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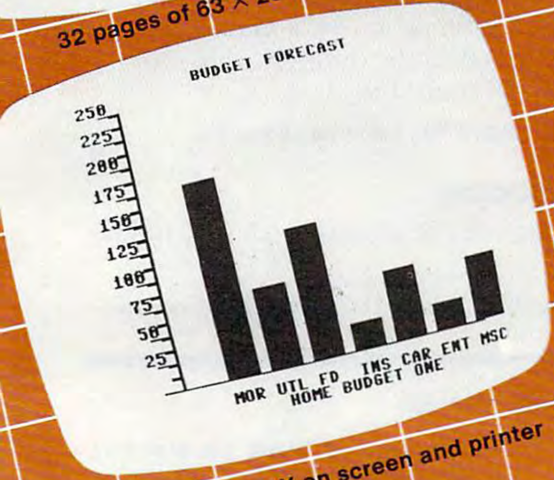

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Examine Program 1 now. The first part shows the "equates" for the program. These equates give names or labels to the various internal addresses that are used by the program. For example, NOKEYS stands for location $C6, and this location always contains the number of keystrokes stored in the keyboard buffer. IRQVEC stands for the IRQ vector stored in RAM (Random Access Memory). And so it goes for all of the labels. Each stands for a location, and usually the label suggests the meaning of the location in question.

The IRQ Routine

The escape key initialization occurs next. A new vector is stuffed into RAM, and this vector directs the computer to always jump to the start of the new IRQ routine. This routine occurs next in the listing. As this is the heart of the whole program, let's examine it in greater detail.

The first thing that happens here is that all of the registers are saved temporarily. Next, the last key depressed is examined. If it wasn't the British pound symbol (which is used for the escape key), then the registers are restored and the normal IRQ is finished. But if it is the desired key, then a zero is stored in three important locations. These are CMODE, REVERS, and NOINST. Stuffing a zero in CMODE turns off the quote mode, a zero in REVERS turns off the reverse screen mode, and a zero in NOINST nulls out the number of inserts pending. Turning off these three locations allows you to escape from all of the "offending" modes.

Blanking The Pound

Recall that a British pound symbol has been printed to the screen. A true escape key shouldn't print anything; it should simply "escape." So the next block of code deposits a blank on top of the British pound character and backs the cursor up one space. The net effect is that no residual character is printed. So a true escape key has been implemented.

Before going on to the rest of the normal IRQ routine (called IRQRTN in Program 1), the registers are restored. We have kept the new routine transparent to the normal VIC-20 operating system. For the Commodore 64, IRQRTN is $EA31 instead of $EABF.

Since there are now countless memory packages available for the VIC-20, some consideration must be given to finding a convenient location for the program. As mentioned, you might wish to assemble your own version. Most users, however, will want to use the BASIC loader in Program 2. This loader will put the program into the top of memory, wherever that might be. Thus, it works for all VIC-20's with any amount of extra memory (if any). For the Commodore 64, a minor change must be made to reflect the different value for IRQRTN, Line 230 should read:

```
230 DATA168,104,170,104,76,49,234
```

Make An Escape

To prepare a copy of this program for use, follow these steps:

1. Type in Program 2. If you have a Commo-

Program 1: Disassembly Of VIC Version

```
0000              NOKEYS = $C6        ;NUMBER OF KEYS IN BUFFER.
0000              REVERS = $C7        ;SCREEN REVERSE FLAG.
0000              ROW    = $D1        ;CURRENT CURSOR ROW.
0000              COLUMN = $D3        ;CURRENT CURSOR COLUMN.
0000              CMODE  = $D4        ;CURSOR MODE:0=DIRECT.
0000              INKEY  = $D7        ;LAST KEYSTROKE IN.
0000              NOINST = $D8        ;NUMBER OF INSERTS PENDING.
0000              KEYBRD = $0277      ;KEYBOARD BUFFER.
0000              IRQVEC = $0314      ;IRQ VECTOR.
0000              IRQRTN = $EABF      ;NORMAL IRQ ROUTINE.
0000              ;
1000  78                 SEI
1001  A2 0D              LDX #<NEWIRQ ;SET UP NEW IRQ VECTOR.
1003  A0 10              LDY #>NEWIRQ
1005  8E 14 03           STX IRQVEC
1008  8C 15 03           STY IRQVEC+1
100B  58                 CLI
100C  60                 RTS          ;RETURN TO BASIC.
100D              ;
100D  48          NEWIRQ PHA          ;SAVE ALL REGISTERS.
100E  8A                 TXA
100F  48                 PHA
1010  98                 TYA
1011  48                 PHA
1012  A5 D7              LDA INKEY    ;GET LAST KEY PUSHED.
1014  C9 5C              CMP #$5C     ;IS IT BRITISH POUND SIGN?
1016  D0 17              BNE MOVEON   ;BRANCH IF NOT.
1018  A2 00              LDX #$00     ;YES.
101A  86 D4              STX CMODE    ;TURN QUOTE MODE OFF.
101C  86 C7              STX REVERS   ;TURN REVERSE MODE OFF.
101E  86 D8              STX NOINST   ;TURN INSERT MODE OFF.
1020  E8                 INX          ;TELL THE KBD BUFFER THAT
1021  86 C6              STX NOKEYS   ;IT CONTAINS ONE KEYSTROKE.
1023  A4 D3              LDY COLUMN
1025  88                 DEY          ;MOVE CURSOR BACK ONE SPACE.
1026  A9 20              LDA #$20     ;THEN DEPOSIT A BLANK.
1028  91 D1              STA (ROW),Y
102A  A9 9D              LDA #$9D     ;FINALLY, PUT A CURSOR LEFT
102C  8D 77 02           STA KEYBRD   ;IN THE KEYBOARD BUFFER.
102F  68          MOVEON PLA          ;RESTORE ALL REGISTERS.
1030  A8                 TAY
1031  68                 PLA
1032  AA                 TAX
1033  68                 PLA
1034  4C BF EA           JMP IRQRTN   ;FINISH NORMAL INTERRUPT.
```

dore 64, be sure to make the change to line 230 mentioned above.

2. Check for errors.
3. Save the program first.
4. Now try it out. Type RUN and hit RETURN.
5. Almost instantly, the program will relocate to the top of memory and perform a self-initialization. You may leave the program in place for the duration of a programming session; it will not interfere with normal BASIC operation.

Typing NEW will not affect the escape key program, but if you hit the RUN-STOP/RESTORE key combination, the program will be disabled. You can re-enable it quite easily by typing:

SYS 256*PEEK(56) + PEEK(55)

Since cassette operations affect the IRQ loop, you may wish to disable the escape option with a RUN-STOP/RESTORE before doing any loading or saving and re-enable it afterwards with the SYS 256*PEEK(56) + PEEK(55).

If you have the program in place, try it out. For example, type a quote mark. Now hit the RIGHT key a number of times. Do you see the reverse field brace? Now hit the British pound key. Then hit the RIGHT key once more. Notice that this time you actually move to the right. Think of the most outlandish combination of keystrokes that you can, then try the escape.

Program 2: BASIC Loader

```
100 T=256*PEEK(56)+PEEK(55)-55:GOSUB160
110 POKE56,HI%:POKE55,LO
120 FORA=TTOT+54:READD:POKEA,D:NEXT
130 X=T:T=T+13:GOSUB160:POKEX+2,LO:POKEX
    +4,HI%
140 SYS(X)
150 NEW
160 HI%=T/256:LO=T-HI%*256:RETURN
170 DATA120,162,13,160,16,142,20,3
180 DATA140,21,3,88,96,72,138,72
190 DATA152,72,165,215,201,92,208,23
200 DATA162,0,134,212,134,199,134,216
210 DATA232,134,198,164,211,136,169,32
220 DATA145,209,169,157,141,119,2,104
230 DATA168,104,170,104,76,191,234
```
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Musical Atari Keyboard

Paul N. Havey

This program makes your Atari into a musical instrument. The sound of bells, piano, organ, etc. – it's all in your computer's keyboard.

"Music Keyboard 3" makes the Atari typewriter keyboard a music keyboard.

You can play the keyboard much like playing an organ. Strike a key, the note plays; release the key, the note stops. You can also change the decay of a note to sound like a piano, organ, or bells, and you can change registers to bass or treble with the SHIFT key.

Features

1. Variable decay of a note
2. Preset attack and release
3. Five octave range (C1 to C6)
4. Two-tier keyboard
5. Keyboard display on the screen
6. Monotonic (one note at a time)
7. Fast action

When you run this program, a picture of the Atari keyboard appears on the screen. The keys that are outlined only are not usable as notes. The white and black keys represent the same keys on a keyboard instrument.

Here's how to use the program:

- Starting-up
  1. Insert the Atari BASIC cartridge.
  2. Load or type into RAM memory Music Keyboard.
  3. Type RUN, then press RETURN.
  4. When the prompt "INPUT DECAY (0-1)" appears in the lower left section of the screen, type in a decimal number between zero and one (example: 0.89) and then press the RETURN key.
  5. When the word "PLAY" appears, begin playing.
- Changing the decay of a note after starting up:
  1. Press the space bar.
  2. Press the BREAK key.
  3. Type GOTO 1000, then press the RETURN key.
  4. When "INPUT DECAY (0-1)" appears, type in the decay value, then press RETURN.
  5. When the word "PLAY" appears, begin playing.
- Changing registers
  1. Press the SHIFT key.

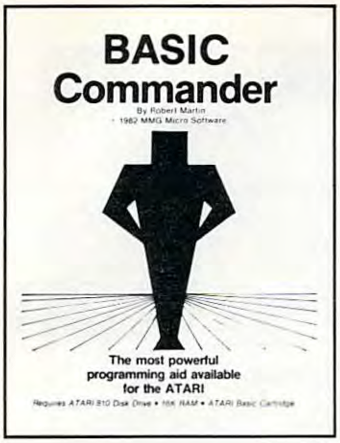
Fast Keyboard Action

The Serial Port Control register, SKCTL, changes whenever a key is pressed or released. By reading SKCTL and using the value it contains as an expression in a GOTO statement, the program can decide what to do. SKCTL detects one of four possible keyboard conditions: the SHIFT and one of the character keys pressed together; the SHIFT key pressed by itself; a character key pressed by itself; or no key pressed at all.

Here are a few tricks used to get fast keyboard action. First, the value in SKCTL is used in the GOTO statements to direct the flow of control. Second, placing the logic for note playing at the beginning of the program increases speed since a GOTO target is found by searching a program from beginning to end. Third, removing the REM statements at the beginning leaves fewer statements to search to find the referenced line number. Fourth, using GRAPHICS 2 increases speed over GRAPHICS 0 by 20 percent. The display exists for reasons other than just showing the keyboard. Fifth, converting audio frequency codes to notes on the keyboard by table look-up avoids time-consuming computation. The keyboard code is used as an index to an array containing the frequency for that note. Sixth, POKEs are used instead of the SOUND statement.

Program Description

This program has three major sections. Lines 243-256 will cause a note to play when you press a key. Table 3 lists the SKCTL keyboard condition codes. Lines 400-1530 set up the display, the re-



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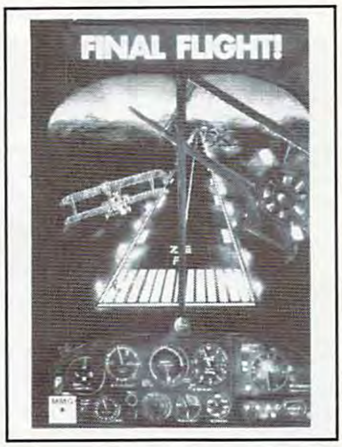

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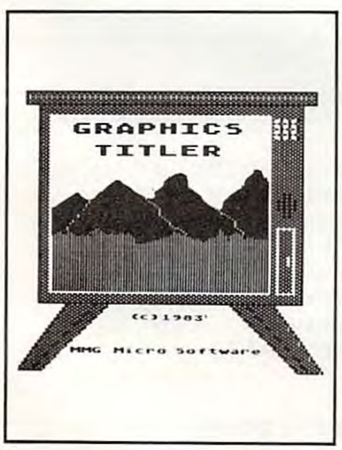

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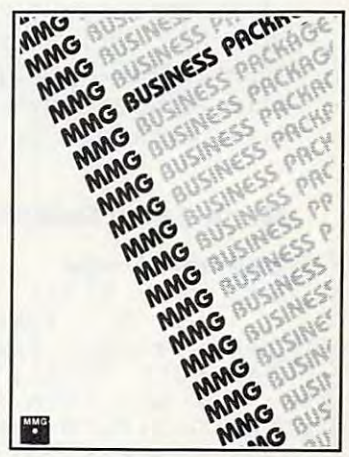

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defined characters, and the variables for the play section. Lines 1560-4000 contain data for the note and character tables.

Line 240 directs the program to the setup section. After setup is complete, control goes to the play section.

Lines 243-244 contain the action the program takes with both the SHIFT and a character key pressed. A note decays while the register changes. The register cannot change again until the SHIFT key is released. Lines 247-248 are accessed only if the SHIFT key alone is pressed. A register change – from bass to treble or from treble to bass – occurs, but no decay or release action is necessary.

Lines 251-253 direct the program to play a note if a character key only is pressed. The note does not change unless it is different from the last note played. The register changes from bass to treble or vice versa when a key on the keyboard is first pressed. The note decays as long as the same key is held down. Lines 255-256 take effect if no key is pressed. The sound stops and remains that way until another key is pressed.

The setup logic begins on line 520. Program variables are initialized on lines 520-530. Lines 540-570 select the screen mode and colors and print the title to the screen. Lines 600-630 transfer the treble and bass register notes into an array.

The table on page 58 of the *Atari BASIC Reference Manual* gives the hardware frequency codes with musical note values for the treble register. The bass register table, not found in any Atari manual, is in Table 4 of this article.

Lines 710-750 read the redefined character set data and place the entire character set in a new location. Lines 760-820 display the redefined characters as a picture of the keyboard. Table 5 gives the color factor to add to the character code. Lines 1000-1020 prompt the user to input the decay value and play. Lines 1520-1530 wait until no key is pressed to start the play logic.

Table 1: Program Variables*

Name	Description
A	temporary data
CHR	character number plus color code
DECAY	user option value
I	temporary index
L	current loudness
LOUD	maximum loudness
NP	new pitch table index
P	current pitch table index
R	Audio Control value (AUDCTL)
REG	pitch table register index
REP	number of character repeats
S	prior key pressed code
T	Audio Tone value
X	current character position – horizontal
XREF	left-most keyboard position
Y	current character position – vertical
YREF	upper-most keyboard position

**Also see Table 2*

Table 2: Hardware And O/S (PEEK & POKE) Descriptions

Name*	Address	Description
AUDF1	53760	Audio Channel 1 Freq.
AUDC1	53761	Audio Channel 1 Control
AUDCTL	53768	Audio Control
KBCODE	53769	Keyboard Code
SKCTL	53775	Serial Port Control
RAMTOP	106	Size defined by power ON
CRSINH	752	Cursor Inhibit (0 = Cursor On)
CHBAS	756	Character Base Register
CHRORG	57344	Character Set

**Also see the* Atari Operating System User's Manual

Table 3: Serial Port Control Keyboard Codes

Keys Pressed	Code
Character*	251
Shift	247
Shift/Character	243
No Key	255

**Excludes the BREAK, SHIFT, and CTRL keys.*

Musical Atari Keyboard

```
240 GOTO 500
243 POKE 53761,T+L:L=L*DECAY*(L>0.5)
    :IF S<3 THEN R=R=0
244 S=4:GOTO PEEK(53775)
247 POKE 53761,T+L:L=L*0.5*(L>0.5):I
    F S<3 THEN R=R=0
248 S=3:GOTO PEEK(53775)
251 NP=PEEK(53769):IF NP-P OR S-2 TH
    EN P=NP:POKE 53768,R:REG=64*R:L=
    LOUD:POKE 53760,P(REG+P)
252 POKE 53761,T+L:L=L*DECAY*(L>0.5)
253 S=2:GOTO PEEK(53775)
255 POKE 53761,T+L:L=L*0.5*(L>0.5)
256 S=1:GOTO PEEK(53775)
400 REM *** SET-UP SECTION ***
500 REM REDEF. CHARS. - DISPLAY
520 LOUD=15:T=160:SOUND 0,0,0,0
530 REG=0:R=0
540 GRAPHICS 2:SETCOLOR 1,0,12
550 SETCOLOR 2,15,6:SETCOLOR 3,0,4
560 SETCOLOR 4,15,6:SETCOLOR 0,0,0
570 ? #6;" MUSIC KEYBOARD  2.0":POKE
     752,1:? " PLEASE WAIT"
600 DIM P(255)
610 FOR I=0 TO 127
620 READ P:P(I)=P:P(I+128)=P
630 NEXT I
710 CHSET=(PEEK(106)-8)*256
720 CHORG=57344
730 FOR I=0 TO 511:POKE CHSET+I,PEEK
    (CHORG+I):NEXT I
740 FOR I=8 TO 11*8+7:READ A:POKE CH
    SET+I,A:NEXT I
750 POKE 756,CHSET/256:XREF=1:YREF=2
```

Table 4:
Bass Register Pitch Codes (TONE = 10 AUDCTL = 1)

Pitch	AUDFX	Pitch	AUDFX
C4	29	F2	89
B3	31	E2	94
(Bb3 or A#3)	33	(Eb2 or D#2)	100
A3	35	D2	106
(Ab3 or G#3)	37	(Db2 or C#2)	112
G3	39	C2	119
(Gb3 or F#3)	41	B1	126
F3	44	(Bb1 or A#1)	134
E3	47	A1	142
(Eb3 or D#3)	49	(Ab1 or G#1)	150
D3	52	G1	159
(Db3 or C#3)	56	(Gb1 or F#1)	169
C3	59	F1	179
B2	63	E1	190
(Bb2 or A#2)	66	(Eb1 or D#1)	201
A2	70	D1	213
(Ab2 or G#2)	75	(Db1 or C#1)	226
G2	79	C1	239
(Gb2 or F#2)	84	B0	253

Table 5: Character Color Codes

Color	Code
Black	32
White	0
Gray	128
Orange*	160

**Background*

Notes:

1. Redefined characters have Atari internal code numbers one to eleven inclusive.
2. Adding color code above to internal code displays characters in that color.
3. For more information, see the *Atari BASIC Reference Manual*, chapter nine.

```
760 FOR Y=1 TO 5:X=1
770 READ CHR,REP:IF CHR+REP=Ø THEN 8
    2Ø
78Ø COLOR CHR
79Ø PLOT XREF+X,YREF+Y:X=X+1
8ØØ REP=REP-1:IF REP THEN 79Ø
81Ø GOTO 77Ø
82Ø ? #6:NEXT Y
1ØØØ POSITION 13,9:? #6;"{4 SPACES}"
1Ø1Ø POKE 752,Ø:? "{CLEAR}INPUT DECA
     Y [Ø-1]":INPUT DECAY:POKE 752,1
     :?
1Ø2Ø POSITION 13,9:? #6;"PLAY"
152Ø IF PEEK(53775)-255 THEN 152Ø
153Ø GOTO 255
156Ø REM TREBLE REGISTER DATA
16ØØ DATA 114,136,1Ø2,Ø,Ø,Ø,Ø,85
161Ø DATA 35,Ø,31,45,Ø,4Ø,3Ø,Ø
162Ø DATA 182,Ø,193,Ø,Ø,162,217,243
163Ø DATA Ø,Ø,68,5Ø,Ø,57,76,85
164Ø DATA 121,Ø,1Ø8,144,Ø,128,96,91
165Ø DATA 6Ø,Ø,64,47,91,53,72,81
166Ø DATA 37,Ø,33,Ø,Ø,42,Ø,Ø
167Ø DATA Ø,153,2Ø4,Ø,Ø,172,23Ø,Ø
1674 REM BASS REGISTER DATA
168Ø DATA 112,134,1ØØ,Ø,Ø,Ø,Ø,84
169Ø DATA 35,Ø,31,44,Ø,39,29,Ø
17ØØ DATA 179,Ø,19Ø,Ø,Ø,159,213,239
171Ø DATA Ø,Ø,66,49,Ø,56,75,84
172Ø DATA 119,Ø,1Ø6,142,Ø,126,94,89
173Ø DATA 59,Ø,63,47,89,52,7Ø,79
174Ø DATA 37,Ø,33,Ø,Ø,41,Ø,Ø
175Ø DATA Ø,15Ø,2Ø1,Ø,Ø,169,226,Ø
179Ø REM NEW CHARACTERS
18ØØ DATA Ø,6Ø,66,66,66,66,6Ø,Ø
181Ø DATA Ø,3,4,4,4,4,3,Ø
182Ø DATA Ø,195,36,36,36,36,195,Ø
183Ø DATA Ø,6Ø,126,126,126,126,6Ø,Ø
184Ø DATA Ø,3,7,7,7,7,3,Ø
185Ø DATA Ø,195,231,231,231,231,195,
     Ø
186Ø DATA Ø,255,255,255,255,255,255,
     Ø
187Ø DATA Ø,252,2,2,2,2,252,Ø
188Ø DATA Ø,252,254,254,254,254,252,
     Ø
189Ø DATA Ø,63,127,127,127,127,63,Ø
19ØØ DATA Ø,195,228,228,228,228,195,
     Ø
2ØØØ REM CHARACTER DISPLAY DATA
2Ø2Ø DATA 129,1,36,3,129,1,36,2
2Ø3Ø DATA 129,1,36,3,129,4,Ø,Ø
2Ø4Ø DATA 1Ø,1,6,11,11,1,3,1
2Ø5Ø DATA 8,1,Ø,Ø
2Ø6Ø DATA 37,1,41,1,129,1,36,2
2Ø7Ø DATA 129,1,36,3,129,1,36,2
2Ø8Ø DATA 129,1,36,1,129,1,Ø,Ø
2Ø9Ø DATA 5,1,7,1,6,12,9,1,Ø,Ø
3ØØØ DATA 16Ø,3,138,1,135,7,137,1
3Ø1Ø DATA 16Ø,3,Ø,Ø
4ØØØ END
```

3-D Color Computer Patterns

George Trepal

Watching your computer trace harmonic visual figures and then rotating the completed patterns can be a most pleasant experience. Use these two programs to plot points, at different speeds, for your patterns.

