \$6000-\$6FFF and the Plus code at \$5B00-\$5FFF.

The first features of the Plus code which we shall examine are the commands and jump vectors. This segment of code is found at \$5F15-\$5F39. Note that the jump vectors for the @ command and the › command are both to \$5CD8. The first change is to add a shifted B command by locating the \$3E in the line starting at \$5F15 and changing it to \$C2. Now you can test this by issuing a shifted B command.

If you don't get the disk status, you have made an error and should correct it before entering further code. Next, change the second occurrence of the pattern D8 5C to 4A 5F. The code of the bank command will be assembled starting at \$5F4A. If you wish to enter your own command into this monitor, you would follow a similar procedure.

The commands are obtained by the command search and dispatch routine found at \$5B69 to \$5B86. The commands start at \$5F15; the jump vectors start at \$5F22. If the value of the X register becomes negative, it signals that the command was not found and an error message is printed.

The design of the command is the next step. My idea of the B command was to print out the present bank setting on B ‹return›. Change the bank setting on entering any hex value from 0 to F, then print out the altered status. Any character other than spaces between the B and the parameter would be an error; the error message (?) should be printed to show this fact.

Note: if after the break a simple G command is issued, Micromon Plus with a BANK command added will perform a cold start. The code for adding the bank command is found in Program 1. You may enter it directly with the command: A 5F4A JSR \$6006 etc. Just enter the listed code until you reach the end of the bank code at \$5F8D. (If you make any entry errors, use the D command to correct the assembled code.)

Easy Relocation

A text message is easily printed by loading the Y and A registers with the address of the string followed by JSR STROUT. This was the first approach; however, the two-byte immediate instructions will not relocate properly when the finished code is moved. A careful study of the Micromon Plus code reveals that if the address is contained in a pointer, it will change automatically with the N command word option and make it easy for the user to relocate the code to any desired address. If your own routine is to use ROM-based routines which require setting up certain registers, then a similar analysis will reveal whether you need to reserve some memory as pointers to your code.

Micromon is designed to work for both Upgrade and 4.0 operating systems so look up both routines and code accordingly. SuperPET is available only for 4.0 operating systems, yet the code will operate on Upgrade BASIC which has a bank-switched RAM board (the hidden RAM feature of the 8032 excepted).

Next, the text message and the hexadecimal data need to be moved to safe ("hidden") memory. This is the purpose of the initialization code presented in Program 2. Again, just use the A command of Micromon Plus to assemble the code starting at $5AD7.

The final step is to enter the text and data. Using the M command, change the contents of locations $5F15-$5F45 and $5F90-$5FF0 to read exactly like those presented in the text of the article. This change will also enter your pointers, which will allow easy relocation of the code. Before saving the code, load the correct version of Micromon. As I mentioned, running the Plus portion will alter the Micromon code and make relocation difficult. When all these changes have been made correctly, you are ready to save the finished product. Now save the finished product by entering: S "0FILENAME",08,5AD7,7000.

You are now ready to test the operation of the bank command. Since this was written to overcome some of the shortcomings of the resident monitors present in the SuperPET, flip your machine to the 6809 setting and load in the development system. This step will fill your 64K bank switched RAM and give you something to explore. Now flip back to the 6502 side and load in Bankplus or whatever you called it when you saved the program.

Enter a SYS(1024) to get the monitor and then a command of: G 5AD7. Since this is an assembler, linker, and editor, let's try to find the instruction set text for 6809 opcodes. Enter the command: B0 followed by M 9000 9FFF to examine bank zero.

Examine Both 6502 And 6809

What? Something passed by which you wanted to see! You now have the power of Micromon Plus to examine not only the 6502 side, but also the 6809 side of your SuperPET. Before working with the 6809 monitor, you would have had to reissue the command and hope to narrow down on the target. Now, to catch that segment you missed, just hit the cursor keys and scroll up or down through memory.

Did you want to hunt through memory for the 6809 equivalent of the JSR and RTS statements to more closely zero in on the code to be translated later by the 6809 translate instruction? (While you're at it, if you turn on the printer you'll have the results of your search as hardcopy.) Want a printed hex dump of the APL in the SuperPET? Since this is larger than the 64K, you now know why the code for BANK switching must be easy to relocate. For those who are becoming impatient, the opcode data table will be found in bank six at locations $9660-$9A70.

The next step is instructions to move the code. I am certain that SuperPET owners will want to explore not only the languages, but also the operating system itself. To do this we will want to relocate Micromon to start at $7000 and the Bankplus addition to run from $0AD7-0FFF. This will allow us to move a copy of the 6809 operating system from $A000-FFFF to the freed space from $1000-6FFF. The goal is achieved by writing a simple 6809 move routine. The trick is to power-up with the switch in program mode, and then, once the code has been moved, change the registers to automatically switch to the 6502 mode. Be certain that you know how to control the diagnostic sense pin, or you will completely wipe out your freshly moved code. You'll notice that the stack pointer is messed up. Don't try to correct it: just get the code to the disk as a file.

Step-by-step

The following instructions will achieve this relocation of the code:

1. T 6000 6FFF 7000
   (first move Micromon)
2. N 7000 7FFF 1000 6000 6FFF
   (relocate the code)
3. N 7FB0 7FFF 1000 6000 6FFFW
   (relocate the words)
4. T 5AD7 5FFF 0AD7
   (move Plus and additions)
5. N 0AD7 0FFF B000 5000 5FFF
   (relocate Plus)
6. N 0F4A 0F8F B000 5000 5FFF
   (relocate Bank)
7. N 0AD7 0FFF 1000 6000 6FFF
   (correct any Micromon calls from Plus)
8. N 0D4A 0F8F 1000 6000 6FFF
   (correct any Micromon calls from Bank)

```
5F15 50 C4 49 CD 40 C2 DA 4A CB CC 5E 55 59 BE 5B 89PDIM@BZJKL^UY>[.
5F25 5B 6B 5C 16 5C D8 5C 4A 5F 27 5E 3A 5E 62 5E 69[k\.\X\J_'^:^b"^i
5F35 5E 77 5E 82 5E D2 5E 69 5B 00 5B B0 5F D7 5A 31^w^.^R^i[.[0_WZ1
5F45 30 32 31 38 31 20 06 60 C9 20 D0 03 20 17 6C C902181 .`I P. .lI
```

Figure 1: Command/Jump Vectors

```
5F90 0D 2E 20 42 41 4E 4B 20 3D 20 30 2E 0D 2E 00 00.. BANK = 0.....
5FA0 30 31 32 33 34 35 36 37 38 39 41 42 43 44 45 460123456789ABCDEF
5FB0 93 4D 49 43 52 4F 4D 4F 4E 20 50 4C 55 53 0D 42.MICROMON PLUS.B
5FC0 59 3A 20 42 2E 20 53 45 49 4C 45 52 0D 11 42 41Y: B. SEILER..BA
5FD0 4E 4B 20 43 4F 44 45 20 41 44 44 45 44 0D 42 59NK CODE ADDED.BY
5FE0 3A 20 47 2E 20 52 41 54 4C 49 46 46 0D 0D 00 00: G. RATLIFF....
5FF0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00................
```

Figure 2: Text String Area

9. N 0F22 0F47 B000 5000 5FFFW
(correct the word tables)

At this point you can run the code and issue a load command to recall the file of the 6809 operating system. Save the whole thing, and with one very powerful monitor you can examine the 6502 ROM, the relocated code of the 6809 side of the SuperPET, and any of the languages which load into the bank-switched RAM space. Furthermore, you can also load and save segments of 6809 code. (A feature omitted from the 6809 monitor.) Not only this, but you can also determine where the 6809 programs load with the J "1:FILENAME" command of Plus and alter this location with the Y command to load the short program "loader" into the bank-switched RAM space.

I would like to learn how the disassembler works. The biggest headache in writing a disassembler in BASIC is getting the data statements correct. Since these are easily copied in from the source code used in the development system, I think the disassembler from Micromon could be converted to translate the 6809 opcodes and also print them in a correct format. How about it? Is anyone game for writing a 6809 disassembler routine in 6502? Would such a product be called a cross disassembler? You can now bank switch; let's translate too.

Program 1: Add the Bank Command

```
5F4A 20 06 60 JSR $6006
5F4D C9 20    CMP #$20
5F4F D0 03    BNE $5F54
5F51 20 17 6C JSR $6C17
5F54 C9 0D    CMP #$0D
5F56 F0 14    BEQ $5F6C
5F58 A2 0F    LDX #$0F
5F5A DD E0 87 CMP $87E0,X
5F5D F0 06    BEQ $5F65
5F5F CA       DEX
5F60 10 F8    BPL $5F5A
5F62 4C 8E 60 JMP $608E
5F65 8A       TXA
5F66 8D DF 87 STA $87DF
5F69 8D FC EF STA $EFFC
5F6C AE DF 87 LDX $87DF
5F6F BD E0 87 LDA $87E0,X
5F72 8D DA 87 STA $87DA
5F75 A0 87    LDY #$87
5F77 A9 D0    LDA #$D0
5F79 AE 00 C0 LDX $C000
5F7C E0 40    CPX #$40
5F7E F0 06    BEQ $5F86
5F80 20 1D BB JSR $BB1D
5F83 4C 89 5F JMP $5F89
5F86 20 1C CA JSR $CA1C
5F89 00       BRK
5F8A 20 60 6C JSR $6C60
5F8D 6C 3E 5F JMP ($5F3E)
```

Program 2: Initialization of Bank Command

```
5AD7 AC 41 5F LDY $5F41
5ADA AD 40 5F LDA $5F40
5ADD AE 00 C0 LDX $C000
5AE0 E0 40    CPX #$40
5AE2 F0 06    BEQ $5AEA
5AE4 20 1D BB JSR $BB1D
5AE7 4C ED 5A JMP $5AED
5AEA 20 1C CA JSR $CA1C
5AED A2 1F    LDX #$1F
5AEF BD 90 5F LDA $5F90,X
5AF2 9D D0 87 STA $87D0,X
5AF5 CA       DEX
5AF6 10 F7    BPL $5AEF
5AF8 A9 00    LDA #$00
5AFA 8D DF 87 STA $87DF
5AFD 8D FC EF STA $EFFC
```

©

Automatic VIC Appending

Mark Niggemann

It's quite simple to add two programs together to make a single, larger program. This brief tutorial shows how and explains how the VIC automatically relocates programs in memory.

One of the nice features of the VIC is the auto-relocation of BASIC programs during a LOAD. The VIC puts a program into the correct place in RAM memory automatically because programs can be located at three different places in VIC, depending on the memory size that it has. If you saved a program on a 3.5K VIC and later on you bought a 3K expander, it would be next to impossible to RUN that program if the locator didn't make an adjustment.

BASIC on a 3.5K machine expects the starting memory address to be 4097. All programs are saved with this memory address as their starting point. On an expanded-by-3K VIC, the starting memory address is 1025. Since the starting point of BASIC can thus vary, it's left up to the relocator to set things right.

How The Relocator Works

The relocator first checks to see where the start of BASIC is. This is an address POKEd by the computer into locations 43 and 44 when the VIC is switched on. This "start of BASIC" address is where the relocator will begin to store any program that the VIC is LOADing. *Note:* This does not include programs that are saved using absolute save mode, as in Jim Butterfield's "Tinymon" (**COMPUTE!**, January 1982, #20).

Since the relocator depends on the "start-of-BASIC" memory locations (called "pointers") to know where to start storing a program during a LOAD, it is possible to join two separate programs by using a method that I will describe later on. Note that the two programs to be joined must not have overlapping line numbers and that the program in memory at the time must have lower line numbers than the program you are "appending" onto it from tape.

Type in this example program:

```
50 REM PART 2 OF TEST PRG.
60 PRINT "THIS A TEST"
70 PRINT "TO SEE A VIC"
80 PRINT "APPENDING!"
```

Now save this example on tape and clear the memory using NEW to make way for the next program:

```
SAVE"PART 2"
PRESS PLAY & RECORD ON TAPE
OK
SAVING PART 2
READY.
NEW
```

Now type in this example program:

```
10 REM PART 1 OF TEST PRG.
20 PRINT "WILL THIS WORK?"
30 PRINT "I HOPE IT DOES."
40 PRINT "I KNOW IT WILL!"
```

I had you type in the second part first so that part one, the program we are appending, is in memory, and part two is on tape.

Clear the screen and type the following in direct mode:

```
PRINT PEEK(43),PEEK(44)
```

On a 3.5K machine you should get 1 and 16, respectively. Write down these printed values because you're going to need them again later on.

Now type in the following in direct mode:

```
POKE 43,PEEK(45)-2:POKE 44,PEEK(46)
LOAD"PART 2"
PRESS PLAY ON TAPE
OK
SEARCHING FOR PART 2
LOADING PART 2
READY.
```

The above lines typed in direct mode set the start of BASIC to the end of the current program already in memory. Then you load part two as you would any other program. The key to the whole thing is that the relocator will use as its starting location the start of BASIC which is directed by locations 43 and 44.

There is one final step before the two programs are finally appended. You must reset the start of BASIC to what it was before you loaded in part two. To do this, you simply POKE the two values that you previously PEEKed into their respective memory locations. For a 3.5K machine it would look like the following:

```
POKE 43,1:POKE 44,16
```

If you made no error in the procedure outlined above, you should be able to list the whole program with both parts together. Appending can be a very powerful programming aid, since it allows you to develop several sets of subroutines and then later on lets you patch them into a main program at will.

Why not create a library of frequently used subroutines (that: shuffle cards, round off numbers, accept INPUT in a special way, anything you use in lots of different programs)? Simply use high line numbers for the subroutines (50000 and up) and then use this technique to add them painlessly to your main programs. ©

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16-Bit Atari Music

Fred Tedsen

Did you know that you can improve the tuning of your Atari's notes and extend its range dramatically? Normally you can only choose between 256 notes with the ordinary SOUND command. These subroutines let you have more than 65,000 frequencies to make music that's more precise and more pleasant to hear.

As I listened to my Atari play a new song that I had entered from a magazine listing, I could hear that some of the notes were not quite right. The music extended into the third octave above middle C, and though the tune was recognizable, some of the notes were off pitch enough to make listening to the tune unpleasant. I decided that it was time for me to investigate 16-bit music. What I discovered was not only that the accuracy of the notes could be improved dramatically, but also that the effective range could be more than doubled.

How SOUND Works

Before we discuss 16-bit music, let's take a look at what is happening when we use the SOUND statement or in other words, eight-bit sound, in Atari BASIC. The following registers in the POKEY chip are used for sound generation:

AUDF1 (53760) - Audio Frequency Register 1
AUDC1 (53761) - Audio Control Register 1
AUDF2 (53762) - Audio Frequency Register 2
AUDC2 (53763) - Audio Control Register 2
AUDF3 (53764) - Audio Frequency Register 3
AUDC3 (53765) - Audio Control Register 3
AUDF4 (53766) - Audio Frequency Register 4
AUDC4 (53767) - Audio Control Register 4
AUDCTL (53768) - Audio Mode Control Register

The audio control registers are used to set volume (low order four bits) and sound content (high order bits). Thus there are 16 different volume settings and a variety of sounds available. For this discussion we are concerned only with pure tones, corresponding to SOUND x,x,10,x.

The audio frequency registers are used to control the divide by "N" circuits. These circuits use the contents of the frequency registers to divide a "clock" frequency to produce different output frequencies. Since they are one-byte registers, they are referred to as eight-bit dividers. The output frequency is determined by the formula F0=F/(2x(AUDF+1)), where F is the clock frequency and AUDF the value in the audio frequency register. With a normal clock rate of 64KHz(or more exactly 63,921 cycles per second), the frequency range is about 125Hz to 32KHz.

The effective range for music is limited to about four octaves. This is because the tuning accuracy of notes being reproduced becomes progressively worse as the frequency gets higher. Figure 1 illustrates this very clearly. It shows how far out of tune, measured in "cents," each note in the four octave range is. (A cent is 1/100th of a half-step. A sound which is 50 cents sharp or flat is exactly half-way between two notes.) Notes which are less than ten cents out of tune are usually acceptable, though two notes played together could sound bad if their combined inaccuracy is too large. For example, if you play a note which is eight cents flat followed by a higher note which is eight cents sharp, the second note will probably sound out of tune.

Tuning inaccuracy results from having a limited number of values to use as dividers. With an eight-bit divider, only 256 unique frequencies can be reproduced. The A note in the fourth octave should be 440 cycles per second. To reproduce this note on the Atari, the number 72 is used as a divider. The resulting frequency is 437.8Hz, which is 8.6 cents flat. If instead we use 71 as a divider, the output frequency is 443.9Hz. This note is 15.3 cents sharp and is obviously a poorer choice than the note using 72. The choices become more restricted as the notes get higher. For the A note in the sixth octave, for example, 17 produces a note which is 15.3 cents sharp, while 18 produces a note 78.4 cents flat (closer to G# than A).

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Fine-tuning: 16-Bit Dividers

Luckily, the Atari provides a solution to this problem: 16-bit dividers. With a 16-bit divider 65,536 different output frequencies are possible. For example, to reproduce the A in octave 6, we could use either 502 (1.8 cents flat) or 501 (1.6 cents sharp) and not be able to hear any difference. Figure 2 shows how dramatically the range and accuracy are improved.

More accurate tuning does not come without a price. Sixteen-bit dividers are obtained by combining frequency registers: AUDF1 with AUDF2, or AUDF3 with AUDF4. This gives us a choice of one 16-bit and two eight-bit voices, or two 16-bit voices. We also cannot use the SOUND statement, even for the eight-bit voices, as it will confuse our settings for 16-bit sound. As it turns out, this is not much of a problem since machine language routines to play the music are simple and have the added advantage of being faster than separate SOUND statements.

Now let's look at how 16-bit sound is set up. The audio mode control register has four bits for this purpose:

Bit 6 – Clock channel 1 with 1.79MHz instead of 64KHz

Bit 5 – Clock channel 3 with 1.79MHz

Bit 4 – Combine channels 1 and 2

Bit 3 – Combine channels 3 and 4

The other bits in AUDCTL have no bearing on this discussion, so we will ignore them. If you are curious, see chapters 2 and 3 in the *Hardware Manual*.

The 1.79MHz (1.78979 MHz, to be exact) clock rate is required to obtain the full range of output frequencies. The formula for determining output frequency is a little different: $F0 = F/(2x(AUDF + 7))$. In this case, AUDF is the two-byte frequency register value. The second register of

Note Table.

NOTE	16-BIT	8-BIT	
C	27357		OCTAVE 1
C#	25821		
D	24372		
D#	23003		
E	21712		
F	20493		
F#	19342		
G	18256		
G#	17231		
A	16264		
A#	15351		
B	14489		
C	13675		OCTAVE 2
C#	12907		
D	12182		
D#	11498		
E	10852		
F	10243		
F#	9668		
G	9125		
G#	8612		
A	8128		
A#	7672		
B	7241		
C	6834	243	OCTAVE 3
C#	6450	230	
D	6088	217	
D#	5746	204	
E	5423	193	
F	5118	182	
F#	4830	172	
G	4559	162	
G#	4303	153	
A	4061	144	
A#	3832	136	
B	3617	128	

NOTE	16-BIT	8-BIT	
C	3414	121	OCTAVE 4
C#	3222	114	
D	3040	108	
D#	2869	102	
E	2708	96	
F	2555	91	
F#	2412	85	
G	2276	81	
G#	2148	76	
A	2027	72	
A#	1913	68	
B	1805	64	
C	1703	60	OCTAVE 5
C#	1607	57	
D	1517	53	
D#	1431	50	
E	1350	47	
F	1274	45	
F#	1202	42	
G	1134	40	
G#	1070	37	
A	1010	35	
A#	953	33	
B	899	31	
C	848	30	OCTAVE 6
C#	800	28	
D	755	26	
D#	712	25	
E	672	23	
F	634	22	
F#	598	21	
G	564	19	
G#	532	18	
A	501	17	
A#	473	16	
B	446	15	

NOTE	16-BIT	8-BIT	
C	421	14	OCTAVE 7
C#	397		
D	374		
D#	353		
E	332		
F	313		
F#	295		
G	278		
G#	262		
A	247		
A#	233		
B	219		
C	207		OCTAVE 8
C#	195		
D	183		
D#	173		
E	163		
F	153		
F#	144		
G	136		
G#	128		
A	120		
A#	113		
B	106		
C	100		OCTAVE 9
C#	94		
D	88		
D#	83		
E	78		
F	73		
F#	69		
G	64		
G#	60		
A	57		
A#	53		
B	50		
C	46		OCTAVE 10

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the pair is the low order byte, either AUDF2 or AUDF4. For example, to use 1049 as a divider with registers 1 and 2, we would POKE 4 in AUDF2 and 25 in AUDF1.

