```
                 0501 ;
                 0502 ; the subroutines used by our program
                 0503 ;
                 0510 ; --- perform an OPEN function ---
061A             0511 OPEN
061A 48          0512     PHA           ; save high byte of address
061B A903        0513     LDA #CMDOPEN
061D D00D        0514     BNE CMDJOIN
                 0515 ;
                 0520 ; --- perform a CLOSE function ---
061F             0521 CLOSE
061F 48          0522     PHA           ; save high byte of address
0620 A90C        0523     LDA #CMDCLOSE
0622 D008        0524     BNE CMDJOIN
                 0525 ;
                 0530 ; --- perform a PRINT function ---
0624             0531 PRINT
0624 48          0532     PHA           ; save high byte of address
0625 A909        0533     LDA #CMDPRINT
0627 D003        0534     BNE CMDJOIN
                 0535 ;
                 0540 ; --- perform an INPUT function ---
0629             0541 INPUT
0629 48          0542     PHA           ; save high byte of address
062A A905        0543     LDA #CMDINPUT
                 0545 ;
                 0550 ; code common to OPEN, CLOSE, PRINT, INPUT
                 0551 ;
062C             0552 CMDJOIN
062C 9D4203      0553     STA ICCOM,X ; the command value
062F 68          0554     PLA           ; recover high byte of addr
0630 9D4503      0555     STA ICBADR+1,X ; and set it up in iocb
0633 98          0556     TYA
0634 9D4403      0557     STA ICBADR,X ; ditto with low byte of addr
0637 A900        0558     LDA #0
0639 9D4903      0559     STA ICBLEN+1,X ; set up a maximum length
063C A9FF        0560     LDA #255
063E 9D4803      0561     STA ICBLEN,X ; of 255 bytes
0641 2056E4      0562     JSR CIO       ; then do the I/O operation
0644 98          0563     TYA           ; any boo-boo's ?
0645 60          0564     RTS           ; back to caller with error, if any
                 0565 ; (note that only OPEN call provides for
                 0566 ;  an error...see text)
                 0598     .PAGE ".          The GET Subroutine"
                 0599 ;
                 0600 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                 0601 ; the GET routine...it's special
                 0602 ;
0646             0603 GET
0646 A907        0604     LDA #CMDGET
0648 9D4203      0605     STA ICCOM,X ; set up for GET command
064B A900        0606     LDA #0
064D 9D4803      0607     STA ICBLEN,X ; by zeroing the length field,
0650 9D4903      0608     STA ICBLEN+1,X ; ...we get a single byte to A
0653 2056E4      0609     JSR CIO       ; let OS do the work
0656 C8          0610     INY
0657 88          0611     DEY           ; check status "invisibly"
0658 3001        0612     BMI BADGET    ; oops
065A 60          0613     RTS           ; back to caller
                 0614 ; (remove BMI for caller to get status instead)
                 0615 ;
065B             0616 BADGET
065B 68          0617     PLA
065C 68          0618     PLA           ; this is a cheat
065D 4CE706      0619     JMP LINE400 ; but it works
                 0989     .PAGE ".          BASIC parallel code, lines 100-240"
```

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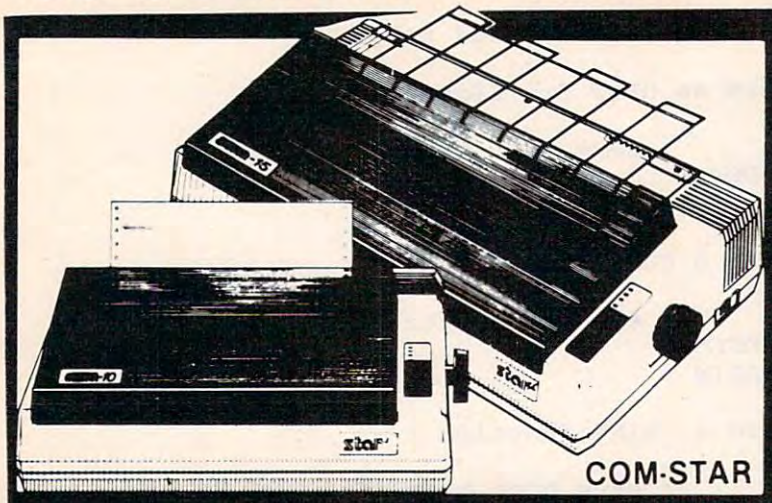

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Tape	$69.00	$49.00	$34.00
Disk	$79.95	$59.00	$39.00
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64 EXPLORER

Larry Isaacs

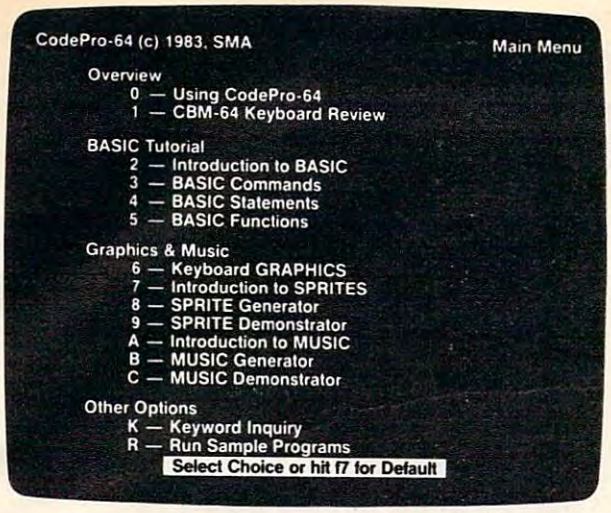
This month we'll take a look at part of a disassembly of the machine language drawing routines which were presented last month. For those who are learning 6502 machine language programming, there are a few items you may find interesting in the source listing for these routines. First of all, if you are new to interfacing machine language routines to BASIC, you can refer to the GETINT subroutine. This subroutine will evaluate an integer expression and return the resulting value. Typically, a machine language routine will need only integer arguments, assuming it needs arguments at all. One potential problem with using a routine like GETINT is that the integer is signed. Integer values greater than 32767 would have to be entered as ‹value› –65536 before they could be fetched by this routine.

Another thing you might note is how a multiplication by 320 was accomplished in the PIXADR subroutine. The code is based on the fact that multiplication and division by powers of two can be done with left and right shifts of the binary number in question. By converting the expression (320*Y) to (256*Y + 64*Y), the multiplication can be carried out by simple shifting. Multiplying by 256 is done by taking the one-byte Y value and storing it as the high byte of a two-byte number. The low byte would be set to zero. The term 64*Y was obtained by dividing the 256*Y term by 4 (that is, two right shifts). Adding the two terms together gives 320*Y.