The computer is capable of turning out interesting and complex Lissajous patterns. Imagine the patterns as being shadows cast by a three-dimensional wire frame on a turntable which can be rotated full circle, 360 degrees. The computer can do this rotation.

Note that the illustrations use small numbers to produce the patterns. Big numbers are much more interesting. One of my favorites is the combination 22 and 21. Numbers higher than 30 exceed the screen resolution and a blob results.

Both programs here use POKE 65495,0. In most Color Computers this POKE speeds up the machine so that it draws faster. Unfortunately, it throws off several important functions such as the ability to make sounds, load or save tapes, or use a printer. To get rid of the speed POKE, you can either press the reset button or POKE 65494,0.

Program 1 lets you rotate the pattern and is rather slow. Program 2 is much faster, but it doesn't allow the pattern to be rotated. Program 2 looks up in a table the place to draw the next line to; this is much faster than calculating each new position, as Program 1 does.

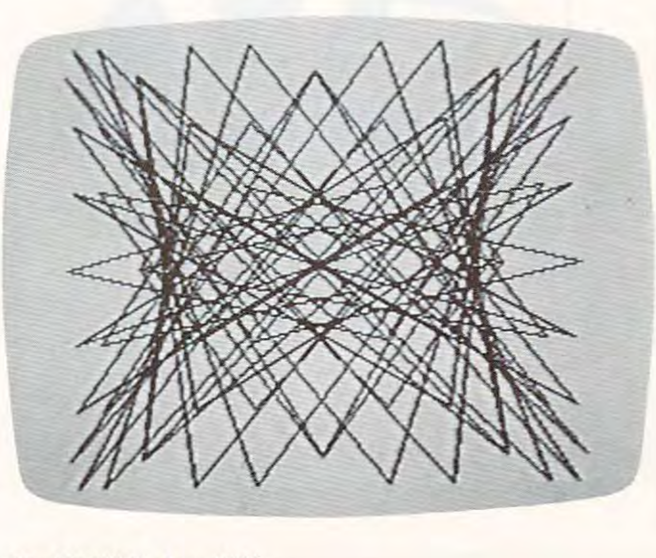
Program Calculations

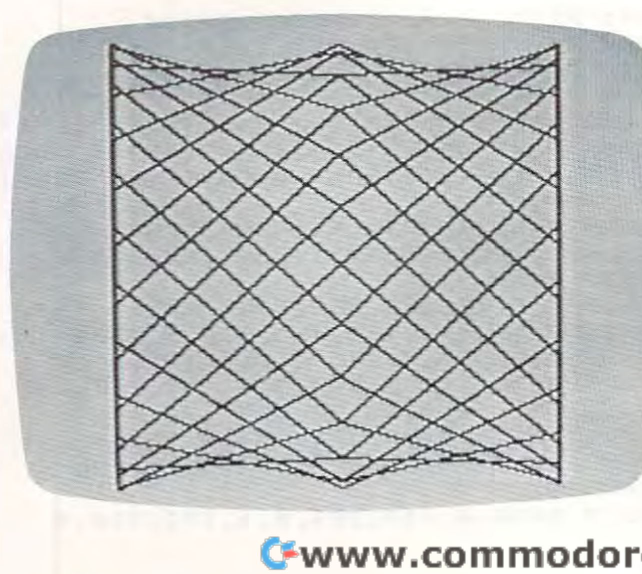
Here's a technical description of Program 1. You can skip the math and just enjoy the art, unless you're curious.

Lissajous patterns are formed by a sine wave of frequency X modulating a sine wave of frequency Y. The result has to be plotted on circular coordinates. Rotation of a pattern is done by altering the phase of one wave in relation to the other.

Lines 20 through 90 give the speed POKE, clear variables, and take in parameters.

Lines 100 to 150 are constants used in the calculations. The reason for letting variables represent the constants is speed. The computer has to change a number into its floating point representation before it can work with it. The process is highly complex and takes time. Since BASIC is interpreted rather than compiled, every time the





program sees a number it has to change it over. Variables are stored in floating point form, however, and simply have to be looked up in memory. This is much faster.

The delay loop in line 160 can be left out without hurting the program. Some people who have played with the program have been startled by the sudden switch from text to graphic screen and have managed to hit interesting things on the keyboard. The delay gives fingers a fraction of a second to move to a less dangerous position.

Lines 170 to 220 are just setting up parameters. The program will calculate a point and draw a line to it and then repeat the process. Lines 210 and 220 calculate an arbitrary line length. The idea is to achieve a compromise between a slowly drawn, beautiful pattern and a quickly drawn, jagged pattern.

Lines 230 and 240 produce the sine calculations. The multiplier expands the pattern to fill the screen. The number added to the end shifts the pattern so that the center of the pattern is also the center of the screen.

Lines 250 and 260 help to make things look a little better. Leave them out of the program to see why. Line 280 checks to see if you've pressed the space bar and want a new pattern.

Program 1: Plotting Points Calculated

```
20 POKE65495,0{3 SPACES}'THIS POKE D
   OUBLES THE SPEED OF MOST COLOR CO
   MPUTERS
30 CLS:PRINT:PRINT
40 PRINT"  PRESS THE SPACE BAR TO ST
   ART{4 SPACES}OVER AGAIN."
50 PRINT
60 C = 0:Z = 0:B = 0
70 PRINT " HORIZONTAL AXIS";:INPUT H
80 PRINT " VERTICAL AXIS";: INPUT V
90 PRINT"VIEWING ANGLE 0 TO 360";:IN
   PUT P
100 RA=57.2957
110 NT=90
120 NF=95
130 OT=120
140 TS=127
150 E=8
160 FOR I = 1 TO 90: NEXT I
170 P=P/RA
180 PMODE 4,1:PCLS:SCREEN 1,1
190 IF V>=H THEN M = V
200 IF H>V THEN M = H
210 Z = Z + H*(E/M)
220 B = B + V*(E/M)
230 Y=INT((SIN(Z/RA + P)*OT)+TS)
240 A=INT((SIN(B/RA)*NT)+NF)
250 C = C + 1
260 IF C =<4 THEN GOTO 300
270 LINE -(Y,A), PSET
280 IF INKEY$= " " THEN GOTO 320
290 GOTO 210
300 LINE -(Y,A), PRESET
310 GOTO 210
320 CLS
330 GOTO 30
```

Program 2: Plotting Points Read From Table

```
20 CLS:PRINT
30 POKE 65495,0{3 SPACES}'THIS POKE
   DOUBLES THE SPEED OF MOST COLOR C
   OMPUTERS
50 PRINT "  NOTE: AFTER YOU ARE THRO
   UGH{5 SPACES}USING THIS PROGRAM P
   USH THE{5 SPACES}RESET BUTTON ON
   THE BACK OF{5 SPACES}THE COMPUTER
   .  YOU WON'T BE{5 SPACES}ABLE TO
   CLOAD UNLESS YOU DO{5 SPACES}THIS
   ."
60 PRINT
70 PRINT "  TO USE THIS PROGRAM PRES
   S{7 SPACES}ANY KEY AFTER YOU HEAR
    THE{6 SPACES}THE BEEP."
80 DATA 128,130,132,135,137,139,141,
   143,146,148,150,152,154,157,159,1
   61,163,165,167,169,171,174,176,17
   8,180,182,184,186,188,190,192,193
   ,195,197,199,201,203,204,206,208,
   210,211,213,215,216,218,219,221
90 DATA 222,224,225,227,228,229,231,
   232,233,235,236,237,238,239,240,2
   41,242,243,244,245,246,247,247,24
   8,249,249,250,251,251,252,252,253
   ,253,253,254,254,254,255,255,255,
   255,255,255,255,255,255,255,255
100 DATA 254,254,254,253,253,253,252
    ,252,251,251,250,249,249,248,247
    ,247,246,245,244,243,242,241,240
    ,239,238,237,236,234,233,232,231
    ,229,228,227,225,224,222,221,219
    ,218,216,215,213,211,210,208,206
    ,204
110 DATA 203,201,199,197,195,193,191
    ,190,188,186,184,182,180,178,176
    ,173,171,169,167,165,163,161,159
    ,157,154,152,150,148,146,143,141
    ,139,137,135,132,130,128,126,124
    ,121,119,117,115,112,110,108,106
    ,104
120 DATA 102,99,97,95,93,91,89,87,85
    ,82,80,78,76,74,72,70,68,66,64,6
    3,61,59,57,55,53,52,50,48,46,45,
    43,41,40,38,37,35,34,32,31,29,28
    ,27,25,24,23,21,20,19,18,17,16,1
    5,14,13,12,11,10,9,9,8,7,7,6,5,5
    ,4,4,3,3,3,2,2
130 DATA 2,1,1,1,1,1,1,1,1,1,1,1,2,2
    ,2,3,3,3,4,4,5,5,6,7,7,8,9,9,10,
    11,12,13,14,15,16,17,18,19,20,22
    ,23,24,25,27,28,29,31,32,34,35,3
    7,38,40,41,43,45,46,48,50,52,53,
    55,57,59,61,63,65,66,68,70,72,74
140 DATA 76,78,80,83,85,87,89,91,93,
    95,97,100,102,104,106,108,110,11
    3,115,117,119,121,124,126,128
150 DIM X(360)
160 FOR J=0 TO 360
170 READ X
180 X(J)=X
190 NEXT J
200 DATA 96,98,99,101,103,104,106,10
    8,109,111,112,114,116,117,119,12
    1,122,124,125,127,128,130,132,13
    3,135,136,138,139,141,142,144,14
    5,146,148,149,150,152,153,154,15
    6,157,158,160,161,162,163,164,16
    5,167,168,169,170,171,172,173,17
    4
```

```
210 DATA 175,176,177,177,178,179,180
    ,181,181,182,183,183,184,185,185
    ,186,186,187,187,188,188,189,189
    ,189,190,190,190,190,190,191,191
    ,191,191,191,191,191,191,191,191
    ,191,190,190,190,190,190,189,189
    ,189,188,188,187,187,186,186,185
    ,185
220 DATA 184,183,183,182,181,181,180
    ,179,178,177,177,176,175,174,173
    ,172,171,170,169,168,167,165,164
    ,163,162,161,160,158,157,156,154
    ,153,152,150,149,148,146,145,143
    ,142,141,139,138,136,135,133,132
    ,130,128,127,125,124,122,121,119
    ,117
230 DATA 116,114,112,111,109,108,106
    ,104,103,101,99,98,96,94,93,91,8
    9,88,86,84,83,81,79,78,76,75,73,
    71,70,68,67,65,63,62,60,59,57,56
    ,54,53,51,50,48,47,46,44,43,41,4
    0,39,37,36,35,34,32,31,30,29,28,
    26,25,24,23,22,21,20,19,18,17,16
    ,15,15,14,13,12,11,11
240 DATA 10,9,9,8,7,7,6,6,5,5,4,4,3,
    3,3,2,2,2,2,2,1,1,1,1,1,1,1,1,1,
    1,1,2,2,2,2,2,3,3,3,4,4,5,5,6,6,
    7,7,8,9,9,10,11,11,12,13,14,15,1
    5,16,17,18,19,20,21,22,23,24,25,
    27,28,29,30,31,32,34,35,36,38,39
    ,40,42,43,44,46,47,49,50,51,53,5
    4,56
250 DATA 57,59,60,62,64,65,67,68,70,
    71,73,75,76,78,80,81,83,84,86,88
    ,89,91,93,94,96
260 DIM Y(360)
270 FOR J=0 TO 360
280 READ Y
290 Y(J)=Y
300 NEXT J
310 POKE 65494,0:SOUND 100,2:POKE 65
    495,0
320 IF INKEY$<>"" THEN GOTO 330 ELSE
     GOTO 320
330 CLS
340 PRINT:PRINT" PRESS THE SPACE BAR
     TO STOP AN  OLD PATTERN AND STA
    RT A NEW{5 SPACES}ONE.":PRINT:PR
    INT
350 PRINT @ 160,"  ENTER A NUMBER FO
    R THE HORI-{4 SPACES}ZONTAL AXIS
    "
360 INPUT "  ";X
370 IF X<0 THEN PRINT @ 224,"
    {18 SPACES}":GOTO 350
380 PRINT @ 256:PRINT "  ENTER A NUM
    BER FOR THE VER-{5 SPACES}TICAL
    AXIS"
390 INPUT "  ";Y
400 IF Y<0 THEN PRINT @ 352,"
    {13 SPACES}":GOTO 380
410 XP=0:YP=0
420 LINE (128,96)-(128+XP,96+YP),PRE
    SET
430 PMODE 4,1:PCLS(5):SCREEN 1,1
440 XP=XP+X
450 YP=YP+Y+PH
460 IF XP>360 THEN XP=XP-360
470 IF YP>360 THEN YP=YP-360
480 LINE -(X(XP),Y(YP)),PRESET
490 IF INKEY$=" " THEN GOTO 330
500 GOTO 440
```

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VIC-20/64 Translations: Reading The Keyboard

Nathan Okun

When I bought my Commodore 64 computer, I recognized that there was very little software written expressly for my machine. But, because of its similarity to the VIC-20, I thought it would be possible to modify most – if not all – VIC programs with minimal effort to run on my computer, too.

A considerable number of locations used by the machines for internal workings are identical in both VIC and 64 memory maps, especially the first several hundred locations up through 831. The cassette buffers are given to location 1019, but some of the 64 sprites use memory from 832 to 1022, so this area is not directly compatible in most cases.

Also, even though the addresses are different, a number of locations seem to be used for the same purpose (excluding the screen and sound processing logic, of course). I recognized that the *contents* of many of these locations would be different, especially those holding addresses of memory limits and the like, but I expected that all of the differences would be straightforward, easily understood changes.

While a great many changes are straightforward, I quickly found a few locations that were not working in the same manner in both machines. Since it will be some time before I walk through enough VIC programs to hit all of the differences that exist, I decided to acquaint some 64 owners immediately with some of the pitfalls I discovered in my VIC to 64 translations. At least this will make you more cautious and keep you from wondering if your machines are broken when you get some weird results.

Hidden Keyboard Differences

In *COMPUTE!'s First Book Of VIC*, the article "Extended Input Devices: Paddles And The Keyboard," by Mike Bassman and Salomon Lederman, explains how the paddle works and how the VIC-20 handles its keyboard input logic, using the "polled" keyboard concept. This was one of my first translation attempts, since it seemed so easy to translate to the 64. After all, the keyboards of both machines are identical, right?

Wrong!

After a little work, I altered the VIC programs 2 and 3 in the article to programs 1 and 2 here. The differences are minor – I used a comma instead of a semicolon in the key code PRINT statement, for example. The hardest part was handling location 808 to turn off the RUN/STOP key's BASIC program BREAK effect. In the VIC, the normal value of this location is 112, but in the 64 it has a normal value of 237.

Changing this location to other values caused some problems until I found that setting it to zero seemed to work. I have no idea if this affects some other portion of the operating system, so the use of zero may not be universally correct.

Once it was written, I fully expected the keyboard matrix table of my 64 to be identical to that of the VIC. When I ran the program, however, I got considerably different results. I double-checked my program several times and could not find any mistakes, so I decided to compile my own 64 keyboard matrix table and see how things differed. Table 1 is the result. Note that the entire table is a transposition (axes swapped) of the VIC matrix with a couple of rows and columns rearranged. Apparently, the 64 designers wanted the RUN/STOP key to be in the upper left corner (127,127), so they made extensive changes for this and perhaps other reasons.

Once I realized that the polling values were different, I rewrote a VIC program which PEEKed into memory to read the character codes where they are stored. The program reads the character codes in location 197 as set by the BASIC program after BASIC has done its own polling of the keyboard. This location has the same meaning in the 64 as it has in the VIC.

At line 5 I added a POKE 808,0 to disable the STOP key's BREAK effect and thus allow me to find out its character code. As with the VIC, the SHIFT keys, the CTRL key, the COMMODORE key, and the RESTORE key have no effect on the value in location 197 – which is 64 when no key is being pressed. My version of the PEEK program has the values running continuously up the TV screen in four columns, just like the version of the polling program that I used.

64's Hierarchy Of Keys

As suspected, the character codes were scrambled when compared to the VIC codes – in only a couple of cases were they the same. Table 2 shows the Commodore 64 character codes for each key. There is also a definite hierarchy in the keys so that if two or more are held down simultaneously, one of them always takes precedence unless an even higher-precedence key is added to the group. The character code number seems to be the order of precedence, with the higher number overriding any lower character number if both are pressed – RUN/STOP has the highest precedence in Table 2 and overrides any other key or keys.

If RUN/STOP is held down after another key has already been pressed and held, it won't cause a BREAK in those cases where the row select code in Table 1 is the same for the two keys when location 808 is returned to the normal 237 value. Apparently, the RUN/STOP key has been "fail-safed" to keep it from BREAKing a program unless the RUN/STOP key, and only the RUN/STOP key, is hit.

The above examples should make it very obvious that there are a number of subtle, but still critical, differences between the Commodore 64 and the VIC-20. Who would have imagined that they would change the keyboard logic when both machines use identical keyboards? Caution is definitely in order.

I now know of the following categories of VIC-20/Commodore 64 differences:

1. Screen and sound chip locations and related logic.

2. Sprite data storage and logic (VIC-20 has no sprites).

3. RAM areas (location, not contents – Commodore 64 is much larger here).

4. ROM operating system logic areas (VIC-20 has a larger operating system).

5. Contents of lower memory BASIC/operating system working areas (limit-of-memory registers and so forth in locations 0-831), though *most* will be straightforward changes from the VIC-20 contents (perhaps there are more differences such as the one in location 808).