The audio control register of the low order frequency register is not used and should be set to zero. Volume is controlled with the second control register only (AUDC2 or AUDC4).

16-Bit Subroutines

Now take a look at the BASIC 16-bit sound subroutines. The first plays one 16-bit and two eight-bit voices, and the second plays two 16-bit voices. Notice the SOUND 0,0,0,0 at the beginning of each routine. This statement must be included to initialize POKEY for sound. The POKE 53768,X initializes AUDCTL for 16-bit sound, either one or two voices. Remember that any SOUND statement executed later will reset this register to zero.

To use these subroutines, simply copy one or the other into your program and do a GOSUB 20100 once at the beginning of the program. Then, to play music, do the appropriate machine language call, X=USR(ADR(HF1$),N1,V1,N2,V2, N3,V3) or X=USR(ADR(HF2$),N1,V1,N2,V2). Nx is the note to be played and Vx is the volume. N1 is the 16-bit voice in the three-voice routine. You don't need to pass parameters for unused voices. For example, if you want only the 16-bit voice in the three-voice routine, you can use X=USR(ADR(HF1$),N1,V1), but to use only an eight-bit voice you would have to use X=USR (ADR(HF1$),0,0,N2,V2).

The note tables give you the most accurate values for four octaves of eight-bit and nine octaves of 16-bit notes. In a practical sense, the first octave of 16-bit notes is not usable because there are some loud harmonics which tend to mask the actual note being played. You can get some good sounds if you hook up to a stereo amplifier, however. Notice that the eight-bit value for F# in the third octave is 172 rather than 173 as shown in the *BASIC Reference Manual*. 173 produces a note which is more than 12 cents flat, while the note from 172 is only 2.4 cents flat.

Finally, some thoughts on when to use 16-bit music. If you have a piece of music which sounds fine using SOUND in BASIC, don't bother changing it – you probably won't be able to hear much improvement. I think you'll find that just about any music which extends into the fifth octave will be worth converting, however, especially if it is very complex. For three-part music, use the 16-bit voice for the highest notes. Some chord combinations may still sound slightly out of tune, in which case you might want to tune the 16-bit voice a little sharp or flat to match the eight-bit voices. The large number of divider values available gives you plenty of possibilities.

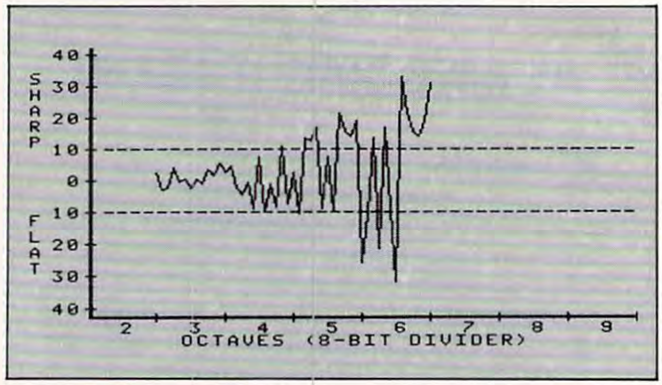

Figure 1: Tuning inaccuracy of musical notes in cents using 8-bit dividers

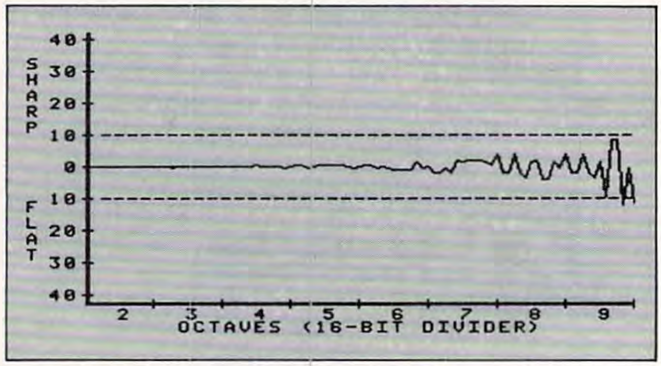

Figure 2: Tuning inaccuracy of musical notes in cents using 16-bit dividers

Program 1.

```
20000 REM 16-BIT SOUND ROUTINE 1
20010 REM
20020 REM 1 16-BIT & 2 8-BIT VOICES
20030 REM
20040 REM X=USR(ADR(HF1$),N1,V1,N2,V2
      ,N3,V3)
20050 REM
20100 SOUND 0,0,0,0:X=64+16:POKE 5376
      8,X
20110 DIM HF1$(56):RESTORE 20140
20120 FOR I=1 TO 56:READ X:HF1$(I,I)=
      CHR$(X):NEXT I
20130 RETURN
20140 DATA 104,170,104,141,2,210,104,
      141,0,210,104,104,41,15,9,160,1
      41,3,210
20150 DATA 224,2,240,32,104,104,141,4
      ,210,104,104,41,15,9,160,141,5,
      210
20160 DATA 224,4,240,14,104,104,141,6
      ,210,104,104,41,15,9,160,141,7,
      210,96
```

Program 2.

```
20000 REM 16-BIT SOUND ROUTINE 2
20010 REM
20020 REM 2 16-BIT VOICES
20030 REM
20040 REM X=USR(ADR(HF2$),N1,V1,N2,V2
      )
```

```
20050 REM
20100 SOUND 0,0,0,0:X=(64+16)+(32+8):
      POKE 53768,X
20110 DIM HF2$(41):RESTORE 20140
20120 FOR I=1 TO 41:READ X:HF2$(I,I)=
      CHR$(X):NEXT I
20130 RETURN
20140 DATA 104,170,104,141,2,210,104,
      141,0,210,104,104,41,15,9,160,1
      41,3,210
20150 DATA 224,2,240,17
20160 DATA 104,141,6,210,104,141,4,21
      0,104,104,41,15,9,160,141,7,210
      ,96
```
©

Custom Catalog

G. J. Vullings

For Apples with DOS 3.2.1 or 3.3, all memory sizes, this program lets you create customized directory headers, with inverse or normal input.

Have you ever wished to personalize your disks, identify the theme of a series of programs on a disk, or just improve the appearance of the directory as it appears on the screen after a CATALOG command? "Custom Catalog" will allow you these prerogatives and more by creating seven "bogus" files at the top of the directory. These bogus files will serve as a header to the disk's directory, displaying contents, ownership, DOS version, or whatever you wish.

The program is designed to run in either a DOS 3.2.1 or 3.3 environment. It will, additionally, permit either inverse or normal input and will allow toggling between the two input states. These features make possible directories with content and artistry.

Your Choice Of Input Types

The program should be used only with newly-initialized diskettes since it will occupy the first seven entries in the directory. Thus, if the program is used with established diskettes, the first seven programs will become inaccessible. To implement Custom Catalog, initialize a diskette the normal way and then delete the "HELLO" program. Run Custom Catalog and, when prompted, insert the diskette to be customized.

You have an initial choice of input states (normal or inverse) and may then design seven lines of 23 characters each (any except for control characters) to represent your identifying remarks or messages. The program sets aside a buffer of 256 bytes in high memory, using the input/output block at decimal location 896. There it stores the last sector of the directory track, which is normally track 17, sector 12 or sector 15, depending on the DOS version.

Each directory entry occupies 35 bytes. The first two represent the track and sector of the track/sector list (header). These we will direct towards an empty sector, namely track 17 (in most cases), sector one. The third byte represents the file type. Here we will use "00" to indicate an unlocked text file. The next 30 bytes represent the file name. We will make the first seven bytes backspaces to eliminate the "t" (for text) and the sector count from the display. The remaining 23 bytes may be anything of your choosing (normal or inverse). The 34th byte is the file length. This we set to "00" and the last byte is the end marker, which is also normally "00".

We now alter the entries in the buffer, but one problem remains. The output for the directory listing is via the COUT routine at $FDED using screen ASCII values, but keyboard ASCII values which we entered are in a different range. We can translate these values listing logical variables (one of the least used, yet very powerful, variable types). See page 15 of the *Apple Reference Manual* for screen ASCII values for both normal and inverse display. After altering the buffer, the revised version is written back to the disk.

Using a similar technique, track 2, sector 2 is then read into the buffer and the DISK VOLUME message which occupies the 176th to 186th bytes, inclusive, may be optionally changed.

A typical directory header might look like the following example:

```
&&&&&&&&&&&&&&&&&&&&&&&
& APPLE II - DOS 3.3  &
&   DISK UTILITIES    &
&    JANUARY 1983     &
&PROP. OF G.J.VULLINGS&
&&&&&&&&&&&&&&&&&&&&&&&
```

The above looks especially attractive in inverse mode. A hint: if the seventh line is left blank, a natural break is formed to separate the header from the rest of the directory.

Both backspace and forwardspace editing are implemented and work normally, with a few enhancements (because of the two modes of input). The only exception to normal implementation is that you cannot backspace beyond the first column (column numbers are provided to make centering easier). Therefore, pressing "RETURN" or typing past column 23 is final.

After the seventh line is entered, you are given the choice of accepting or rejecting the header that you have constructed. If you reject it, the procedure will begin again. Rejecting headers will give practice in obtaining a result which is aesthetically pleasing. If, on the other hand, you accept the header, it will be permanently written to the disk. The choice will then be offered to change the DISK VOLUME message to any 11 (or fewer) characters of your choice.

You can create additional custom entries using the method in this program, or you might want flashing entries, which you can get by translating to the required ASCII values. Have fun experimenting, and happy customizing.

How It Works

LINES

30-220 – the input routine, which allows input in two modes as well as forwardspace and backspace editing.

250-260 – translate keyboard ASCII into screen ASCII and store into disk buffer.

280-290 – toggle input status.

310-330 – backspace edit routine.

350-390 – forwardspace edit routine. Translate screen ASCII to keyboard ASCII.

410-450 – point each of the "bogus" header files to empty track 17, sector 1; declare each file to be of type "text-unlocked" of length zero; and set the end marker.

470 – inputs a series of seven backspaces into the filenames so that the lock indicator, file type, and sector count do not appear on screen.

480 – checks the memory size of your Apple and sets up a disk buffer, making the program virtually memory-size independent.

500-570 – organize screen display.

590-620 – set HIMEM: to protect the buffer and also initialize the variables.

640-670 – use track 17, sector 0, to find the directory, thus making it possible to use the program with either DOS 3.2.1 or 3.3, or even with disks having directories on tracks other than track 17.

680-800 – main routine.

820-840 – write the catalog header to the disk.

860-920 – change DISK VOLUME message.

940-990 – finishing touches.

1020-1040 – set up the input/output block for the Read Write Track Sector routine.

```
5  TEXT : HOME : ONERR  GOTO 1000
10  GOTO 480
20  REM   ***.INPUT ROUTINE.***
30  FOR I = 0 TO 6
40  VTAB VTB + I: HTAB HTB
50 CN = 1
60  INVERSE
70  IF  NOT INV THEN  NORMAL
80  GET CH$: IF CH$ <  > CHR$ (13) THEN 110

90  IF CN > 23 THEN 200
100  FOR Z = CN TO 23:CH$ = " ": PRINT CH$;:
     GOSUB 250:CN = CN + 1: NEXT : GOTO 200

110  IF CH$ =  CHR$ (27) THEN  GOSUB 270: GOTO
     60
120  IF CH$ =  CHR$ (8) THEN  GOSUB 300: GOTO
     60
130  IF CN > 23 THEN 200
140  IF CH$ =  CHR$ (21) THEN  GOSUB 340: GOTO
     160
150  IF  ASC (CH$) < 32 THEN 60
160  PRINT CH$;
170  GOSUB 250
180 CN = CN + 1
190  GOTO 60
200  GOSUB 460
210  GOSUB 400
220  NEXT
230  RETURN
240  REM   ***.SCRN ASC INTO BUFFER.***
250  IF  ASC (CH$) >  = 32 AND  ASC (CH$) <
     64 THEN  POKE BFR + I * 35 + 10 + CN, ASC
     (CH$) + ( NOT INV > 0) * 128: RETURN
260  POKE BFR + I * 35 + 10 + CN, ASC (CH$) -
     (INV > 0) * 64 + ( NOT INV > 0) * 128: RETURN
270  REM   ***.CHANGE INPUT STATE.***
280  IF INV THEN INV = 0: RETURN
290 INV = 1: RETURN
300  REM   ***.BACKSPACE ROUTINE.***
310 CN = CN - 1: IF CN = 0 THEN  POP : GOTO
    50
320  PRINT CH$;
330  RETURN
340  REM   ***.FORWARD SPACE ROUTINE.***
350 ASKII =  PEEK ( PEEK (40) + 256 *  PEEK
    (41) +  PEEK (36))
360  IF ASKII < 32 THEN CH$ =  CHR$ (ASKII +
     64): RETURN
370  IF ASKII < 64 THEN CH$ =  CHR$ (ASKII):
     RETURN
390 CH$ =  CHR$ (ASKII - 128): RETURN
400  REM   ***.PLACE COMMON POINTERS.***

410  POKE BFR + I * 35 + 1,TRK
420  POKE BFR + I * 35 + 2,1
430  POKE BFR + I * 35 + 3,0
440  POKE BFR + I * 35 + 34,0
450  POKE BFR + I * 35 + 35,0: RETURN
460  REM   ***.PUT BKSPACES IN DIRECTORY.***

470  FOR M = 4 TO 10: POKE BFR + I * 35 + M,
     136: NEXT : RETURN
475  REM   ***.SET DISK BUFFER.***
480 BL =  PEEK (115):BH =  PEEK (116) - 1:BU
    FR = BL + BH * 256
490  REM    ***.INITIALIZE SCREEN.***
500  TEXT : HOME : VTAB 2: INVERSE : FOR I =
     1 TO 40: PRINT "=";: NEXT
510  PRINT "=        APPLE II CATALOG CUSTOMIZ
     ER      =";
520  PRINT "=";
530  FOR I = 1 TO 38: PRINT " ";: NEXT
540  PRINT "=";
550  PRINT "=                  ";: NORMAL : PRINT
     "BY G.J. VULLINGS";: INVERSE : PRINT "
       =";
560  FOR I = 1 TO 40: PRINT "=";: NEXT : NORMAL

570  POKE 34,6
580  REM   ***.INITIALIZE VARIABLES.***
590  HIMEM: BUFR:IOB = 904:ITRK = IOB + 4:IS
     ECT = IOB + 5:IBUFP = IOB + 8:ICMD = IO
     B + 12:ST = IOB + 13:RWTS = 896:D$ =  CHR$
     (13) +  CHR$ (4):RD = 1:WRT = 2:BFR = B
     UFR + 10
600  GOSUB 1020: POKE IBUFP,BL: POKE IBUFP +
     1,BH
610  HOME : VTAB 20: PRINT "INSERT DISK TO B
     E CUSTOMIZED"
620  VTAB 22: PRINT "THEN PRESS ";: INVERSE
     : PRINT " RETURN ";: NORMAL : GET Z$: PRINT
     Z$
630  REM   ***.READ CATALOG INTO BUFFER.***

640 TRK = 17:SECTR = 0
650  POKE ITRK,TRK: POKE ISECT,SECTR: POKE I
     CMD,RD: CALL RWTS
660 TRK =  PEEK (BUFR + 1):SECTR =  PEEK (BU
    FR + 2)
670  POKE ITRK,TRK: POKE ISECT,SECTR: CALL R
     WTS
```

```
675  REM    ***.MAIN ROUTINE.***
680  HOME : VTAB 20: PRINT "(I)NVERSE OR (N)
     ORMAL ";: GET A$: PRINT A$:VTB = 12:HTB
      = 8
690 INV = 0
700  IF A$ = "I" THEN INV = 1
710 Z1$ = "0000000001111111112222"
720 Z2$ = "12345678901234567890123"
730  VTAB 10: HTAB HTB: PRINT Z1$: HTAB HTB:
      PRINT Z2$
740 TB = 12: FOR Z = 0 TO 6
750  VTAB TB + Z: HTAB 7: PRINT "+";: IF INV
      THEN  INVERSE
760  FOR J = 1 TO 23: PRINT " ";: NEXT : NORMAL
      : PRINT "+"
770  NEXT
780  VTAB 20: CALL  - 958: HTAB 5: PRINT "IN
     PUT LINES OF CUSTOM CATALOG"
790  VTAB 22: PRINT " PRESS ";: INVERSE : PRINT
      " ESC ";: NORMAL : PRINT " TO CHANGE DI
     SPLAY STATUS"
800  GOSUB 30: NORMAL
810  REM    ***.WRITE SECTOR TO DISK.***
820  PRINT : VTAB 20: CALL  - 958: PRINT "IS
      THIS WHAT YOU WANT? (Y/N) ";: GET ZZ$:
      PRINT ZZ$
830  IF ZZ$ = "N" THEN 680
840  POKE ICMD,WR: CALL RWTS
850  REM    ***.CHANGE DISK VOLUME.***
860  PRINT : PRINT "IS ";: INVERSE : PRINT "
      DISK VOLUME ";:: NORMAL : PRINT " TO B
     E REPLACED? (Y/N) ";: GET Z$: PRINT Z$
870  IF Z$ <  > "Y" THEN 930
880 TRK = 2:SECTR = 2: POKE ITRK,TRK: POKE I
     SECT,SECTR: POKE ICMD,RD: CALL RWTS
890  INPUT "INPUT 11 CHARACTER HEADER: ";MS$
     :LN =  LEN (MS$): IF LN >  = 11 THEN MS
     $ =  LEFT$ (MS$,11): GOTO 910
900  FOR I = LN + 1 TO 11:MS$ = MS$ + " ": NEXT
910 J = 0: FOR I = BUFR + 176 TO BUFR + 186:
      POKE I, ASC ( MID$ (MS$,11 - J,1)) + 1
     28:J = J + 1: NEXT
920  POKE ICMD,WR: CALL RWTS
930  REM    ***.DISPLAY CATALOG AND FINISH.**
     *
940  HOME : PRINT D$"CATALOGD1"
950  PRINT : PRINT "MORE CUSTOMIZING? (Y/N)
     ";: GET ZZ$: PRINT ZZ$
960  IF ZZ$ = "Y" THEN 610
970  TEXT : HOME : VTAB 10: HTAB 11: FLASH :
      PRINT " SEE YA' LATER!! ": NORMAL
980  VTAB 23: END
990  RETURN
1000  HOME : PRINT "***.ERROR.***": END
1010  REM  ***.SET-UP IOB.***
1020  FOR I = 1 TO 25: READ I%: POKE 896 + I
      - 1,I%: NEXT I: RETURN
1030  DATA  160,136,169,3,32,181,183,96,1,96
     ,1,0,17,15,251,183,0,128,0,0
1040  DATA  2,2,254,96,1,59,236,236,59,59,23
     6,236,59,27,236,28,29,30,236,236
```

©

VIC Tracing Disassembler

Peter Busby

Here's a handy tool to let you look at machine language programs – those in your VIC BASIC ROM chips, programs you've typed in from **COMPUTE!**, *or some you've written yourself. If you don't know machine language, seeing it and watching how fast it executes might tempt you to learn more about it.*

This article also describes how to adapt a special cassette technique to the VIC.

What is a disassembler? It is a program which looks at the machine code in memory, RAM or ROM, and prints the hexadecimal and decimal values or, more importantly, translates the hex code into 6502 mnemonics. These abbreviated words describe what the microprocessor is doing at that point in the machine language program being disassembled.

Why use a disassembler? Suppose you have Louis Sander's article on PET tape header machine language programs (**COMPUTE!**, July 1981, #14), which you wish to utilize with your computer. You would use the disassembler to discover how your computer handles tape headers and SAVEs. Hardly a week passes that I do not spend some time exploring the operating system.

The addressing modes are:

#	– Immediate
Z	– Zero Page
-A	– Accumulator
(X)	– Indexed Indirect
(Y)	– Indirect Indexed
Z,X / **Z,Y**	– Zero Page Indexed
,X / **,Y**	– Absolute Indexed
(I)	– Indirect

No mode indicated represents either Absolute Addressing or an implied or relative operation. The addresses are shown first in hexadecimal, then in decimal, notation.

When disassembling, it is often convenient to jot down the mnemonics and assign descriptive labels to the branch targets and subroutine locations. At first these will be no more than "A", "B", etc.; but, as the purpose of each part becomes clear, the names evolve to "CHRGET", "SCNKEY", etc. Those of you with printers may wish to add a subroutine to print to hard copy.