I hope the comments in the source code provide enough information to understand what the program is doing. If you have an assembler at your disposal, you are certainly welcome to use any of the routines here for your own experiments.

Machine Language Drawing Routines

```
;
; MACHINE LANGUAGE DRAWING ROUTINES
;
; EQUATES
;
TIMACT   = $DCØE ;TIMER A CONTROL
MEMCTL   = $DDØØ ;C64 MEMORY CONTROL
VICCTL   = $DØ11 ;VIC CONTROL REGISTER
VICCT2   = $DØ16 ;VIC CONTROL REGISTER
VICMCT   = $DØ18 ;VIC MEMORY CONTROL
BCREG    = $DØ21 ;BACKGROUND COLOR REG.
BMBASE   = $EØØØ ;BIT-MAP BASE
BMOFFS   = $Ø8   ;8K OFFSET BYTE
SMBASE   = $CØØØ ;SCREEN MEMORY BASE
CMBASE   = $DØØØ ;COLOR MEMORY BASE
SMOFFS   = $2Ø   ;SCREEN MEMORY OFFSET
BMMODE   = $2Ø   ;BIT-MAP ENABLE BIT
MCMODE   = $1Ø   ;MULTICOLOR MODE
;
; COMMODORE ROUTINES
;
ADRAY2   = $ØØØ5 ;INT TO FLOAT (VECTOR)
FTOINT   = $B1AA ;FLOAT TO INT
COMMA    = $AEFD ;CHECKS FOR COMMA
EVAL     = $AD9E ;EVALUATE ARGUMENT
;
; PAGE ZERO EQUATES
;
ROMCTL   = $1   ;ROM CONTROL REGISTER
VALTYP   = $ØD  ;TYPE OF ARGUMENT
TMP      = $61  ;TEMP BYTE
TMP1     = $FB  ;TEMP 1
TMP2     = $FD  ;TEMP 2
DX       = $62  ;DELTA X
DY       = $64  ;DELTA Y
R        = $66  ;REMAINDER VARIABLE
XINC     = $6A  ;X INCREMENT
YINC     = $6C  ;Y INCREMENT
CNT      = $68  ;COUNTER
;
; JUMP TABLE
;
         *= $CØØØ
         JMP SVSCRN ;SAVE SCREEN PARMS
         JMP RSSCRN ;RESTORE PARMS
         JMP GRSCRN ;ENABLE GRAPHICS
         JMP CLRSCR ;CLEAR GR. SCREEN
         JMP MOVE   ;MOVE TO X,Y
         JMP PLOT   ;PLOT X,Y
         JMP DRAW   ;DRAW TO X,Y
         JMP SETDRM ;SET DRAWING MODE
         JMP SELCOL ;SELECT COLOR
         JMP RDBYTE ;READ BYTE FUNCTION
;
; LOCAL STORAGE
;
XC       .WORD Ø ;CURRENT X-COORD
YC       .WORD Ø ;CURRENT Y-COORD
XN       .WORD Ø ;NEW X-COORD
YN       .WORD Ø ;NEW Y-COORD
COLOR    .BYTE $FF ;DRAWING COLOR DUPL.
                   ;IN EACH PIXEL POS.
DRMODE   .BYTE $8Ø ;DRAWING MODE
                   ;$ØØ & $4Ø = ERASE
                   ;$8Ø=DRAW, $CØ=FLIP
MCFLAG   .BYTE Ø   ;MULTICOLOR FLAG
MASK1    .BYTE $Ø7 ;BIT MASK
MASK2    .BYTE $F8 ;BIT MASK INVERTED
;
S1       .BYTE Ø ;SAVE MEMCTL
S2       .BYTE Ø ;SAVE VICMCT
S3       .BYTE Ø ;SAVE VICCTL
S4       .BYTE Ø ;SAVE VICCT2
;
; CMD SUB: SAVE SCREEN PARMS
;
SVSCRN   LDA MEMCTL
         STA S1
         LDA VICMCT
         STA S2
         LDA VICCTL
```



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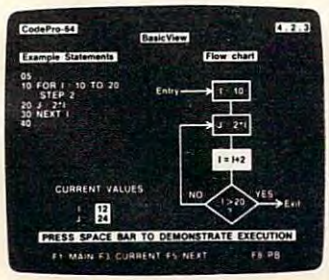