6. LOAD/SAVE procedures (VIC-20 is considerably less complex, but this is one of the things that requires its extensive operating system memory area).

7. Keyboard polling values (Table 1) and character codes (Table 2).

8. Extra built-in joystick port and extra TV RF output in addition to the NTSC color monitor

How To Read Table 1:
The key code value is set into location 56321 when the indicated key is hit *and* that key's row has been previously selected by POKEing row select code into location 56320; otherwise, the value of 255 will be in location 56321. The indicated value will remain set as long as the key remains depressed. (Commodore 64 keyboard hardware does the setting automatically.) If more than one key *in a row* is hit simultaneously, the key codes are ORed together.

Table 1: Commodore 64 Keyboard Matrix Table

Key Code (for PEEK) Returned From Location 56321 ($DC01)
(Contents of Location 56321 = 255 Otherwise)

Legal Keyboard Row Select Code Values (Must Be POKEd Into Location 56320 ($DC00))

	127	191	223	239	247	251	253	254
127	RUN STOP	Q	COMMODORE	SPACE	2	CTRL	←	1
191	/	↑	=	RIGHT SHIFT	HOME	;	*	£
223	,	@	:	.	-	L	P	+
239	N	O	K	M	0	J	I	9
247	V	U	H	B	8	G	Y	7
251	X	T	F	C	6	D	R	5
253	LEFT SHIFT	E	S	Z	4	A	W	3
254	↑CURSOR↓	f5	f3	f1	f7	←CURSOR→	RETURN	DEL

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output port (lots of tricks probably possible with these!)

Other hidden differences are probably waiting for the unwitting Commodore 64 owner to stumble over when he wants to use a VIC program. I hope that anyone who does find some will write in to tell the rest of us.

Table 2:

Character Codes Returned From Location 197 For Each Key Entry (Commodore 64)

KEY	CHAR CD	KEY	CHAR CD	KEY	CHAR CD	KEY	CHAR CD
←	57	Q	62	STOP	63	Z	12
1	56	W	9	A	10	X	23
2	59	E	14	S	13	C	20
3	8	R	17	D	18	V	31
4	11	T	22	F	21	B	28
5	16	Y	25	G	26	N	39
6	19	U	30	H	29	M	36
7	24	I	33	J	34	,	47
8	27	O	38	K	37	.	44
9	32	P	41	L	42	/	55
0	35	@	46	:	45	CRSR DN	7
+	40	*	49	;	50	CRSR RT	2
-	43	↑	54	=	53	SPACE	60
£	48	f1	4	RETURN	1		
HOME	51	f3	5				
DEL	0	f5	6				
		f7	3				

NO KEY = SHIFT KEY (either) = CTRL KEY = COMMODORE KEY = RESTORE KEY = 64 as CHAR CODE

Note: Higher values of the CHAR CODE override lower values if two or more keys are pressed simultaneously. If any key in the 127 *row* of Table 1 is held down prior to pressing the RUN/STOP key, location 197 will change to 63 but a BREAK will not occur.

Program 1:

Machine Language Program To Capture Key Code Before Changed By BASIC. (Incorporated as a BASIC loader in Program 2.)

Note: Change 127 ($7F) to any of the other legal row select values, depending on the key used. See Table 1. The routine is needed because the BASIC interpreter is continually changing the row select value to 127 to check for a STOP input from the keyboard at the end of every command, so we must grab the key code for our key by setting the desired row select and saving our key code for that row before the end of any BASIC instruction. It is used in Program 2, and it can be used in any program you create to check for keyboard inputs.

(Hex)	Assembly	Comments
A9 7F	LDA #$7F	;Row select code = 127 (example)
8D 00 DC	STA $DC00	;Set row select code (56320)
AD 01 DC	LDA $DC01	;Get key code from 56321
8D FF 9F	STA $9FFF	;Save key code at 40959
60	RTS	;Return

Program 2:

Disable RUN/STOP Key And PRINT Key Code Of Pressed Key(s)

Note: You will probably want to delete REM statements when you key this in. Also, putting 0 in location 808 works, but this is an important location and a value of 0 might not be correct for every program.

```
5 POKE 8Ø8,Ø:REM NORMAL VALUE=237. DISAB
   LES RUN/STOP WHEN = Ø.
8 REM LINE 1Ø CUTS OUT 21 BASIC RAM LOCA
   TIONS
1Ø POKE 51,235:POKE 52,159:POKE 55,235:PO
   KE 56,159
2Ø FOR K=Ø TO 11:READ X:POKE 4Ø94Ø+K,X:NE
   XT:REM LOAD MACHINE LANGUAGE
3Ø SYS 4Ø94Ø:REM CALL MACHINE LANGUAGE PR
   OGRAM--SAVES KEY CODE IN 4Ø959
4Ø PRINT PEEK(4Ø959),:REM PRINTS 255 UNTI
   L KEY(S) IN SELECTED ROW ARE HIT
5Ø GOTO 3Ø:REM KEEP PRINTING UNTIL MACHIN
   E TURNED OFF (STOP IS DISABLED)
6Ø DATA 169,127,141,Ø,22Ø,173,1,22Ø,141,2
   55,159,96: REM MACHINE LANGUAGE
7Ø REM ML PROGRAM TO SAVE KEY CODE LOADED
    INTO LOCATIONS 4Ø94Ø-4Ø951           ©
```

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MACHINE LANGUAGE

Jim Butterfield, Associate Editor

A Bagel Break

Let's walk through an example of programming a complete game, including machine language. We'll make it a simple one: "Bagels," a guessing game that has appeared under other names, including the commercially packaged game, *Master Mind*.

We'll make this one simple, with few frills. We could do it entirely in BASIC, of course; we're using machine language for the practice and for the thrill of seeing the answers come up instantly. You can judge for yourself whether or not machine language handles the job more efficiently.

Ground Rules

We will assume that BASIC will generate the random codes. Yes, you can generate pseudo-random numbers in machine language, too, but we'll shorten the job with BASIC. Once we're into a game, we'll stay entirely in machine language.

The program is written to work on all Commodore machines up to and including the VIC and 64. This means that we need to be careful about memory, since different machines have differently arranged memories. We'll avoid this problem by using the cassette buffer area that is located in the same area in all these machines. And of course, we'll use the built-in Kernal routines that work on all Commodore units: FFD2 to print, FFE4 to get a character.

Planning

We'll need the following work areas:

- A counter which keeps track of the number of guesses (let's put this at $0240 hexadecimal);
- A counter which says how many "exact" matches have been found on this guess (let's use $0241);
- A counter which says how many "inexact" matches have been found (use $0242);
- A counter to keep track of the number of characters typed by the player (we'll use $0243);
- A place to keep the mystery code (four locations from $0244 to $0247 hex);
- A place to put a copy of the mystery code (from $0248 to $204B);
- A place for the user's guess (from $024C to $024F).

Why do we make a copy of the mystery code? Because we will destroy parts of this copy as we test for matches. That way, we will never count the same item twice as a match.

Writing The Program

We lay out a blank piece of paper and try to write the logic. We assume that the BASIC program has placed the mystery code (alphabetic characters from A to F) into hex addresses 0244 to 0247 before it calls upon our program to play the game. Here we go: we'll write a "main routine" first. Although we plan to put it into the cassette buffer (starting at hex 033C), we don't need to write in the addresses – yet.

```
START    LDA #$00
         STA $0240
```

We set our "number of guesses" to zero for starting. Now, on to the next guess:

```
GUESS    INC $0240
         LDA $0240
```

Our guess-number is set one higher, and we bring it into the A register.

```
         CMP #$0A
         BEQ QUIT
```

If we've had nine guesses, we quit here and let BASIC take over. By the way, we don't know exactly where to branch ahead, so we give the branch location a name rather than an address. We'll fill this in soon. In the meantime, if we don't branch, it's time to play:

```
         JSR PLAY
```

This subroutine will do the whole job of receiving one guess from the user and accounting for it. If the user guesses perfectly, the Z flag will be set. In any other case, we'll need to go back:

```
         BNE GUESS
QUIT     RTS
```

Again, we may not know the exact address to which we're looping back at the time we scribble down our first program outline. We'll fill it in later. Sometimes we do this by "hand," and sometimes an assembler program will do it for us. A full-scale assembler will take the "labels" we have used – GUESS, QUIT, and PLAY – calculate their addresses, and make the substitution for us. If we have a smaller assembler, or are assembling by hand, we'll need to write in the addresses. We do this in two columns:

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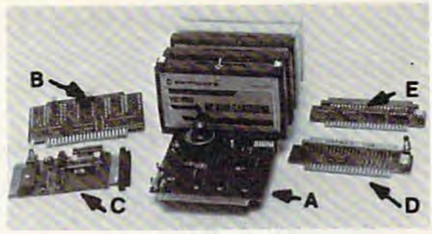

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```
        033C   LDA #$00
        033E   STA $0240
GUESS   0341   INC $0240
        0344   LDA $0240
        0347   CMP #$0A
        0349   BEQ $0350
        034B   JSR $0351
        034E   BNE $0341
QUIT    0350   RTS
```

The programmer will quickly learn to convert the program into whatever form his development programs need.

We'll assume this translation (at least in part) and continue with subroutine PLAY. First, we must print the guess number. The binary number in the A register must be converted to ASCII, and printed, together with a following space:

```
0351  PLAY     ORA  #$30
               JSR  $FFD2
               LDA  #$20
               JSR  $FFD2
```

Now, on to the main play. Let's zero the counters, including the player input count:

```
               LDX  #$00
               STX  $0241
               STX  $0242
               STX  $0243
```

Here comes another loop, as we wait for each character to be input. We test each character to make sure that it's a letter from A to F:

```
0366  INLOOP   JSR  $FFE4
               CMP  #$41
               BCC  INLOOP
               CMP  #$47
               BCS  INLOOP
```

We have a legal letter; echo it to the screen and put it to memory.

```
               JSR  $FFD2
               LDX  $0243
               INC  $0243
               STA  $024C,X
```

We must also copy the "secret" code into a work area, so that we can destroy it as we test for matches:

```
               LDA  $0244,X
               STA  $0248,X
```

Have we received all four letters of the guess yet? If not, go back:

```
               CPX  #$03
               BNE  INLOOP
```

Now we may check for exact matches. X is conveniently at three, so we may count it down as we compare:

```
0381  COMPAR   LDA  $0248,X
               CMP  $024C,X
               BNE  SKIP
```

If they don't match, we'll skip the next part. If they do, we must count the match and destroy the values so that we don't use them again:

```
               INC  $0241
               LDA  #$00
               STA  $0248,X
               STA  $024C,X
```

Now, our coding rejoins. We move along to test for the next match:

```
0394  SKIP     DEX
               BPL  COMPAR
```

We have logged any exact matches. Now we must look for the out-of-place matches. We may use X and Y to move through the two values, remembering to skip zeros.

```
               LDY  #$00
0399  RETRY    LDX  #$00
039B  CHECK    LDA  $0248,Y
               BEQ  PASS
               CMP  $024C,X
               BNE  PASS
```

Again, if we see a zero (already counted) or no match, we skip the next bit and go to PASS. Otherwise, we've got a match; we count it and destroy the entry, as before:

```
               INC  $0242
               LDA  #$00
               STA  $0248,Y
               STA  $024C,X
```

Our code comes together again. We have two loops to pick up:

```
03B0  PASS     INX
               CPX  #$04
               BCC  CHECK
               INY
               CPY  #$04
               BCC  RETRY
```

Now we may print the two results, stored in $0241 and $0242. A loop will save a little time and space:

```
               LDX  #$00
03BC  PLOOP    LDA  #$20
               JSR  $FFD2
               LDA  $0241,X
               ORA  #$30
               JSR  $FFD2
               INX
               CPX  #$02
               BCC  PLOOP
```

Now a carriage return to end the line. Finally, we must check for a "correct" solution (exact matches=4) so that the calling routine will know whether to quit or not:

```
               LDA  #$0D
               JSR  $FFD2
               LDA  $0241
               CMP  #$04
               BNE  PLAY
               RTS
```

That's it for our machine language part; we'll start to put it together next time. ©

Etch-Atari

Roy Glover

This brief review of Atari's GTIA graphics includes a joystick sketch program to draw on screen and examine the visual potential of this powerful computer.

After months of rumors about a display chip that would "someday replace the present one" in the Atari 400 and 800 computers, Atari introduced the GTIA.

CTIA And ANTIC

Before taking a close look at the GTIA itself, let's review Atari's graphics and display system. There are two integrated circuits in the Atari which generate the television display: the CTIA and the ANTIC. The CTIA contains the circuitry which actually displays the data according to the information given to it by the ANTIC, which is a microprocessor dedicated to interpreting the video instructions of the computer program. In other words, your program tells ANTIC what to display, and ANTIC tells CTIA how to display it on the screen.

CTIA offers 14 display modes. Nine of these modes are directly accessible from BASIC, the other five only from machine language. Of the nine BASIC modes, there are three character (text) modes and six graphics (plotted point) modes. GRAPHICS 8, the highest resolution graphics mode, is made up of 320 pixels (picture elements) horizontally and 192 pixels vertically. That is, a GRAPHICS 8 display is composed of 61,440 plotted points (pixels), all restricted to one color and to one of two luminances. Each pixel is either on or off.

Additional Graphics Modes With GTIA

Early in 1982, Atari began replacing the CTIA in 400 and 800 computers with the GTIA chip. The two perform the same tasks and are identical, except that the GTIA offers three additional graphics modes: BASIC modes GRAPHICS 9, 10, and 11.

All three new graphics modes have the same resolution: 80 pixels horizontally and 192 pixels vertically. The pixels are the same height, but four times as wide as pixels in GRAPHICS 8.

GRAPHICS 9 allows each pixel to be displayed with any one of 16 luminances, while all pixels displayed are restricted to the same hue.

GRAPHICS 11 allows each pixel to be displayed with any one of 16 hues, while all pixels displayed are restricted to the same luminance.

GRAPHICS 10 allows each pixel to be displayed with any one of nine hue and luminance combinations.

Using GRAPHICS 9 and 11 is similar to using GRAPHICS 3, 5, and 7. In GRAPHICS 9 the luminance of *each* pixel displayed can be changed by specifying COLOR 0 through COLOR 15. Using SETCOLOR 4,H,0, where H is a number from 0 to 15, the hue of *all* pixels plotted will be changed.

In GRAPHICS 11, COLOR 0 through COLOR 15 specify the hue of *each* pixel displayed, while SETCOLOR 4,0,L, with L being from 0 to 15, changes the luminance of *all* pixels plotted. GRAPHICS 10 requires POKEing values of hue and luminance directly into the nine color registers.

Joystick Sketching

Try the program "Etch-Atari," which enables you to draw on the screen using a joystick. When the program is run, a prompt asks you to select GRAPHICS 9 or 11 and a hue or luminance, respectively. Then a bar appears across the bottom of the screen showing the color you will be drawing with. To change color, press the SELECT key. If you hold it down, the bar will step through the colors. The OPTION key turns the bar off or on. If the bar is off and the SELECT key is pressed, the bar will be turned back on so you can see which color is selected. To clear the screen and start over without returning to the menu, simply press START.

The drawing point starts at the center of the screen. To reposition the point without drawing, press the trigger button while moving the joystick.

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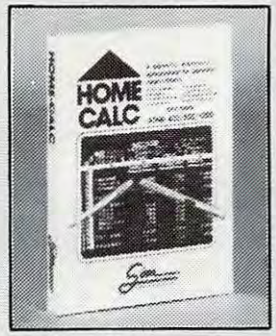

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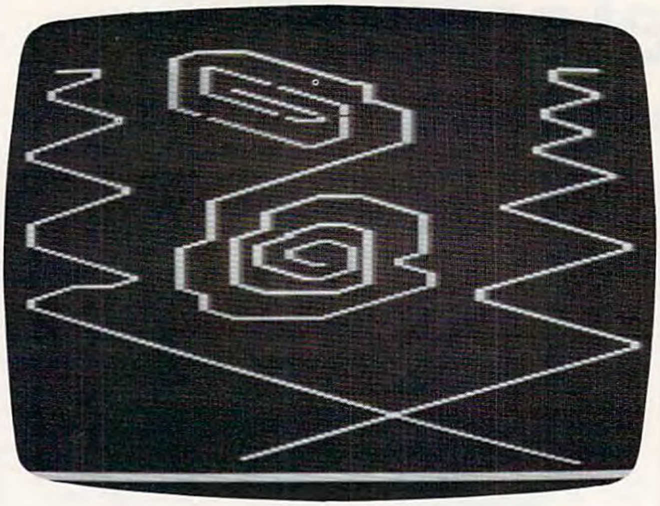

A sample drawing for "Etch-Atari."

This also allows you to trace over and erase points already drawn.

If the joystick is not moved for more than nine minutes, the computer will go into the attract mode (the screen will start changing colors). As long as you are drawing, the attract mode will be defeated.

If you run into the border, a thumping sound will be heard, letting you know that you cannot go any further in that direction. If you feel that the drawing speed is too slow, remove the sound statement at line 90.

If you would like the program to start automatically after loading, save it with SAVE "C:" and reload it with RUN "C:". If you choose CSAVE and CLOAD, line 1000 can be omitted.

Etch-Atari

```
5 GOTO 800
10 GRAPHICS G:SETCOLOR 4,H,L
15 C=1:COLOR C
20 GOSUB 620
30 X=40:Y=96
40 S=STICK(0):IF S=15 THEN SOUND 0,0
,0,0:SOUND 1,0,0,0
50 IF S<15 THEN POKE 77,0:REM Defeat
 attract mode while drawing
60 IF PEEK(53279)=6 THEN GOTO 10:REM
 Check START
70 IF PEEK(53279)=5 THEN GOSUB 600:R
EM Check SELECT
80 IF PEEK(53279)=3 THEN GOSUB 700:R
EM Check OPTION
90 SOUND 0,X*RND(0),12,2:SOUND 1,Y*R
ND(0),12,2
100 IF S=14 THEN Y=Y-1:N=Y+1:M=X
110 IF S=6 THEN X=X+1:Y=Y-1:M=X-1:N=
Y+1
120 IF S=7 THEN X=X+1:M=X-1:N=Y
130 IF S=5 THEN X=X+1:Y=Y+1:M=X-1:N=
Y-1
140 IF S=13 THEN Y=Y+1:N=Y-1:M=X
150 IF S=9 THEN X=X-1:Y=Y+1:M=X+1:N=
Y-1
160 IF S=11 THEN X=X-1:M=X+1:N=Y
170 IF S=10 THEN X=X-1:Y=Y-1:M=X+1:N
=Y+1
200 IF X>78 THEN X=78:GOSUB 400:REM
Set plot limits-Sound warning
210 IF X<1 THEN X=1:GOSUB 400
220 IF Y>187 THEN Y=187:GOSUB 400
230 IF Y<1 THEN Y=1:GOSUB 400
240 COLOR C:PLOT X,Y
250 IF STRIG(0)=0 THEN COLOR 0:PLOT
M,N
260 GOTO 40
400 FOR F=10 TO 0 STEP -1
405 SOUND 2,20*F,12,F
410 NEXT F
415 RETURN
600 C=C+1
610 IF C>15 THEN C=1
620 Z=C
630 COLOR Z
640 PLOT 1,189:DRAWTO 78,189:PLOT 1,
190:DRAWTO 78,190:PLOT 1,191:DRA
WTO 78,191
650 FOR W=1 TO 20:NEXT W
660 RETURN
700 IF Z>0 THEN Z=0:GOTO 630
710 IF Z=0 THEN Z=C:GOTO 630
800 GRAPHICS 0
805 POKE 752,1:REM Disable cursor
810 POKE 710,2:REM Background grey
815 ? :?
820 ? "{13 SPACES}ETCH-A-TARI"
825 ? :?
830 ? "START:  Clears screen and pos
itions"
835 ? "{8 SPACES}cursor at center.":
?
840 ? "SELECT: Selects color of next
"
845 ? "{8 SPACES}point drawn(color o
f bar"
850 ? "{8 SPACES}at bottom of screen
).":?
855 ? "OPTION: Turns color bar off o
r on.":?
860 ? "Press Trigger button to re-po
sition"
865 ? "cursor without drawing, and t
o erase"
870 ? "over points already drawn.":?
875 ? "Select GRAPHICS 9 or 11"
880 ? "and RETURN";:TRAP 885:INPUT G
:TRAP 40000
885 IF G<>9 AND G<>11 THEN ? "{3 UP}
{3 DEL LINE}":GOTO 875:REM (3 ES
C CTRL UP)(3 ESC SHFT DEL)
890 ?
895 IF G=9 THEN ? "Select Hue 0 to 1
5":? "and RETURN ";:TRAP 900:INP
UT H:L=0:TRAP 40000
900 IF H<0 OR H>15 THEN ? "{3 UP}
{3 DEL LINE}":GOTO 895
905 IF G=11 THEN ? "Select Luminance
 0 to 15":? "and RETURN ";:TRAP
910:INPUT L:H=0:TRAP 40000
910 IF L<0 OR L>15 THEN ? "{3 UP}
{3 DEL LINE}":GOTO 905
915 ? "{CLEAR}":POSITION 15,11
920 ? "Press START"
925 IF PEEK(53279)=6 THEN GOTO 10:RE
M Check START
930 GOTO 925
1000 RUN "C:"
```

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Input Functions On The VIC

John Ging

The "dynamic keyboard" technique can solve many kinds of programming problems: it's a way to make a program change itself *during execution. One use of dynamic keyboard is illustrated here with a program which lets you enter a function, while a program is RUNning. There's also information on the DEF FN command itself.*

If you use the DEF FN instruction much in your programming, you may have wondered if you can make this instruction "user friendly" by entering the function into the program via an INPUT statement. The obvious way to do this would be to begin your program with:

```
10 INPUT "PROMPT"; A$
```

and to follow this instruction with:

```
20 DEF FNA(X) = A$.
```

Unfortunately, this won't work. If you RUN the program, the computer prints PROMPT on the screen and waits for you to type in the string representing the function. Suppose you type in X↑2+ 7*X and then hit RETURN. The action of the computer is to fill the string variable A$ with the string you just typed in, namely, with X↑2 + 7*X. Then when the program execution continues with instruction 20, the string X↑2 + 7*X is substituted for A$ in the DEF FNA(X) = A$ statement. Right? Wrong.

If you follow instruction 20 with:

```
30 PRINT FNA(2)
```

you will get a

```
? TYPE MISMATCH
ERROR IN 30
```

Evidently, the computer has done nothing with the string you just typed in. It still thinks that FNA(X) is literally equal to the string variable *name* A$ rather than equal to the string *represented* by A$.

A Way Out

The only solution would seem to be to LIST instruction 20 and alter the string after "DEF FNA =" by directly typing it in every time you want to change the function represented by FNA(X), and that's not very "user friendly."

Fortunately, on the VIC, there is a way out: the "dynamic keyboard" feature. If you LIST an instruction, alter it from the keyboard, and then hit RETURN while the cursor is on the instruction line, the altered instruction is entered into memory. The trick is to force your program to alter *its own instructions* by causing them to be printed to the screen and RETURNs to be forced over them. This makes it possible for the computer to simulate the INPUT of a function.

The program at the end of this article shows how it works. The essential part of the program is contained in lines 10-40. Line 10 causes

```
F(X) = ?
```

to be printed on the screen and waits for the string representation of the function FNA(X) to be typed in. Line 20 prints

```
60 DEF FNA(X) = "string" (represented by A$)
GO TO 50
```

invisibly (in white) beginning on the second line of the screen. Line 30 POKEs the keyboard buffer with "HOME" and "CURSOR DOWN." Line 40 POKEs the keyboard buffer with two RETURNs, POKEs location 198 with the number of characters in the keyboard buffer (four), and then ENDs the program. When the program ENDs, it skips a line and prints "READY" (also in white) on the screen; then the RETURNs are executed. The execution continues at line 50, which skips down under the INPUT line and returns the character color to the normal blue.

The purpose of the program is to find the area under the graph of the function FNA(X) from X = X1 to X = X2 with N subdivisions (N should be an even number). As an example, RUN the program and type in 4/(1 + X↑2) after the prompt

```
F(X) = ?.
```

Then type in 0 and 1, respectively after the prompts

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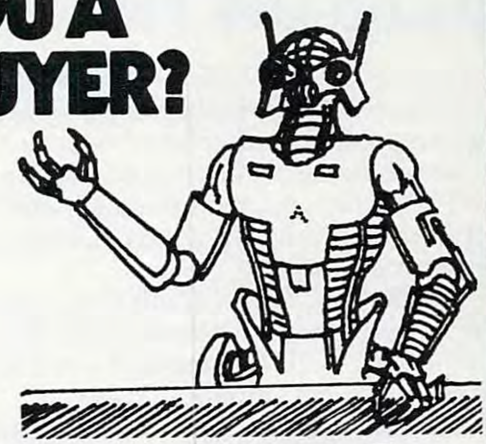

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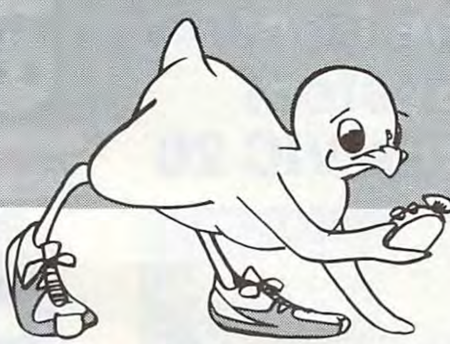

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```
X1=?
X2=?
```

and type in 100 after N=?.

Using DEF FN

A *function* is a BASIC word that takes a number within parentheses, performs some operation on it, and gives you a result. For example, some common functions are INT(X), which removes the fractional part of a number, or ABS(X), which makes negative numbers positive.

With the DEF FN command, you can create your own functions. Here's one way: to round X to the nearest cent you might type in: X=INT(X*100+.5)/100.

If you want to round off in this way many times throughout a program, you could define a function to do it for you. Just type: 10 DEF FNROUND(X)=INT(X*100+.5)/100. Notice that you give it a name, just like you do with variables.

You have just created a function, whose name is ROUND. You can use ROUND just like any other function. From now on, you can round numbers to the nearest cent without having to type in the whole equation. For example, if you type:

PRINT FNROUND(7.3628)

the result will be 7.36. Some other possibilities are:

PROFIT=FNROUND(GROSS) -FNROUND (OVERHEAD)

or

PROFIT=FNROUND(GROSS-OVERHEAD)

You cannot make functions that use strings (words), and you cannot type DEF FN directly like a PRINT; it must be inside a program.

When using ROUND, any number between the parentheses will be used as X in the equation INT(X*100+.5)/100.

If we now write:

20 DEF FNTEST(B)=B*A

B will be whatever number we put between parentheses, and A will have the same value it does everywhere else in the program.

For example:

A=3
PRINT FNTEST(5)

will give 15, since FNTEST will multiply whatever is in the brackets by A.

The result will be given by INTEGRAL= , and the answer is a good approximation to π.

Input Functions

```
2 REM:FINDS THE AREA{2 SPACES}UNDER THE
  GRAPH OF A{2 SPACES}FUNCTION FROM X1 T
  O X2WITH N SUBDIVISIONS.
5 PRINT "{CLR}{3 SPACES}INPUT A FUNCTION "
10 PRINT"{HOME}{9 DOWN}":INPUT"F(X)=";A$
20 PRINT"{HOME}{DOWN}{WHT}60 DEFFNA(X)="
   ;A$:PRINT"GOTO 50"
30 POKE 631,19:POKE 632,17
40 FOR I=633 TO 634:POKE I,13:NEXT:POKE
   198,4:END
50 PRINT"{7 DOWN}{BLU}"
70 INPUT"X1=";X1
80 INPUT"X2=";X2
90 INPUT"N=";N
100 D=(X2-X1)/N
110 S=0
120 FOR I=1 TO N-1 STEP 2
130 S=S+FNA(X1+I*D):NEXT:S=S*2
140 FOR I=2 TO N-2 STEP 2
150 S=S+FNA(X1+I*D):NEXT
160 S=D*(2*S+FNA(X1)+FNA(X2))/3
170 PRINT"INTEGRAL=";S
175 POKE 36878,15:POKE 36876,170:FOR I=
    1 TO 200:NEXT:POKE 36876,0
180 PRINT
190 PRINT"TO CONTINUE,HIT ANY{3 SPACES}K
    EY."
200 GET A$:IF A$="" THEN 200
210 GOTO 5
```

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Wally Hubbard

Did you think that there's no way to put RETURNs into REM statements? Or into PRINT statements? Or to put backspace characters into REM statements?

This machine language search and replace program opens a universe of options like these. Use your imagination after you type in the BASIC listing. This article also throws some light on how BASIC is stored in your computer.

A machine language program can be stored in your Apple computer three ways: (1) by typing on the keyboard; (2) by loading it from cassette or disk; (3) by LOADing a BASIC program and having it POKE the machine language into place. It's the third method that we'll use here.

When you RUN this program, it will ask you to provide information so that it can set itself up for the particular function you have in mind. Once you have done this, you can LOAD another BASIC program without affecting the machine language program. Then to change the new program, type & and press RETURN. The computer will jump to the machine language program, execute it, and return to BASIC.

Search And Replace

This program will search through your BASIC program until it finds a REM statement, then read the information between REM and the end of the line, and change any control-A's to carriage returns. When it reaches the end of the line (or a colon), it goes on to the next line and continues its search for REM statements until it reaches the end of the BASIC program.

You can change it so that it will look for any other command, and change characters that follow on that line, until the end of the line or the colon is encountered.

For example, say you want to make your REM statements easier to read by inserting carriage returns. When you type the REM statement, type a control-A everywhere you want a carriage return. Then, when you're finished, use the & command to execute the machine language program. You'll see the results when you list your program.

As another example, suppose your printer requires the Escape character to access special functions. It is possible to type your BASIC program with control-E's in place of the Escape character, then later run the machine language program to make a switch.

BASIC Tricks

BASIC uses some space-saving tricks to store a program. For one, it converts commands into tokens. So REM is not stored as the ASCII codes for R, E, and M. Instead, the entire word is converted to the value $B2. (The $ indicates the value is in hexadecimal notation. $B2 is equivalent to 178 in ordinary decimal notation.)

Another trick is using the character that indicates the end of a program line. You would assume (because you hit RETURN to tell the computer you have finished entering a line) that it would store the ASCII code for RETURN, $0D (13). But it doesn't. Instead, it stores $00 (0).

A third trick is the conversion of all line numbers to two bytes. A line number of 1 is stored as $01 00, and a line number of 256 is stored as $00 01. The high-order (more significant) byte is in the second position.

The machine language program puts this information to good use. Every time it encounters $00, it skips over the line number (and two more bytes which hold the location of the next line) to the beginning of the next command sequence. If it finds a value of $B2, the token for REM, when it is looking for REM statements, it jumps to the subroutine that switches one character for another. If the subroutine encounters a $00, or the ASCII token for ":", it ends and the program starts looking for the next REM statement.

Here's a list of some tokens and ASCII values of interest. You can find a list of ASCII codes used by Applesoft on pages 138 and 139 of the *Applesoft BASIC Programming Manual*. The tokens for the commands can be found on page 121.

Hex	Decimal	Printed As	
$B2	178	REM	(Token)
BA	186	PRINT	(Token)
84	132	INPUT	(Token)
8B	139	IN#	(Token)
8A	138	PR#	(Token)
23	35	#	(ASCII)
01	1	(Control-A)	(ASCII)
0D	13	(RETURN)	(ASCII)

You should know that DOS commands in a BASIC program are not tokenized. In

```
10 PRINT CHR$(4);"PR# 1"
```

PR# is stored as the ASCII equivalents for P, R, and #. Take this into consideration when setting up the machine language program. The token to search for in such a situation is $23, the ASCII code for #.

Changing Switch Without Loader

Let's call the BASIC program listed with this article *Loader* and the machine language program that it produces *Switch*. Once you have run Loader, you can change Switch, without rerunning Loader, using POKE commands.

To change the command token, use POKE 796, (new token).

To change the byte to be replaced, use POKE 815, (new byte).

To change the replacement, use POKE 821, (new byte).

Here's an example. If you want to change all of the control-B's in all of your PRINT statements to control-G's (bell ringers), you must first know that the token for PRINT is 186, that the ASCII byte for control-B is 2, and that the ASCII byte for the bell character is 7. Then enter:

```
] 10 POKE 796,186 : POKE 815,2 : POKE 821,7
```

The equivalent monitor command line is:

```
* 31C:BA N 32F:02 N 335:07
```

(The N allows you to put more than one command on a line.) Then enter & to make the change (or 300G in machine language).

Some Quick Facts About The Program

The machine language program can be placed anywhere in memory. Normally it resides at $300-$350 (768 to 848).

Locations $F9 and $FA (249 and 250) are normally unused by BASIC, DOS, or the monitor, but are used by Switch to keep track of its current point in the BASIC program it is changing.

Switch gets its information for the beginning and end locations of the program from $67 and $68 (103 and 104) and $AF and $B0 (175 and 176), respectively.

The & vector must be set to $300 (768). This is done by Loader.

Bytechanger

```
10  REM


SWITCH LOADER

20  HOME : REM  CLEAR SCREEN
30  PRINT "THIS UTILITY WILL ALLOW YOU
     TO MAKE"
40  PRINT "GLOBAL CHANGES IN YOUR PROGR
     AM.  IT IS"
50  PRINT "SET UP TO CHANGE ALL CTRL-A'
     S IN REM "
60  PRINT "STATEMENTS TO RETURNS."
70  RESTORE : GOSUB 320: REM POKESWITCH
     INTO MEMORY
80  PRINT : INPUT "WOULD YOU LIKE TO CH
     ANGE IT? Y/N ";A$
90  IF  LEFT$ (A$,1) = "N" THEN 280
100  IF  LEFT$ (A$,1) <  > "Y" THEN 20
110  HOME
120  VTAB 10: PRINT "I WANT TO CONVERT
     THIS CHARACTER: ";: GET A$: PRINT
     A$: REM  'GET'
     ALLOWS YOU TO GRAB CARRIAGE
     RETURNS AND ESCAPES
130  PRINT "TO THIS CHARACTER: ";: GET
     B$: PRINT B$
140  PRINT "IN ALL"
150  PRINT "    1 REM"
160  PRINT "    2 PRINT"
170  PRINT "    3 INPUT"
180  PRINT "    4 IN#    (NO DOS)"
190  PRINT "    5 PR#    (NO DOS)"
200  PRINT "    6 #      (DOS IN USE)"
210  PRINT "STATEMENTS.  CHOOSE # ";: GET
     C$: PRINT C$
220  IF  VAL (C$) = 2 THEN  POKE 796,18
     6
230  IF  VAL (C$) = 3 THEN  POKE 796,13
     2
240  IF  VAL (C$) = 4 THEN  POKE 796,13
     9
250  IF  VAL (C$) = 5 THEN  POKE 796,13
     8
260  IF  VAL (C$) = 6 THEN  POKE 796,35
270  POKE 815, ASC (A$): POKE 821, ASC
     (B$): REM  POKE ASCII
     VALUES INTO SWITCH
280  POKE 1013,76: POKE 1014,0: POKE 10
     15,3: REM  POKE IN THE
     VECTOR FOR THE '&' COMMAND
290  PRINT : PRINT "USE '&' TO CONVERT"
300  END
310  REM
```

```
DATA FOR SWITCH

320  FOR A = 768 TO 848: READ B: POKE A
     ,B: NEXT : RETURN
330  DATA 169,0,133,249,165,104,133,250
     ,169,3,24,101,103,144,2,230,250,16
     8,200
340  DATA 208,2,230,250,177,249,240,31,
     169,178,209,249,208,241,200,208,2,
     230,250
350  DATA 177,249,240,16,201,58,240,228
     ,169,1,209,249,208,237,169,13,145,
     249,208
360  DATA 231,162,4,200,208,2,230,250,2
     02,208,248,165,250,197,176,144,200
     ,240,198
370  DATA 196,175,144,194,96
380  REM
     THIS REMARK WAS PRECEDED
     BY A CARRIAGE RETURN AND
     FIVE SPACES ON EACH LINE
```

©

Part I

Mixing Graphics Modes On The 64

Sheldon Leemon

It's possible to have several different graphics modes simultaneously on the 64 screen. Program 1 shows you how to divide the display into three zones: high resolution, regular text, and multicolor bitmap mode. Program 2 uses the same utility program, but creates entirely different effects. The screen displays all three text modes: regular, extended background color, and multicolor.

This graphics technique provides you with significant control over what appears on your screen. For example, you can switch modes with simple POKEs. Although there's plenty of technical information here for advanced programmers, the author has provided instructions and example programs which beginners can follow. Everyone can take advantage of these important techniques.

The *Commodore 64 Programmer's Reference Guide* hints that more than one graphics mode may be displayed on the screen at once. When it comes time to explain how it can be done, however, the *Guide* states only that you must set a raster interrupt for the screen line where you want a different type of display to start, set the VIC-II chip for the new mode during that interrupt, and then set up another interrupt to change the mode back a little farther down the display. This explanation might be clear to advanced machine language programmers, but it leaves a lot of others in the dark.

In this tutorial, we'll look at some examples of raster interrupts that can be easily used by BASIC programmers to create split-screen displays and other effects. We'll also discuss, in more detail, how machine language programmers can use the raster interrupt capability.

The Interrupt

The most obvious place to start our discussion is by explaining what an interrupt is. An interrupt is a signal given to the microprocessor (the "brains" of the computer) that tells it to stop executing its machine language program (for example, BASIC itself is a machine language program) and to work on another program for a short time, perhaps only a fraction of a second. After finishing the interrupt program, the computer goes back to executing the main program, just as if there had never been a detour.

There are several ways to cause such an interrupt on the 64. Pressing the RESTORE key causes an interrupt, and if the STOP key is also pressed, the interrupt routine clears the screen and restores the computer to its normal state. There are internal timers on the CIA Input/Output chips that can each generate interrupts. One of these timers is set by the operating system to interrupt every sixtieth of a second, and the interrupt routine that is called is used to check the keyboard and to update the jiffy clock which is used by TI and TI$. In addition, the VIC-II chip can also interrupt normal program execution when one of a number of events related to the graphics display occurs. One of these is called a raster interrupt.

On a normal TV display, a beam of electrons (raster) scans the screen, starting in the top left-hand corner and moving in a straight line to the right, lighting up appropriate parts of the screen line on the way. When it comes to the right edge, the beam moves down a line and starts again from the left. There are 263 such lines that are scanned by the 64 display, 200 of which form the visible screen area. This scan updates the complete screen display 60 times every second.

The VIC-II chip has memory registers that keep track of the line that the raster is scanning at any given moment. Since the line number can be greater than 255, one register is not enough to do the job. Therefore, the part of the number that is less than 256 is kept in location 53266 ($D012 hex), and if bit 7 of location 53265 ($D011) is set to 1, 256 is added to that number to arrive at the correct scan line. Of course, since these numbers change 15,780 times per second, a BASIC program executes far too slowly to read the registers and take effective action based on their contents. Only a machine language program has the speed to accomplish something with a particular raster scan line, and even it may not be quick enough to change the display without some slight, but visible, disruption.

The raster registers have two functions. When read, they tell what line is presently being scanned. But when written to, they designate a particular scan line as the place where a raster interrupt will occur. If the raster interrupt is enabled, the interrupt program will be executed at the exact moment that the raster beam reaches that line. This allows the user to reset any of the VIC-II registers at any point in the display and thus change character sets, background color, or graphics mode for only a part of the screen display.