As you work through a program, you may occasionally find "ILLEGAL" opcodes or perhaps misleading ones, particularly between subroutines. You have to follow the logic of the routines so that these traps do not prevent easy decoding. There may also be bytes of data interspersed with the program.

No one minds if you look at and disassemble a routine in order to decipher its workings and access points. If you discover that the routine you need is at $E165, by all means have your program go SYS 57701 and use the routine. On the other hand, you may not distribute any portion of copyrighted material, even with the (variable) names changed, without written permission. This program is intended only to explore the workings of your computer or to verify the assembly of your own programs.

Here's how to adapt the tape header machine language program ("MLP") routine to the VIC-20. Develop your MLP according to the precepts in Louis Sander's article. Prepare to load the program whose header you are using; place its title somewhere in RAM above the program (I use $333F on), and follow it immediately with the MLP. Generally, the title would be 16 characters and blanks and the MLP up to 171 bytes. With your monitor, display the six registers starting at $00B7 and place these values:

$ 00B7 – length of MLP + 16 for the title
00B8 – 0
00B9 – 0
00BA – 1
00BB / **00BC** } **– address of first byte of title, low byte first (e.g., 00BB - 3F;00BC - 33)**

Now enter .G E156. Presto! Your program title and MLP, when LOADed, will start at $033F.

The VIC Disassembler will handle more than 10 subroutine levels with two adjustments that, however, do use extra memory: at the end of Line 520 may be added:

:DIM RE(99)

or however many you desire; also place this figure inside the parentheses in Line 280:

(SR<99)

or whatever.

```
10 PRINT"{CLEAR}  6502 DISASSEMBLER"
20 GOSUB520
30 PRINT:PRINTSE$"ELP   "RIGHT$(STR$(SR),2
   );:GOSUB70
40 GOSUB80:FORI=1TO12:IFA$<>MID$(SE$,I,1)
   THENNEXT:GOTO40
50 PRINT"                    ";:GOSUB70
60 MODE$="    ":LI=PA:ONIGOSUB220,220,200,
   630,210,180,580,999,170,190,220,6
   00:GOTO30
70 FORJ=0TO18:PRINTCHR$(157);:NEXT:RETURN
   :REM CURSOR LEFT'S - APPLE USE CH
   R$(8)
80 POKE198,0:WAIT198,1:GETA$:RETURN:REM A
```

```
   PPLE USE GETA$:ON-(A$="")GOTO8Ø:R
   ETURN
90 J=3+2*(A<LI):K=16
100 A%=A+HI*(A>H):AD$="":FORI=ØTOJ:AD$=AD$
    +MID$(H$,(A%/K↑(J-I)AND(K-1))+1,1
    ):NEXT:RETURN
110 AD=Ø:FORL=1TOR:GOSUB26Ø:A=PEEK(X):AD=A
    D+A*PA↑(L-1):GOSUB9Ø:MN$=AD$+LEFT
    $(MN$,2):NEXT
120 RETURN
130 J=1Ø:A=Ø:K=A:L=5
140 GOSUB8Ø:IFK=ØTHENIFA$="$"ORA$="%"THENP
    RINTA$;:K=1:J=16:IFA$="%"THENJ=2:
    L=9
150 ON-(A$=CHR$(13))GOTO12Ø:FORI=1TOJ:IFA$
    <>MID$(H$,I,1)THENNEXT:GOTO14Ø
160 PRINTA$;:A=A*J+I-1:K=K+1:ON-(K<L)GOTO1
    4Ø:RETURN
170 GOSUB29Ø:X=Y-3:GOTO22Ø
180 R=-1:X=Z:GOTO22Ø
190 Y=BR:FL=Ø:IFR=-1THENX=X+2*(X>1):GOTO22
    Ø
200 IFFLAG<4THENONFLGOSUB27Ø,28Ø,29Ø:Z=Y
210 X=Z:R=Ø
220 Z=X:A=X:LIMIT=Ø:GOSUB9Ø:LI=PA:PRINTAD$
    " ";:A=PEEK(X):IFR>-1THENGOSUB3ØØ
230 IFR=-1THENGOSUB9Ø:PRINTAD$;A;IL$;:GOTO
    26Ø
240 PRINTMN$;MO$" ";IL$;:MN$="    "
245 IF FL=1 THEN GOSUB 11Ø:LI=Ø:A=Y:GOSUB ~
    9Ø:LI=PA:PRINT MN$" "AD$;:GOTO 26
    Ø
250 IFRTHENGOSUB11Ø:PRINTBS$(R);MN$;AD;BS$
    (R);
260 IL$="":X=X-(X<HI-1):RETURN
270 BRANCH=X-2:RETURN
280 SRTN=SR-(SR<1Ø):RETURN
290 SR=SR+(SR>Ø):Y=RE(SR):RETURN
300 R=Ø:FL=4:ONAAND3GOTO43Ø,45Ø,46Ø:ONFNA(
    4)GOTO37Ø:MN$=MID$(ZE$,(AAND248)/
    8*3+1,3)
310 IF(AAND31)=16THENR=1:Y=PEEK(X+1):Y=X+2
    +Y-2*(YAND128):FL=1
320 ON-((AAND31)>Ø)GOTO12Ø:ONFNA(128)GOTO3
    4Ø:ONFNA(32)GOTO35Ø
330 IL$="             END OF ROUTINE":RETUR
    N
340 ON-(A=128)GOTO46Ø:R=1:MO$=" # ":RETURN
350 ONFNA(64)GOTO36Ø:R=2:Y=FNX(Ø):RE(SR)=X
    +3:FL=2:RETURN
360 FL=3:ON-(SR=Ø)GOTO33Ø:RETURN
370 ONFNA(128)GOTO41Ø:IF(AAND247)=36THENMN
    $="BIT":GOTO42Ø
380 ON-((AAND223)<>76)GOTO46Ø:R=2:FL=Ø:MN$
    ="JMP":Y=FNX(Ø)
390 IFA=1Ø8THENMO$="(I)":Y=PEEK(Y)+PEEK(Y+
    1)*PA
400 RETURN
410 MN$=MID$(ZE$,(AAND224)/8*3+1,3):IF(AAN
    D8Ø)=8ØORA=156THEN46Ø
420 MO$=MID$(MD$,(AAND28)/4*3+1,3):R=1-((A
    AND31)=25)-((AAND15)>11):RETURN
430 GOSUB42Ø
440 MN$=MID$(OP$(AAND3),(AAND224)/32*3+1,3
    ):ON-(A=137)GOTO46Ø:RETURN
450 ONFNA(4)GOTO5ØØ:ONFNA(8)GOTO47Ø:MO$=" ~
    # ":R=1:IFA=162THEN44Ø
460 R=-1:IL$="ILLEGAL":RETURN
470 ONFNA(16)GOTO49Ø:ONFNA(128)GOTO48Ø:MO$
    ="-A ":GOTO44Ø
480 MN$=MID$(TW$,(AAND96)/32*3+1,3):RETURN
490 ON-((AAND2Ø8)<>144)GOTO46Ø:MN$="TSX":O
    NFNA(32)GOTO12Ø:MN$="TXS":RETURN
500 GOSUB43Ø:ON-((AAND2Ø8)<>144)GOTO12Ø:ON
    FNA(8)GOTO51Ø:MO$="Z,Y":RETURN
510 ON-(A=158)GOTO46Ø:MO$=",Y ":RETURN
520 H$="Ø123456789ABCDEF":SELECT$=" ABCDEN
    QRU H"
530 ZERO$="BRKPHPBPLCLCJSRPLPBMISECRTIPHAB
    VCCLIRTSPLABVSSEI"
540 ZE$=ZE$+"STYDEYBCCTYALDYTAYBCSCLVCPYIN
    YBNECLDCPXINXBEQSED"
550 OP$(1)="ORAANDEORADCSTALDACMPSBC":OP$(
    2)="ASLROLLSRRORSTXLDXDECINC"
560 MD$="(X) Z  #    (Y)Z,X,Y ,X ":TWO$="T
    XATAXDEXNOP":BS$(2)=CHR$(157):REM
     CURSOR LEFT
570 HI=65536:H=32767:PAGE=256:DEFFNX(A)=PE
    EK(X+1)+PEEK(X+2)*PA:DEFFNA(B)=(A
    ANDB)/B
580 PRINT"ENTER STARTING ADDRESS (PREFIX '
    $' FOR HEX)":GOSUB13Ø
590 X=A*-(A<HI):Z=X:BR=X:RE(Ø)=X+3
600 PRINT:PRINT" A-DVANCE ONE STEP    B-R
    ANCH/GO SUBROUTINE C-ONVERT BASES
610 PRINT" D-ISASSEMBLE CODES    E-XAMINE ~
    ADDRESSES     N-EW START ADDRESS   ~
      Q-UIT
620 PRINT" R-ETURN SUBROUTINE    U-NBRANCH
    /BACKSTEP UP  (SUBROUTINE LEVEL)"
    :RETURN
630 PRINT"ENTER NUMBER (PREFIX  '$'=HEX, '
    %'=BINARY)":GOSUB13Ø
640 PRINT:IFA>HI-1THENPRINT"OUT OF RANGE";
    :RETURN
650 GOSUB9Ø:IFA>255THENPRINT"$"AD$;A;:RETU
    RN
660 PRINT"$"AD$" %";:K=2:J=7:GOSUB1ØØ:PRIN
    TAD$;A;:RETURN
999 END
```

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ZX-81/TS-1000 Data Management

George W Miller

The user of the Timex-Sinclair computer can *store and work with data files, even though some commands for handling data are missing. This program can be easily adapted for other kinds of data management too.*

There are no commands for DATA, READ, RESTORE, RIGHT$, LEFT$, and MID$ in Sinclair BASIC. However, there are ways of getting around this lack of data management commands.

The easiest way to store data is in string arrays, using a FOR/NEXT loop to load the array, and using substrings to retrieve the information.

The program here is a file of addresses, but you could use the same method to keep track of membership rosters, records for an amateur radio station, a reference index for keeping track of interesting magazine articles or recipes. I do all these things with it.

The data is saved on tape by the SAVE command and is loaded into the computer for use. However, you don't start the program with RUN.

The RUN command clears all variables, so all that's left is a program with no data. If you do forget and hit RUN, you'll have to stop and reload your program from the tape.

Handy Address File

The "Addfile" program is set up to store 100 names, addresses, and phone numbers, and to search for information by either name or city.

If you have a printer, just add another function, LPRINT, and the appropriate subroutine, and you can have a printout of any addresses you desire.

Type the program into RAM. Try using inverse video on some of the headings to dress up your program a bit.

Notice lines 10-17, the dimension statements. Line 13 sets up an array named N$ which is a two-dimensional array with 100 subscripts for N$, each 30 characters in length. Or you may find it easier to visualize as a block 100 lines long and 30 characters wide in which information can be stored.

In lines 40-46, I'm just being fancy. The Timex-Sinclair Computer can look for headings to execute commands as well as looking the more common way, by checking line numbers.

CHANGE=500 is setting up a change for later; the correction sub-program begins at line 500. Likewise for ENTER=1000, LIST=1500, and SEARCH=2000.

In typing in my program menu, I used inverse letters for my commands. Note that for the stop in line 63, the shifted A is not spelled out.

In the SEARCH routine, we are using substrings to compare the characters stored in the file to the information supplied from the keyboard.

If you don't enter the FAST command, the program will run very slowly as the computer searches sequentially through its memory for the information.

After typing in the program, you're ready to RUN it; this is the *only* time you'll use the command RUN, unless you want to clear the variables to start a new file.

After entering RUN, the computer sets aside space in RAM for the variables, and will initialize the FOR/NEXT loops.

The screen will display the title block, then go to the menu. Enter "E" to go into the Entry Mode.

The program will display the last number used; this number is stored in memory for use in the change mode.

Caution: Narrow String Arrays

Follow the program prompts to enter data into the string arrays. Note that the strings for name and address are only 30 characters wide, so some abbreviation may be necessary. Any extra characters entered will be ignored.

The array for the phone number is 12 characters wide, so an area code can be included.

Zip code, Z$, is only five characters wide. If the postal service goes to the expanded zip code, you'll have to re-dimension this array to store the extra digits.

In line 1115, the computer will ask if you want to make another entry. By answering "N", you will exit the loop, but the number is stored in line 47 by allowing N=L.

Whenever you return to the Entry Mode, the program will pick up at the number where you stopped and then continue to number 100, when the "memory full" message will be displayed.

After entering "Y", you will drop to line 1140, and go back to the start of the loop.

If you notice an error in your data, complete the entry of information called for in the prompts by entering anything; then, when asked for another entry, enter "N". The screen will clear, and the program menu will be displayed.

Enter "C" and go into the Change Mode, which begins with line 500.

The display will ask for the number to change and, after receiving the number, will display the data on file at the top of the screen. Follow the instructions from the computer to reenter your data. Note that you will have to enter all the information for that entry.

After you complete the corrections, the screen will clear, and the menu will be displayed.

Choose Any Function

Now, you can enter "E" and continue making entries to your file, or enter any other function displayed on the menu.

If you'd like to scan your file, enter "L" for list. Be careful – this is the letter "L", not the function list. If you're like me, you'll want to keep entering the function "LIST", which will print as a "K"; the computer will ignore this error and ask for another command.

The screen will now begin to scroll up, displaying the contents of your file. After printing the last data in the file, the display will pause several seconds, and then the display will begin to scroll off, one line at a time. This is annoying, but I couldn't find any way around it after scrolling a long list.

After the screen is cleared, the display will go blank for several seconds, then return to the program menu.

Here's the most interesting feature of the program. Enter "S" to start the Search Mode.

The computer will ask if you'd like to search for a name or for all the names in a given city.

If you're looking for an address, enter the appropriate command from the prompts.

Make sure the spelling is correct. It may be necessary to try several variations if you're not sure of the spelling because the computer will only give you the information stored in the memory if there is a perfect match. For instance, if the name you're looking for is "John Smith" and the computer has "Mr. and Mrs. John R. Smith" stored in memory, the display will indicate "Name Not Found".

City-Wide Search

If you want a listing of all the names and addresses in your file from a given area, enter the CITY SEARCH command, and the computer will print a list of all names in memory in that city.

Again, the list must be exact for the computer to print it, so be consistent with your entries. Don't list Penna. one time and Pa. the next.

If there are more names and addresses than can be displayed on the screen, the program will fill the screen and return the error code 55/2041. After using the displayed information, enter CONT to clear the screen and continue with the listing of data from the memory.

By using subscripts in the arrays, the computer is comparing each character in the key arrays to find the matches. This is why you must be very careful with the data you input to get anything useful in output. If the program fails to run properly, check your input.

In the search mode, the command PAUSE 30000 is used. This holds the display for about nine minutes to give you a chance to use the displayed data. Since you will seldom need nine minutes, just press ENTER when you're finished, and the program menu will be displayed.

After working on your file, return to the program menu, and enter the function STOP (shifted A). The cursor will disappear and an error message will be displayed to indicate a break in the program.

All the data you entered is now stored in the string arrays. Enter LIST, get a display of the program listing, and SAVE in the usual manner; enter SAVE "ADDFILE".

This program takes about seven minutes to LOAD or SAVE, so don't be concerned about the time the screen is flickering.

It is probably worthwhile to save the program twice, for insurance against missing bytes. If the first program fails to load, the second follows immediately; the computer will pick it up.

Then use your file, LOADing in the normal way. However, after getting the 0/0 report, enter LIST, or just GOTO 35. This keeps all your data stored in the variables. If you pressed RUN and ENTER, you'll have to reload the tape to retrieve your data. From the program listing, enter GOTO 35 as shown in line 8.

If you'd like to make changes in the program for other uses, just change the title in the title subroutine to one more appropriate, and change the PRINT statements in the program prompts.

If your file is filled and you need to start a second file, just load the program into RAM, enter RUN to clear the variables, and start a new file, holding your old file on the cassette tape. Change the title blocks to indicate that two files exist, and remember that the information you don't have in one file may exist in the other.

Note: All underlined characters should be entered in *inverse video.*

```
1 REM "ADDFILE"
5 REM  START PROGRAM BY ENTERING GOTO 35
10 DIM L(1)
11 DIM S$(1,30)
12 DIM T$(1,30)
13 DIM N$(100,30)
14 DIM A$(100,30)
15 DIM C$(100,25)
16 DIM P$(100,12)
17 DIM Z$(100,5)
25 LET L=0
30 LET N=0
35 GOTO 5000
40 LET CHANGE=500
42 LET ENTER=1000
44 LET LIST=1500
46 LET SEARCH=2000
```

```
47 LET N=L
49 CLS
5Ø PRINT AT Ø,1Ø;":FUNCTION:"
52 PRINT
54 PRINT TAB 5;"ENTER C FOR CHANGE MODE"
55 PRINT
56 PRINT TAB 5;"ENTER E FOR ENTRY MODE"
57 PRINT
59 PRINT TAB 5;"ENTER L FOR LIST MODE"
6Ø PRINT
61 PRINT TAB 5;"ENTER S FOR SEARCH MODE"
62 PRINT
63 PRINT TAB 5;"ENTER STOP...TO STOP"
65 INPUT B$
67 IF B$="C" THEN GOTO CHANGE
68 IF B$="E" THEN GOTO ENTER
69 IF B$="L" THEN GOTO LIST
7Ø IF B$="S" THEN GOTO SEARCH
71 IF B$=" STOP " THEN STOP
75 GOTO 49
113 PRINT
5ØØ CLS
51Ø PRINT AT Ø,12;"CHANGE MODE"
512 PRINT
513 PRINT TAB 5;"ENTER NUMBER TO CHANGE
514 INPUT C
515 CLS
516 PRINT N$(C,1 TO 3Ø)
517 PRINT A$(C,1 TO 3Ø)
518 PRINT C$(C,1 TO 3Ø)
519 PRINT Z$(C,1 TO 5)
52Ø PRINT P$(C,1 TO 12)
524 PRINT AT 1Ø,5;"ENTER CORRECT NAME"
525 INPUT Y$
53Ø LET N$(C,1 TO 3Ø)=Y$
535 PRINT AT 1Ø,5;"ENTER CORRECT ADDRESS"
54Ø INPUT H$
545 LET A$(C,1 TO 3Ø)=H$
55Ø PRINT AT 1Ø,5;"ENTER CORRECT CITY"
555 INPUT G$
56Ø LET C$(C,1 TO 25)=G$
562 PRINT AT 1Ø,5;"ENTER CORRECT ZIP CODE"
563 INPUT Z$(C)
564 PRINT AT 1Ø,5;"ENTER CORRECT PHONE NUMBER"
565 INPUT P$(C)
57Ø GOTO 49
1ØØØ CLS
1Ø1Ø FOR X=N+1 TO 1ØØ
1Ø15 IF X=1ØØ THEN GOTO 1142
1Ø2Ø LET L=X
1Ø3Ø CLS
1Ø4Ø PRINT AT Ø,1Ø;"    ENTRY MODE "
1Ø5Ø PRINT AT 2,1Ø;"LAST ENTRY WAS : ";X-1
1Ø52 PRINT
1Ø55 PRINT "ENTER NAME"
1Ø6Ø INPUT N$(X)
1Ø7Ø PRINT
1Ø75 PRINT "ENTER ADDRESS"
1Ø8Ø INPUT A$(X)
1Ø9Ø PRINT
1Ø95 PRINT "ENTER CITY"
11ØØ INPUT C$(X)
11Ø5 PRINT
11Ø7 PRINT "ENTER ZIP CODE"
11Ø8 INPUT Z$(X)
11Ø9 PRINT
111Ø PRINT "ENTER PHONE NUMBER"
1111 INPUT P$(X)
1112 PRINT
1115 PRINT "ANOTHER ENTRY?? (Y/N)"
113Ø INPUT F$
1138 IF F$<>"Y" THEN GOTO 47
114Ø NEXT X
1142 PRINT
1145 PRINT "          LIST FILLED"
1147 PAUSE 2ØØ
115Ø GOTO 47
15ØØ CLS
15Ø5 PRINT AT 2Ø,12;"LIST MODE"
151Ø FOR V=1 TO L
1515 SCROLL
152Ø PRINT N$(V);V
1521 SCROLL
1522 PRINT A$(V)
1523 SCROLL
1524 PRINT C$(V)
1525 SCROLL
1526 PRINT Z$(V)
1527 SCROLL
1528 PRINT P$(V)
1529 SCROLL
153Ø PRINT
1532 NEXT V
154Ø PAUSE 2ØØ
155Ø GOTO 49
2ØØØ CLS
2Ø2Ø PRINT AT Ø,12;"SEARCH MODE"
2Ø21 PRINT
2Ø22 PRINT "SEARCH NAME(N) OR CITY(C)??"
2Ø23 INPUT V$
2Ø33 FAST
2Ø34 IF V$="N" THEN GOTO 2Ø5Ø
2Ø36 PRINT "ENTER CITY AND STATE"
2Ø37 PRINT "NOTE: SPELLING MUST BE EXACT"
2Ø38 INPUT T$(1,1 TO 25)
2Ø39 FOR S=1 TO L
2Ø4Ø IF C$(S, 1 TO 25)=T$(1,1 TO 25) THEN GOTO ~
     216Ø
2Ø41 NEXT S
2Ø42 SLOW
2Ø43 PRINT TAB 5;"      END OF LIST"
2Ø44 PAUSE 3ØØØØ
2Ø45 GOTO 47
2Ø47 PRINT
2Ø5Ø PRINT "ENTER NAME FOR SEARCH"
2Ø55 PRINT
2Ø6Ø INPUT S$(1,1TO 3Ø)
2Ø62 FAST
2Ø63 FOR S=1 TO L
2Ø65 IF N$(S,1 TO 3Ø)=S$(1,1 TO 3Ø THEN GOTO 21
2Ø7Ø NEXT S
21ØØ PRINT
211Ø PRINT       ; "NAME NOT FOUND"
2115 PAUSE 3ØØØØ
2117 SLOW
212Ø GOTO 47
214Ø PRINT N$(S)
2141 PRINT A$(S)
2142 PRINT C$(S)
2143 PRINT Z$(S)
2144 PRINT P$(S)
2145 SLOW
2146 PAUSE 3ØØØØ
215Ø GOTO 47
216Ø PRINT N$(S)
2161 PRINT A$(S)
2162 PRINT C$(S)
2163 PRINT Z$(S)
2164 PRINT P$(S)
2165 GOTO 2Ø41
5ØØØ PRINT "**********************************"
5ØØ5 PRINT "*                                *"
5ØØ6 PRINT "*                                *"
5ØØ7 PRINT "*                                *"
5ØØ8 PRINT "*                                *"
5ØØ9 PRINT "*                                *"
5Ø1Ø PRINT "*                                *"
5Ø11 PRINT "*                                *"
5Ø12 PRINT "**********************************"
5Ø13 REM FILE NAME
5Ø15 PRINT AT 4,5;"    ADDRESS FILE"
5Ø2Ø PAUSE 3ØØ
5Ø21 CLS
5Ø22 PRINT "THIS PROGRAM WILL STORE UP TO"
5Ø23 PRINT
5Ø24 PRINT "1ØØ NAMES, ADDRESSES AND PHONE"
5Ø25 PRINT
5Ø26 PRINT "NUMBERS, AND WILL SEARCH BY NAME"
5Ø27 PRINT
5Ø28 PRINT "OR CITY"
5Ø29 PAUSE 5ØØ
5Ø3Ø GOTO 38
```