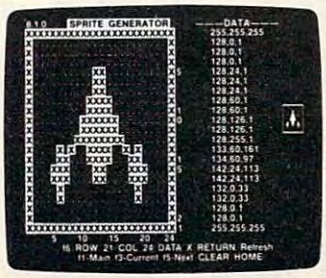

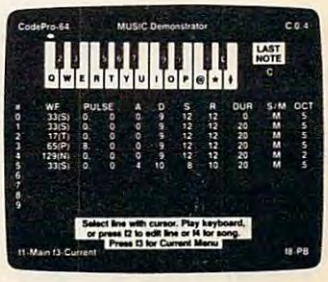

SYSTEMS MANAGEMENT ASSOCIATES

```
        STA S3
        LDA VICCT2
        STA S4
        RTS
;
; CMD SUB: RESTORE SAVED SCREEN PARMS
;
RSSCRN  LDA S1
        STA MEMCTL
        LDA S2
        STA VICMCT
        LDA S3
        STA VICCTL
        LDA S4
        STA VICCT2
        RTS
;
; SUB: TURN OS ROM OFF
;
OSOFF   PHA
        LDA TIMACT ;TURN OFF IRQ'S
        AND #$FE
        STA TIMACT
        LDA ROMCTL ;TURN OFF OS ROM
        AND #$FD
        STA ROMCTL
        PLA
        RTS
;
; SUB: TURN BASIC ROM ON
;
OSON    PHA
        LDA ROMCTL ;TURN ON OS ROM
        ORA #$02
        STA ROMCTL
        LDA TIMACT ;ENABLE IRQ'S
        ORA #$01
        STA TIMACT
        PLA
        RTS
;
; SUB: FILL AN AREA OF MEMORY
;
; ON ENTRY: A= FILL BYTE
; TMP1 = POINTER TO AREA
; TMP2 = # BYTES TO FILL
;
; ON RETURN: A AND X PRESERVED.
; Y, TMP1, AND TMP2 CLOBBERED.
;
FILL    LDY TMP2+1 ;FILL WHOLE PAGES
        BEQ FILL3  ;BR IF NONE
FILL1   LDY #0
FILL2   STA (TMP1),Y
        INY
        BNE FILL2
        INC TMP1+1 ;INCREMENT POINTER
        DEC TMP2+1 ;DECREMENT # PAGES
        BNE FILL1  ;BR IF MORE PAGES
FILL3   LDY TMP2   ;CHECK PARTIAL PAGE
        BEQ FILL6  ;BR IF DONE
        DEY        ;CLEAR PARTIAL PAGE
        BEQ FILL5  ;GO CLEAR LAST BYTE
FILL4   STA (TMP1),Y
        DEY
        BNE FILL4
FILL5   STA (TMP1),Y ;THE LAST BYTE
FILL6   RTS
;
; SUB: FILL BIT-MAP AND SCREEN MEM
;
; ON ENTRY: A=SCREEN MEMORY COLORS
; X=COLOR MEMORY COLOR IF MULTICOLOR
;
; ON RETURN: ALL REGISTERS CLOBBERED
;
FILLSC  JSR OSOFF    ;TURN OS ROM OFF
        LDY #<SMBASE ;FILL SCREEN MEM
        STY TMP1
        LDY #>SMBASE
        STY TMP1+1
        LDY #<1000 ;1000 BYTES
        STY TMP2
        LDY #>1000
        STY TMP2+1
        JSR FILL
        BIT MCFLAG ;MULTICOLOR MODE?
        BPL FILLS1 ;BR IF NO
        LDY #<CMBASE ;FILL COLOR MEM
        STY TMP1
        LDY #>CMBASE
        STY TMP1+1
        LDY #<1000
        STY TMP2
        LDY #>1000
        STY TMP2+1
        TXA
        JSR FILL
FILLS1  LDA #<BMBASE ;CLEAR BIT-MAP
        STA TMP1
        LDA #>BMBASE
        STA TMP1+1
        LDA #<8000 ;8000 BYTES
        STA TMP2
        LDA #>8000
        STA TMP2+1
        LDA #0
        JSR FILL   ;CLEAR
        JMP OSON   ;TURN OS ROM ON
                   ;AND RETURN
;
; SUB: GET AN INTEGER ARGUMENT
;
; ON ENTRY: NO REGISTER ARGUMENTS
;
; ON RETURN: X,A = INTEGER, A=LOW BYTE
;
GETINT  JSR COMMA  ;MAKE SURE COMMA
        JSR EVAL   ;GET ARGUMENT
        JSR FTOINT ;CONVERT TO INTEGER
        TAX
        TYA
        RTS
;
; SUB: GET X AND Y COORDINATES
;
; ON ENTRY: NO REGISTER ARGUMENTS
;
; ON RETURN: ALL REGISTERS CLOBBERED
; XN,YN = COORDINATES
;
GETXY   JSR GETINT ;GET X
        STA XN
        STX XN+1
        JSR GETINT ;GET Y
        STA YN
        STX YN+1
        RTS
;
; CMD SUB: ENABLE GRAPHICS SCREEN
;
; SYNTAX:  SYS GRSCRN,MC
; MC: 0=HIRES, 1=MULTICOLOR
;
```

```
GRSCRN  JSR GETINT ;GET MODE
        BEQ GRSCR1 ;BR IF LOW BYTE=Ø
        LDA #$8Ø
GRSCR1  STA MCFLAG ;SET FLAG
        LDA MEMCTL ;SET GRAPHICS BANK
        ORA #$Ø3
        EOR #BMBASE/$4ØØØ
        STA MEMCTL
        LDA VICMCT ;SET OFFSETS
        AND #$Ø7   ;CLEAR OLD BITS
        ORA #BMOFFS ;SET BIT-MAP OFFSET
        ORA #SMOFFS ;SET SCREEN OFFSET
        STA VICMCT
        LDA VICCTL ;ENABLE BIT-MAP
        ORA #BMMODE
        STA VICCTL
        BIT MCFLAG
        BPL GRSCR2 ;BR IF HIRES
        LDA VICCT2 ;SELECT MULTICOLOR
        ORA #MCMODE
        STA VICCT2
        LDA #$Ø3   ;SET MASKS
        BNE GRSCR3 ;BR ALWAYS
;
GRSCR2  LDA VICCT2 ;DISABLE MULTICOLOR
        AND #$FF-MCMODE
        STA VICCT2
        LDA #$Ø7   ;SET MASKS
GRSCR3  STA MASK1
        EOR #$FF
        STA MASK2
        LDA #$FF
        STA COLOR ;INIT COLOR
        RTS
;
; CMD SUB: CLEAR GRAPHICS SCREEN
;
; SYNTAX: SYS CLRSCR,CØ,C1     (HIRES)
;  SYS CLRSCR,CØ,C1,C2,C3 (MULTICOLOR)
;
CLRSCR  JSR GETXY ;GET TWO COLORS
        BIT MCFLAG
        BMI CLRSC1 ;BR IF MULTICOLOR
        LDA YN     ;GET "ON" COLOR
        ASL A    ;SHIFT TO UPPER NIBBLE
        ASL A
        ASL A
        ASL A
        STA YN
        LDA XN     ;GET "OFF" COLOR
        AND #$ØF
        ORA YN     ;COMBINE THE TWO
        JMP FILLSC ;GO FILL SCREEN
CLRSC1  LDA YN     ;GET COLOR 1
        ASL A    ;SHIFT TO UPPER NIBBLE
        ASL A
        ASL A
        ASL A
        STA YN
        JSR GETINT ;GET COLOR 2
        AND #$ØF
        ORA YN     ;GET SCR MEM COLORS
        STA YN
        JSR GETINT ;GET COLOR 3
        TAX        ;MOVE TO X
        LDA XN
        STA BCREG  ;SET BACKGRND COLOR
        LDA YN
        JMP FILLSC ;GO FILL SCREEN
;
; CMD SUB: MOVE TO X,Y
;
; SYNTAX: SYS MOVE,X,Y
;
MOVE    JSR GETXY
MOVEA   LDX #3    ;ALTERMATE ENTRY POINT
MOVE1   LDA XN,X
        STA XC,X
        DEX
        BPL MOVE1
        RTS
;
; SUBROUTINE CALCULATE PIXEL ADDRESS
;
; ON ENTRY: NO REGISTER ARGUMENTS
; XC,YC = X,Y COORDINATES
; FOR HIRES MODE
;   MASK1=$Ø7,MASK2=$F8,MCFLAG=Ø
; FOR MULTICOLOR MODE
;   MASK1=$Ø3,MASK2=$FC,MCFLAG=$8Ø
;
; ON RETURN: A AND Y CLOBBERED
; X = INDEX TO PIXEL IN BYTE
; TMP1 = POINTER TO BYTE
;
PIXADR  SEC
        LDA #199   ;GET 199 - Y COORD
        SBC YC
        PHA        ;SAVE Y COORD
        LSR A      ;CALCULATE ROW=Y/8
        LSR A
        LSR A
        STA TMP1+1 ;STORE ROW*256
        LDY #Ø
        STY TMP1   ;INIT LOW BYTE
        LSR A      ;GET ROW*64=
        ROR TMP1   ;    (ROW*256)/4
        LSR A
        ROR TMP1
        ADC TMP1+1 ;ADD ROW*256+ROW*64
        STA TMP1+1 ;THIS IS ROW*32Ø
        LDA XC
        LDX XC+1
        AND MASK2  ;GET INT(X/BPP)*8
        BIT MCFLAG ;TEST FOR MC MODE
        BPL PIXAD1 ;BR IF HIRES BIT MAP
        ASL A      ;* 2 IF MC BIT MAP
        PHA
        TXA
        ROL A
        TAX
        PLA
PIXAD1  CLC
        ADC TMP1   ;ADD TO ADDRESS
        STA TMP1
        TXA
        ADC TMP1+1
        STA TMP1+1
PIXAD2  PLA        ;GET BACK Y COORD
        AND #$Ø7   ;GET Y AND $Ø7
        CLC
        ADC TMP1   ;ADD TO ADDRESS
        BCC PIXAD3 ;BR IF NO CARRY
        INC TMP1+1 ;BUMP HIGH BYTE
PIXAD3  CLC
        ADC #<BMBASE ;ADD BASE ADDRESS
        STA TMP1
        LDA TMP1+1
        ADC #>BMBASE
        STA TMP1+1
        LDA XC     ;GET INDEX TO BIT
        AND MASK1
        TAX
        RTS
```