Setting up a raster interrupt program is admittedly not a job for a beginning programmer, but with the following step-by-step explanation, most machine language programmers should be able to write such a routine. Those with no machine language experience should read the explanation in order to get a general idea of what is taking place. Afterwards, we'll see how to use the example interrupt routine even if you don't know anything about machine language programming.

Writing A Raster Interrupt

When you have finished writing the machine language routine that you want the interrupt to execute, the steps required to set up the raster interrupt are:

1. Set the interrupt disable flag in the status register with an SEI instruction. This will disable all interrupts and prevent the system from crashing while you are changing the interrupt vectors.

2. Enable the raster interrupt. This is done by setting bit 0 of the VIC-II chip interrupt enable register at location 53274 ($D01A) to 1.

3. Indicate the scan line on which you want the interrupt to occur by writing to the raster registers. Don't forget that this is a 9-bit value, and you must set both the low byte (in location 53264) and the high bit (in the register at 53265) in order to insure that the interrupt will start at the scan line you want it to, and not 256 lines earlier or later.

4. Let the computer know where the machine language routine that you want the interrupt to execute starts. This is done by placing the address in the interrupt vector at locations 788-789 ($314-$315). This address is split into two parts, a low byte and a high byte, with the low byte stored at 788. To calculate the two values for a given address AD, you may use the formula HIBYTE=INT(AD/256) and LOWBYTE=AD-(HIBYTE*256). The value LOWBYTE would go into location 788, and the value HIBYTE would go into location 789.

5. Re-enable interrupts with a CLI instruction, which clears the interrupt disable flag on the status register.

When the computer is first turned on, the interrupt vector is set to point to the normal hardware timer interrupt routine, the one that advances the jiffy clock and reads the keyboard. Since this interrupt routine uses the same vector as the raster interrupt routine, it is best to turn off the hardware timer interrupt by putting a value of 127 in location 56333. If you want the keyboard and jiffy clock to function normally while your interrupt is enabled, you must preserve the contents of locations 788 and 789 before you change them to point to your new routine. Then you must have your interrupt routine jump to the old interrupt routine exactly once per screen refresh (every sixtieth of a second).

Another thing that you should keep in mind is that at least two raster interrupts are required if you want to change only a part of the screen. The interrupt routine must not only change the display, but it must also set up another raster interrupt that will change it back.

Program 1 is a BASIC program that uses a raster-scan interrupt to divide the display into three sections. The first 80 scan lines are in high-resolution bitmap mode, the next 40 are regular text, and the last 80 are in multicolor bitmap mode. The screen will split this way as soon as a SYS to the routine that turns on the interrupt occurs, and the display will stay split even after the program ends. Only if you hit the STOP and RESTORE keys together will the display return to normal.

Program 2 shows how a completely different split screen can be set up using the same machine language program. The DATA statements for the interrupt routine are the same as for Program 1, except for the tables starting at line 49264. By changing these tables, we now have a display that shows all three text modes: regular, extended background color, and multicolor. Upper- and lowercase text are mixed, and each area has a

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different background color. This program also shows that you can change the table values during a program by POKEing the new value into the memory location where those table values are stored. In that way, you can, for example, change the background color of any of the screen parts while the program is running.

Once you know how to use all the graphics features that the VIC-II chip makes available, the sample interrupt program should enable you to combine several different display modes on a single screen, so that you can take maximum advantage of the 64's graphics power.

Program 1: Text With Graphics

```
10 FOR I=49152 TO 49278: READ A:POKE I,A
   :NEXT:SYS12*4096
20 PRINT CHR$(147):FOR I=Ø TO 8:PRINT:NE
   XT
30 PRINT"THE TOP AREA IS HIGH-RES BIT MA
   P MODE"
40 PRINT:PRINT"THE MIDDLE AREA IS ORDINA
   RY TEXT "
50 PRINT:PRINT"THE BOTTOM AREA IS MULTI-
   COLOR BIT MAP"
60 FORG=1Ø24 TO 1383:POKEG,114:NEXT:FORG
   =1384 TO 1423:POKE G,6:NEXT
70 FORG=1664 TO 2Ø23:POKEG,234:NEXT
80 FORG=55936TO56295:POKEG,13:NEXT
90 FOR I=8192 TO 11391:POKE I,Ø:POKE I+4
   8ØØ,Ø:NEXT
100 BASE=2*4Ø96:BK=49267
110 H=4Ø:C=Ø:FORX=ØTO319:GOSUB15Ø:NEXT
120 H=16Ø:C=Ø:FORX=ØTO319STEP2:GOSUB15Ø:
    NEXT:C=4Ø:FORX=1TO319STEP2:GOSUB15Ø:
    NEXT
130 C=8Ø:FOR X=Ø TO 319 STEP2:W=Ø:GOSUB1
    5Ø:W=1:GOSUB15Ø:NEXT
140 GOTO 14Ø
150 Y=INT(H+2Ø*SIN(X/1Ø+C)):CH=INT(X/8):
    RO=INT(Y/8):LN=YAND7
160 BY=BASE+RO*32Ø+8*CH+LN:BI=ABS(7-(XAN
    D7)-W)
170 POKEBY,PEEK(BY)OR(2↑BI):RETURN
49152 DATA 12Ø, 169, 127, 141, 13, 22Ø
49158 DATA 169, 1, 141, 26, 2Ø8, 169
49164 DATA 3, 133, 251, 173, 112, 192
4917Ø DATA 141, 18, 2Ø8, 169, 24, 141
49176 DATA 17, 2Ø8, 173, 2Ø, 3, 141
49182 DATA 11Ø, 192, 173, 21, 3, 141
49188 DATA 111, 192, 169, 5Ø, 141, 2Ø
49194 DATA 3, 169, 192, 141, 21, 3
492ØØ DATA 88, 96, 173, 25, 2Ø8, 141
492Ø6 DATA 25, 2Ø8, 41, 1, 24Ø, 43
49212 DATA 198, 251, 16, 4, 169, 2
49218 DATA 133, 251, 166, 251, 189, 115
49224 DATA 192, 141, 33, 2Ø8, 189, 118
4923Ø DATA 192, 141, 17, 2Ø8, 189, 121
49236 DATA 192, 141, 22, 2Ø8, 189, 124
49242 DATA 192, 141, 24, 2Ø8, 189, 112
49248 DATA 192, 141, 18, 2Ø8, 138, 24Ø
49254 DATA 6, 1Ø4, 168, 1Ø4, 17Ø, 1Ø4
4926Ø DATA 64, 76, 49, 234
49264 DATA 49, 17Ø, 129 :REM SCAN LINES
49267 DATA Ø, 6, Ø:REM BACKGROUND COLOR
4927Ø DATA 59, 27,59:REM CONTROL REG. 1
49273 DATA 24, 8, 8:REM CONTROL REG. 2
49276 DATA 24, 2Ø, 24:REM MEMORY CONTROL
```

Program 2: The Three Text Modes

```
10 FOR I=49152 TO 49278: READ A:POKE I,A
   :NEXT:SYS12*4096
20 PRINTCHR$(147)CHR$(5):POKE 5328Ø,Ø
30 POKE 5328Ø,Ø:POKE 53282,6:POKE 53283,
   5:POKE 53284,4
40 PRINT:PRINT"THIS IS MULTI-COLOR TEXT
   MODE"
50 PRINT:PRINT"FOUR-COLOR CHARACTERS ARE
    HARD TO READ"
60 PRINT:PRINT CHR$(15Ø)"ABCDEFGHIJKLMNO
   PQRSTUVWXYZ123456789Ø"
70 PRINT:PRINT:PRINT:PRINT CHR$(28)"THIS
    IS NORMAL TEXT MODE..."
80 PRINT:PRINT"NOTHING FANCY GOING ON HE
   RE":PRINT:PRINT:PRINT
90 PRINTCHR$(144)"{6 SPACES}EX{RVS}TE
   {OFF}ND{RVS}ED{OFF} BA{RVS}CK{OFF}GR
   {RVS}OU{OFF}ND{RVS} C{OFF}OL{RVS}OR
   {OFF} MO{RVS}DE{OFF}{UP}"
100 PRINT:PRINT"LETS YOU USE DIFFERENT B
    ACKGROUND COLORS"
110 PRINT "{RVS}LETS YOU USE DIFFERENT B
    ACKGROUND COLORS"
120 PRINT"LETS{SHIFT-SPACE}YOU
    {SHIFT-SPACE}USE{SHIFT-SPACE}DIFFERE
    NT{SHIFT-SPACE}BACKGROUND
    {SHIFT-SPACE}COLORS"
130 PRINT "{RVS}LETS{SHIFT-SPACE}YOU
    {SHIFT-SPACE}USE{SHIFT-SPACE}DIFFERE
    NT{SHIFT-SPACE}BACKGROUND
    {SHIFT-SPACE}COLORS";
140 FORS=ØTO3ØØØ:NEXT
150 FORS=49267TO49269:POKES,RND(1)*16:FO
    R I=1 TO 2ØØØ:NEXT I,S:GOTO 14Ø
49152 DATA 12Ø, 169, 127, 141, 13, 22Ø
49158 DATA 169, 1, 141, 26, 2Ø8, 169
49164 DATA 3, 133, 251, 173, 112, 192
4917Ø DATA 141, 18, 2Ø8, 169, 24, 141
49176 DATA 17, 2Ø8, 173, 2Ø, 3, 141
49182 DATA 11Ø, 192, 173, 21, 3, 141
49188 DATA 111, 192, 169, 5Ø, 141, 2Ø
49194 DATA 3, 169, 192, 141, 21, 3
492ØØ DATA 88, 96, 173, 25, 2Ø8, 141
492Ø6 DATA 25, 2Ø8, 41, 1, 24Ø, 43
49212 DATA 198, 251, 16, 4, 169, 2
49218 DATA 133, 251, 166, 251, 189, 115
49224 DATA 192, 141, 33, 2Ø8, 189, 118
4923Ø DATA 192, 141, 17, 2Ø8, 189, 121
49236 DATA 192, 141, 22, 2Ø8, 189, 124
49242 DATA 192, 141, 24, 2Ø8, 189, 112
49248 DATA 192, 141, 18, 2Ø8, 138, 24Ø
49254 DATA 6, 1Ø4, 168, 1Ø4, 17Ø, 1Ø4
4926Ø DATA 64, 76, 49, 234
49264 DATA 49, 177, 113 :REM SCAN LINES
49267 DATA 2, 7, 6:REM BACKGROUND COLOR
4927Ø DATA 91, 27,27:REM CONTROL REG. 1
49273 DATA 8, 8, 24:REM CONTROL REG. 2
49276 DATA 2Ø, 22, 2Ø:REM MEMORY CONTROL©
```

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A Fig-Forth Utility

Jürgen Pfeifer

There are several versions of Forth. The most popular is the Implementation of the Forth-Interest-Group (FIG), the well known fig-Forth.. But there exists an improvement, the 79-Standard Forth, which is very close to fig-Forth.

The 79-Standard describes a very useful word, which doesn't exist in fig-Forth. It is the word "roll." The Forth stack notation for roll is:

roll n–

This word extracts the nth stack value to the top of stack, not counting n itself, moving the remaining values into the vacated position. n must be strictly positive.

Examples: 3 roll = rot (a fig-word).
1 roll = no operation.

The screens here contain a low-level definition of "roll" for a 6502 fig-Forth, using the Forth 6502 macroassembler.

As an application, the screens contain the definition of the signed double-integer multiplication operator "d*". Try to define it without roll!

```
SCR # 106
( ROLL                                                    JPF   JUL82 )
CODE ROLL ( N --- )
  1 # LDA, SETUP JSR, XSAVE STX, N LDA, SEC, 1 # SBC, CS
  IF, 0= NOT IF,
                TAY, .A ASL, CLC, XSAVE ADC, TAX,
                BOT LDA, PHA, BOT 1+ LDA, PHA,
                BEGIN, DEX, DEX,
                       BOT LDA, SEC STA,
                       BOT 1+ LDA, SEC 1+ STA,
                       DEY, 0=
                UNTIL, PLA, PUT JMP,
             THEN,
  THEN, NEXT JMP, END-CODE
( ROLL : EXTRACT THE N-TH STACK VALUE TO THE TOP OF STACK, NOT
         COUNTING N ITSELF, MOVING THE REMAINING VALUES INTO THE
         VACATED POSITION. N>0 )

SCR # 107
( ROLL APPLICATION                                        JPF   JUL82 )
: PICK 2* SP@ + @ ;
  ( N1 --- N2 : RETURN THE CONTENTS OF THE N1-TH STACK VALUE,
                NOT COUNTING N1 ITSELF. N>0 )

: 2SWAP ROT >R ROT R> ;
  ( D1 D2 --- D2 D1 : EXCHANGE THE TOP TWO DOUBLE NUMBERS
                      ON THE STACK. )

: D* OVER 5 PICK U* 6 ROLL 4 ROLL * + 2SWAP * + ;
  ( D1 D2 --- D3 : LEAVES THE ARITHMETIC PRODUCT OF THE
                   DOUBLE PRECISION INTEGERS D1 AND D2 )
```

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Banish Atari INPUT Statements

Jim Faryar

If you use BASIC's INPUT statement, you relinquish control to the computer. Here is a subroutine that lets you avoid INPUT by using the Atari's string-handling.

Here's an enhanced No-INPUT-Statement Input subroutine for the Atari. It is a useful application of Atari's string-handling method. We use POS to keep track of the relative position of the cursor within the string INP$. Then, we assign the character typed in by the user, CHR$(KEY), to the input string INP$ at position (POS,POS), replacing anything in that position (line 47).

Cursor right and left keys result in a change in POS, but no character assigned to INP$. The BACK-S key results in a change in POS, as well as a space assigned to replace the character in the new position INP$(POS,POS). Additional control is provided by keeping POS within the space ("mask") allowed for input, and by allowing characters of only type T$ (see below) to be typed in.

The subroutine:

- Supports the insert, delete, and right and left cursor keys, as well as the BACK-S key.
- Inhibits cursor movement outside the input "mask" to protect the screen display.
- Controls the length of the user's input.
- Controls the range of characters the user may input.
- Beeps when the user attempts an unauthorized keystroke.

Type in the program.

Lines 10-17 support the use of the INSERT key.
Lines 18-27 support the use of the DELETE key.
Lines 28-33 support the use of the CURSOR-RIGHT key.
Lines 34-42 support the use of the CURSOR-LEFT and BACK-S keys.
Lines 43-49 restrict the characters that may be input.
Lines 100-300 are a demonstration.

Be careful to include the semicolon that ends most of the PRINT statements. Run the program: try any keystrokes you wish and see the result. I could not disable the BREAK or the SYSTEM RESET keys (can anyone show me how?).

To use the subroutine in your own programs, simply:

1. Start your program at line 100.

2. PRINT your input prompt, ending it with a semicolon.

3. LET L1 = length you will allow for input.

4. LET T$ = type of characters you will allow:
"A" – converts all lowercase letters input to uppercase.
"9" – allows numbers only.
"X" – allows all characters.
(You can add to and modify these categories, by altering lines 44-45.)

5. GOSUB 5.

6. INP$ will contain the value input. You can set it equal to your own variable, for example:

NAME$ = INP$
NUM$ = INP$: NUM = VAL(NUM$).

Note that, for numeric variables, I do not take VAL(INP$), but VAL of an intermediate variable NUM$: because VAL(INP$) adversely affects the use of INP$ in subsequent calls to the subroutine. I don't know why this happens.

7. Remember not to use the variables I1, L1, T$, KEY, INP$, and POS anywhere else in your program.

INPUT Mask

```
1 REM INPUT MASK
2 OPEN #1,4,0,"K:"
3 DIM INP$(37),T$(1)
4 GOTO 100
5 POS=1
6 INP$="":IF T$="9" THEN INP$="0"
7 GET #1,KEY
8 IF KEY=155 THEN RETURN
9 IF (KEY>31) AND (KEY<125) THEN 43
10 IF KEY<>255 THEN 18
11 IF LEN(INP$)=L1 THEN 50
12 PRINT CHR$(255);
13 FOR I1=LEN(INP$)+1 TO POS+1 STEP -1
14 INP$(I1,I1)=INP$(I1-1,I1-1)
15 NEXT I1
16 INP$(POS,POS)=" "
17 GOTO 7
18 IF KEY<>254 THEN 28
19 IF POS>LEN(INP$) THEN 50
20 PRINT CHR$(254);
21 IF LEN(INP$)=1 THEN 5
22 IF POS=LEN(INP$) THEN INP$=INP$(1,POS-1):GOTO 7
23 FOR I1=POS TO LEN(INP$)-1
24 INP$(I1,I1)=INP$(I1+1,I1+1)
25 NEXT I1
26 INP$=INP$(1,I1-1)
27 GOTO 7
```

```
28 IF (KEY=30) OR (KEY=126) THEN 34
29 IF KEY<>31 THEN 50
30 IF POS>=L1 THEN 50
31 PRINT CHR$(31);:POS=POS+1
32 IF POS-LEN(INP$)>1 THEN INP$(POS-
   1,POS-1)=" "
33 GOTO 7
34 IF POS<=1 THEN 50
35 IF POS=LEN(INP$) THEN IF INP$(POS
   ,POS)=" " THEN INP$=INP$(1,POS-1)
36 POS=POS-1
37 IF KEY=30 THEN PRINT CHR$(30);:GO
   TO 7
38 PRINT CHR$(126);
39 IF LEN(INP$)=1 THEN 5
40 IF POS=LEN(INP$) THEN INP$=INP$(1
   ,POS-1):GOTO 7
41 INP$(POS,POS)=" "
42 GOTO 7
43 IF POS>L1 THEN 50
44 IF (T$="A") AND (KEY>96) THEN KEY
   =KEY-32
45 IF (T$="9") AND ((KEY<48) OR (KEY
   >57)) THEN 50
46 PRINT CHR$(KEY);
47 INP$(POS,POS)=CHR$(KEY)
48 POS=POS+1
49 GOTO 7
50 PRINT CHR$(253);:GOTO 7
60 REM
70 REM
100 DIM NAME$(20),NUM$(12)
110 PRINT CHR$(125)
120 POSITION 4,2
130 PRINT "NAME: ";
140 L1=20:T$="A":GOSUB 5
150 NAME$=INP$
160 POSITION 4,4
170 PRINT "NUMBER: ";
180 L1=4:T$="9":GOSUB 5
190 NUM$=INP$:NUM=VAL(NUM$)
200 POSITION 4,6
210 PRINT "Is ALL the above correct?
    ";
220 L1=3:T$="A":GOSUB 5
230 IF ASC(INP$)<>89 THEN 110
240 POSITION 4,12
250 PRINT NAME$,LEN(NAME$),NUM,ASC(I
    NP$)
300 END
```

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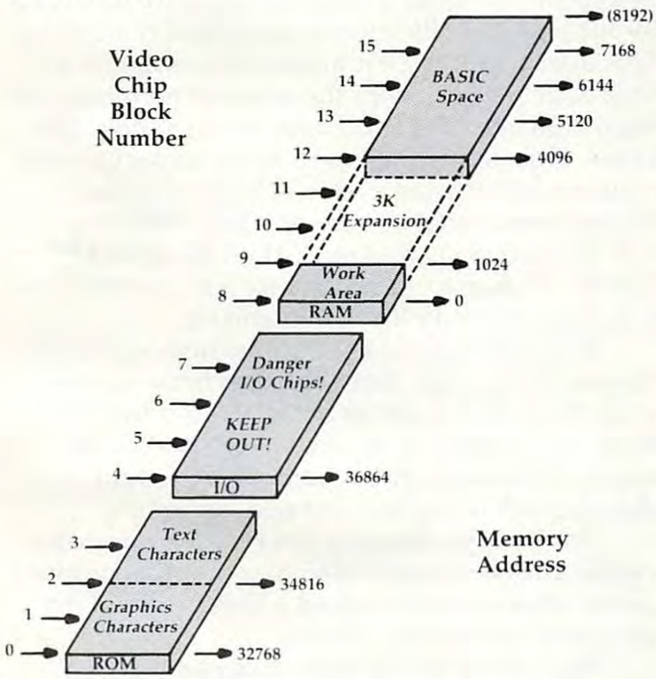
Part IV

Visiting The VIC-20 Video

Jim Butterfield, Associate Editor

In which the traveller finds that the highest resolutions can be achieved by setting his sights a little lower.