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Managing Memory: VIC And Atari

Charles Brannon, Editorial Assistant

Properly handling and allocating memory can be quite a challenge. This article, for the VIC and Atari, reveals some of the tricks used to successfully manage your computer's memory.

Programmers often wrangle with limitations and possibilities involving their computer's memory. For one thing, there never seems to be enough of it. If you have a 48K machine, you may never come close to filling it with a BASIC program. But when you start allocating RAM for graphics, or use your 48K for VisiCalc or a word processor, you need all you can get, and then some.

Where Did It Go?

A confusing problem is the discrepancy between memory installed and what you get from PRINT FRE(0). The 5K VIC has 3583 bytes free; the 48K Atari has less than 38K available for BASIC (this varies if you use DOS, or if the RS-232 handler is installed). Where did the missing memory go?

You've probably heard of the *operating system* (OS). It is a series of machine language programs in your computer's ROM that handle such mundane but vital functions as keyboard input, screen display, cassette and disk input/output, and interpreting BASIC code. The OS resides in permanent ROM memory, so it's not included in your RAM memory size. But since it is a program like any other, it needs some RAM for variables and buffers. The OS uses about 1K of low memory (starting from zero) and varying amounts of high memory for screen display.

Going...Going...

For example, the Atari GRAPHICS 0 text screen uses 960 bytes, the VIC's combination text/color map screen uses 1012 bytes. So, on the VIC-20, 5K less 2K gives about 3K. 48K - 2K=46K on the Atari. Using the BASIC cartridge disables another 8K on the Atari (if you have 48K, since a cartridge "maps" into the same memory range as upper RAM), so we get the approximate figure of 38K. Extensions to the OS, such as the DOS (Disk Operating System), gobble up from 4-9K of memory. And adding software-based languages, such as Atari Microsoft BASIC or BASIC A+, can use from 16-26K more! Whatever's left is yours to use for BASIC programming, variables, arrays, strings, and graphics.

Graphics

Using graphics consumes even more memory. A full character set on the Atari uses 1024 bytes; a full set on the VIC uses 2048 bytes of memory. A full set is required for a VIC-20 hi-res screen. Atari's super hi-resolution screen (and the 16-color GTIA modes) uses almost 8K of RAM. Player/missile graphics uses at least 2K.

Picky Computers

And if that weren't enough, the computer can make life even harder for programmers. The VIC and Atari won't use just any block of RAM you've generously set aside – they're too choosy for that. The graphics chips in the Atari frequently require that the memory be on a 1K, 2K, or 4K boundary (explained later). VIC's requirements are similar.

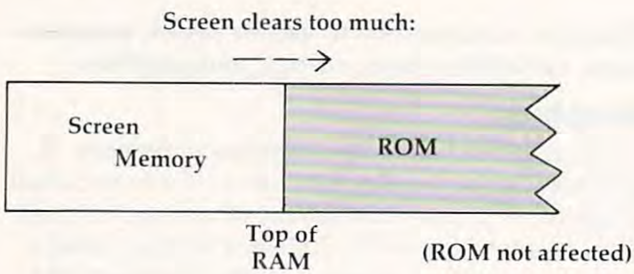
In addition, the memory we reserve must be protected. Unless we say otherwise, BASIC will probably encroach upon our block of memory. We'll have to lower the "top-of-memory" pointer that tells BASIC or the OS how much memory it has. In effect, we'll fool the computer and reserve some "high memory" for our own purposes. Even this can cause problems, however, and we'll try to document them. Sometimes it's safer to use low memory (discussed later).

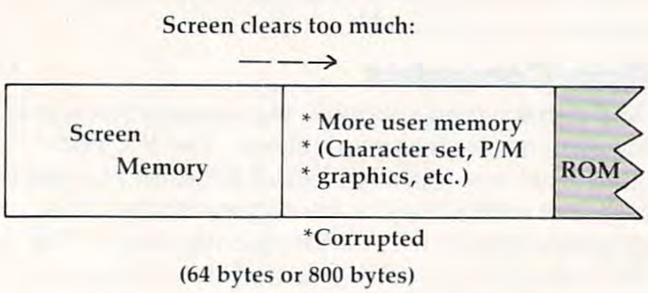
Getting Specific

Let's start with screen memory. This is the area where the text you see on the screen is stored. It can also hold the information required for a high-resolution, multicolor display. Many programmers use POKE, rather than PRINT, to place information directly on the screen. For example, if you enter POKE 7680,1 on a 5K VIC, or POKE 40000,33 on a 48K Atari, an A will appear at the upper left-hand corner of the screen. Using these same POKEs on an expanded VIC or 16K Atari won't work. This is because the screen memory "moves around," depending on the amount of memory installed.

Screen Memory: Atari

The Atari likes to keep its screen at the very top of memory, so that it's side by side with ROM. That way, the screen can be erased with a massive series of zeros. Because of the way the screen clear code is written, it overshoots the end of screen memory. With the screen tucked up next to ROM, it won't matter. ROM is safe from these extra POKEs. But if you have relocated the Atari screen, memory just past the end of screen memory won't be safe. Clearing the screen can erase 64 bytes past the top of screen memory. Scrolling the text window can clear up to 800 bytes.





One solution is to reserve more memory than you need, and position your character set or P/M graphics higher up. You might be able to prevent the screen from scrolling or clearing. To reserve memory, just POKE a new value into RAMTOP (location 106) and re-execute a GRAPHICS statement. For example:

```
POKE 1Ø6, PEEK(1Ø6)-4:GRAPHICS Ø
```

reserves four pages (1K) of high memory. The GRAPHICS command moves the screen and display list below RAMTOP. Everything above RAMTOP is yours. It will not be altered except as noted above. RAMTOP will be restored only by system reset.

You can find out the new address of screen memory with:

```
SCREEN=PEEK(88)+256*PEEK(89)
```

SCREEN will contain the proper address for any memory size. So instead of POKEing directly to locations 40000-40959 on a 48K Atari, use the above code and POKE SCREEN instead. This permits your program to run on any Atari, and the code is even more readable.

Screen Memory: VIC

Text screen memory is at location 7680 on a 5K VIC. This changes when you add memory. To obtain the correct text screen address on any VIC, use:

```
TEXT=4*(PEEK(36866)AND128)+64*
(PEEK(36869)AND12Ø)
```

Color memory (normally at 38400) is determined with:

```
COLOUR=37888+4*(PEEK(36866)AND128)
```

Now if you want to manually move the screen, things get more complicated. One use of multiple screens is *page flipping*, where you use two or more views of an object and show them in sequence to provide animation. See Jim Butterfield's "Alternate Screens," in *COMPUTE!'s First Book of VIC*. We've reprinted his dual screen program at the end of this article. Press the F1 key to switch screens.

More Moving Memory

Other areas of memory also change with various memory sizes. Most Atari programs are stored at the same location in low memory, but if you boot DOS, the LOMEMory pointer is bumped up, and BASIC starts higher up (at about $2000). You can determine the start of BASIC on any Atari with:

```
STARTP=PEEK(136)+256*PEEK(137)
```

The VIC is notorious for moving BASIC. On a PET/CBM, BASIC always starts at $0401 (decimal 1025). 5K VICs start at $1001 (decimal 4097). Add 3K of memory (8K total), and it's just like the PET – decimal 1025. But add 8K to a 5K VIC (13K total), and the start of BASIC moves again, this time to 4609 decimal. You can eliminate all the guesswork with:

```
BASIC=PEEK(43)+256*PEEK(44)
```

This information is useful if you're trying to load a VIC program into a PET.

Character Sets: Atari

A character set must be located on a 512 byte boundary. You can even use pages four to six, subject to interference by floating point routines. (*Pages* are blocks of 256 bytes, starting at location zero. Thus, *page* zero would be the addresses from 0-255.) The easiest way is to simply "step back" from the top of RAM, without altering RAMTOP. If you place it behind the display list, but well above BASIC, it will be safe. Large BASIC programs, however, can encroach upon your reserved area. And if you change graphics modes, you must step back past the largest mode used.

The step size has to be a multiple of four for a full 1024-byte character set. You need to step back four pages to get past the screen in modes 0,1,2,3,4 and 5, and then four more to hold your character set, for a total of eight. GRAPHICS 6 would require

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12, GRAPHICS 7 would require 20, and you would need to step back a whopping 36 pages to fit your character set beneath a GRAPHICS 8 display.

A statement like:

```
CHSET=(PEEK(1Ø6)-8)*256
```

is most often used. CHSET will hold the starting address where you should POKE your character set, or copy from ROM character set at 57344.

Character Sets: VIC

You have to lower high memory on the VIC to protect a custom character set from BASIC's string storage. The high memory pointer is at location 56. For a small character set, you need to protect two 256-byte *pages* at the top of memory. POKE 56,PEEK(56)-2 protects the RAM. You also have to change BASIC's string pointer. Use these lines:

```
X=PEEK(56)-2:POKE52,X:POKE56,X:
POKE51,PEEK(55):CLR CS=256*PEEK
(52)+PEEK(51)
```

You have to execute CLR to reset BASIC's pointers after you lower high memory. Find the character set area as CS. (Use POKE 36868,255 to tell VIC where the new character set is.) This technique doesn't work on expanded VICs. Instead, you can store a full character set at locations 4096 to 7615 on an expanded VIC if you execute the following series of POKEs:

```
POKE 52,22:POKE 56,22:CLR:POKE
36869,24Ø
```

To use these POKEs with an 8K expander, you'll have to relocate the start of BASIC as well:

```
POKE 44,32:POKE 8192,Ø:NEW
```

Naturally, the latter code cannot be within a main program. You'll also have to relocate the screen:

```
POKE 36866,15Ø:POKE 648,3Ø:PRINT
CHR$(147);
```

This will set the screen memory to location 7680, just like an unexpanded VIC.

Player/Missile Graphics On Atari

There are two types of P/M graphics: single and double line resolution. Single line resolution requires 2K of RAM: 256 bytes for each player (4 x 256 = 1K), 256 bytes for the missiles, and 768 unused bytes. Single line resolution, which has the vertical "fineness" of GRAPHICS 8 pixels, must start its memory on a 2K boundary (divisible by eight pages).

Double-line resolution, where two bytes are displayed for every byte in the shorter 128-byte player area, uses only 1K. 128 bytes are used for each player, 128 for the missiles, and 384 bytes are wasted. We've reprinted at the end of this article the memory table that pictorially represents this layout. You can easily store a small character set, machine language, or player shapes in the unused area.

If you lower RAMTOP, you have to subtract eight for single-line resolution, and four for double line. If you must fit large GRAPHICS screens (greater than seven) below RAMTOP, you must be sure to lower RAMTOP in 4K blocks. You can also just step back past the existing screen display (without touching RAMTOP). You must step back a multiple of four pages for double line resolution, and a multiple of eight pages for single-line.

To be safe, step back eight pages (or 16 for single-line) from modes 0-6. Go back 16 pages for double / 24 pages for single resolution in GRAPHICS 7, and 36/40 pages for GRAPHICS 8. The same problems apply as with character sets: lowering RAMTOP can cause up to 800 bytes of your protected area to be erased.

An Alternative: Use LOMEM

Let's take a look at another technique for reserving memory on an Atari. Various utilities and extensions (such as large machine language programs) frequently load in at low memory. For example, DOS loads in at $0700. To protect itself, DOS bumps up the low memory pointer to the end of DOS, where BASIC programs will then be stored. You can do the same trick to protect your own area of memory. Pick any point after about $1F00 to store your machine language, character sets, or P/M graphics. Address $2000 is perfect – it's on a 1K, 2K, and 4K boundary.

Before using the low RAM, it must be protected by changing LOMEM, $02E7. After you change LOMEM, you have to re-initialize the machine, so any program in memory will be lost. The best solution is to use a two-part program. Let the first part protect low memory, and then run the second part. For example, let's say you want to protect 2K of memory from $2000. The last byte in the 2K range will be $27FF. To place $2800, the new low memory value into LOMEM, use:

```
POKE 743,Ø:POKE 744,4Ø:POKE 8,Ø:A=
USR(4Ø96Ø)
```

POKEing 0 into WARMST ($08) tells the OS to re-initialize, and jumping to address 40960 ($A000) re-executes the cartridge (BASIC). The memory below $2800 is safe from any interference.

Cheer Up

Someday, computers will have unlimited RAM. We already see low-cost 64K and high-end 896K *microcomputers*. Even languages will likely grow larger, becoming faster and easier to use. There

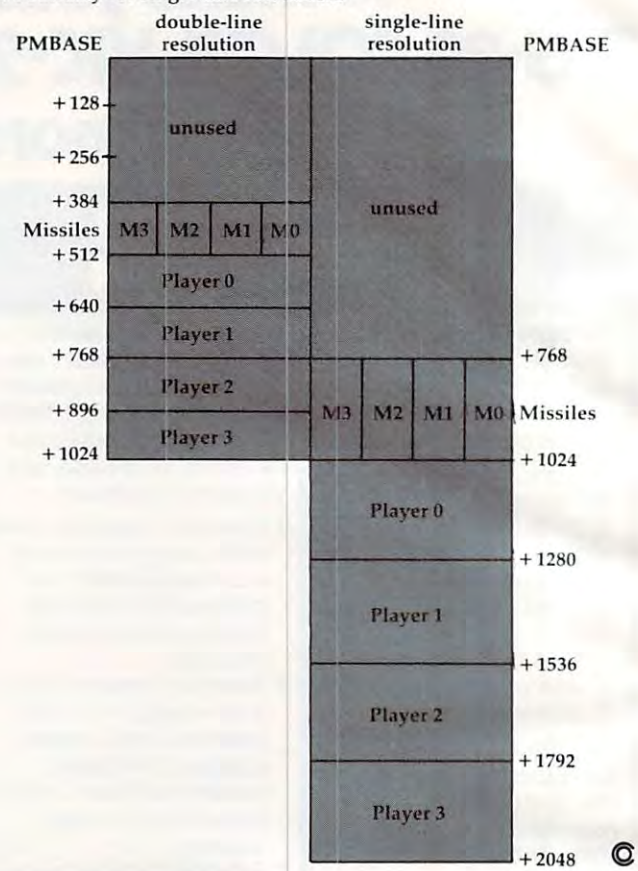
are already languages available for the VIC and Atari that ease the hassle of memory allocation, such as BASIC A+ for Atari, with its built-in P/M graphics commands, and the Super Expander for the VIC, which adds easy high-resolution commands such as CIRCLE and PAINT (adding 3K of RAM as a bonus!). But if you're interested in doing it yourself (and you have to in machine language), I hope these suggestions help.

Page Flipping for VIC

```
100 REMDUAL SCREEN JIM BUTTERFIELD
110 POKE56,28:CLR
120 DIML%(23)
130 GOSUB400:PRINTCHR$(147):GOSUB400
140 Z$=CHR$(133)
200 GETX$:IFX$=Z$THENGOSUB400
210 PRINTX$;:GOTO200
400 REM SWITCH
410 S=PEEK(648)
420 IFS=28THENS=30:T=150:GOTO500
430 IFS=30THENS=28:T=22:GOTO500
440 STOP: REMARK: ERROR
500 POKE648,S:POKE36866,T
510 FORJ=0TO23
520 V=PEEK(J+217):POKEJ+217,L%(J):
530 L%(J)=V
540 NEXTJ
550 PRINT:RETURN
```

Memory Allocation for P/M Graphics

PMBASE must be on 1K boundary for double-line resolution, 2K boundary for single-line resolution.



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Take a few minutes to enter the demo program into your computer. You can eliminate the REM statements to save keystrokes, but don't change the line numbers. Note that lines 310, 450, and 470 have two (2) spaces between the empty quotes, and line 90 has *no* space in the empty quotes. After you have entered the program and checked for errors, type RUN and hit RETURN. Now, let's walk through the program and see what's happening.

Easy Editing

The computer first asks for the number of entries (for our test, let's enter 10) and DIMensions A$ to this figure. We then enter a loop to input our data, using subroutine 310-350 as the INPUT routine (let's enter "THIS IS A TEST TO SEE HOW THE PROGRAM WORKS" – one word for each input prompt). Subroutine 310 looks rather involved for a simple input statement, but we'll see how this routine really shines, later on. After making each entry, we go back to line 90, and the computer checks to see if that entry was the letter E (for EDIT). For input prompt number 4, let's enter TYST and hit RETURN. For entry number 5, enter E and hit RETURN. Now the last entry is an E, and the program will jump to line 210, the EDIT routine.

If we know which entry number we want to correct, we simply enter that number. However, if we forget the number, or if it has scrolled off the screen, we enter 0. In the latter case, the program goes to yet another subroutine, the SCAN routine at line 370. This allows the user to scan up and down the list of data simply by holding down the f7 or f5 FUNCTION keys until the desired entry (along with its associated number) comes on screen. We note the number, hit the f1 key, and enter this number in response to the prompt at line 210.

Armed with this information, the computer counts the number of characters in our selected entry, and tells us to make our changes and hit the RETURN key. Now the power of the INPUT subroutine comes into play. First, the routine prints the entry number, then the entry itself – TYST. Then the cursor is moved BACK to the LEFT of the entry, the input prompt is displayed, and the cursor is left flashing on the first letter of the entry, which is all neatly printed out for us. We need only move the cursor to the trouble spot (the letter Y), make our correction (E), and hit RETURN. The computer's screen editor then accepts the change and replaces the old entry with the new one – and we had to type only one letter! Obviously, this is a great help when dealing with long, complicated strings, and will eliminate the chance of making further errors, since we don't have to re-type the whole entry. Inserts and deletions are perfectly acceptable too, of course.