MACHINE LANGUAGE

Jim Butterfield, Associate Editor

A Program Critique — Part 3

This month we continue with comments on Bud Rasmussen's program to copy files on the Commodore 64 with a single disk unit. The program has so far read into RAM memory a file specified by the user.

In this session, we'll track the routine that writes the file to a new disk.

```
                    ;
                    ;
                    ; START OUTPUT PHASE
                    ;
                    ;
C2F7  20  E4  FF  SOP   JSR  GETIN    ;GET CHARACTER
C2FA  F0  FB            BEQ  SOP      ;IF NONE, TRY
                                       AGAIN
C2FC  C9  0D            CMP  #RK      ;IS THIS
C2FE  F0  01            BEQ  POPM     ;RETURN KEY
C300  00                BRK           ;IF NOT, BRK
                    ;
```

Wait for the RETURN key. If any other key is received, the program will break to the machine language monitor (if there is one). This has a possible problem: Keyboard bounce could cause a halt here. I'd prefer something like this:

```
                        JSR  GETIN    ;clear input
                   LOOP JSR  GETIN    ;get character
                        CMP  #RK      ;if not RETURN...
                        BNE  LOOP     ;go back and wait
```

As mentioned before, a BRK (Break) is to be avoided since users won't understand what it means.

Output Phase Begun

Next, we arrange to print an advice message:

```
C301  A2  23      POPM LDX  #OPBML ;PRINT
C303  A0  C3           LDY  #>OPBM ;'OUTPUT
C305  A9  18           LDA  #<OPBM ;PHASE BEGUN'
C307  20  75  C1       JSR  PR     ;MSG
                    ;
C30A  A9  00           LDA  #0     ;CLEAR
C30C  8D  62  03       STA  OSF    ;OUTPUT STATUS
                                    FLAG,
C30F  8D  63  03       STA  OEC    ;OUTPUT ERROR
                                    CODE
                    ;
```

Again, clearing these flags may be overkill. They will take care of themselves.

```
C312  20  3F  C4       JSR  ID     ;INIT DISK
C315  4C  3B  C3       JMP  SNO    ;GOTO SET NAME
                                    OUTPUT
                    ;
```

The new disk is initialized. A wise precaution, in case the new disk happens to have the same ID as the old one.

```
                    ;
                    ; OUTPUT PHASE BEGUN MESSAGE
                    ;
                    ;
C318  0D  0D  12  OPBM  .BYTE$0D,$0D,$12
C31B  2A  2A  2A        .ASC "*** OUTPUT PHASE
                        BEGUN ***"
C339  0D  0D            .BYTE$0D,$0D
C33B              OPBML = *-OPBM
                    ;
```

Now we will go through the same routine which was used for input. The main difference is that this time, the name of the file is four characters longer, since ",S,W" is added to make this a write file.

```
                    ;
                    ; SET NAME (OUTPUT)
                    ;
                    ;
C33B  AD  AB  02  SNO   LDA  OFNL     ;OUTP FILE NM LEN
C33E  A2  40            LDX  #<FNA    ;LOAD FILE NAME LO
C340  A0  03            LDY  #>FNA    ;LOAD FILE NAME HI
C342  20  BD  FF        JSR  SETNAM
                    ;
                    ; SET LOGICAL FILE (OUTPUT)
                    ;
                    ;
C345  A9  03      SLFO  LDA  #3       ;LOGICAL FILE
                                       NUMBER
C347  A2  08            LDX  #8       ;LOAD DEVICE
                                       ADDRESS
C349  A0  03            LDY  #3       ;LOAD SEC.
                                       ADDRESS
C34B  20  BA  FF        JSR  SETLFS
                    ;
                    ;
                    ; OPEN FILE (OUTPUT)
                    ;
                    ;
C34E  20  C0  FF  OFO   JSR  OPEN     ;OPEN FILE
C351  A5  90            LDA  IOS      ;TEST
C353  F0  0B            BEQ  OCO      ;STATUS
C355  8D  62  03        STA  OSF      ;STORE STATUS
C358  A9  01            LDA  #1       ;SET/STORE
C35A  8D  63  03        STA  OEC      ;ERROR CODE
C35D  4C  C5  C3        JMP  OE       ;OUTPUT ERROR
                    ;
```

Check The Disk Status

As previously noted, checking location $90, IOS—the BASIC ST variable—isn't enough to insure that the file is properly opened. You must call in the disk status over the command channel. There could be many problems in opening a file for writing: A file of that name may already exist, the disk may have the write-protect tab in place, the disk may be unformatted, or the disk might be full, to name just a few. Location $90 won't tell you about such things.