We've spent some time viewing the world (or at least memory) from a video chip's-eye view, and we've noted that the video chip sees memory in its own way:



How the video chip sees memory.

We've muddled with the character set, both built-in and home brewed. But we haven't seemed to deal with achieving that mystic goal – high resolution screen control.

We've dealt with custom characters. And as Glinda the Good Witch could have said to Dorothy, "If you had known their powers, you could have done it the very first day." In other words, we've been looking at high resolution all along without recognizing it.

Here's the trick: if every position on the screen contained a different character, and if we can define any character at will, we can define any spot on the screen as we wish.

Filling In

Mechanically, we do it this way: the first cell on the screen will contain character zero; the next will contain character one; and so on. To change the upper-leftmost pixel on the screen, we modify the upper-left pixel of character zero, and the screen immediately shows the change.

This is a change from our usual use of screen and character set. Our screen memory is now totally fixed and must not change. Normal print-out and things like scrolling must stop. The characters, on the other hand, are now completely variable, with pixels turning on and off according to what the picture needs.

Wait – there's a problem. It seems that the screen has room for 506 characters; yet we know that we can make only 256 individual characters. Something doesn't fit. How can we resolve this problem?

There are two ways. One is to use "double characters" – the jumbo-sized characters that we get when we POKE an odd number into address 36867. Each of our 256 characters now occupies twice the space on the screen, so that we can cover the screen easily. The character set table now becomes huge, of course: each character takes 16 bytes to describe, making the whole table up to 4096 bytes long.

Since we're trying to describe things you can achieve in an unexpanded VIC, this becomes impractical – it's hard to take 4K away from a machine that has only 3.5K available to start with. On a machine with memory expansion, however, this is quite practical; read on, for we'll use tricks on the small machine that will come in handy even on the big ones.

The other method is this: cut the size of the screen so that it contains only 256 characters or less. We can store the number of columns and rows we want into 36866 and 36867. POKE 36866,16 will set 16 columns; and POKE 36867,32 will set 16 rows (we must multiply the number by two here). How many characters can we store? 256 – and that number may sound familiar by now.

By the way, BASIC won't know how to cope with the peculiar row and column counts if you do this as a direct command, so be prepared for an odd-looking screen. Neatness fanatics will want to center the remaining display by appropriate POKEs to 36864 and 36865, but I'll leave this as an exercise for you.

Diving In

Enough of this abstract theory. Let's dive into a program to prove that even the humble minimum VIC can do high resolution graphics.

```
100 POKE 56,22:CLR    (Drop top of BASIC)
110 POKE 36869,222    (Relocate screen...)
120 POKE 36866,144    (and character set)
```

Note that the above line sets the screen to a half-block (128) and sets up 16 columns instead of the normal 22 (128 plus 16 gives 144). We may as well go ahead and change the rows:

```
130 POKE 36867,32   (16 rows times 2)
200 FOR J=6144 TO 8191
210 POKE J,0:NEXT J
```

We've cleared the entire character set to zero (all pixels off). Now let's set up the screen with character zero in the first slot, etc.:

```
300 FOR J=0 TO 255
310 POKE J+5632,J
320 NEXT J
```

Let's set all characters to color black:

```
330 FOR J=37888 TO 38911
340 POKE J,0:NEXT J
```

Our screen is now ready. Serious graphics takes quite a bit of math (dividing by 16 to find the row and column; dividing by 8 for the pixel position), but we'll substitute a little simple coding to draw a triangle:

```
400 FOR J=6792 TO 6816 STEP 8
410 POKE J,255   (horizontal line)
420 NEXT J
500 FOR J=6280 TO 6664 STEP 128
510 FOR K=J TO J+7
520 POKE K,128   (vertical line)
530 NEXT K,J
600 FOR J=6280 TO 6704 STEP 136
610 X=128   (leftmost pixel)
620 FOR K=J TO J+7
630 POKE K,PEEK(K) OR X
640 X=X/2   (move pixel right)
650 NEXT K,J
700 GOTO 700
```

The program is now complete. It will wait in a loop at line 700 until you press RUN/STOP. When you do so, a number of odd things will happen. The computer will try to print the word READY into screen memory, but screen memory is intended for a different usage now, and all that will result is screen "clutter."

Bring everything back to sanity by holding down RUN/STOP and hitting the RESTORE key.

Extra Ideas

Effective graphics calls for the use of a fair bit of mathematics. To place (or clear) a pixel, you need to find the row and column by dividing the X and Y coordinates by the appropriate scaling factor. You need to change this to a screen character number by multiplying the row number by the total number of columns and then adding the column number. Multiply this by eight, and you'll get the position where the character is located within the character set. Now we must go for the pixels within this character: the bits within a byte are pixels "across" and the eight consecutive bytes are pixels "down." Now you know why people buy a Super Expander – to save them from the math.

Even when you have plenty of memory available, which allows you to use double characters and get lots of pixels on the screen, it's usual to "trim" the screen a little. The normal 22 columns by 23 rows are usually trimmed back to 20 columns by 20 rows (actually ten rows of double characters). This does two things: it makes the arithmetic a little easier, and it drops the memory requirements from 4096 bytes for a full deck down to only 3200 bytes. This, in turn, gives us space to pack screen memory into the same 4K block. That's handy, because we cannot be sure that the video chip will have access to any more than 4K of RAM. BASIC, of course, will long since have been moved to occupy memory from 8192 and up.

If you want to add text to the high resolution display, it's a snap. Just copy the characters you want from the Character Set ROM and transfer them to the appropriate character slots on the screen. Of course, you would have thought of that yourself if I hadn't just told you.

Don't forget that you can POKE appropriate values into 36864 and 36865 to center the graphics neatly. Our example looked a little lopsided; try your hand at making it neater.

High resolution is there and waiting. Yes, you can do it on a small screen PET.

There's a good bit of math needed. You may find this a challenge: after all, isn't that what a computer does best?

Even if the mathematics befogs your mind and causes you to go out and buy a Super Expander, you'll have learned a few new things. First, the Super Expander doesn't make graphics possible – they were there all the time – it just makes them easier. Second, you'll have a better idea of what's going on inside your marvellous VIC computer.

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PROGRAMS FOR THE COMMODORE 64 AND VIC 20

VICplot

Gerald Chick

This utility draws or erases points on a 64 x 64 grid. The program also lets you examine a point to determine its previous status. Using the example program, you can get a feel for the uses of this short, but effective, programming tool. If you LOAD a program in from cassette, you'll need to re-READ the DATA of VICplot back into the cassette buffer (see lines 1399-1420 and 1510-1560). For the VIC, expanded by 3 or 8K of memory.

"VICplot" is a simple utility for the VIC-20 designed to plot or erase points on a 64 x 64 grid. VICplot's 83-byte program accomplishes three important functions: it allows plotting, erasure, and indicates a point's previous condition.

Functions to draw, erase, or examine a point (similar to Super Expander commands POINT c,x,y and RDOT(x,y)) are included in VICplot. The last function is particularly important. Quite often you will want to know whether a point was lit or not. The sample program uses this function to gather data.

Protecting The Character Set

The character set which makes up the grid is stored in 2K of RAM beginning at 5120 ($1400). This set must be established by BASIC. VICplot is placed in the cassette buffer, so only the character set need be protected from BASIC. If you are using 3K or less expansion, type:

POKE 56,20 :POKE 52,20 :POKE 55,0

With 8K of added RAM, you will have to type:

POKE 44,28 :POKE 7168,0

before you load the program. This sets the start of BASIC above the character set.

The pointer to character memory must also be reset: POKE 36869, 205 for 8K expansion; POKE with 253 for less memory. The sample program has a subroutine at 1400 to load VICplot and draw the screen. Once this is finished, VICplot is ready to use. A few precautions are in order, though.

First, there is no error detection. A too large Y coordinate will plot in the wrong column. Worse than that, a too large X coordinate will be placed *beyond* the matrix, possibly in BASIC or on the screen. A value of 128 for X will cause a point to appear in your BASIC program around location 9200. Second, don't be surprised at the size of the dots. They are actually two pixels square.

Plotting Points With A Sample Program

To access VICplot, the X and Y coordinates should be placed in locations 251 and 252, respectively. To plot this point, place a one in location 253. To erase, place a zero there. Now call VICplot with SYS 832. *Voilà*! Location 251 now holds the status flag. It can be read with

F= -(PEEK (251) =0).

If F=1 then the point was lit previously. A zero indicates it was dark.

A point can be lit in one of three colors (character, border, or auxiliary) set by the user. The color used is determined by the following table, which shows the value for each color. The data for this table is in line 1500 of the sample program.

The sample program is a good demonstration of how VICplot works. Two areas are selected, and 4000 random points are plotted on each. If a chosen point is already lit, a counter is incremented. Ten samples are taken of this count, and a bar graph is drawn to compare each trial. The bars are numbered, and the graph is scaled by hundreds.

The program is written for the 8K expander. To work in less memory, the POKEs for screen and color will have to be changed. The many REMarks should help you understand all the elements of this handy program.

VICplot Color Table

COLOR:	Screen	Border	Char.	Aux.
828	0	1	2	3
829	0	4	8	12
830	0	16	32	48
831	0	64	128	192
033C	00	01	02	03
033D	00	04	08	0C
033E	00	10	20	30
033F	00	40	80	C0

VICplot

```
1 REM GRAPH DEMO USING{10 SPACES}VICPLOT
  .
4 REM ----------------
5 REM THIS PROGRAM WRITTEN FOR 8K EXPAND
  ER
6 REM ----------------
10 DIMR(1,11)
15 GOSUB1400:GOTO100
19 REM USE: IFX>63ORY>63THENRETURN FOR E
   RROR PROTECT AT LINE 20 IF NECESSARY
20 POKE251,X:POKE252,Y:POKE253,E
30 SYS832
```

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```
40 F=-(PEEK(251)=Ø)
50 RETURN
99 REM DATA COLLECTION{7 SPACES}LOOP
1ØØ FORJ=ØTO1:POKE36878,PEEK(36878)AND15
    OR(16*(2+3*J)):REM SET AUX. COLOR
11Ø A=1:FORI=1TO4ØØØ
12Ø X=INT(RND(1)*(32*(2-J)))
13Ø Y=INT(RND(1)*(32*(2-J)))
14Ø E=1:GOSUB2Ø
15Ø IFFTHENR(J,A)=R(J,A)+1:REM COUNT REP
    LOT
16Ø IFI/4ØØ=INT(I/4ØØ)THENA=A+1:R(J,A)=R
    (J,A-1):REM NEXT SAMPLE
17Ø NEXTI
18Ø FORT=1TO1ØØØ:NEXT
19Ø GOSUB149Ø:NEXTJ
195 REM DISPLAY DATA
2ØØ CM=5364:CL=38Ø45:CR=33152:L=Ø
2Ø9 REM TRANSFER CHAR DATA FROM ROM TO C
    HAR MATRIX
21Ø FORI=1TO1Ø:POKECL+I,6:IFI=1ØTHENL=-8
    Ø
22Ø FORJ=ØTO7
23Ø A=PEEK(CR+J+8*I+L):POKECM+J,A
24Ø NEXTJ
25Ø POKECM-4,255:CM=CM+128
26Ø NEXTI
27Ø CM=CM-6:CL=CL+I
279 REM DRAW Y SCALING OF GRAPH
28Ø FORI=-11ØTOØSTEP4:POKECM+I,24Ø:FORJ=
    1TO3:POKECM+I+J,128:NEXT
285 POKECL+INT(I/16)*22,6:NEXT
289 REM SET RIGHT OF EACH CHARACTER TO P
    LOT IN SCREEN COLOR, SET AUX. COL TO
     RED
29Ø POKE83Ø,8:POKE831,2:POKE36878,PEEK(3
    6878)AND15OR32
3ØØ X1=1:Y1=55:E=1
3Ø9 REM DRAW BARS
31Ø FORI=1TO1Ø:X1=X1+4
32Ø FORJ=ØTO1:REM LOOP TO GRAPH BOTH SAM
    PLES
33Ø X=X1+J:A=INT(R(J,I)/5Ø):IFA>54THENA=
    55
34Ø IFA=ØTHEN38Ø
35Ø FORY=Y1-A+1TOY1
36Ø GOSUB2Ø
37Ø NEXTY
38Ø NEXTJ,I
39Ø GOTO39Ø
999 END
1399 REM POKE VICPLOT INTO CASS. BUFFER
14ØØ FORX=828 TO91Ø
141Ø READA:POKEX,A
142Ø NEXT
1429 REM PUT CHARACTERS ON SCREEN
143Ø PRINT"{CLR}":FORX=ØTO15
144Ø FORY=ØTO7
145Ø POKE4Ø99+X+22*Y,8*X+Y:REM7683 FOR 3
     K
146Ø POKE37891+X+22*Y,13:REM 384Ø3 FOR 3
     K
147Ø NEXTY,X
1479 REM SET CHAR POINTER TO RAM AND SET
      DBL HEIGHT CHARACTERS
148Ø POKE36869,2Ø5:POKE36867,PEEK(36867)
     AND128OR25:REM 253 FOR 3K
1489 REM CLEAR CHARACTER MATRIX
149Ø FORI=512ØTO7168:POKEI,Ø:NEXT:RETURN
1495 REM DATA FOR COLOR TABLE OF VICPLOT
15ØØ DATA192,48,12,3
15Ø5 REM * * * * *
15Ø9 REM DATA FOR VICPLOT
151Ø DATA169,Ø,133,1,165,251,74,74,74,13
     3,254
152Ø DATA144,4,169,128,133,1,165,254,24,
     1Ø5,2Ø
153Ø DATA133,2,165,252,1Ø,168,165,251,41
     ,3
154Ø DATA17Ø,169,Ø,133,251,197,253,24Ø,1
     7,189,6Ø,3
155Ø DATA17,1,2Ø9,1,24Ø,4,133,251,145,1,
     2ØØ,145,1,96
156Ø DATA189,6Ø,3,133,254,17,1,2Ø9,1,24Ø
     ,2,133,251,229,254,145,1,2ØØ,145,1,
     96
16ØØ TO USE VICPLOT IN YOUR OWN PROGRAMS
161Ø COPY LINES 14ØØ-156Ø.
162Ø GOSUB14ØØ TO POKE VICPLOT AND DRAW
     MATRIX.
163Ø GOSUB149Ø TO CLEAR MATRIX.
164Ø USE THE SUBROUTINE AT LINE 2Ø TO
165Ø CALL VICPLOT
166Ø NOTE: YOU MAY WANT TO PREVENT POINT
     S OVER 63 FROM BEING PLOTTED.
```

©

VIC Display Messages

Rick Keim

"Display Messages" is a program which will do just that on the VIC color screen. The message appears on the right, one character at a time, moves leftward across the screen, and then vanishes. The program can be used to display business hours, holiday greetings, information, directions, and so forth. Passersby can't resist reading the messages.

Program 1 can be incorporated easily as a subroutine in games and other programs where an eye-catcher is needed. It is a demonstration and you can quickly substitute a message of your own by changing the DATA statements at the end of the program. Be sure to type the program exactly as shown. After you have the program running, try changing the number of cursors-left in line 50 and see what happens. Try changing the TAB(20) to another number. This should give you some idea of how the program moves your message.

The key is line 50, with the proper number of tabs and cursors-left. Most important is the CHR$(20), which actually causes the movement by removing a space at column 2, line 11. That makes everything move one space to the left.

Note: The VIC will not print some punctuation marks – including commas and colons – from the DATA statements unless they are enclosed in quotation marks. Program 1 is useful for short, reusable messages. These can be stored easily on tape.

However, long messages require very long DATA statements which are time-consuming and awkward. Program 2 allows direct typing of your message without the use of DATA statements. The program also offers a choice of screen and letter colors and provides two areas for stationary messages to appear. The mid-screen area is used for the moving display, while the upper- and lower-screen portions may be used for up to five lines of stationary messages or graphics. The format is as follows:

1. Choose screen and border colors
2. Top screen message (yes or no)
 a. letter color
 b. five lines of messages
3. Bottom screen message (yes or no)
 a. letter color
 b. five lines of messages
4. Moving display letter color
 a. reverse or normal letters
 b. number of characters needed
5. Write display message
6. Run

The length of any message is determined and limited only by the amount of memory available. You select the approximate number of characters needed and perform a DIM statement on A$. It will hold the characters entered for your display message.

RETURN Key Options

The RETURN is used to speed input. Using RETURN for any input requested in the program will give preset values; for colors RETURN selects blue; for screen and border, RETURN gives cyan with white screen; and for yes or no questions, RETURN gives a no answer. Once the message is running it is in an endless loop. To stop the program, hit the RUN/STOP key and the RESTORE key at the same time.

The program as shown does not have the capability to save and store a message on tape for later use. That takes more memory and, therefore, limits the length of messages you can write. If you have an expanded VIC-20, however, you need not worry about memory space. Additions and changes for the Display Messages program are included to change it into a display and save program (see Program 3). Program 3 can be used on an unexpanded VIC-20 if you are careful to use 25 or fewer characters in your moving display message. If you use more than 25 characters, there is not enough memory to complete the save portion of the program. You will get an "out of memory" error and will have lost your message.

Ideas For Other Programs

Several programming ideas here might prove useful in other programs. One is the use of the letter color subroutine. If you look at lines 400 to 510, you will notice that the routine uses DATA statements to select the correct CHR$ number. The number of the color input in line 420 tells line 440 how many of the DATA statements to read in line 510. The CHR$ number read from the DATA statement then sets the color for CHR$(X(G)) which is used in the program to PRINT the color selected.

By adding and changing the lines from Program 3, you will have a program which can save a display on a file tape. This file tape can be used later with Program 4 to play back your message.

You can also have upper- and lowercase letters in your display messages by pressing the SHIFT and COMMODORE keys at the same time. Do this at the beginning of the program. You can save the program on a file tape, recover it using the load display, then press the SHIFT and COMMODORE keys to restore proper case.

Program 4 recovers the data from a file tape containing the message. Lines 30-130 use this data to display the message. You may notice that in line 224 the value of I has been doubled. This is necessary because as the data is saved on the file tape with a GET# statement, a CHR$(13), a RETURN, is entered after each data bit. Without doubling (I) you are returned only half of your message, and it contains a space between each character. Line 80 then takes the doubled (I) and by using a STEP 2 eliminates all of the spaces caused by the GET# statement. The result is a display message exactly like the one saved by the display and save program.

If you put Program 4 as the first program on a file tape, then save your messages after it, you'll have easy access to your library of messages. Just one tape is needed since the load and file are together.

If you would like the programs, but don't have time to type them in, send $3, a tape, and a stamped, self-addressed mailer to:

Rick Keim
306 Yorktown Dr.
Goshen, IN 46526

Program 1:
Routine For Short Reusable Display Messages

```
10 PRINT"{CLR}"
20 READ A$
30 IF A$="-1" THEN RESTORE:GOTO 20
40 PRINT"{HOME}{11 DOWN}"
50 PRINT TAB(20)"";A$:PRINT"{21 LEFT}";CH
   R$(20)
60 FOR T=1 TO 150:NEXT:GOTO 20
100 DATA T,H,I,S, ,I
110 DATA S, ,A, ,D,I
120 DATA S,P,L,A,Y
130 DATA ,M,E,S,S,A
140 DATA G,E, , , , ,-1
```

Program 2:
Program For Long Display Messages