The computer then asks if we have any more changes to make – if we do, the EDIT routine repeats. If we have no more changes, the E we entered in input number 5 is wiped out, and we are asked for a new entry number 5. The whole input loop continues until all the entries are made, at which point the program goes on with its other chores (sorting, number crunching, filing, etc.). You can check to see if our correction was accepted by entering the following line in direct mode:
FOR I=1 TO N: PRINT A$(I);: PRINT " ";: NEXT I

Changing Input Prompts

These subroutines can be called from any place in the program, but keep in mind that the cursor positioning in the INPUT routine works from the character count of the specified (or last used) entry. To get "new" input prompts, you must initialize

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A$(I) and CH, as shown in line 90, or you may get funny-looking prompts. E is given the value of I because the INPUT subroutine uses both the original loop (line 90) and the EDIT routine (line 210) as sources for printing the input prompt.

A sample application: you might want to use the sample program pretty much as is when initially entering your data. You then might re-scan all the entries to check for omissions and typos, then sort the data and scan once again. Now any duplications will be readily apparent (right next to each other), and you can make further corrections (using the INPUT routine) as required, and re-sort, if desired. You then may file or print out the results – one time, with all your corrections made, thanks to the help of the powerful screen editor of the computer.

One final note – on my VIC, the SCAN routine sometimes works only partially (the scan continues only when the f7 or f5 key is re-pressed). This happens only when I've entered a large number of strings and I don't have one of the RAM cartridges inserted. Apparently, the VIC needs lots of elbow room to juggle the strings around during the SCAN routine. Don't worry, though; if this happens, simply press and hold the function key again, and another batch of strings will come up on the screen.

```
10 REM INPUT WITH SCREEN EDIT DEMO
50 PRINT"{CLEAR}HOW MANY ENTRIES":INPUT"W
   ILL YOU BE MAKING";N:DIMA$(N):PRINT
70 FORI=1TON
90 A$(I)="":E=I:CH=O:GOSUB310:IFA$(I)="E"
   THENGOSUB210
110 PRINT:NEXTI:GOSUB130:END:REM CONTINUE
    W/MAIN PROGRAM
130 PRINT:PRINT"MORE CHANGES (Y/N)?":Y$=""
150 GETY$:IFY$=""THEN150
170 IFY$="Y"THEN210
190 IFY$="N"THENI=I-1:RETURN
210 PRINT:PRINT"TITLE# (IF UNKNOWN,":INPUT
    "ENTER 0)";E
230 IFE=0THENGOSUB370:GOTO210
250 PRINT:PRINT"CHANGE ENTRY & {REV}RETURN
    {OFF}":CH=LEN(A$(E))
270 PRINT:GOSUB310
290 PRINT:PRINT:S=0:E=0:GOSUB130:RETURN
310 PRINT"ENTRY#"E;:PRINT"   ";:PRINTA$(E);

330 FORK=1TO(CH+2):PRINT"{LEFT}";:NEXTK
350 INPUTA$(E):RETURN
370 PRINT:PRINT"HIT F7 KEY TO SCAN UP.":PR
    INT"HIT F5 KEY TO REVERSE."
390 PRINT"HIT F1 KEY TO STOP.":S=1:POKE650
    ,128
410 E$="":PRINT
430 GETE$:IFE$=""THEN430
450 IFPEEK(197)=63THENPRINTS"   ";:PRINTA$(
    S):S=S+1:IFS=N+1THENS=1
470 IFPEEK(197)=55THENPRINTS"   ";:PRINTA$(
    S):S=S-1:IFS<1THENS=N
490 IFPEEK(197)=39THENPOKE650,0:RETURN
510 GOTO410
```

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PETterns

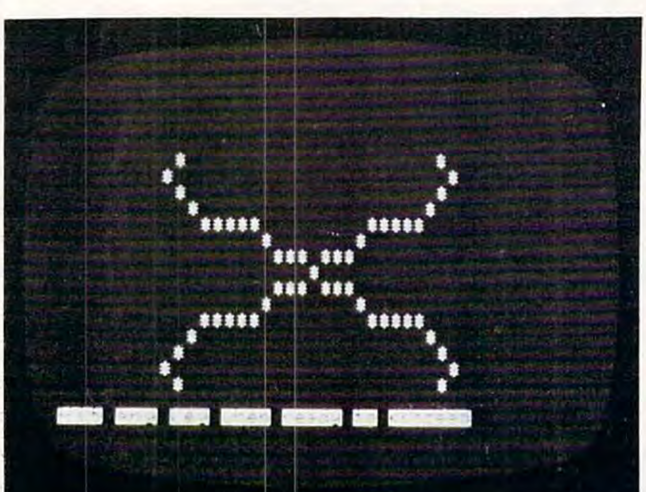
Bruce Shawyer

For PET/CBM's with 40-column screens, "PETterns" creates patterns, rotates and reflects them, and can be used to introduce mathematical concepts to students. Although the program can use the Commodore 2022 printer for hardcopy, it will also work with most other printers.

"PETterns" will create patterns on the screen, rotate them, and reflect them. For any created pattern, the user can print it as it was created, print its rotation through 90°, 180°, or 270°, print its reflection in the positive diagonal line (its inverse), or print the rotations of the inverse. Certain combinations of these can be obtained directly in order to create pretty patterns.

The program is useful in introducing students to group theory, for the basis of the program is the group of symmetries of the reflections and rotations of the square (the dihedral group). This group has two generators, but they are, of course, not unique. For the first, I chose the rotation through 90° in the positive (counterclockwise) sense. For the other, I chose the reflection in the positive diagonal line (the line Y=X).

The other group operations are done within the program by calling the appropriate combinations of the generators. Thus they are slightly slower. I chose the second generator because it gives the inverse relation to the relation created, and so is useful in illustrating, for example, that the inverse of a function is not necessarily a function.



A crystalline shape begins to form in "PETterns."

The program given here is designed for a 40-column screen PET and uses the alternate character set. For reasons of symmetry, patterns of 39-columns by 25-rows are allowed. This permits the right-hand column to be reserved for a set of prompts to the set of input codes.

Patterns start at the center of the screen. This point is the origin for the X- and Y-axes. A symbol, initially a "*", will appear at this point. To print the next point, use the numeric key-pad in the conventional way. "5" is the center. The other non-zero digits are used to enter the direction for the next point to be printed. For example, entering "9" results in the next point printed being in a *north-east* direction from the previous point.

7	8	9
4	*	6
1	2	3

There are also five codes which allow combinations of the above to be printed. These codes are "a", "b", "c", "d" and "e".

Code "a" prints the original pattern together with reflections as if the X- and Y-axes were mirrors. That is, we have p, S, t and F.

Code "b" prints the inverse of the pattern together with reflections as if the X- and Y-axes were mirrors. That is, we have P, s, T and f.

Code "c" prints the original pattern together with its rotations. That is, we have p, s, t and f.

Code "d" prints the inverse of the pattern together with its rotations. That is, we have P, S, T and F.

Code "e" prints everything, that is, all eight possible positions.

There are two codes not appearing in the prompt column. The first is "h". This stands for "cHange the symbol". When you hit "h", the right-hand column is replaced by a list of symbols. Each has a number beneath it. By hitting the number that appears below a symbol, you cause that symbol to be the next printed in the patterns. This new symbol will continue until another symbol is selected. Note that "1" is below the blank symbol.

The second code is "v". This stands for "change Vector length". When you hit "v", the right-hand column is replaced by the words "CHANGE VECTOR LENGTH"; beneath them is the length of the present vector. When you hit a non-zero number, a new vector length is entered. When a new point is next entered, it will be repeated the number of times of the length of the vector.

Here is a list of other codes appearing in the prompt column, with an explanation of their effects:

CODE	EFFECT	
q	QUIT	- terminates the program.
r	RUN	- restarts the program for a new pattern.
n	NOTHING	- clears the screen.
o	OUTPUT	- prints the pattern on the printer. This program is written for a CBM 2022 printer.
p	PRINT	- prints your pattern on the screen.
s	SECOND	- rotates the pattern through 90°.
t	THIRD	- rotates through 180°.
f	FOURTH	- rotates through 270°.
P	(Shift)p	- reflects the pattern in the positive diagonal.
S	(Shift)s	- reflects, then rotates 90°.
T	(Shift)t	- reflects, then rotates 180°.
F	(Shift)f	- reflects, then rotates 270°.

```
10 REM     PETTERNS
11 REM
12 REM
13 REM   ******************************
14 CS=59468:CG=PEEK(CS):POKECS,14:PRINT"{CLEA
   CLEAR}":VL=1:B$=CHR$(1):GOTO77
15 REM   ******************************
16 REM
17 REM     THE ROTATIONS AND INVERSES
18 REM
19 REM   ******************************
20 T=X:X=Y:Y=T:RETURN:INVERSE "P"
21 RETURN: NO CHANGE P
22 T=X:X=-Y:Y=T:RETURN:ROTATE 90' S
23 GOSUB22:GOSUB22:RETURN:ROTATE 180' T
24 GOSUB23:GOSUB22:RETURN:ROTATE 270' F
25 GOSUB20:GOSUB22:RETURN: "S = PS"
26 GOSUB20:GOSUB23:RETURN: "T = PT"
27 GOSUB20:GOSUB24:RETURN: "F = PF"
28 FORC=2TO8STEP2:GOSUB46:NEXT:RETURN:COMB.A
29 FORC=1TO7STEP2:GOSUB46:NEXT:RETURN:COMB.B
30 FORC=2TO5:GOSUB46:NEXT:RETURN:COMB.C
31 C=1:GOSUB46:FORC=6TO8:GOSUB46:NEXT:RETURN:
   COMB.D
32 FORC=1TO8:GOSUB46:NEXT:RETURN:COMB.E
33 REM   ******************************
34 REM
35 REM    PLACING THE POINT ON SCREEN
36 REM
37 REM   ******************************
38 IFABS(X)>19THENX=19*SGN(X)
39 IFABS(Y)>12THENY=12*SGN(Y)
40 POKEOG+X-40*Y,SY:RETURN:PLACE POINT
41 REM   ******************************
42 REM
43 REM     WHICH OPERATION TO BE DONE
44 REM
45 REM   ******************************
46 X=0:Y=0:FORI=0TON:GOSUB55:XX=X:YY=Y
47 ONCGOSUB20,21,22,23,24,25,26,27,28,29,30,3
   1,32
48 IFC>0ANDC<9THENGOSUB38
49 X=XX:Y=YY:NEXT:RETURN
50 REM   ******************************
51 REM
52 REM       VECTOR FOR NEXT POINT
53 REM
54 REM   ******************************
55 IFI=0THENX=0:Y=0:GOSUB38:RETURN
56 V=V(I):IFV<4THENY=Y-1
57 IFV>6THENY=Y+1
58 IFV=2ORV=8THENRETURN
59 IFINT(V/3)*3=VTHENX=X+1:RETURN
60 X=X-1:RETURN
61 REM   ******************************
62 REM
63 REM       OUTPUT TO THE PRINTER
64 REM
65 REM   ******************************
66 OPEN6,4,6:PRINT#6,CHR$(32):OPEN1,4,1:CMD1:
   SC=2^15:FORVY=0TO24:PRINTB$;:FORVX=0T
   O38
67 VZ=SC+VX+40*VY:V=PEEK(VZ):A$=" ":IFV=32THE
   N70
68 FORVZ=2TO26STEP3:IFSY(VZ)<>VTHENNEXT
69 A$=SY$(INT(VZ/3))
70 PRINTA$;:NEXT:PRINT:NEXT
71 PRINT#1:CLOSE1:CLOSE6:RETURN:SCREEN DUMP T
   O PRINTER
72 REM   ******************************
73 REM
74 REM       MAIN PROGRAM - SET UP
75 REM
76 REM   ******************************
77 DIMSY(27),VL(27):FORVX=0TO26:SY(VX)=32:NEX
   T:FORVX=1TO26STEP3
78 SY(VX+2)=50+INT(VX/3):NEXT:SY(23)=160
79 SY(2)=42:SY(5)=43:SY(8)=35:SY(11)=15:SY(14
   )=170:SY(17)=171:SY(20)=91
80 SY$(0)="*":SY$(1)="+":SY$(2)="#":SY$(3)="O
   ":SY$(4)="{REV}*{OFF}":SY$(5)="{REV}+
   {OFF}"
81 SY$(6)="[":SY$(7)="{REV} {OFF}":C$=""
82 VL(0)=32:VL(1)=67:VL(2)=8:VL(3)=1:VL(4)=14
   :VL(5)=7:VL(6)=5:VL(7)=32
83 VL(8)=86:VL(9)=5:VL(10)=3:VL(11)=20:VL(12)
   =15:VL(13)=18:VL(14)=32
84 VL(15)=76:VL(16)=5:VL(17)=14:VL(18)=7:VL(1
   9)=20:VL(20)=8
85 DIMSZ(25):SZ(0)=17:SZ(1)=18:FORSX=2TO4:SZ(
   SX)=12+SX:NEXT:SZ(5)=19:SZ(6)=20
86 SZ(7)=6:SZ(8)=80:SZ(9)=83:SZ(10)=84:SZ(11)
   =70:FORSX=1TO5:SZ(SX+11)=SX:NEXT
87 FORSX=49TO56:SZ(SX-32)=SX:NEXT:FORSX=21TO2
   5:SZ(SX)=SZ(SX)+1:NEXT
88 O=2^15+39:DIMV(500):SY=42:OG=O+460:GOSUB15
   9:GOSUB124
89 X=0:Y=X:I=X:N=X:GOSUB38
90 REM   ******************************
91 REM
92 REM           MAIN PROGRAM
93 REM
94 REM   ******************************
95 GOSUB308:FORII=1TOVL:GOSUB131:C=0:IFV$="5"
   ORV$="0"THEN95
96 V=VAL(V$):IFV=0THEN98
97 N=N+1:I=N:V(I)=V:GOSUB55:GOSUB38:GOSUB124:
   NEXTII:GOTO95
98 IFV$="Q"THENPRINT"{CLEAR}":POKECS,CG:END
99 IFV$="R"THENC$="  AGAIN ?":GOSUB168:GOSUB1
   24:GOTO89
100 IFV$="N"THENPRINT"{CLEAR}":GOSUB124:GOTO95
101 IFV$="H"THENGOSUB141:GOSUB124:GOTO95
102 IFV$="V"THENGOSUB150:GOSUB124:GOTO95
103 IFV$="O"THENGOSUB66:GOSUB124:GOTO95
104 IFV$="P"THENC=2:GOTO117
105 IFV$="P"THENC=1:GOTO117
106 IFV$="S"THENC=3:GOTO117
107 IFV$="T"THENC=4:GOTO117
108 IFV$="F"THENC=5:GOTO117
```

```
109 IFV$="S"THENC=6:GOTO117
110 IFV$="T"THENC=7:GOTO117
111 IFV$="F"THENC=8:GOTO117
112 IFV$="A"THENC=9:GOTO117
113 IFV$="B"THENC=10:GOTO117
114 IFV$="C"THENC=11:GOTO117
115 IFV$="D"THENC=12:GOTO117
116 IFV$="E"THENC=13
117 IFC>0THENGOSUB46
118 GOSUB124:GOTO95
119 REM    ******************************
120 REM
121 REM          R H COLUMN OF CODES
122 REM
123 REM    ******************************
124 FORVX=0TO999STEP40
125 POKEO+VX,SZ(INT(VX/40)):NEXT:RETURN
126 REM    ******************************
127 REM
128 REM           HIGHLIGHTING CODE
129 REM
130 REM    ******************************
131 T=ASC(V$):IFT<58THEN133
132 T=T-64:IFT>64THENT=T-64
133 FORVX=OTOO+1000STEP40
134 VY=PEEK(VX):IFVY=TTHENPOKEVX,VY+128:RETURN

135 NEXT:RETURN
136 REM    ******************************
137 REM
138 REM           CHANGE THE SYMBOL
139 REM
140 REM    ******************************
141 FORVX=OTOO+990STEP40:POKEVX,SY(INT((VX-O)/
    40)):NEXT:POKEO,49
142 GOSUB308:IFVAL(V$)<1THEN142
143 IFV$="1"THENSY=32:RETURN
144 SY=SY(3*VAL(V$)-4):RETURN
145 REM    ******************************
146 REM
147 REM        CHANGE VECTOR LENGTH
148 REM
149 REM    ******************************
150 FORVX=21TO26:VL(VX)=32:NEXT:VL(22)=48+VL
151 FORVX=OTOO+990STEP40:POKEVX,VL(INT((VX-O)/
    40)):NEXT
152 GOSUB308:IFVAL(V$)=0THEN152
153 VL=VAL(V$):RETURN
154 REM    ******************************
155 REM
156 REM             INSTRUCTIONS
157 REM
158 REM    ******************************
159 PRINT"{CLEAR}{06 DOWN}{15 RIGHT}{REV}PETTE
    RNS{OFF}"
160 PRINT"{02 DOWN}{05 RIGHT}A PROGRAM TO CREA
    TE PATTERNS."
161 PRINT
162 FORN=1TO3000:NEXT
163 REM    ******************************
164 REM
165 REM   INSTRUCTIONS - YES OR NO?
166 REM
167 REM    ******************************
168 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}DO YOU WIS
    H TO READ THE INSTRUCTIONS";:IFC$=""T
    HENPRINT" ?"
169 PRINTC$"{DOWN}":PRINT"{DOWN}IF SO, {REV}HI
    T{OFF} {REV}RETURN{OFF}"
170 PRINT"{03 DOWN}IF YOU ARE READY TO MAKE PA
    TTERNS,"
171 PRINT"{DOWN}{REV}HIT{OFF} {REV}ANY{OFF} {R
    REV}OTHER{OFF} {REV}KEY{OFF}":GOSUB30
    8
172 IFV$=CHR$(13)THEN179
173 PRINT"{CLEAR}":RETURN
174 REM    ******************************
175 REM
```

```
176 REM   INSTRUCTIONS - GENERAL
177 REM
178 REM    ******************************
179 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}THIS PROGR
    AMS ENABLES YOU TO CREATE"
180 PRINT"PATTERNS ON THE SCREEN, AND TO PRINT
    "
181 PRINT"THEIR ROTATIONS AND INVERSES.  VARIO
    US"
182 PRINT"COMBINATIONS ARE ALSO POSSIBLE."
183 PRINT"{DOWN}{02 RIGHT}YOU CAN PRINT THE NE
    XT POINT ON YOUR"
184 PRINT"DIAGRAM USING THE NUMERIC KEYS AS SH
    OWN"
185 PRINT"BELOW."
186 PRINT"{02 DOWN}{05 RIGHT}7 8 9":PRINT"{05
    RIGHT}4 * 6":PRINT"{05 RIGHT}1 2 3"
187 PRINT"{DOWN}{02 RIGHT}TO MOVE FROM THE POI
    NT  '*'  TO THE"
188 PRINT"NEXT POINT, HIT THE NUMBER THAT IS I
    N"
189 PRINT"THE DESIRED DIRECTION.":GOSUB309
190 PRINT"{REV}OF{OFF} {REV}INSTRUCTIONS.{OFF}
    "
191 PRINT"{CLEAR}{05 DOWN}THE WHOLE SCREEN CAN
     BE USED EXCEPT"
192 PRINT"FOR THE RIGHT HAND COLUMN.  IT WILL"

193 PRINT"DISPLAY A SET OF CODES TO REMIND"
194 PRINT"YOU OF WHAT YOU CAN DO."
195 PRINT"{DOWN}WHEN AN OPERATIONS IS BEING"
196 PRINT"PERFORMED, THAT CODE WILL BE"
197 PRINT"HIGHLIGHTED IN REVERSE MODE."
198 PRINT"{DOWN}THE LIST WILL NOW BE DISPLAYED
    "
199 PRINT"IN ITS POSITION.":FORI=1TO7000:NEXT:
    GOSUB124
200 PRINT"{DOWN}THESE INSTRUCTIONS WILL BE EXP
    LAINED"
201 PRINT"IN WHAT FOLLOWS.":GOSUB309
202 REM    ******************************
203 REM
204 REM   INSTRUCTIONS - Q R N O
205 REM
206 REM    ******************************
207 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}THE FIRST
    FOUR CODES ARE"
208 PRINT"{02 DOWN}      Q     R     N     O"
209 PRINT"{02 DOWN} Q  MEANS QUIT AND ENDS THE
     PROGRAM."
210 PRINT"{DOWN} R  MEANS RUN AND RESTARTS THE
     PROGRAM."
211 PRINT"{DOWN} N  MEANS NOTHING ON THE SCREE
    N."
212 PRINT"{DOWN} O  MEANS OUTPUT AND PRINTS WH
    AT IS ON"
213 PRINT"{DOWN}              THE SCREEN ON THE
     PRINTER.":GOSUB309
214 REM    ******************************
215 REM
216 REM   INSTRUCTIONS - P S T F
217 REM
218 REM    ******************************
219 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}THE SECOND
    FOUR CODES ARE"
220 PRINT"{02 DOWN}      P     S     T     F"
221 PRINT"{02 DOWN} P  MEANS PRINT AND PRINTS
    THE PATTERN"
222 PRINT"{DOWN}              ON THE SCREEN."
223 PRINT"{DOWN} S  MEANS SECOND AND ROTATES T
    HRU' 90'"
224 PRINT"{DOWN} T  MEANS THIRD AND ROTATES TH
    RU' 180'"
225 PRINT"{DOWN} F  MEANS FOURTH AND ROTATES T
    HRU' 270'":GOSUB309
226 REM    ******************************
227 REM
228 REM   INSTRUCTIONS - "P S T F"
```

```
229 REM
230 REM   ******************************
231 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}THE THIRD
    FOUR CODES ARE"
232 PRINT"{02 DOWN}       P     S     T     F"
233 PRINT"{02 DOWN} P  MEANS PRINT THE INVERSE
    PATTERN."
234 PRINT"{DOWN}            THAT IS, THE REFL
    ECTION"
235 PRINT"{DOWN}            IN THE LINE  Y =
    X."
236 PRINT"{DOWN} S  MEANS  P  FOLLOWED BY  90'
    ROTATION ";
237 PRINT"{DOWN} T  MEANS  P  FOLLOWED BY  180
    ' ROTATION";
238 PRINT"{DOWN} F  MEANS  P  FOLLOWED BY  270
    ' ROTATION":GOSUB309
239 REM   ******************************
240 REM
241 REM   INSTRUCTIONS - A B C D E
242 REM
243 REM   ******************************
244 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}THE NEXT F
    IVES CODES ARE"
245 PRINT"{02 DOWN}     A    B    C    D    E"
246 PRINT"{DOWN}THESE GIVE COMBINATIONS OF THE
    CODES"
247 PRINT"{DOWN}EXPLAINED ABOVE."
248 PRINT"{02 DOWN}HERE IS A DEMONSTRATION OF
    CODE  'A'."
249 PRINT"{DOWN}{02 RIGHT}THE ORIGINAL PATTERN
     WILL FIRST BE":PRINT"DISPLAYED."
250 FORT=1TO5:V(T)=9:V(T+4)=6:V(T+8)=9:NEXT:N=
    13:V(2)=6:V(3)=6:V(13)=7
251 GOSUB315:C=2:PRINT"{CLEAR}":GOSUB46:FORT=1
    TO9:PRINT"{DOWN}":NEXT: GOSUB315
252 C=9:PRINT"{CLEAR}":GOSUB46:FORT=1TO9:PRINT
    "{DOWN}":NEXT:GOSUB315
253 PRINT"{CLEAR}{06 DOWN}HERE IS A DEMONSTRAT
    ION OF CODE  'B'."
254 PRINT"{DOWN}{02 RIGHT}THE ORIGINAL PATTERN
     WILL FIRST BE":PRINT"DISPLAYED."
255 GOSUB315:C=2:PRINT"{CLEAR}":GOSUB46:FORT=1
    TO9:PRINT"{DOWN}":NEXT: GOSUB315
256 C=10:PRINT"{CLEAR}":GOSUB46:FORT=1TO9:PRIN
    T"{DOWN}":NEXT:GOSUB315
257 PRINT"{CLEAR}{06 DOWN}HERE IS A DEMONSTRAT
    ION OF CODE  'C'."
258 PRINT"{DOWN}{02 RIGHT}THE ORIGINAL PATTERN
     WILL FIRST BE":PRINT"DISPLAYED."
259 GOSUB315:C=2:PRINT"{CLEAR}":GOSUB46:FORT=1
    TO9:PRINT"{DOWN}":NEXT: GOSUB315
260 C=11:PRINT"{CLEAR}":GOSUB46:FORT=1TO9:PRIN
    T"{DOWN}":NEXT:GOSUB315
261 PRINT"{CLEAR}{06 DOWN}HERE IS A DEMONSTRAT
    ION OF CODE  'D'."
262 PRINT"{DOWN}{02 RIGHT}THE ORIGINAL PATTERN
     WILL FIRST BE":PRINT"DISPLAYED."
263 GOSUB315:C=2:PRINT"{CLEAR}":GOSUB46:FORT=1
    TO9:PRINT"{DOWN}":NEXT: GOSUB315
264 C=12:PRINT"{CLEAR}":GOSUB46:FORT=1TO9:PRIN
    T"{DOWN}":NEXT:GOSUB315
265 PRINT"{CLEAR}{06 DOWN}HERE IS A DEMONSTRAT
    ION OF CODE  'E'."
266 PRINT"{DOWN}{02 RIGHT}THE ORIGINAL PATTERN
     WILL FIRST BE":PRINT"DISPLAYED."
267 GOSUB315:C=2:PRINT"{CLEAR}":GOSUB46:FORT=1
    TO9:PRINT"{DOWN}":NEXT: GOSUB315
268 C=13:PRINT"{CLEAR}":GOSUB46:FORT=1TO9:PRIN
    T"{DOWN}":NEXT:GOSUB309
269 REM   ******************************
270 REM
271 REM   INSTRUCTIONS - NUMBERS
272 REM
273 REM   ******************************
274 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}THE LAST S
    ET OF CODES IS"
275 PRINT"{02 DOWN}  9  8  7  6  4  3  2  1"
276 PRINT"{02 DOWN}THEY ARE TO REMIND YOU OF T
    HE DIRECTION"
277 PRINT"KEYS.":GOSUB309
278 REM   ******************************
279 REM
280 REM   INSTRUCTIONS - H  AND  V
281 REM
282 REM   ******************************
283 PRINT"{CLEAR}{02 DOWN}{02 RIGHT}THERE ARE
    TWO CODES NOT"
284 PRINT"DISPLAYED IN THIS WAY.  THEY ARE":P
    RINT"{DOWN}{09 RIGHT}H    AND     V"
285 PRINT"{DOWN}{RIGHT}H  MEANS C{REV}H{OFF}AN
    GE THE SYMBOL"
286 PRINT"{DOWN}BEING PRINTED ON THE SCREEN BY
    "
287 PRINT"ENTERING THE NUMBER BELOW THE SYMBOL
    "
288 PRINT"AS DISPLAYED IN THE RIGHT HAND "
289 PRINT"COLUMN AS NOW SHOWN.":GOSUB313:GOSUB
    141
290 PRINT"{DOWN}{RIGHT}V  MEANS CHANGE {REV}V{
    OFF}ECTOR LENGTH"
291 PRINT"BY ENTERING THE NUMBER REQUIRED.":GO
    SUB313:GOSUB150
292 REM   ******************************
293 REM
294 REM   INSTRUCTIONS - REPEAT ?
295 REM
296 REM   ******************************
297 PRINT"{CLEAR}{03 DOWN}IF YOU WISH TO SEE T
    HE INSTRUCTIONS"
298 PRINT"{DOWN}ONCE MORE, {REV}HIT{OFF} {REV}
    RETURN{OFF}"
299 PRINT"{03 DOWN}IF YOU ARE READY TO MAKE PA
    TTERNS,"
300 PRINT"{DOWN}{REV}HIT{OFF} {REV}ANY{OFF} {R
    REV}OTHER{OFF} {REV}KEY{OFF}":GOSUB30
    8
301 IFV$=CHR$(13)THEN179
302 VL=1:SY=42:PRINT"{CLEAR}":RETURN
303 REM   ******************************
304 REM
305 REM        PROCEEDING ROUTINES
306 REM
307 REM   ******************************
308 FORT=1TO10:GETVV$:NEXT:GOTO311
309 PRINT"{02 DOWN}{REV}HIT{OFF} {REV}ANY{OFF}
     {REV}KEY{OFF} {REV}WHEN{OFF} {REV}RE
    ADY{OFF} {REV}FOR{OFF} {REV}THE{OFF}"
310 PRINT"{REV}NEXT{OFF} {REV}SET{OFF} {REV}OF
    {OFF} {REV}INSTRUCTIONS.{OFF}":GOTO30
    8
311 GETV$:IFV$=""THEN311
312 RETURN
313 PRINT"{DOWN}{REV}HIT{OFF} {REV}ANY{OFF} {R
    REV}NUMBER{REV} {REV}KEY{OFF} {REV}AB
    OVE{OFF} {REV}0{OFF}"
314 PRINT"{REV}TO{OFF} {REV}PROCEED{OFF}.":RET
    URN
315 PRINT"{02 DOWN}{REV}HIT{OFF} {REV}ANY{OFF}
     {REV}KEY{OFF} {REV}WHEN{OFF} {REV}RE
    ADY{OFF} {REV}TO{OFF} {REV}PROCEED{OF
    OFF}":GOTO308
316 PRINT"{DOWN}THESE INSTRUCTIONS WILL BE EXP
    LAINED"
317 PRINT"IN WHAT FOLLOWS.":RETURN
```