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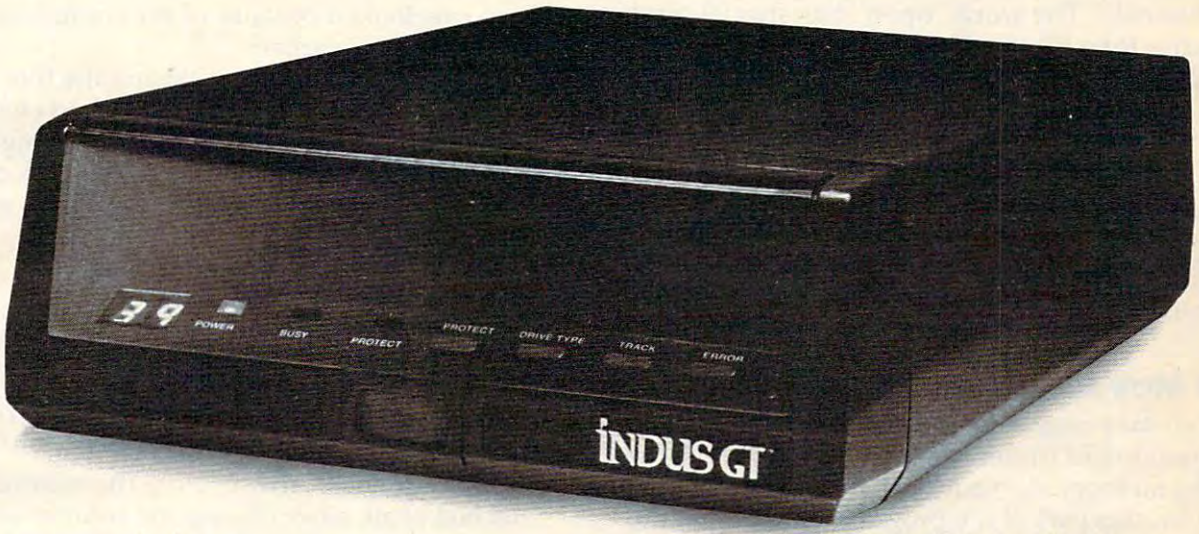

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```
                    ;
                    ; OPEN CHANNEL (OUTPUT)
                    ;
                    ;
C360  A2  03        OCO  LDX  #3      ;OPEN
C362  20  C9  FF         JSR  CHKOUT  ;CHANNEL 3
C365  A5  90             LDA  IOS     ;TEST
C367  F0  0B             BEQ  SOB     ;STATUS
C369  8D  62  03         STA  OSF     ;STORE STATUS
C36C  A9  02             LDA  #2      ;SET/STORE
C36E  8D  63  03         STA  OEC     ;ERROR CODE
C371  4C  C5  C3         JMP  OE      ;OUTPUT ERROR
                    ;
```

As during the reading phase, I'd rather the comments said, "connect channel" rather than "open channel." The word "open" has special significance for a file; we have already performed the open activity with our call to OPEN ($FFC0).

```
                    ;
                    ; SET OUTPUT BUFFER
                    ;
                    ;
C374  A0  00        SOB  LDY  #0      ;BUFFER INDEX=0
C376  A9  00             LDA  #0      ;LOAD BFR
C378  85  FB             STA  BAL     ;ADDR LO
C37A  AD  3D  C4         LDA  SP      ;LOAD BFR
C37D  85  FC             STA  BAH     ;ADDR HI
                    ;
```

It May Miss The Address

You may recall that the input section of the program might under some circumstances change the memory start address, moving it down by 4K. If so, this part of the program would miss the changed address completely. Oops.

```
                    ;
                    ; OUTPUT LOOP
                    ;
                    ;
C37F  B1  FB        OL   LDA  (BAL),Y ;GET CHAR
C381  20  D2  FF         JSR  CHROUT  ;PUT CHAR
```

Output has been switched to logical channel 3; instead of printing to the screen, JSR $FFD2 sends to the file.

```
C384  A5  90             LDA  IOS     ;TEST
C386  F0  0B             BEQ  IBA     ;STATUS
C388  8D  62  03         STA  OSF     ;STORE STATUS
C38B  A9  03             LDA  #3      ;SET/STORE
C38D  8D  63  03         STA  OEC     ;ERROR CODE
C390  4C  C5  C3         JMP  OE      ;OUTPUT ERROR
                    ;
                    ;
                    ; INCR BUFFER ADDR
                    ;
C393                IBA  =    *
C393  E6  FB             INC  BAL     ;INCR BFR ADDR LO
C395  D0  02             BNE  CEA     ;IF NOT 0, CHK END
                                       AD
C397  E6  FC             INC  BAH     ;INCR BFR ADDR HI
                    ;
                    ; COMPARE END ADDRESS
                    ;
C399  A5  FC        CEA  LDA  BAH     ;LOAD BFR ADDR HI
C39B  C5  FE             CMP  EAH     ;BAH VS END ADDR
                                       HI
C39D  90  E0             BCC  OL      ;IF LO, CARRY ON
C39F  A5  FB             LDA  BAL     ;LOAD BFR ADDR LO
C3A1  C5  FD             CMP  EAL     ;BAL VS END ADDR
                                       LO
C3A3  90  DA             BCC  OL      ;IF LO, CARRY ON
                    ;
```

After a comparison, BCC may be taken to mean "Branch if less." Thus, we'll branch back to OL, the output loop, if the high byte of the write address is less than that of the end address, or failing that, if the low byte is less. In this case, BNE (Branch not Equal) would do the job equally well.

Disconnecting The Channel

Next, the program closes the file since all bytes have been written. But there's an omission: Before closing the file, we should disconnect the output channel from it with JSR $FFCC. I wonder if this was overlooked because of the confusing use of the term *open*, earlier?

At this point, before closing the file, I would recommend looking at the command channel for any possible disk error message that might have been created during the write. The disk could become full as we write the program, for example.