```
0 PRINT"{CLR}{3 SPACES}{3 DOWN}{RVS}
  {RED}DISPLAY MESSAGES{OFF}{BLU}"
4 PRINT"{4 DOWN}(SEE VIC SCREEN CODES
  {2 SPACES}APPENDIX E PAGE 134
  {4 SPACES}VIC-20 GUIDE BOOK)"
5 INPUT"{6 UP}SCREEN COLOR#(8-255)";C
6 IFC<8ORC>255THENC=27
8 GOSUB200:RESTORE
10 PRINT"{CLR}{DOWN}{RVS}{RED}DISPLAY ME
   SSAGE{OFF}{BLU}{7 SPACES}(MOVING)
   {DOWN}"
12 GOSUB400
14 PRINT"{2 DOWN}{2 SPACES}{RVS}{RED}REV
   ERSE{OFF}{BLU} OR NORMAL?{3 SPACES}1-
   {RVS}{RED}REVERSE{OFF}{BLU}{3 SPACES}
   0-NORMAL":INPUTR
15 IFR=1THENR=18
16 PRINT"{CLR}{DOWN}{2 SPACES}# OF LETTE
   RS NEEDED{3 SPACES}FOR MOVING MESSAGE
   {3 SPACES}(PUSH RETURN FOR 250)
17 INPUTML:IFML=0THENML=250
18 DIMA$(ML)
20 PRINT"{CLR}{DOWN}{5 SPACES}{RVS}{BLU}
   WRITE MESSAGE{OFF}":PRINT"{13 DOWN}
   {2 SPACES}{RVS}{RED}PUSH RETURN TO EN
   D{OFF}{BLU}"
22 PRINT"{DOWN}{3 SPACES}PUSH F1 TO STAR
   T{7 SPACES}MESSAGE OVER"
23 PRINT"{DOWN}{2 SPACES}USE {RVS}{RED}I
   NST/DEL{OFF}{BLU} TO{6 SPACES}BACKSPA
   CE ON ERRORS"
25 FORI=0TOML
30 GETA$:IFA$=""THEN30
35 IFA$=CHR$(13)THENFORI=ITOI+5:A$(I)=CH
   R$(32):NEXTI:PRINT"{CLR}":GOTO100
36 IFA$=CHR$(133)THEN20
37 IFA$=CHR$(20)THENI=I-1:GOTO52
45 PRINT"{HOME}{2 DOWN}":PRINTTAB(I)"";A
   $:A$(I)=A$
50 NEXTI:GOTO60
52 PRINT"{HOME}{2 DOWN}":PRINTTAB(I)"
   {LEFT}":GOTO30
```

```
60 PRINT"{CLR} SORRY-OUT OF MESSAGE
   {2 SPACES}SPACE, INCREASE # OF
   {2 SPACES}LETTERS NEEDED"
62 PRINT"{DOWN}{5 SPACES}PUSH {RVS}RETUR
   N{OFF}{BLU}":PRINT"{4 SPACES}TO START
    OVER"
64 GETA$:IFA$=""THEN64
66 POKE36879,27:RUN
100 PRINT"{CLR}":POKE36879,C
101 PRINT"{HOME}{2 DOWN}"
102 FORD=ØTOT:PRINTTAB(L(D))""CHR$(X(1))
    ;TS$(D):NEXTD
103 PRINT"{HOME}{14 DOWN}"
104 FORD=ØTOU:PRINTTAB(LL(D))""CHR$(X(2)
    );BS$(D):NEXTD
105 PRINT"{HOME}{1Ø DOWN}"
11Ø FORN=ØTOI
12Ø PRINTTAB(2Ø)"";CHR$(R);CHR$(X(3));A$
    (N);"{2Ø LEFT}";CHR$(2Ø)
13Ø PRINT"{2 UP}"
135 FORT=1TO15Ø:NEXT
14Ø IFN=ITHEN1Ø5
15Ø NEXTN
2ØØ PRINT"{CLR}{DOWN}ANY NON-MOVING MESS
    AGE FOR TOP SCREEN":PRINTTAB(5)"1-
    {RVS}{RED}YES{OFF}{BLU}","Ø-NO":INPU
    TS
2Ø2 ONSGOSUB21Ø:GOTO25Ø
21Ø RESTORE:GOSUB4ØØ
211 PRINT"{CLR}{DOWN}WRITE UP TO 5 LINES
     AT22 CHARACTERS PER LINE"
212 PRINT"PUSH {RVS}{RED}RETURN{OFF}
    {BLU} TO END"
214 FORT=ØTO4:INPUTTS$(T):IFTS$(T)=""THE
    NRETURN
216 L(T)=(22-LEN(TS$(T)))/2
218 PRINTTAB(L(T))"";TS$(T):NEXTT:RETURN
25Ø PRINT"{CLR}{DOWN}ANY NON-MOVING MESS
    AGE FOR BOTTOM SCREEN":PRINTTAB(5)"1
    -{RVS}{RED}YES{OFF}{BLU}","Ø-NO"
252 INPUTD
254 ONDGOSUB26Ø:RETURN
26Ø RESTORE:GOSUB4ØØ
261 PRINT"{CLR}{DOWN}WRITE UP TO 5 LINES
     AT22 CHARACTERS PER LINE"
262 PRINT"PUSH {RVS}{RED}RETURN{OFF}
    {BLU} TO END"
264 FORU=ØTO4:INPUTBS$(U):IFBS$(U)=""THE
    NRETURN
266 LL(U)=(22-LEN(BS$(U)))/2
268 PRINTTAB(LL(U))"";BS$(U):NEXTU:RETUR
    N
4ØØ PRINT"LETTER COLOR? (CHOOSE COLOR #)
    ":G=G+1
41Ø FORA=ØTO7:READA$:PRINTTAB(5)"";A$:NE
    XTA
42Ø INPUTLC(G)
43Ø IFLC(G)<1ORLC(G)>8THENX(G)=31:GOTO14
44Ø FORB=1TOLC(G):READW:NEXTB:X(G)=W
45Ø RETURN
5ØØ DATA1-BLACK,2-WHITE,3-RED,4-CYAN,5-P
    URPLE,6-GREEN,7-BLUE,8-YELLOW
51Ø DATA144,5,28,159,156,3Ø,31,158
```

Program 3: Save And Display Messages

```
16 PRINT"{CLR}{DOWN}{2 SPACES}# OF LETTE
   RS NEEDED{3 SPACES}FOR MOVING MESSAGE
   {3 SPACES}(PUSH RETURN FOR 1ØØ)
17 INPUTML:IFML=ØTHENML=1ØØ
35 IFA$=CHR$(13)THENFORI=ITOI+5:A$(I)=CH
   R$(32):NEXTI:PRINT"{CLR}":GOTO7ØØ
9Ø PRINT"{CLR}{4 DOWN}{4 SPACES}PUSH ANY
    KEY TO{2 SPACES}{DOWN}{2 SPACES}STOP
    DISPLAY MESSAGE {DOWN}{4 SPACES}AND
   RETURN TO"
92 PRINT"{DOWN}{4 SPACES}{RVS}{RED}SELEC
   T OPTION{OFF}{BLU}"
95 FORQ=ØTO2ØØØ:NEXT
135 FORTT=ØTO25:GETC$:IFC$=""THEN138
136 POKE36879,27:PRINT"{CLR}":GOTO7ØØ
138 NEXTTT
6ØØ POKE36879,27:PRINT"{CLR}{2 DOWN}
    {RVS}{RED}SAVE FILE#{OFF}{BLU}":INPU
    TF
61Ø OPENF,1,1
62Ø B(Ø)=I:B(1)=T:B(2)=U:B(3)=C:B(4)=R
622 FORA=ØTO4:PRINT#F,B(A):NEXT
625 FORG1=1TO3:PRINT#F,X(G1):NEXT
63Ø FORT1=ØTOT:PRINT#F,TS$(T1):NEXT
64Ø FORT2=ØTOU:PRINT#F,BS$(T2):NEXT
65Ø FORII=ØTOI:PRINT#F,A$(II):NEXT
66Ø CLOSEF
7ØØ PRINT"{2 DOWN}{RVS}{RED}SELECT OPTIO
    N{OFF}{BLU}{DOWN}":PRINT"{4 SPACES}
    {RVS}1{OFF}-NEW MESSAGE":PRINT"
    {4 SPACES}{RVS}2{OFF}-SAVE MESSAGE"
71Ø PRINT"{4 SPACES}{RVS}3{OFF}-RUN MESS
    AGE"
72Ø INPUT"{RVS}SELECTION{OFF}";SO
73Ø IFSO<2THEN66
74Ø IFSO=2THEN6ØØ
75Ø IFSO>2THEN9Ø
```

Program 4: Message Playback

```
1Ø PRINT"{CLR}":
2Ø GOSUB2ØØ
3Ø PRINT"{CLR}":POKE36879,C
4Ø FORD=ØTOT:L(D)=(22-LEN(TS$(D)))/2:PRI
   NTTAB(L(D))""CHR$(X(1));TS$(D):NEXT
5Ø PRINT"{HOME}{15 DOWN}"
6Ø FORD=ØTOU:LL(D)=(22-LEN(BS$(D)))/2:PR
   INTTAB(LL(D))"";CHR$(X(2));BS$(D):NEX
   T
7Ø PRINT"{HOME}{1Ø DOWN}"
8Ø FORN=ØTOISTEP2
9Ø PRINTTAB(2Ø)"";CHR$(R);CHR$(X(3));A$(
   N);"{2Ø LEFT}";CHR$(2Ø)
1ØØ PRINT"{2 UP}"
11Ø FORT=1TO15Ø:NEXTT
12Ø IFN=ITHEN7Ø
13Ø NEXTN
2ØØ PRINT"{CLR}{2 DOWN}{RVS}{RED}LOAD FI
    LE#{OFF}{BLU}":INPUTF:INPUT"FILE NAM
    E";F$
21Ø OPENF,1,Ø,F$
222 FORA=ØTO4:INPUT#F,B(A):NEXT
224 I=B(Ø)*2:T=B(1):U=B(2):C=B(3):R=B(4)
23Ø DIMA$(I)
24Ø FORG1=1TO3:INPUT#F,X(G1):NEXT
25Ø FORT1=1TOT:INPUT#F,TS$(T1):NEXT
26Ø FORT2=1TOU:INPUT#F,BS$(T2):NEXT
27Ø FORII=1TOI:GET#F,A$(II):NEXT
28Ø RETURN
```

©

Floating Point Division

Matt Ganis

The screen given below will create four new words (three "helper" words and one main word). Here is a description of all four words:

1TO3 – This word will duplicate the value on top of the stack into the third position of the stack (note: the current third value becomes the fourth value; the current fourth value becomes the fifth value, etc.).

For example, if the stack looks like this:

```
[1 2 3]
top      bottom
```

A call to 1TO3 will leave the stack as follows:

```
[1 2 1 3]
top      bottom
```

QUOT – This word will compute and output the quotient of A/B. Also, the decimal point is output in this word (the 46 EMIT. is a decimal value of 46).

REMAIN – This word will output the next digit in the remainder. It should be understood that on each call only *one* digit is returned. Also, the 48 + converts the digit to ASCII code so that it can be printed instead of being popped off the stack with the . word.

FPDIV – This is the word that will be used when you want to divide two numbers (for example, 5 3 FPDIV will divide 5/3). In this example, FPDIV will return ten digits of the remainder (because of the 10/0 DO LOOP). If, for some reason, you want 100 digits in the remainder, simply change the 10 to a 100.

The value returned can't be used in a program. It is useful in that you may divide two numbers and obtain any precision that you desire.

Screen for the floating point division word.
For fig-FORTH or compatible FORTHs

```
SCR # 76

: 1TO3 DUP ROT SWAP ;

: QUOT 1TO3 /MOD . 10 * SWAP
  1TO3 46 EMIT ;

: REMAIN /MOD 48 + EMIT
  10 * SWAP 1TO3 ;

( **MAIN WORD IS 'FPDIV' *** )

: FPDIV DECIMAL QUOT 10 0 DO
  REMAIN LOOP DROP DROP DROP ;

;S
```

Make these changes if your /MOD works 'backwards':