©

COMPUTE!'s Mapping The Atari

Author: Ian Chadwick
(Introduction by Bill Wilkinson)
Price: $14.95
On Sale: Now

The inner workings of today's advanced personal computers unfortunately remain a mystery to many users. From beginners to machine language programmers, people are hungry for vital information about the insides of their machines. For example, there are tens of thousands of memory locations...which are safe to use? How can changing one number in a certain memory cell dramatically speed up output to the disk drive? Which memory address reveals what Operating System is in the computer? How can changing certain numbers in various memory locations improve a program's sound and graphics?

The key to finding one's way around the inside of a computer is a memory map. But often this important information is unavailable from the manufacturer. Or it can be obtained only in piecemeal fashion from scattered sources.

Now, for the first time, there is a comprehensive guidebook available for the Atari 400/800 computers which answers all of these questions, and hundreds more. *Mapping The Atari*, by Ian Chadwick, is a complete reference guide and memory map for one of the most popular of personal computers. From memory location zero to 65,535, *Mapping The Atari* is the most exhaustive memory sourcebook ever offered to Atari users.

Chadwick started by diligently assembling all the information he could find. Then he went a step further by testing this information, to verify its accuracy. And finally, he added months of his own research, delving deep into little-known areas of the Atari's memory to explore every secret. The result, *Mapping The Atari*, is an indispensable reference work for Atari programmers.

TABLE OF CONTENTS

But *Mapping The Atari* is more than just a comprehensive reference book. It is also a tutorial for *all* inquisitive Atari enthusiasts – not just advanced programmers. *Mapping The Atari* explains each memory location in depth for beginning and intermediate programmers. Some descriptions of important locations fill several pages. And the book is packed with ready-to-type example programs and routines which show exactly how to put the information to work.

There's more. A special introduction by Bill Wilkinson, an author of Atari BASIC and the Atari Disk Operating System, explains how to access the Atari's memory in every available programming language. And there are *ten* appendices, covering such topics as "VBLANK Processes," "Atari Timing Values," "Color," "Sound And Music," "Player/Missile Graphics Memory Map," "Display Lists," and others. And to make the book still more useful, there are *two* indices – an Index By Label, and an Index By Subject.

Best of all, *Mapping The Atari* is from **COMPUTE! Books**, associated with **COMPUTE!** Magazine, the leading consumer publication of home, educational, and recreational computing. **COMPUTE!** has led the way for Atari owners since the computers were first introduced in 1979. In the **COMPUTE!** tradition, *Mapping The Atari* is carefully written and edited to be useful to beginners and experts alike. And it is spiral-bound to lie flat while typing programs.

Available at computer dealers and bookstores nationwide. To order directly call TOLL FREE 800-334-0868. In North Carolina call 919-275-9809. Or send check or money order to **COMPUTE! Books**, P.O. Box 5406, Greensboro, NC 27403.

Add $2 shipping and handling. Outside the U.S. add $5 for air mail, $2 for surface mail. All orders prepaid, U.S. funds only.

COMPUTE! Back Issues

Here are some of the applications, tutorials, and games from available back issues of **COMPUTE!**. Each issue contains much, much more than there's space here to list, but here are some highlights:

February 1981: Simulating PRINT USING, Using the Atari as a Terminal for Telecommunications, Attach a Printer to the Atari, Double Density Graphing on C1P, Commodore Disk Systems, PET Crash Prevention, A 25¢ Apple II Clock.

May 1981: Named GOSUB/GOTO in Applesoft, Generating Lower Case Text on Apple II, Copy Atari Screens to the Printer, Disk Directory Printer for Atari, Realtime Clock on Atari, PET BASIC Delete Utility, PET Calculated Bar Graphs, Running 40 Column Programs on a CBM 8032.

June 1981: Computer Using Educators (CUE) on Software Pricing, Apple II Hires Character Generator, Ever- expanding Apple Power, Color Burst for Atari, Mixing Atari Graphics Modes 0 and 8, Relocating PET BASIC Programs, An Assembler In BASIC for PET, QuadraPET: Multitasking?

July 1981: Home Heating and Cooling, Animating Integer BASIC Lores Graphics, The Apple Hires Shape Writer, Adding a Voice Track to Atari Programs, Machine Language Atari Joystick Driver, Four Screen Utilities for the PET, Saving Machine Language Programs on PET Tape Headers, Commodore ROM Systems, The Voracious Butterfly on OSI.

August 1981: Minimize Code and Maximize Speed, Apple Disk Motor Control, A Cassette Tape Monitor for the Apple, Easy Reading of the Atari Joystick, Blockade Game for the Atari, Atari Sound Utility, The CBM "Fat 40," Keyword for PET, CBM/PET Loading, Chaining, and Overlaying.

October 1981: Automatic DATA Statements for CBM and Atari, VIC News, Undeletable Lines on Apple, PET, VIC, Budgeting on the Apple, Switching Cleanly from Text to Graphics on Apple, Atari Cassette Boot-tapes, Atari Variable Name Utility, Atari Program Library, Train your PET to Run VIC Programs, Interface a BSR Remote Control System to PET, A General Purpose BCD to Binary Routine, Converting to Fat-40 PET.

December 1981: Saving Fuel $$ (Multiple Computers: versions for Apple, PET, and Atari), Unscramble Game (multiple computers), Maze Generator (multiple computers), Animating Applesoft Graphics, A Simple Printer Interface for the Apple II, A Simple Atari Wordprocessor, Adding High Speed Vertical Positioning to Atari P/M Graphics, OSI Supercursor, A Look At SuperPET, Supermon for PET/CBM, PET Mine Maze Game.

January 1982: Invest (multiple computers), Developing a Business Algorithm (multiple computers), Apple Addresses, Lowercase with Unmodified Apple, Cryptogram Game for Atari, Superfont: Design Special Character Sets on Atari, PET Repairs for the Amateur, Micromon for PET, Self-modifying Programs in PET BASIC, Tinymon: a VIC Monitor, Vic Color Tips, VIC Memory Map, ZAP: A VIC Game.

February 1982: Insurance Inventory (multiple computers), Musical Transposition (multiple computers), Multitasking Emulator (multiple computers), Disassemble Apple Programs from BASIC, Plotting Polar Graphs on Apple, Atari P/M Graphics Made Easy, Atari PILOT, Put A Rainbow in your Atari, Marquee for PET, PET Disk Disassembler, VIC Paddles and Keyboard, VIC Timekeeping.

March 1982: Word Hunt Game (multiple computers), Infinite Precision Multiply (multiple computers), Atari Concentration Game, VIC Starfight Game, CBM BASIC 4.0 To Upgrade Conversion Kit, Apple Addresses, VIC Maps, EPROM Reliability, Atari Ghost Programming, Atari Machine Language Sort, Random Music Composition on PET, Comment Your Apple II Catalog.

April 1982: Track Down Those Memory Bugs (multiple computers), Shooting Stars Game (multiple computers), Intelligent Input Subroutines (multiple computers), Ultracube for Atari, Customizing Apple's Copy Program, Using PET/CBM In The High School Physics Lab, Grading Exams on a Microcomputer (multiple computers), Atari Mailing List, Renumber VIC Programs The Easy Way, Browsing the VIC Chip, Disk Checkout for PET/CBM.

May 1982: VIC Meteor Maze Game, Atari Disk Drive Speed Check, Modifying Apple's Floating Point BASIC, Fast Sort For PET/CBM, Extra Atari Colors Through Artifacting, Life Insurance Estimator (multiple computers), PET Screen Input, Getting The Most Out Of VIC's 5000 Bytes.

June 1982: Outpost Game (multiple computers), Apple Pascal Lister, Income Property (multiple computers), VIC Intelligent Videodisc System, Atari Disk Operating Systems, PET/Apple Search, A Self-modifying Atari P/M Utility, Use Atari Joysticks with VIC, VIC/PET Program Transfers.

July 1982: Gold Miner Game (Atari and VIC), IRA Planner (multiple computers), Atari Video Graphics, Apple DOS Changer, Super QuadraPET, VIC Overview, Maze Race (multiple computers), Direct Access File Editor (PET and Atari), VIC Super Expander Memory Map, Using The 6560 Video Interface Chip, PET Compactor, Headless FORTH Metacompilation, Test RAM Nondestructively (multiple computers).

August 1982: The New Wave Of Personal Computers, Household Budget Manager (multiple computers), Word Games (multiple computers), Color Computer Home Energy Monitor, Intelligent Apple Filing Cabinet, Guess That Animal (multiple computers), PET/CBM Inner BASIC, VIC Communications, Keyprint Compendium, Animation With Atari, VIC Curiosities, Atari Substring Search, PET and VIC Electric Eraser.

September 1982: Apple and Atari and the Sounds of *TRON*, Commodore Automatic Disk Boot, VIC Joysticks, Three Atari GTIA Articles, Color Computer Graphics, The Apple Pilot Language, Sprites and Sound on the Commodore 64, Peripheral Vision Exerciser (multiple computers), Banish INPUT Statements (multiple computers), Charades (multiple computers), PET Pointer Sort, VIC Pause, Mapping Machine Language, Editing Atari BASIC With the Assembler Cartridge, Process Any Apple Disk File.

Home and Educational COMPUTING! (Fall 1981 and Summer 1981 – count as one back issue): Exploring The Rainbow Machine, VIC As Super Calculator, Custom Characters, Alternate Screens, Automatic Line Numbers, Using The Joystick (Spacewar Game), Fast Tape Locater, Window, VIC Memory Map.

Back issues are $3 each or six for $15. Price includes freight in the US. Outside the US add $1 per magazine ordered for surface postage. $4 per magazine for air mail postage. All back issues subject to availability.

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NEWS & PRODUCTS

Commodore 64 And VIC-20 Products

Human Engineered Software (HES) has introduced new software products and a sound-enhancing peripheral for Commodore 64 computers.

Soundbox improves the VIC-20's sound output for arcade games. In addition to the VIC-20, it can be used with Atari, Texas Instruments and other Commodore systems. Soundbox features include audio out, video out and audio in (for Commodore 64). Its suggested retail price is $14.95.

HES's 6502 Professional Development System is a cassette-based assembler package that offers a one-or two-pass 6502 assembler using standard MOS mnemonics and operand formats. It is available for the VIC-20 as well as for the Commodore 64 and has a suggested retail price of $29.95.

HESMON 64 is an adaptation of the HESMON cartridge for the VIC-20. It gives 64 owners the same machine language monitor with mini-assembler. The suggested retail price is $39.95.

HESCARD is an expansion board that includes four switchable slots and a reset button. The board has high-quality connectors and gold-plated edge fingers. Its suggested retail price is $29.95.

Turtle Graphics II is an advanced version of David Malmberg's Turtle Graphics that uses the full graphics features of the Commodore 64. Suggested retail is $59.95.

HESWRITER 64 is a sophisticated word processing package for the Commodore 64, based on HESWRITER for the VIC-20. Its features include full-screen editing; the package has a suggested retail price of $44.95.

Human Engineered Software
71 Park Lane
Brisbane, CA 94005
(415)468-4900

HESWRITER 64 is one of several new releases from Human Engineered Software.