```
                    ;
                    ; END OF DISK I/O
                    ;
                    ;
C3A5  A9  03             LDA  #3      ;SET CH 3
C3A7  20  C3  FF         JSR  CLOSE   ;FOR CLOSE
                    ;
C3AA  A9  0F             LDA  #15     ;SET CH 15
C3AC  20  C3  FF         JSR  CLOSE   ;FOR CLOSE
```

Good sequence. Always close the command channel last of all, since closing the command channel automatically causes all outstanding disk files to be closed.

```
C3AF  20  E7  FF         JSR  CLALL   ;CLOSE ALL FILES
                    ;
```

Not needed, if the output is properly disconnected with JSR $FFCC before closing logical file 3.

```
C3B2  A2  71             LDX  #FCML   ;PRINT
C3B4  A0  C3             LDY  #>FCM   ;'FILE
C3B6  A9  CC             LDA  #<FCM   ;COPIED'
C3B8  20  75  C1         JSR  PR      ;MSG
                    ;
```

As the program usually does, a message is neatly printed, telling the user what's going on.

```
C3BB  20  E4  FF  FG     JSR  GETIN   ;GET CHARACTER
C3BE  F0  FB             BEQ  FG      ;IF NONE, TRY
                                       AGAIN
C3C0  C9  0D             CMP  #RK     ;IS THIS
C3C2  F0  05             BEQ  TA      ;RETURN KEY
C3C4  00                 BRK          ;IF NOT, BRK
                    ;
```

Use RTS Instead Of BRK

See the previous comment on waiting for a key to be pressed. When the program is finished, it should terminate with a BRK (Break) command only if it was invoked from the machine language monitor with a .G (Go) command. Otherwise, an RTS (ReTurn from Subroutine) will return control to BASIC.

```
                    ;
                    ; OUTPUT ERROR
                    ;
                    ;
C3C5  20  E7  FF  OE     JSR  CLALL   ;CLOSE ALL FILES
```

```
C3C8  00                BRK
                  ;
```

Once again: Errors could be worked through in more detail. A BRK to the machine language monitor is not always explanatory.

```
                  ;
                  ;  TRY AGAIN
                  ;
                  ;
C3C9  4C  00  C0  TA    JMP  CS
                  ;
```

To do another file, we go back to the beginning of the program.

```
                  ;
                  ;  FILE COPIED MESSAGE
                  ;
                  ;
C3CC  12          FCM   .BYTE$12
C3CD  20  20  46        .ASC "FILE SUCCESSFULLY
                        COPIED."
C3F2  0D  0D  12        .BYTE$0D,$0D,$12
C3F5  20  20  50        .ASC "PRESS RETURN TO COPY
                        ANOTHER."
C419  0D  0D  12        .BYTE$0D,$0D,$12
C41C  20  20  50        .ASC "PRESS ANY OTHER KEY TO
                        STOP."
C43B  0D  0D            .BYTE$0D,$0D
C43D              FCML  =   *-FCM
                  ;
```

RAM Limits Are Set

Here are the limits of RAM for the program: They are arbitrarily set to allow space from $4000 to $7F00. I'm not sure why, but it's all right with me.

```
                  ;
C43D  40          SP    .BYTE$40   ;START GOREM
C43E  7F          EP    .BYTE$7F   ;END   GOREM
                  ;
```

The following sequence is intended to initialize the disk. It does it in an unsatisfactory way: It opens the command channel again. (We have already opened the command channel as logical file 15.) The following code sends the BASIC equivalent of OPEN 1,8,15,"I":CLOSE 1. In a moment, I'll give a preferred approach.

```
                  ;
                  ;  INIT DISK
                  ;
                  ;
C43F  A9  01      ID    LDA  #INL
C441  A0  C4            LDY  #>IN
C443  A2  5D            LDX  #<IN
C445  20  BD  FF        JSR  SETNAM
C448  A9  01            LDA  #1
C44A  A2  08            LDX  #8
C44C  A0  0F            LDY  #15
C44E  20  BA  FF        JSR  SETLFS
C451  20  C0  FF        JSR  OPEN
C454  20  CC  FF        JSR  CLRCHN
C457  A9  01            LDA  #1
C459  20  C3  FF        JSR  CLOSE
C45C  60                RTS
                  ;
C45D  49          IN    .ASC "I"
C45E              INL   =    *-IN
                  ;
```

What we should be doing is the BASIC equivalent of PRINT#15,"I", which is much easier:

```
ID    LDX  #15      ;LF 15, command
                    channel
      JSR  $FFC9    ; .. connect to it
      LDA  #"I"     ;Letter I
      JSR  $FFD2    ; .. send it
      JSR  $FFCC    ;disconnect channel
      RTS
```

Error Checking Needs Work

That's the program. It works reasonably well as given. The major improvements I would suggest are additional checking of the disk status (in the program given, the command channel was opened but never used); improved error message procedures; and a little rethinking of the RAM memory allocated.

The program has outstandingly clean documentation; it's a pleasure to read. In the same vein, the messages to the user are good and quite supportive. The coding approach is good, almost classical, in its methodical use of Kernal subroutines. There's a lot to be learned from what's in the program, as well as from what's missing.

I'd like to thank Bud Rasmussen for allowing me to subject his program to analysis, warts and all. It can be embarrassing to have your mistakes—or your style—exposed to public view. I chose to pick through the program in detail because it was well-planned and well-written. Its faults are minor compared to its virtues. ©

C. Regena

TI Graphics

Drawing graphics is one of the things that really make our TI computers fun. Chapter 5 of the *Beginning BASIC* book that comes with your computer tells how you can get going with graphics. Using high-resolution graphics allows you to define your own characters and make detailed drawings on the screen. We can combine high-resolution graphics with text on the same screen, and we can use all 16 colors in high-resolution graphics if we wish.

There are several ways to define the graphics characters; this month we'll look at the most common ways. The CALL CHAR statement defines a certain character number with a certain pattern. If you use a number from 32 to 127, the regular symbol or letter will be redefined.

```
110 CALL CHAR(131,"3838107C10284282
    ")
```

defines character number 131. Notice that the character definition pattern needs to be in quotes.

Using CALL CHAR

Another method is to define a string variable first, then use the CALL CHAR. This can save typing if you have several characters defined with the same shape:

```
150 A$="3838107C10284282"
160 CALL CHAR(128,A$)
170 CALL CHAR(136,A$)
```

If you have a lot of character definitions, DATA statements use less memory than many CALL CHAR statements. The disadvantage is that DATA statements are more difficult to type (and debug). This is an example:

```
200 FOR I=1 TO 10
210 READ C,C$
220 CALL CHAR(C,C$)
230 NEXT I
240 DATA 128,3838107C10284282,129,F
    FFF,130,FFFFFFFFFFFFFFFF,136,83
    E22618186447C1,141,204040808010
    102,142
250 DATA 204040808080C936,143,FFFF,1
    44,01020408,145,0,151,FF
```

This loop defines ten characters, but instead of ten CALL CHAR statements, there are only six statements. This method is even more efficient when more graphics characters are defined. Within the loop, line 210 reads two values from the DATA statement (C and C$). Line 220 uses these two values to define character number C with definition C$.

If all your characters are in numerical order, you can use the character number as the loop counter. The DATA statements then contain only the definitions.