```
: QUOT 1TO3 /MOD SWAP . 10 * SWAP
: REMAIN /MOD SWAP 48 + EMIT
```

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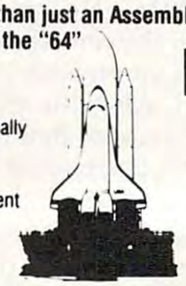

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NEWS&PRODUCTS

Atari Disassembler

Ultra Disassembler, a labelling disassembler for Atari computers, is available from Adventure International.

The program recreates the source code from which a machine language program was assembled. It can disassemble DOS files or code from a list of specified disk sectors.

Output may be written to the screen, printer, or disk file. The disassembly is reversible and may be edited and reassembled with any popular Atari assembler.

Ultra Disassembler sells for $49.95.

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Box 3435
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Vocabulary Builder

Power-of-Words, a word learning game designed by Peter Funk, author of the "It Pays to Increase Your Word Power" column in *Reader's Digest*, is available for Apple computers.

Each volume includes 200 target words and their associated synonyms, antonyms, prefixes, and suffixes. The game features immediate scoring, and after an answer is scored, the program provides additional information about the words used in the quiz.

Power-of-Words, which sells for $79.95, includes two diskettes of five games each, worksheets, and a final quiz covering the words in all the games.

Funk Vocab-Ware
Peter Funk, Inc.
4825 Province Line Road
Princeton, NJ 08540

Memory Expansion And Printer Interface For TI-99/4A

Doryt Systems has introduced a 32K memory expansion unit and a parallel printer interface for the TI-99/4A, both of which can be used without the expansion box.

Paraprint 18A is a parallel 8-bit communication interface that connects directly to the computer and works without the RS-232 interface card. The interface sells for $105.

Memory 32K adds RAM to the TI-99/4A, allowing the use of the Editor Assembler, TI Logo,

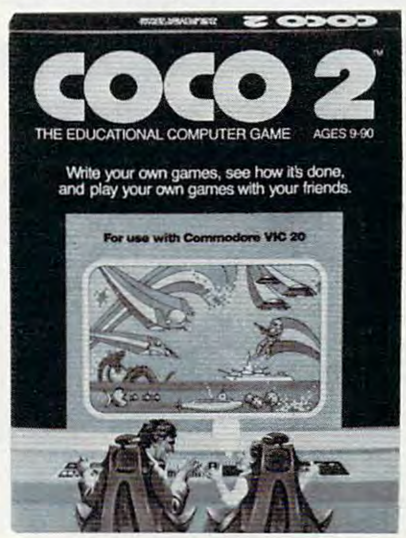
Doryt Systems Memory 32K and Paraprint 18A plug directly into the TI-99/4A and eliminate the need for an expansion box.

and other modules that require memory expansion. Like Paraprint 18A, it plugs directly into the computer and provides a daisy-chain connection for other TI peripherals. Memory 32K is priced at $175.

Doryt Systems, Inc.
14 Glen Street
Glen Cove, NY 11542
(516)676-7950

Game Design Tutor

Coco 2 is a teaching game that explores the fundamentals of computer game design with an approach that assumes no prior computer knowledge. The program follows a fully developed sample game and then helps the user alter the game's concept or



Coco 2 *teaches video game design skills.*

write a totally new game.

Coco 2 is available for the 16K VIC for $39.95. Versions also are available for the Commodore 64, the 32K Atari 400, and the Atari 800 for $44.95.

Human Engineered Software
71 Park Lane
Brisbane, CA 94005

The Computer Control Center is a molded polystyrene work station for the Timex/Sinclair computers.

Timex/Sinclair Control Center

A desk-type work station for the Timex/Sinclair 1000 and Sinclair ZX-81 computers is being marketed by Timeworks.

The Computer Control Center includes an on/off switch to eliminate the constant plugging and unplugging of the system. It also includes space for RAM packs, openings for cassette and printer cables, and a cassette tape storage pocket.

The top of the unit, which is priced at $29.95, can accommodate a 13-inch television or monitor.

Timeworks, Inc.
405 Lake Cook Road, Building A
Deerfield, IL 60016
(312) 291-9200

Game, Utilities For Atari

Generic Software has produced a software package called *Your First Disk* for Atari computers.

The disk includes *Wordzzp*, an educational spelling and vocabulary game, as well as *Catalog*, an autorun disk directory program, and *Sound.Exp*, a program for sound statement experimentation. The diskette also includes files for alphabet learning and math problem creation.

The *Your First Disk* package sells for $18.95.

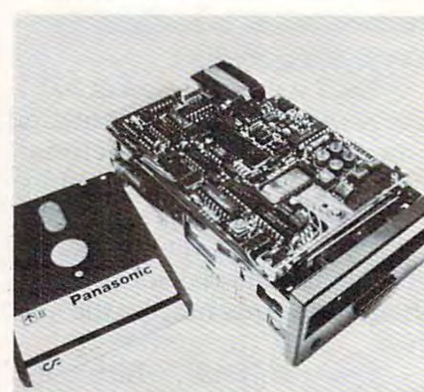
Generic Software
P.O. Box 27463
Golden Valley, MN 55427

3-Inch Disk Drive

A compact, 3-inch floppy disk drive is available from Panasonic. The drive is plug compatible with most 5¼-inch disk interfaces and uses the same recording method, data transfer rate, and disk rotation speed.

The EME-101 drive is roughly half the weight and one-fourth the size of conventional disk drives, but it offers the same storage capacity. A brushless direct-drive DC motor eliminates the need for belts, and a steel band positioning mechanism allows for a 3-millisecond track access time.

Panasonic
One Panasonic Way
Secaucus, NJ 07094



The EME-101 compact disk drive from Panasonic.

Extended Screen Graphics For Apple

Fontrix, an extended screen graphics program for the Apple computer, includes 11 predefined character sets and allows the creation of an unlimited number of other character sets.

The program can be used for charts, diagrams, and newsletters, among other things, and text or illustrations created with the program can be dumped into a variety of printers.

The *Fontrix* program costs $75.

Data Transforms
616 Washington St., Suite 106
Denver, CO 80203

Action/Strategy Games

Several new games for the Atari and Commodore 64 computers are forthcoming from Epyx. They include:

• *PitStop* is a formula I race game in which the players compete in the pit as well as on the track. The race cars include speed and steering controls, and the way you drive affects your car's performance: the faster you take the corners, the faster your tires wear out.

• *Psi Warrior* is a three-dimensional, chess-like game. Up to four players compete against each other or the computer, teleporting around the playing field, and using bolts of energy in their battles.

• In *All-Star Baseball*, players choose an all-star team made up of players from over the last 50 years. Another player or the computer can field the opposing team.

• *Gateway to Apshai*, the latest sequal to *Temple of Apshai*, combines role playing, strategy, and fast action as the player battles his way in and out of the dungeons.

Epyx is also introducing a VIC-20 game, *Fun With Music*. In the game, the player composes a tune and then has to play the song (or one supplied by the computer) without missing a note.

Epyx, Inc.
1043 Kiel Court
Sunnyvale, CA 94086

Organized Programming On TRS-80

Top-Down BASIC for the TRS-80 Color Computer, by Ken Skier, is a book on program design for the computer user who is familiar with BASIC.

The 316-page book outlines a step-by-step approach to produce structured programs that

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BYTE Books/McGraw-Hill
1221 Avenue of the Americas
New York, NY 10020

Expansion For VIC

Mosaic Electronics has introduced the RAMmaster 32 for the VIC-20 computer. RAMmaster 32 includes a built-in expansion port, a pause switch, a write protect switch, and a relocatable memory block.

The unit, which adds 32K of memory, also has a disabler switch so cartridges can be removed without turning off the computer. RAMmaster 32 is expected to sell for under $150.

Mosaic Electronics
P.O. Box 708
Oregon City, OR 97045
(800)547-2807

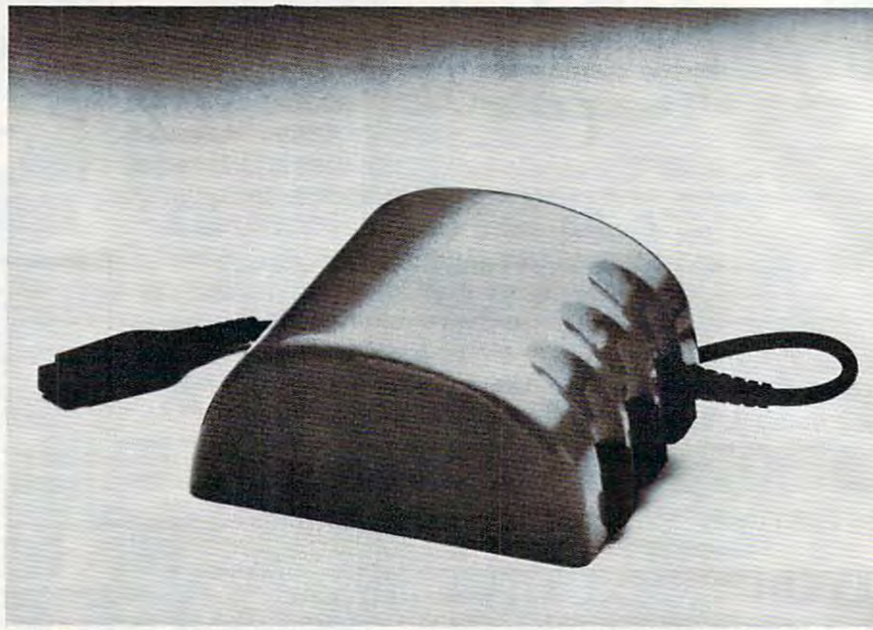
Atari Graphics Utilities

A graphics utility package for the Atari 400 and 800 computers has been released by Synergistic Software.

The *Graphics Workshop*, designed for those familiar with Atari BASIC, includes a player/missile module, a graphics enhancement module, and three graphics editors – a player/missile editor, a bitmap editor, and a character editor.

The program, which is priced at $39.95, requires a 48K computer with one disk drive.

Synergistic Software
830 N. Riverside Dr., Suite 201
Renton, WA 98055
(800) 426-6505



Wico's Command Control Mouse is an optically encoded mechanical cursor control.

Command Control Mouse

Wico has announced it will produce the Command Control Mouse, a mechanical cursor control that allows users to edit, draw lines, or select from a menu without ever touching the keyboard.

By sliding the hand-held device across a desktop, the user can move the cursor to any point on the screen.

The mouse can serve as a word processing editor, a spreadsheet analyst, an alternate input device, or as a graphics plotter. It includes three function buttons and can be used on any flat surface.

Wico will supply Apple or IBM controller cards to serve as hardware interfaces.

Wico Corporation
6400 W. Gross Point Road
Niles, IL 60648

Timex/Sinclair Guidebooks

The Timex/Sinclair 1000 BASIC Handbook, from Sybex, is a dictionary-like listing of all the words in the T/S 1000 BASIC vocabulary.

Each entry includes a description of the word, an example of its proper syntax, a sample program showing how the word is used, and notes explaining any special features of the word.

The book is available for $7.95, plus $2 for postage.

Sybex, Inc.
2344 Sixth St.
Berkeley, CA 94701

In *How to Use the Timex/Sinclair*, Jerry Willis explains the problems many Timex/Sinclair users face: how to get a clear TV picture, how to minimize tape recorder problems, and how to choose accessories for the computer.

The guide, priced at $3.95, also includes information on magazines, books, and user groups that support the Timex/Sinclair computers.

dilithium Press
11000 S. W. 11th St., Suite E
Beaverton, OR 97005

ABC's On Atari

Alphabet Arcade, a series of three games to help reinforce alphabet and dictionary skills, is available from PDI.

The Atari games are designed for children age 5 and up. In "Letters for Lisa," the child helps an animal named Lisa catch letters for dinner. But Lisa is fussy; she only eats in alphabetical order.

In "Letter Treasure," alphabetization skills come into play again as the player helps Diver Dan recover treasure from the bottom of the sea. In "Order, Please," the child is asked to put groups of 4, 8, or 10 words in alphabetical order.

The cassette version of *Alphabet Arcade* requires a 16K machine and sells for $18.95. The disk version, which requires 24K, sells for $23.95.

Program Design Inc.
95 East Putnam Ave.
Greenwich, CT 06830
(203) 661-8799

Low Profile Drives For Apple

Multitech Electronics has introduced a 5¼-inch disk drive for the Apple II that is approximately half the height and weight of a comparable drive from Apple. The design was made possible by simplifying the drive mechanism and by integrating the control electronics. The pro-

duct is fully software transparent with Apple's DOS 3.3 Operating System.

List price for the drive is $299.

Multitech Electronics, Inc.
195 W. El Camino Real
Sunnyvale, CA 94086

Loss-of-Data Insurance

The Association of Computer Users and the St. Paul Fire and Marine Insurance Companies have announced a new type of insurance for small computer owners that includes coverage for accidental loss of data.

The policy covers:

- Direct physical loss or damage to equipment, disks, programs, documentation, and source materials.
- Accidental erasure or loss of data.
- Dishonest acts, fraud, or misuse of equipment by employees or outside parties.
- Extraordinary damage to equipment caused by external electrical problems, such as spikes, brownouts, or power surges.
- Extra expenses incurred as a result of a covered loss.

The cost of coverage is $175 per year for protection up to $25,000, with a $250 deductible.

Association of Computer Users
P.O. Box 9003
Boulder, CO 80301
(303)443-3600

Computer Diet For T/S

The *Personal Weight Control Program* is a computerized diet and nutrition program produced by International Publishing & Software for the Timex/Sinclair computers.

The program, which presents dieting as an exercise in controlling eating habits, consists of three parts:

- Present Status Assessment, which analyzes the eating habits and nutritional needs of the user.
- Menu Building, in which the computer develops menus suited to the needs and tastes of the user.
- Monitoring and Feedback, which tracks progress and adjusts menus accordingly.

The program is available for $29.95.

International Publishing & Software, Inc.
3952 Chesswood Drive
Downsview, Ontario
Canada M3J 2W6

Music For Children

Counterpoint Software has released *Early Games Music*, another program in its Early Games for Young Children series. This program, designed for children ages 4 through 12, is an assortment of games that introduce the basics of music.

Songs created with the program can be saved and played or revised later. *Early Games Music* is available for Apple II and Commodore 64 computers.

Counterpoint Software Inc.
Suite 140, Shelard Plaza North
Minneapolis, MN 55426

Computer Resources

More than 215 new books are listed in the 16th edition of the *Annual Bibliography of Computer-Oriented Books*, published by the University of Colorado.

All introductory-type books published before 1980 have been deleted, but the bibliography still contains more than 1200 books from 170 publishers. The books are listed under 61 categories.

Copies of the bibliography are available for $5, or $6 if an invoice is required.

Computing Newsletter
P.O. Box 7345
Colorado Springs, CO 80933

The Micro Center has compiled a new *Time Saver* catalog of microcomputer courseware. The catalog lists 319 high-quality, high-value educational programs for the Apple, Atari, TRS-80, PET, VIC, and IBM PC.

Copies of the catalog are available free.

The Micro Center
P.O. Box 6
Pleasantville, NY 10570
(800)431-2434

Computer Skill Builders has produced a free catalog of microcomputer resources for the classroom. The book contains 304 computer-related products for education, including software products, books, diskettes, and supplies.

Computer Skill Builders
P.O. Box 42050, Dept. 7Z
Tucson, AZ 85733
(602)323-7500

Selected Microcomputer Software, a 64-page catalog of educational courseware for the Apple II, TRS-80, Commodore PET, and Atari microcomputers, is available free from Opportunities for Learning.

Programs listed in the catalog cover grade levels from primary through college and were selected based on their suitability for use in today's computer-enhanced classroom environment.

Opportunities for Learning, Inc.
8950 Lurline Ave., Dept. L45
Chatsworth, CA 91311

Games For The TI

Vaughn Software has created an array of cassette programs for the TI-99/4A computer. They include:

- *Mariner*, a sea adventure

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800-221-8927

COMMODORE ATARI APPLE TEXAS INSTRUMENTS EPSON with seven game boards, mapped screens, and a sonar readout; $12.99.

• *Red Dread*, an arcade-type board game in which you seek green gems while avoiding the Red Dread; $9.99.

• *Digger Duck*, a colorful maze game that requires strategic planning; $9.99.

• *Chromium Shuttle*, a space game in an endless starfield in which you control an onboard computer, warp drive, and asteroid analyzer; $13.99.

• *Chopper Fireman*, a game that pits you – in an aging and temperamental helicopter – against raging forest fires; requires Extended BASIC, $21.95.

• *Model Rocketry Performance*, an application program that provides the expected performance of model rockets, and allows for quick comparison of models on the drawing board; $25.99.

Vaughn Software
5460 Harlan #84
Arvada, CO 80002

Educational Programs For Apple And Atari

Random House has added several new reading, language arts, and mathematics programs to its library. All of the following programs require 48K computers with disk drives.

• *Fundamental Word Focus:* This series of ten programs for the Atari provides a game-like format to teach vowel identification, syllabication, compound words, and identification of word elements. It includes a record-keeping system and uses color graphics and sound.

• *Tutorial Comprehension:* This Apple program is designed to teach comprehension skills to second, third, and fourth graders. The five comprehension skills presented are details, sequence, main idea, inference, and critical reading.

• *Word Blaster:* This program for both Atari and Apple computers allows students to practice comprehension skills using context clues.

• *Fundamental Punctuation Practice:* This Apple program provides more than 30 lessons on basic punctuation skills. An off-line diagnostic placement test is included with the program.

• *Story Builder:* This Atari program, based on the concept of mix-and-match storybooks, allows students to experiment with sentence structure and to create new and often humorous story situations.

• *Galaxy Math Facts Game* and *Grand Prix:* These games, available in both Apple and Atari versions, put the student at the helm of a spaceship or at the controls of a Grand Prix racer. In each case, the student must show a mastery of basic math facts before he or she can complete the mission, or speed past the checkered flag.

Random House, Inc.
7307 South Yale Avenue
Suite 103
Tulsa, OK 74136

T/S Game In 3-D

Softsync has released *Mothership*, an arcade-style game for the Timex/Sinclair computers.

The game features one or two player options, three levels of play, on-screen scoring and a display that looks as if it's in 3-D.

In *Mothership*, which sells for $16.95 plus $1.50 for shipping and handling, players maneuver their Starlight Fighters down the Zarway space corridor toward the imposing Mothership, which is launching an all-out attack on the planet. Players use the keyboard as a control panel to move their ships through the corridor, while dodging the drone fighters launched by the Mothership.

Softsync, Inc.
14 East 34th Street
New York, NY 10016

CALENDAR

August 10-12, Madison, WI. The second annual Microcomputers and High Technology Conference in Vocational Education. The conference includes beginning and advanced classes on programming, PILOT, CAD, courseware design, and administration. Discussions are planned on microcomputer development and application, and on existing vocational/educational programs using computers. For information, write Dr. Judith Rodenstein, 964 Educational Science Building, 1025 W. Johnson Street, Madison, WI 53706.

August 28, Harrisburg, PA. The Central Pennsylvania Repeater Association will sponsor its 10th Annual Hamfest/Computer Fest. The event, which will be held adjacent to Hersheypark, Chocolate Town, U.S.A., includes indoor dealer displays and a flea market area. Registration $3; tables and table space available. For more information, write Timothy R. Fanus, 6140 Chambers Hill Road, Harrisburg, PA 17111.

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.

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.* ©

CAPUTE!

Modifications Or Corrections To Previous Articles

TI Teeth Wisdom

Line 650 of this program from the July 1983 "Programming The TI" column (p. 199) should read:

```
650 PRINT " ";CHR$(156);"¦}e";CHR$(
    136)&CHR$(137)&CHR$(138);"e~";CH
    R$(127)&CHR$(157)
```

Bee Trap For VIC

In the instructions for keyboard play on page 102 of the June 1983 issue, line 320 should read:

```
320 IFPEEK(KB)=35THEND1=D1+22:GOTO335
```

Memory Trainer For TI

For the TI-99/4A version of this program (June 1983, p. 118) to work in standard TI console BASIC, the following changes must be made:

```
240 IF (DR<1)+(DR>10) THEN 140
270 IF SL<2 THEN 275 ELSE 280
275 SL=2
280 IF SL>90 THEN 285 ELSE 290
285 SL=90
```

Thanks to David Duffan and others who suggested this change.

Atari P/M Graphics Simplified

The following lines in the moving ship example program developed on pages 175-178 of the June 1983 issue need corrections:

```
310 POKE VSA+ADD+1,PMHIGH
360 COLR1=25:COLR2=11:COLR3=74
370 POKE 704,COLR1:POKE 705,COLR2:POKE
    706,COLR3
400 Y1=125:Y2=25:Y3=25
```

Slow List On The VIC-20

The mysterious memory location 37879 described in this article from the June issue (p. 180) is actually location 37159, the high byte of the interrupt clock. Because of incomplete address decoding for the I/O chips, the contents of locations 37136-37167 appear to repeat several times in locations 37168-37887. The location normally contains 66, not 64 as stated in the article. For a thorough discussion of the effects of changing the contents of location 37159, see the article "Versatile Data Acquisition With VIC" (**COMPUTE!**, May 1983, p. 244).

UnNEW For VIC And 64

This utility program from the June 1983 issue (p. 213) will *not* work from disk. It must be SAVEd to tape in the manner described in the article.

Minefield For 64

The 64 version of this game from the June issue (p. 266) requires the following correction:

```
360 B3(J)=BT(J)+.5*BT(J):B4(J)=B3(J)+.25
    *BT(J)
```

Checkers

To allow legal jumps with kings in this game for the Commodore 64 (May 1983, p. 90), the following line must be changed:

```
585 IFL1<=5ANDU1>=2THENIFS(LP,UM)<0ANDS(L1
    +2,U1-2)=0THEN600
```

Crosswords For VIC

Line 860 of this program from the May issue (p. 82) should read:

```
860 GET F$:IF F$=" " THEN 860
```

TI General-Purpose Data Base

Line 203 of this data base management program for the TI from the May issue (p. 232) should read:

```
203 FOR IO=1 TO IR
```

64 Odds And Ends

The article (May 1983, p. 237) noted that listing could be disabled by POKE 775,200. To restore the list feature, POKE 775,167.

Retirement Planner For VIC

Robert A. Brown suggests modifications which make this program for calculating retirement saving needs from the April 1983 issue (p. 71) more accurate, and also allow calculations for any time period, not just multiples of five years. First, delete lines 120, 460-500, 590, and 600, then make the following changes:

```
510 D=AI/(1+AI/2):Q=((1+AI)↑Y-1)/D
540 W=(SR-S1*(1+AI)↑Y)/Q
```

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 the CAPUTE! page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Readers Feedback, P.O. Box 5406, Greensboro, NC 27403.*

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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 the CAPUTE! page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Readers Feedback, P.O. Box 5406, Greensboro, NC 27403.* ©

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, {⅄}.

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/64

Generally, any PET/CBM/VIC/64 program listings will contain words within braces which spell out any special characters: {DOWN} would mean to press the cursor down key. {5 SPACES} would mean to press the space bar five 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 listings. For example, S would mean to type the S key while holding the shift key. If you find an underlined key enclosed in braces (e.g., {10 N}), you should type the key as many times as indicated (in our example, you would enter ten shifted N's). Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

For the VIC and 64, if a key is enclosed in special brackets, ⌊ ⌋, you should hold down the *Commodore key* while pressing the key inside the special brackets. (The Commodore key is the key in the lower left corner of the keyboard.) Again, if the key is preceded by a number, you should press the key as many times as indicated.

The special character ₤ found in VIC and 64 listings represents the British pound symbol (£) key, found between the minus and CLR/HOME keys.

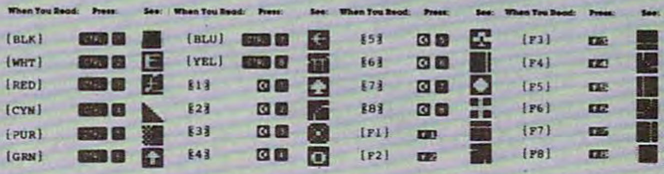
Rarely, you'll see in a Commodore 64 program a solitary letter of the alphabet enclosed in braces. These characters can be entered by holding down the CTRL key while typing the letter in the braces. For example, {A} would indicate that you should press CTRL-A.

About the *quote mode*: you know that you can move the cursor around the screen with the CRSR keys. Sometimes a programmer will want to move the cursor under program control. That's why you see all the {LEFT}'s, {HOME}'s, and {BLU}'s in our programs. The only way the computer can tell the difference between direct and programmed cursor control is the quote mode.

Once you press the quote (the double quote, SHIFT-2), you are in the quote mode. If you type something and then try to change it by moving the cursor left, you'll only get a bunch of reverse-video lines. These are the symbols for cursor left. The only editing key that isn't programmable is the DEL key; you can still use DEL to back up and edit the line. Once you type another quote, you are out of quote mode.

You also go into quote mode when you INSerT spaces into a line. In any case, the easiest way to get out of quote mode is to just press RETURN. You'li then be out of quote mode and you can cursor up to the mistyped line and fix it.

Use the following tables when entering special characters:



All Commodore Machines

Clear Screen	{CLR}	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}

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}		

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

The only special characters used are in PRINT statements to indicate where two or more spaces should be left between words. For example, ENERGY {10 SPACES} MANAGEMENT means that ten spaces should be left between the words ENERGY and MANAGEMENT. Do not type in the braces or the words 10 SPACES. 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.)

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.

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.

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.

January 1983: Sound Synthesis And The Personal Computer, Juggler And Thunderbird Games (multiple computers), Music And Sound Programs (multiple computers), Writing Transportable BASIC, Home Energy Calculator (multiple computers), All About Commodore WAIT, Supermon64, Perfect Commodore INPUTs, Atari Autonumber, Copy VIC Disk Files, Commodore 64 Architecture.

February 1983: How The Pros Write Computer Games, 12 Joysticks Compared, Slalom (a game in 3-D for multiple computers), Super Shell Sort For PET, Atari SuperFont Plus, Creating Graphics On The VIC, Joysticks And Sprites On The 64, Bi-Directional VIC Scrolling, Commodore 64 Video: A Guided Tour, The Atari Cruncher, Easy Apple Editing, VIC Custom Characters For Games.

March 1983: An Introduction To Data Storage (multiple computers), Mass Memory Now And In The Future, Games: Closeout, Boggler, Fighter Aces, Letter And Number Play (all for multiple computers), VIC Music, Direct Atari Disk Access, TRS-80 Color Computer Data Base, Apple Subroutine Capture, PET Quickplot, TI Graphics Made Easy, VIC and Atari Memory Management.

April 1983: Selecting The Right Word Processor (multiple computers), VIC and Atari Word Processor Programs, Typing Teacher, TI Matchem, Retirement Planner (multiple computers), Air Defense (multiple computers), Dr. Video (Commodore), Video 80 (Software for 80 Columns on the Atari), Color Computer Tester, Timex/Sinclair Sound, Estimating TI Memory, Magic Commodore BASIC.

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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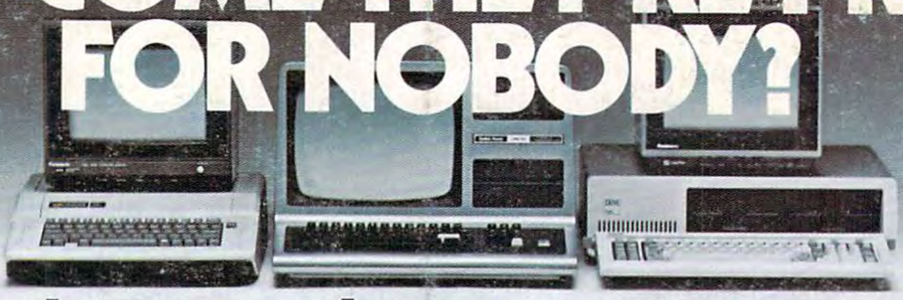

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