Pressure Sensitive Keyboard For The Physically Handicapped

Cacti Computer Services is marketing a large (11" x 21"), pressure sensitive keyboard with widely spaced key contacts to enable users with limited finger and hand control to operate a microcomputer.

The system consists of large keyboard, interface to plug into the computer, connecting cables, plastic mask, and a driver routine to permit the large keyboard to function as a regular keyboard. Once the driver routine has been loaded, both the regular keyboard and the large keyboard function to run commercially available software without modification. The system can be installed and operated with no technical knowledge required.

Several keyboard layouts are available, and custom arrangements will be made at no extra charge.

Cacti Computer Services keyboard.

The system is presently available for immediate delivery for use with the Commodore PET/CBM at a cost of $525 (U.S.), and is being developed for the Apple. Interfaces may be developed for other systems, depending upon demand.

Cacti Computer Services
130 9th St. S.W.
Portage la Prairie
Manitoba, Canada, R1N 2N4

Guide To Applesoft BASIC

Hayden Book Company has published *Basic Apple BASIC*, a complete guide to Applesoft BASIC from beginning concepts to advanced topics. It provides alternative techniques for programming in Apple Integer BASIC and can be used as a textbook or read by anyone interested in BASIC programming on an Apple. The book is written by James Coan, also the author of *Basic BASIC*.

Applesoft BASIC is explained with short, complete programs that are slowly built to larger ones. More than 80 sample programs are presented; all can be quickly located with the book's program index. Programs are divided into small segments, most of which will fit on an Apple screen. Longer programs consist of a control routine at the beginning that handles all program management using subroutines.

Chapter One explains how to enter data and get results, and the programmer's corner covers immediate-mode execution. Chapter Two offers ideas on planning a program; the programmer's corner explains the Apple's special screen editing. Low-resolution graphics are presented in Chapter Three, and the programmer's corner tells how to obtain full-screen graphics.

Chapter Four contains a potpourri of BASIC features and programming techniques, with a programmer's corner that shows how to read the keyboard without using an INPUT statement. Chapter Five presents strings, and the programmer's corner reveals the character sets used by both BASICs. Chapter Six covers

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Commodore Products for the VIC-20

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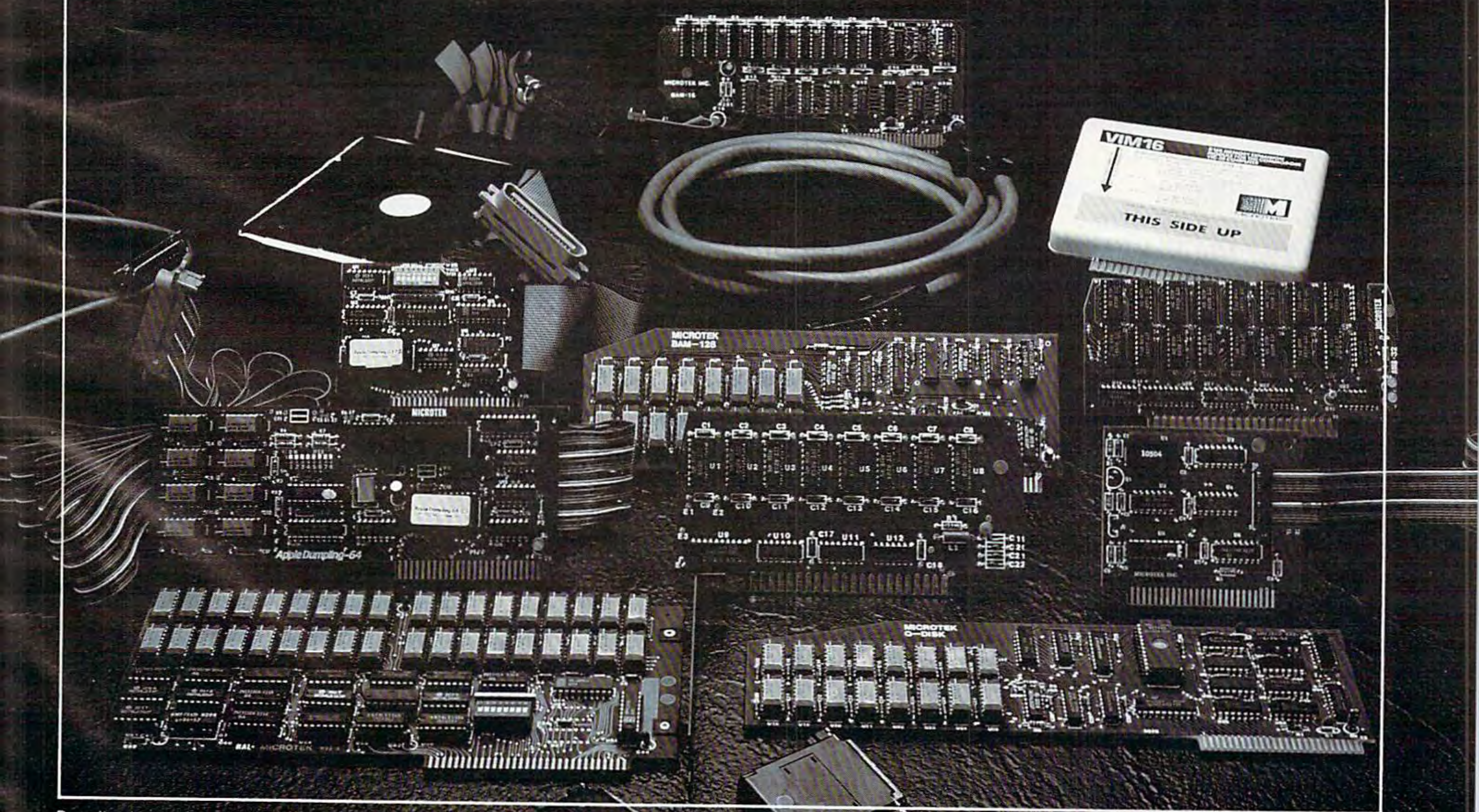

numeric and string arrays, with a programmer's corner presenting integer variables in Applesoft.

Chapter Seven is a collection of miscellaneous applications; the programmer's corner concerns a menu program. Sequential and random access files are the topic of Chapter Eight, and some advanced features of file handling are in the programmer's corner. Chapter Nine presents high-resolution graphics using Applesoft, and the programmer's corner offers an example of a shape table.

Basic Apple BASIC by James Coan, 237 pp., 7 x 9, paper, ISBN-0-8104-5626-5, $12.95.

Hayden Book Company, Inc.
50 Essex Street
Rochelle Park, NJ 07662
(201)843-0550

Keyboard For The Atari 400

Microtronics has released the Joytyper 400, a standard full-travel keyboard for the Atari 400. The keyboard layout is the same as on the Atari 400/800, except that the right-hand SHIFT key is in the more usual location. The game keys are beside the space bar.

The Joytyper 400 has standard gray two-shot molded keycaps. The RESET key has an extra stiff spring, low profile, out-of-the-way keycap. The aluminum case (14" x 5" x 1") is color-matched with the Atari 400.

Electronic connection is simple: unplug the membrane keyboard, then plug in the Joytyper 400. Physical attachment: by industrial adhesive strips or by drill and bolt. The Joytyper 400 comes with a 90-day warranty on materials and workmanship. The cost is $129.95 plus $5 postage and handling.

Microtronics' Joytyper 400.

Microtronics, Inc.
P.O. Box 8894
Fort Collins, CO 80525
(303)226-0108

Preschool Library For The Atari

Program Design has announced the publication of its *Preshool Library*, a package that includes four popular PDI titles:

Sammy the Sea Serpent – An interactive story with a voice narration: the child uses a joystick to guide poor lost Sammy back to the sea. There are also games that the child can play with Sammy.

The Adventures of Oswald – As a narrator tells a story about a young boy named Oswald, children use the joystick to help Oswald walk, climb, jump, and escape from a deep, deep tunnel. There's also a game entitled "Oswald and the Golden Key."

Preschool IQ Builder 1 – Part 1: Decide whether pairs of figures are the same or different. Part 2: Match the letter at the top of the screen with the same letter at the bottom of the screen.

Preschool IQ Builder 2 – Six lessons of increasing difficulty ask the child to match the letter, number, shape or word at the top of the screen with the same object at the bottom of the screen.

PDI's Preschool Library is designed to help three- to six-year-olds develop certain critical skills that will be needed when they start school. The programs have five important objectives:

1. To teach shape, letter, and number recognition

2. To present the concept of *same* and *different*

3. To reinforce directional concepts

4. To develop listening skills

5. To improve hand-eye coordination

The package includes a detailed *User's Guide*. In addition to describing each program and explaining how to use it, the guide presents supplementary activities that reinforce and expand the material covered in the programs.

PDI's Preschool Library is designed for use on Atari 400/800 computers. It consists of four cassettes and the *User's Guide*, packaged in a convenient storage container. It requires a minimum memory of 16K and retails for $59.95.

Each of the four titles in the package is also available individually, on either cassette or disk. The cassette versions of each title require 16K of memory and retail for $16.95. The disk versions require 24K and retail for $23.95.

Program Design, Inc.
11 Idar Court
Greenwich, CT 06830
(203)661-8799

New Products For Commodore Computers

Computer Marketing has released several new products for Commodore computers. *Calc Result* is a three-dimensional spread-sheet program for the CBM 8032/8096 and Commodore 64. It provides a minimum of 32 pages of 63 x 254 cells, graphics (histograms) on screen and printer, the capability to view as many as three spread-sheets at one time through a window and split screen, and help functions on-line.

VIC/64 Switch connects up to eight VICs or 64's to share disks and printers. VIC-Relay Cartridge simplifies control of

electrical equipment; contains six relays and two optocouplers. VIC-Graf Cartridge is an aid for studying complicated equations and functions by their graphs.

VIC-Stat Cartridge is a programmable cartridge consisting of assembler codes to simplify work with statistics and graphics, adding 15 commands to BASIC. VIC-FORTH Cartridge is a powerful operating system and programming language suitable for various applications in business and process control.

Computer Marketing Services, Inc.
300 W. Marlton Pike
Cherry Hill, NJ 08002
(609)795-9480

Daisy Wheel Printer For TRS-80

Radio Shack has added a second full-featured daisy wheel printer to its TRS-80 computer product line. The new DWP-410 (26-1250) is available for $1495 at Radio Shack Computer Centers and participating Radio Shack stores and dealers.

Radio Shack's daisy wheel printer.

The DWP-410 prints executive-quality correspondence and reports at over 300 words per minute. It features selectable pitch – either 10 or 12 characters per inch – or proportional spacing. Interchangeable 124-character print wheels provide easy type-face selection. External Program Mode allows the use of print wheels with different pitch or special characters.

The DWP-410 also features forward and reverse full and half line paper feed, underline, and programmable backspace, plus 1/120-inch minimum space and 1/48-inch line feed. Automatic Paper Set makes paper insertion easy and precise.

The DWP-410 Daisy Wheel Printer is U.L. listed, includes a standard parallel interface, and comes complete with print wheel and carbon ribbon cartridge.

Tandy Corporation / Radio Shack
1800 One Tandy Center
Fort Worth, TX 76102

Recorder Interface For Sinclair/Timex

Bytesize Computer Products has introduced the Z-DUBBER, an interface between the Sinclair computer and its cassette recorder which allows even the most difficult cassette program to load more easily. Additionally, the Z-DUBBER allows you to connect two cassette recorders to create perfect backup copies of your Sinclair programs. The Z-DUBBER operates on two AAA cells. It is available for $29.95 plus 3% shipping.

Bytesize Computer Products
P.O. Box 21123
Seattle, WA 98111

Z-DUBBER interface for Sinclair/Timex.

Printer Interface For The Commodore VIC And 64

Cardco, Inc., has introduced a microprocessor controlled printer interface for the Commodore VIC-20 and 64 computers. The "Card/?" (pronounced card-print) features an eight-bit, eight-megahertz Intel microprocessor with 1K of onboard ROM software. This advanced design allows the user to plug any standard parallel printer into the VIC printer port.

Using the VIC's own printer commands, in conjunction with seven additional commands added by the interface, allows currently available programs to be run without any modifications to the hardware or software. All of the CBM ASCII irregularities are compensated for by the interface.

Features such as upper/lowercase selection and auto line feed after carriage return can be controlled from the keyboard or from program control. Additionally, the unit offers a graphics mode that will pass all character string numbers without modification, and a special program listing mode that automatically substitutes bracketed letters in place of VIC graphic characters in program listings, making them far easier to read.

The "Card/?" includes all necessary cords and cables. Simply plug it in and print, no switches to switch, and no modifications required.

The "Card/?" is available from computer stores nationwide for only $79.95 suggested retail.

Cardco, Inc.
3135 Bayberry
Wichita, KS 67226
(316)685-9536

Drawing Program For Children

Spinnaker Software has released *Delta Drawing Computer Graphics*, an introduction to programming for children 4 to 14.

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With *Delta Drawing*, children create colorful drawings on the computer screen using single keystroke commands to control the Delta Cursor. Complex pictures, patterns, and designs can be built from simple drawings because drawings are stored as programs and can be used to create extremely complex and sophisticated graphics. Drawings also can be saved on a disk and printed, if a graphics printer is available.

Spinnaker Software's graphics package for children.

In the new program, developed by Computer Access Corporation, editing pictures has been made as simple as pushing E for erase. There are no syntax errors to frustrate the young learner.

The program has been extensively play-tested in Boston-area schools since March 1982. Teachers have recommended using *Delta Drawing* prior to introducing children to Logo's Turtle Graphics. *Delta Drawing* has been commended for its simplicity and the ease by which children can produce a stunning variety of computer graphics. No prerequisites are required. A user does not have to be able to read, write, or even know English to use *Delta Drawing*.

The program is compatible with Apple, Atari, and IBM systems. The cost is $59.95.

Spinnaker Software
215 First Street
Cambridge, MA 02142
(617)868-4700

Darkroom Process Timer For The Atari

Darkroom Software has introduced *Computer Clockwork*, a flexible, programmable darkroom process timer.

– May be used to time most photographic processes.

– Counts down each step of a processing program second by second, and displays remaining time in both digital and bar graph format.

– Permits varying times for each step in a process, from one second to 36 hours.

– Allows between 25 and 300 single option steps, depending on available memory.

– Temporarily suspends the timing of a step, then will continue, skip over, or restart the step without restarting the whole process.

– Uses the Atari's sound capabilities to help the user maintain consistent film agitation.

– Requires no special timing modules or interface cards.

– Comes with 24-page user's guide.

The program requires an Atari 400/800, 16K (cassette) or 32K (diskette), Atari BASIC cartridge, and extra cassettes or diskettes to save process programs. Optional accessories: one joystick controller, and a red or amber plastic screen cover. The cost is $24.95 for cassette or diskette, plus $2 for shipping and handling.

Darkroom Software
1925-D Pacific Beach Drive
San Diego, CA 92109
(619)274-3495

Games From Children's Television Workshop For Apple

The playful approach to learning used in *Sesame Street* television programs is incorporated into 16 new computer games now available from Apple Computer, Inc.

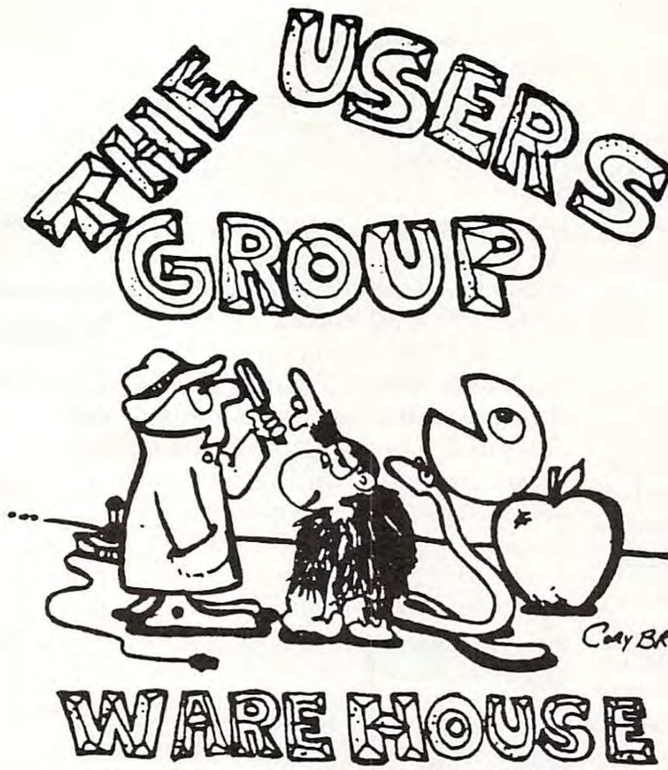
Discovery Games were developed by Children's Television Workshop (CTW), the creators of *Sesame Street*, for use in the home by children aged 4 to 13. Colorful, animated characters, including the familiar Muppets, and lively sound effects encourage children to practice reading, problem-solving and motor skills, and to use their creative abilities.

As they play with *Discovery Games*, children practice number skills and work with words and sentences. The programs also exercise recall ability, stimulate creativity, and acquaint children with computers.

Four *Discovery Games* packages are available, each containing four games.

* *Ernie's Quiz*, for ages 4 to 7, includes Muppet and number guessing games and a program that lets the child create a face, using game paddles to select

New computer programs from Apple Computer and the Children's Television Workshop.



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USERS GROUP WAREHOUSE P.O. BOX 1075 GLENDALE, CA 91209 : 213-247-6484 from a variety of eyes, noses, and other facial features.

* *Instant Zoo,* for ages 7 to 10, is a set of fast-moving games that encourage quick reactions as the child unscrambles words, spots shooting stars, names animals, and matches pairs of words. A word editor lets the child or parent add word lists to the easy, medium, and hard lists provided in the program.

* *Spotlight,* for ages 9 to 13, includes games that present advanced ideas, such as the way light will angle when reflected off a mirror, and how to guess a three-digit number using clues.

* *Mix and Match* is for all ages, allowing families to play *Discovery Games* together. The package includes easy games for younger children as well as more advanced programs for other members of the family.

Each of the four packages is sold separately at a suggested retail price of $50. The packages include activity booklets of ideas for using the games to exercise the child's imagination and creativity.

The programs run on 48K Apple II or Apple II Plus systems with one disk drive. A color monitor or television is recommended. *Mix and Match* requires Applesoft BASIC, and the other packages require Integer BASIC. *Ernie's Quiz* and *Spotlight* also require hand controllers. The games which do not require paddles will run in emulation mode on an Apple III.

Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014
(408)973-3019

Video Games For The VIC-20

Tronix Publishing has introduced three fast action video games for use with the Commodore VIC-20 home computer.

The new games are *SWARM!, Sidwinder,* and *Galactic Blitz.*

Created by designer Jimmy Huey, the three games feature frenetic action, colorful graphics and sound effects, and all are written in VIC-20 machine code. All the games are responsive to joysticks, and *SWARM!* works with a trackball as well.

SWARM! players must contend with deadly android wasps that are aided by various alien creatures. The wasps and aliens jump, fly, crawl, and hurl themselves at players, and any contact insures instant destruction. *SWARM!* offers 40 levels of play. Suggested list price is $29.95.

Sidewinder *for the VIC from Tronix Publishing.*

In *Sidewinder,* players lead their squadron of skilled helicopter commandos into deadly battle with killer pods in outer space. The Sidewinder forces go head to head with alien oblitojets while also dodging stalker bombs at high speed. Complete with a firing button and warning buzzers which sound when the enemy presses in, *Sidewinder* offers ten battle levels. It is priced at $29.95.

Galactic Blitz pits the player against a squadron of killer aliens who attack en masse. The aliens include Heartattacks, Pearons, Energridders, Beheadhinds and Towelships. *Galactic Blitz* offers 15 play patterns, the price is $24.95.

Accompanying each game is a four-color, self-displaying package for the games which holds 12 products.

Tronix Publishing, Inc.
701 West Manchester Blvd.
Inglewood, CA 90301
(213)761-8440

Talking Game Contest

The Alien Group, manufacturers of the Voice Box speech synthesizer for Atari and Apple II computers, has announced the Voice Box-ing Match Contest for the best talking or singing game program. This contest is for educational, adventure, arcade-style games, or something completely new in amusement or educational programming.

A panel of 13- to 18-year-old computer game players will judge entries on the basis of originality, playability, and quality of Voice Box use.