```
200 FOR C=97 TO 127
210 READ C$
220 CALL CHAR(C,C$)
230 NEXT C
240 DATA FFFF,,3838107C10284282,E0C
    8 (etc. for all the definitions
    )
```

Zeros Are Assumed

You can define a character with 16 numbers or letters (up to F). If you use fewer, the computer will automatically assume zeros for the rest of the definition. For example, FFFF really means FFFF000000000000. If you want to save memory and typing, arrange your graphics so the zeros are toward the bottom of the square defined. In other words, 0000FFFF00000000 and 000000000000FFFF and FFFF all look the same, but FFFF is the easiest to use. (The "bar" is positioned in different places in the graphics square.)

A character defined as null will be a blank square, or a square of the background color:

```
300 CALL CHAR(130,"")
```

In the DATA statement method, you can have commas with nothing between them:

```
310 DATA FFFF,,F0F
```

The middle definition is null. Both commas are

vital. This particular DATA statement contains three definition strings.

Likely Errors

I mentioned that the data method of defining characters is more difficult to debug. If there is a problem, the most likely message is

BAD VALUE IN 220

You could also get the message

DATA ERROR IN 210

or

OUT OF DATA IN 210

Usually the typing in lines 210 and 220 is fine—the typing error is in the DATA statements. The DATA error messages occur if you don't have the commas placed correctly or if you're reading a string when it should be a number. The BAD VALUE message occurs because the program cannot define the character with what you have read in as data.

The easiest way to find the error is to RUN the program, then when it stops with the error message, print the variables involved. In this case PRINT C,C$ and press ENTER to see what values we have for those variables. You should be able to see exactly what is wrong with your variables. C will tell you how far in the loop you got. Perhaps C$ will have the letter O instead of the number zero, or maybe you've typed a period instead of a comma. In any case, you should be able to spot that error among your DATA statements so it can be corrected.

The CALL CHAR statement only defines the graphics character; you need to put the character on the screen using CALL HCHAR, CALL VCHAR, or PRINT. If a character is already on the screen and you use CALL CHAR to redefine it, all the characters on the screen with that character number will instantly change.

Changes On The Screen

Here's an example of changing character definitions while something is on the screen. Type this short program in, then RUN it.