$6,800 in prizes plus royalties will be awarded, as follows:

First Prize	$5,000
Second Prize	$1,000
Third Prize	$500
Fourth Prize	$200
Fifth Prize	$100

Contest rules and further information can be obtained by writing:

The Alien Group
27 W. 23rd St.
New York, NY 10010

Games For Atari

Brøderbund Software has introduced two new games for the Atari:

David's Midnight Magic, by David Snider, is a pinball game for the Atari 400/800, 48K diskette. The game has dual flipper controls, bumper action, rollovers, multiple ball play, and all the sounds and lights of a classic

tele soft, inc.

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commodore

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arcade pinball machine. Requires paddles; suggested retail is $34.95.

Stellar Shuttle, by Matt Rutter, is an arcade-style game with four levels of play. You are assigned a dangerous rescue mission to the planet Ttam. You must maneuver your space shuttle among streaking asteroids, using retro rackets to control your rate of descent to the planet's surface. The rockets are also your only defense against the dragons that try to prevent you from rescuing the hostages and transporting them safely to the mother ship. Available only for Atari 400/800 (32K disk, 16K cassette); joystick controlled. Suggested retail is $24.95.

Brøderbund Software, Inc.
1938 Fourth Street
San Rafael, CA 94901
(415)456-6424

Commodore Donates Educational Programs

This fall Commodore announced the donation of 656 educational computer programs to the public domain. The programs may be copied by public and private educational institutions and by private computerists.

The first 656 programs in the series, drawn from educators around the world, have been standardized, categorized, and recorded on 50 disks.

The programs are compatible with any Commodore computer, including the PET 2001 and 4000 series, the CBM, and the new Commodore 64.

CALENDAR

March 10-12, 1983, Great Falls, Montana. The Second Annual Rocky Mountain Computer Conference, conducted by the Montana Council of Teachers of Mathematics (MCTM) and the Montana Office of Public Instruction. Seventy sections and workshops will be available in all areas of interest. Also available: mini-courses with three or four sessions in a single area of interest, and many workshops providing hands-on experience. Areas to be presented in workshops include reading, special education, music, vocational education, computer networks, English, and many others. Registration for members of Math, Reading and Science Councils is $15; registration for non-members is $43. For more information, contact Dan Dolan, Math and Computer Education Specialist, Office of Public Instruction, Helena, MT 59620. 1-800-332-3402. For pre-registration information, contact Gary Bauer, Conference Chairman, 125 Rieverview 2E, Great Falls, MT 59404.

April 26-28, New York; June 14-16, Washington; July 5-7, London; July 11-15, Los Angeles. Technology Opportunity Conferences, focusing on the convergence of optical storage, videodisk, and computer technology. Conference series (five more scheduled for 1983) launched by Edward S. Rothchild, publisher of *Optical Memory Newsletter Including Interactive Videodisks*, San Francisco, California, and Roy R. Goodman, Managing Director of Office of the Future Limited, of Richmond, England. One of several aims of the conferences is to provide an ongoing dialogue between executives in both vendor and end user organizations to plan future products, applications, and markets. In the U.S., contact Ed Rothchild, (415)626-1133; in the U.K., Roy Goodman 01-948-2203.

April 28-30, Washington, DC. Ed·Com/Spring '83, a national computer conference and exposition for educators of all levels. More than 300 session hours featuring demonstrations, seminars, hands-on sessions, panels, and MicroCourses. For further information, contact Carol Houts, Judco Computer Expos, Inc., 2629 North Scottsdale Road, Suite 201, Scottsdale, AZ 85257, toll free outside Arizona (800)528-2355; in Arizona (602)990-1715.

May 21, University of Oklahoma, Norman. The sixth annual spring microComputer Show & Tell Conference to permit sharing of hardware, software, and state-of-the-art ideas. Two major 45-minute talks are planned, as well as 30 five-minute talks. Each set of six five-minute talks will be followed by a 30-minute question/answer/demonstration period. An on-the-spot programming contest (with prizes) will also be held. Computer buffs not actually attending the conference may participate by submitting *original* programs for possible publication in *Conference Proceedings* and for a prize competition. Additional information, application forms, or directions for submitting programs may be obtained by sending an SASE to: Show & Tell, Dr. Richard V. Andree, 601 Elm, Room 423, Norman, OK 73019.

COMPUTE! *welcomes notices of upcoming events and requests that the sponsors send a short description, their name and phone number, and an address to which interested readers may write for further information. Please send notices at least three months before the date of the event, to: Calendar, P.O. Box 5406, Greensboro, NC 27403.*

New Product releases are selected from submissions for reasons of timeliness, available space, and general interest to our readers. We regret that we are unable to select all new product submissions for publication. Readers should be aware that we present here some edited version of material submitted by vendors and are unable to vouch for its accuracy at time of publication. ©

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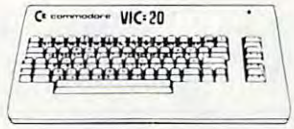

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How To Type COMPUTE!'s Programs

Many of the programs which are listed in **COMPUTE!** contain special control characters (cursor control, color keys, inverse video, etc.). To make it easy to tell exactly what to type when entering one of these programs into your computer, we have established the following listing conventions. There is a separate key for each computer. Refer to the appropriate tables when you come across an unusual symbol in a program listing. If you are unsure how to actually enter a control character, consult your computer's manuals.

Atari 400/800

Characters in inverse video will appear like: INVERSE VIDEO
Enter these characters with the Atari logo key, {人}.

When you see	Type	See	
{CLEAR}	ESC SHIFT <	↖	Clear Screen
{UP}	ESC CTRL -	↑	Cursor Up
{DOWN}	ESC CTRL =	↓	Cursor Down
{LEFT}	ESC CTRL +	←	Cursor Left
{RIGHT}	ESC CTRL *	→	Cursor Right
{BACK S}	ESC DELETE	◀	Backspace
{DELETE}	ESC CTRL DELETE	◧	Delete character
{INSERT}	ESC CTRL INSERT	◨	Insert character
{DEL LINE}	ESC SHIFT DELETE	⊟	Delete line
{INS LINE}	ESC SHIFT INSERT	⊞	Insert line
{TAB}	ESC TAB	▶	TAB key
{CLR TAB}	ESC CTRL TAB	◧	Clear tab
{SET TAB}	ESC SHIFT TAB	◨	Set tab stop
{BELL}	ESC CTRL 2	◪	Ring buzzer
{ESC}	ESC ESC	↰	ESCape key

Graphics characters, such as CTRL-T, the ball character ● will appear as the "normal" letter enclosed in braces, e.g. {T}.

A series of identical control characters, such as 10 spaces, three cursor-lefts, or 20 CTRL-R's, will appear as {10 SPACES}, {3 LEFT}, {20 R}, etc. If the character in braces is in inverse video, that character or characters should be entered with the Atari logo key. For example, {♥} means to enter a reverse-field heart with CTRL-comma, {5U} means to enter five inverse-video CTRL-U's.

Commodore PET/CBM/VIC

Generally, any PET/CBM/VIC program listings will contain bracketed words which spell out any special characters: {DOWN} would mean to press the cursor-down key; {3DOWN} would mean to press the cursor-down key three times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing the other key), the key would be underlined in our listing. For example, S would mean to type the S key while holding the shift key. This would result in the "heart" graphics symbol appearing on your screen. Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

Sometimes in a program listing, especially within quoted text when a line runs over into the next line, it is difficult to tell where the first line ends. How many times should you type the SPACE bar? In our convention, when a line breaks in this way, the ~ symbol shows exactly where it broke. For example:

```
100 PRINT "TO START THE GAME  ~
    YOU MAY HIT ANY OF THE KEYS
    ON YOUR KEYBOARD."
```

shows that the program's author intended for you to type two spaces after the word *GAME*.

All Commodore Machines

Clear Screen	{CLEAR}	Cursor Left	{LEFT}
Home Cursor	{HOME}	Insert Character	{INST}
Cursor Up	{UP}	Delete Character	{DEL}
Cursor Down	{DOWN}	Reverse Field On	{RVS}
Cursor Right	{RIGHT}	Reverse Field Off	{OFF}

VIC/CBM 64 Conventions

Set Color To Black	{BLK}	Function Two	{F2}
Set Color To White	{WHT}	Function Three	{F3}
Set Color To Red	{RED}	Function Four	{F4}
Set Color To Cyan	{CYN}	Function Five	{F5}
Set Color To Purple	{PUR}	Function Six	{F6}
Set Color To Green	{GRN}	Function Seven	{F7}
Set Color To Blue	{BLU}	Function Eight	{F8}
Set Color To Yellow	{YEL}	Any Non-implemented Function	{NIM}
Function One	{F1}		

To enter any color code, hold down CTRL and press the appropriate color key. Use CTRL-9 for RVS on and CTRL-0 for RVS off.

8032/Fat 40 Conventions

Set Window Top	{SET TOP}	Erase To Beginning	{ERASE BEG}
Set Window Bottom	{SET BOT}	Erase To End	{ERASE END}
Scroll Up	{SCR UP}	Toggle Tab	{TGL TAB}
Scroll Down	{SCR DOWN}	Tab	{TAB}
Insert Line	{INST LINE}	Escape Key	{ESC}
Delete Line	{DEL LINE}		

When you see an underlined character in a PET/CBM/VIC program listing, you need to hold down SHIFT as you enter it. Since the VIC-20 and Commodore 64 have fewer keys than the PET/CBM, some graphics are grouped with other keys and have to be entered by holding down the Commodore key. If you see any of the symbols in the left column underlined in a listing, hold down the Commodore key and enter the symbol in the right column. Just use SHIFT to enter all other underlined characters.

!	K	←	*	1	E
"	I	↑	PI	2	R
#	T	.	S	3	W
$	@	–	Z	4	H
%	G	=	X	5	J
'	M	<	C	6	L
&	#	>	V	7	Y
\	–	,	D	8	U
;	F	/	P	9	I
?	B	*	N	@	SHIFT*
(	£	+	Q	[	SHIFT +
)	SHIFT-£	0	A	]	SHIFT –

Apple II / Apple II Plus

All programs are in Applesoft BASIC, unless otherwise stated. Control characters are printed as the "normal" character enclosed in brackets, such as {D} for CTRL-D. Hold down CTRL while pressing the control key. You will not see the special character on the screen.

TRS-80 Color Computer

No special characters are used, other than lowercase. When you see letters printed in inverse video (white on black), press SHIFT-0 to enter the characters, and then press SHIFT-0 again to return to normal uppercase typing.

Texas Instruments 99/4

No special control characters are used. Enter all programs with the ALPHA lock on (in the down position). Release the ALPHA lock to enter lowercase text.

Timex TS-1000, Sinclair ZX-81

Study your computer manual carefully to see how to enter programs. Do not type in the letters for each command, since your machine features single-keystroke entry of BASIC commands. You may want to switch to the FAST mode (where the screen blanks) while entering programs, since there will be less delay between lines. (If the blanking screen bothers you, switch to the SLOW mode.)

A Beginner's Guide To Typing In Programs

What Is A Program?

A computer cannot perform any task by itself. Like a car without gas, a computer has *potential*, but without a program, it isn't going anywhere. Most of the programs published in **COMPUTE!** are written in a computer language called BASIC. BASIC is easy to learn and is built into most computers (on some computers, you have to purchase an optional BASIC cartridge).

BASIC Programs

Each month, **COMPUTE!** publishes programs for many machines. To start out, type in only programs written for your machine, e.g., "TI Version" if you have a TI-99/4. Later, when you gain experience with your computer's BASIC, you can try typing in and converting certain programs from one computer to yours.

Computers can be picky. Unlike the English language, which is full of ambiguities, BASIC usually has only one "right way" of stating something. Every letter, character, or number is significant. A common mistake is substituting a letter such as "O" for the numeral "0", a lowercase "l" for the numeral "1", or an uppercase "B" for the numeral "8". Also, you must enter all punctuation such as colons and commas just as they appear in the magazine. Spacing can be important. To be safe, type in the listings *exactly* as they appear.

Brackets And Special Characters

The exception to this typing rule is when you see the curved bracket, such as "{DOWN}". Anything within a set of brackets is a special character or characters that cannot easily be listed on a printer. When you come across such a special statement, refer to the appropriate key for your computer. For example, if you have an Atari, refer to the "Atari" section in "How to Type COMPUTE!'s Programs."

About DATA Statements

Some programs contain a section or sections of DATA statements. These lines provide information needed by the program. Some DATA statements contain actual programs (called machine language); others contain graphics codes. These lines are especially sensitive to errors.

If a single number in any one DATA statement is mistyped, your machine could "lock up," or "crash." The keyboard, break key, and RESET (or STOP) keys may all seem "dead," and the screen may go blank. Don't panic – no damage is done. To regain control, you have to turn off your computer, then turn it back on. This will erase whatever program was in memory, so always SAVE a copy of your program before you RUN it. If your computer crashes, you can LOAD the program and look for your mistake.

Sometimes a mistyped DATA statement will cause an error message when the program is RUN. The error message may refer to the program line that READs the data. *The error is still in the DATA statements, though.*

Get To Know Your Machine

You should familiarize yourself with your computer before attempting to type in a program. Learn the statements you use to store and retrieve programs from tape or disk. You'll want to save a copy of your program, so that you won't have to type it in every time you want to use it. Learn to use your machine's editing functions. How do you change a line if you made a mistake? You can always retype the line, but you at least need to know how to backspace. Do you know how to enter inverse video, lowercase, and control characters? It's all explained in your computer's manuals.

A Quick Review

1) Type in the program a line at a time, in order. Press RETURN or ENTER at the end of each line. Use backspace or the back arrow to correct mistakes.

2) Check the line you've typed against the line in the magazine. You can check the entire program again if you get an error when you RUN the program.

3) Make sure you've entered statements in brackets as the appropriate control key (see "How To Type COMPUTE!'s Programs" elsewhere in the magazine.)

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in **COMPUTE!** *due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on this page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Ask The Readers, P.O. Box 5406, Greensboro, NC 27403.*

CAPUTE!

Modifications Or Corrections To Previous Articles

Supermon 64

To get Jim Butterfield's machine language monitor for the Commodore 64 in the January 1983 issue to run properly, it is necessary to change the direct mode command listed on page 164 as POKE 45,232 to POKE 45,235.

Thunderbird

Some additional initialization is required in the Color Computer version of this game, which appeared in the January issue (p. 71). In order to get 1000 points on each new board and 10000 points with a new reset after the second board, you should add these two lines:

```
2011 TY=0
3035 HIT=0
```

Apple Memory Aid

In the article "Apple Machine Language Memory Aid" in the January issue (p. 160), lines 31, 29, 35, 33, and 51 mentioned in the text should be 310, 290, 350, 330, and 510. In the program listing, line 68 should be deleted.

WAITing On The VIC-20

In the notes in the January 1983 issue (p. 156) on testing VIC-20 joysticks with the WAIT statement, the following changes should be made:

```
LEFT   WAIT 37137,16,16
DOWN   WAIT 37137,8,8
```

Atari Simulator

The following changes will allow proper operation of the +, -, *, and / functions in the Atari version of the electronic spreadsheet program Tiny Plan, page 80 of the December 1982 issue.

```
2310 IF T$="+ " THEN DA(R3,C3)=DA(R1,
     C1)+DA(R2,C2)
2320 IF T$="- " THEN DA(R3,C3)=DA(R1,
     C1)-DA(R2,C2)
2330 IF T$="* " THEN DA(R3,C3)=DA(R1,
     C1)*DA(R2,C2)
2340 IF T$="/ " AND DA(R2,C2)<>0 THEN
      DA(R3,C3)=DA(R1,C1)/DA(R2,C2)
2350 IF T$="% " THEN DA(R3,C3)=DA(R1,
     C1)*DA(R2,C2)/100
```

VIC Hi-Res Graphics

The following correction will clear up some confusion concerning the article "Understanding VIC High Resolution Graphics" which appeared in the December issue. To make the 8K example

PRODUCT MART

(CAPUTE! (continued)

(Program 2) load correctly, replace the sentence on page 167 which now reads:

> Before typing in or loading this program, type in the following:

with these corrected instructions:

> Type in Program 2 and then SAVE it. Next, type in the following three POKE commands and then LOAD your hi-res program.

CalCalc

For those in the age bracket 40-50 who felt left out when attempting to use this program from the December 1982 issue (p. 84), the line below should be added to both the Microsoft and Atari versions.

```
785 IFAGE>=40ANDAGE<=50THEN CPD=3008:IF SX
     THEN CPD=2162
```

Atari Lister

In the program on page 191 of the January 1983 issue, the GOTO 32710 in lines 32715 and 32725 should be changed to GOTO 32705.

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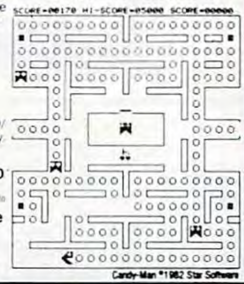

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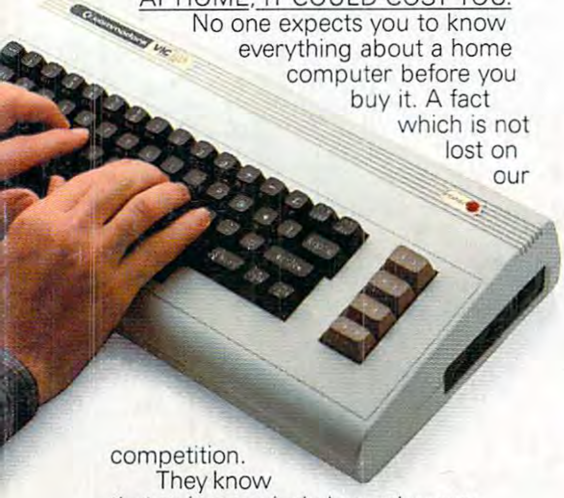

No one expects you to know everything about a home computer before you buy it. A fact which is not lost on our competition.

They know that an impressively low price can divert your attention from some depressingly cheap features. So that you won't know what you may be missing with their home computer until after it's been in your home for a while.

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Fortunately, you don't have to be a computer engineer to tell what makes the Commodore VIC 20™ superior to the competition. All you have to do is take advantage of three of your five senses.

Use your sense of vision and read this comparison chart. You can see in black and white where two of our major competitors have skimped. Use your sense of touch in the store. You'll feel the VIC 20's superiority immediately. It feels a lot more expensive than it is.

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NOW THAT YOU KNOW HOW EASY A COMMODORE HOME COMPUTER IS TO OWN, FIND OUT HOW EASY IT IS TO EXPAND.

One thing about home computers that you're bound to discover at home is that, once you learn what they can do, you'll want them to do more and more. To do this, you may need accessories called peripherals. These let you get more out of a home computer by letting you put more into it.

They include items like cassette recorders and disk drives to input data, modems for telecomputing and printers. And all VIC 20 peripherals are fully compatible with the powerful Commodore 64™ personal computer.

PLAN AHEAD.

When you start looking at your first home computer, you may think it's too early to start planning to add peripherals. If that's what you think, you're once again playing right into the hands of our competitors.

Because once they've gotten you to buy their home computer, for what seems to be a reasonable price, they have you hooked on their system.

The costs of which, if you'll examine the chart below, can really start getting unreasonable. For example, while these computers may seem to be close to the same price to start, an expanded system can cost you twice as much with TI or Atari as with the Commodore VIC 20 or Commodore 64.

EXPANSION COSTS	VIC 20™ or COMMODORE 64™	TI99/4A®	ATARI 400®
BASIC	Included	Included	$59.95
Peripheral Expansion System	Not Necessary	$249.95	Not Necessary
Disk Drive	$399.00	399.95	599.95
Disk Controller Card	Included	249.95	Included
Modem	109.95	224.95	199.95
Modem Interface	Included	174.95	219.95
TOTAL	**$508.95**	**$1299.75**	**$1079.80**

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THINK OF IT AS BUYING A TOASTER.

It's easy to fill up a computer ad with RAM's and ROM's, numbers and technical jargon. But when it comes right

down to it, buying a home computer is just like buying anything else. It's important to know just what you're getting for your hard-earned money.

And we hope we've accomplished that here by telling you about the cost of expanding your Commodore VIC 20 or Commodore 64 computer.

COMPUTER FEATURES	VIC 20	TI 99/4A	ATARI 400
Typewriter Keys	Yes	Yes	No
Typewriter Feel	Yes	No	No
Color Control Keys	Yes	No	No
Graphics on Keys	Yes	No	No
Reverse Letters	Yes	No	Yes
Programmable Function Keys	Yes	No	No
Works with TV or Monitor	Yes	Yes	No
True Lower Case Letters	Yes	No	Yes
DISK FEATURES			
Capacity	170K	90K	88K

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