```
100 PRINT "ABCDABCD"
110 FOR DELAY=1 TO 400
120 NEXT DELAY
130 CALL CHAR(65,"006666004224 18")
140 FOR DELAY=1 TO 400
150 NEXT DELAY
160 END
```

The screen turns green when the program starts to run, and ABCDABCD is printed on the screen. After a delay loop, line 130 redefines character 65, which is the letter A. All the A's on the screen change. After another delay, the program ends. This technique might be useful to you in game situations when you want to change the graphics quickly.

I use a similar principle to PRINT graphics a little more quickly than using CALL HCHAR or CALL VCHAR (as long as you don't have to worry about scrolling). Redefine as graphics the characters 96 through 126. Now, instead of using several CALL HCHAR statements to put the graphics on the screen, use PRINT with the lowercase letters. Suppose you have a snake defined in six graphics characters, 97 to 102. You can use PRINT "abcdef" to draw the snake on the screen.

Using Lowercase Letters

Release the ALPHA LOCK key to type the lowercase letters (which are actually small capital letters). Use FCTN and the key to type any symbol on the fronts of the keys. The reason you can use characters 96 through 126 so often in programs is that you may rarely need the symbols or lowercase letters in the text within a program.

To use characters from 129 to 159 in this PRINT method, look at the CONTROL KEY CODES list on your Reference Card (or in the Appendix of the *User's Reference Guide*). You can still PRINT graphics and in the quotes use the control key and the appropriate letter for the character number you want. You'll see either a blank or a funny graphics character as you're typing, but it will work fine in the program.

Every so often I read an article complaining that the TI does not have the capability to print graphics using built-in graphics characters or character strings. My rebuttal is that we *do* have the means to PRINT graphics, but we are not limited to graphics shown on the keys (such as on VIC-20, MC-10, or Timex graphics keys). We can define high-resolution graphics any way we wish, then PRINT the graphics using either lowercase letters, symbols, control characters, or CHR$.

Changes For The TI-99/4

A special note to TI-99/4 (square-keyed console) owners: You cannot type in listings using lowercase letters, but a program typed on the TI-99/4A will work on the TI-99/4. If you don't have access to the 4A console, you can convert the PRINT statements by using the ASCII codes of the lowercase letters. 96 is ` (grave), then the lowercase letters start with 97 and go to 122. Instead of PRINT "abcdef", you can use

PRINT CHR$(97)&CHR$(98)&CHR$(99)&CHR$(100)&CHR$(101)&CHR$(102)

You may use either the ampersand (&) or semicolons between the character numbers.

Our characters are grouped by eights into character sets which are used in defining colors. We use the CALL COLOR statement to define foreground and background colors for a particular character set—then all characters in that set will be the specified colors. If you need lots of colors on the screen, use different character sets. ©

Commodore Information Handyman

F. Joseph Walker

"Information Handyman" demonstrates some practical uses of data files, and includes a program to keep track of your checking account. Originally written for the VIC with Datassette, the program can also be used on the Commodore 64 and PET/CBM, and can be modified for use with disk.

When data is needed during a program, it is often input from the keyboard or read from DATA statements within the program. Such data is program-dependent, part of the program itself, and therefore not available to other programs. But programs can also use data stored in files. A data file contains information, alphabetic or numeric, that is completely separate from a program. (It's program-independent.) Program-independent files make it possible to share information among several different programs.

Let's say you have computerized your Christmas card list and put the information into a data file. The file contains the names, addresses, cities, states, and zip codes of individuals to whom you will send cards. You can create various programs to manipulate the same information in different ways. For example, you could write one program to sort the names alphabetically, another program to sort by state or zip code, and still another program to search for the mailing information when given a name. You could write an editing program to add, change, or delete names from the list.

Creating A Data File

Let's look at how a data file is created. The general steps are:

1. OPEN a file for data entry.
2. Collect the information to be stored in the file.
3. Write the data to the file.
4. CLOSE the file.

"Information Handyman" illustrates this process by setting up a data file on cassette tape to maintain records of your checking account. Once you understand how the program works, you can easily modify it to handle similar types of information.

Changing Information In The File

Here is some information about the program's operation. Suppose an error was made in an entry when a file was created. Lines 5000–5120 show how the error can be corrected. First, the file must be opened for output, read into memory, and closed. The program then asks for the item to be changed (line 5025) and searches for a match (lines 5030–5040). If the item is not found, the program asks for another item to be changed (line 5045). As with the file creation section, entering STOP for the search item ends the entry process.

The program is set up to search for check numbers, but this can easily be changed. For example, if you changed the C$(R,1) in line 5035 to C$(R$,2), you could search for a particular payee name instead. After all corrections have been made, the file is opened again for writing (line 5090), the entire file is rewritten (lines 5095–5115), and finally the file is closed (line 5120).

Adding Data To The File

As your data base grows, so does the length of your file. Lines 6000–6080 show how data may be added to a previously created file. The original file must be opened, read into memory, and closed by the file-reading routine. When data is added to a sequential file, it is added at the end of the existing data. To add data, the computer must know where the last record is located. The reading routine provides that information in the variable R1. Line 6015 checks to see if the file already contains the maximum number of records. Line 6030 starts the addition at the next available record, R1+1.

The new data is entered in lines 6035–6045. As before, entering STOP for the check number will end the entry process. Entry will also end when the maximum 25 entries are made. After all the new entries have been made, lines 6060–6080

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open the file for writing, write the file (including the new entries), and close the file.

Other Features

The program includes routines to display the records sorted by check number (lines 2000–2060) or by payee name (lines 3000–3050). Both of these use the simple sorting routine in lines 9000–9035. Also included is a routine which will find the payee name and amount when given the check number. As with the correction routine, it would be simple to modify this to search for check number when given the payee name.

Another user-friendly feature is the subroutine at line 9900. This halts the program until you rewind the tape, to insure that you will always begin recording at the start of the file.

Customizing The Program

It may be more efficient to have a separate program for each of the functions, particularly if you have only limited memory, as with the unexpanded VIC. Each of the major routines presented here can be separated into an individual program. Note, however, that most of the routines call other routines. For example, the routine in lines 2000–2055 also needs lines 8000–8040, 9000–9035, and 9900.

The screen displays in the program have been set up for the VIC's 22-column screen. If you are using a 64 or PET/CBM, you can adjust the PRINT statements so that the output will look better on your wider screen display. No other modifications are necessary, but 64 users should remember that the 64 screen display will blank while the program is searching for or reading the file. Also, when the file is found, you'll need to press the Commodore logo key for the reading to proceed.

For unexpanded VICs, not enough memory is available to set up the array for 25 checks. To prevent an OUT OF MEMORY ERROR, you'll have to change the DIM in line 110 to C$(5,3) and the 25 in lines 1025, 6015, 6030, and 8010 to 5. You'll also need to omit spaces everywhere in the program except in the PRINT statements. A file of five records isn't long enough to store a useful amount of information, but it will illustrate the principles of data files. On the other hand, if you have a 64 or PET/CBM, you may have enough memory for arrays of more than 25 rows, and changing the lines mentioned above will allow you to create files with more records.

Disk Modifications

The procedure for creating and manipulating disk data files is essentially the same as that for tape data files. In fact, working with disk files is much easier, since it is not necessary to constantly stop and rewind the tape. Also, the reading and writing is much faster.

To use the program presented here with disk, first delete all the lines which refer to rewinding the tape: 1005, 1010, 2005, 3005, 4005, 5005, 5015, 6005, 6020, and 9900.

These are the lines which must be modified to use the program with a disk drive:

```
1015 OPEN 1,8,8,"0:CHECK INFO FILE,S,W"
5090 OPEN 1,8,8,"@0:CHECK INFO FILE,S,W"
6060 OPEN 1,8,8,"@0:CHECK INFO FILE,S,W"
8005 OPEN 1,8,8,"0:CHECK INFO FILE,S,R"
```

Information Handyman For Commodore

Refer to the "Automatic Proofreader" article before typing this program in.

```
100 PRINT"{CLR}{2 SPACES}{RVS}C H E C K
    {2 SPACES}M E N U{OFF}":CLR    :rem 71
110 DIM C$(25,3):Z$=CHR$(13)       :rem 149
115 PRINT:PRINT "CODE";TAB(5);"FUNCTION":
    PRINT                          :rem 142
120 PRINT" 1 - ENTER CHECK":PRINTTAB(6)"I
    NFORMATION"                    :rem 77
125 PRINT" 2 - DISPLAY IN CHECK":PRINTTAB
    (6)"NO. SEQUENCE"              :rem 96
130 PRINT" 3 - DISPLAY IN PAYEE":PRINTTAB
    (6)"NAME SEQUENCE"             :rem 201
135 PRINT" 4 - FIND PAYEE NAME":PRINTTAB(
    6)"AND CK. AMOUNT              :rem 43
140 PRINT" 5 - CHANGE ITEMS IN":PRINTTAB(
    6)"FILE"                       :rem 16
145 PRINT" 6 - ADD ITEMS TO":PRINTTAB(6)"
    FILE"                          :rem 69
150 PRINT" 7 - END PROGRAM":PRINT:PRINT
                                   :rem 72
155 PRINT"1,2,3,4,5,6, OR 7:";     :rem 246
160 INPUT C1$:C=VAL(C1$):REM C1$=CHOICE
                                   :rem 227
165 IF C<1 OR C>7 THEN 160         :rem 250
170 PRINT"IS ";C1$;" CORRECT{2 SPACES}";:
    INPUT"YES{5 LEFT}";E$          :rem 88
175 IF LEFT$(E$,1)<>"Y" THEN 155 :rem 115
180 ON C GOTO 1000,2000,3000,4000,5000,60
    00,7000                        :rem 22
1000 REM DATA ENTRY                :rem 81
1005 PRINT"{CLR}REMOVE PROG. TAPE AND REP
     LACE WITH FILE TAPE (REWOUND)"
                                   :rem 82
1010 PRINT"TYPE {RVS}CONT{OFF} TO CONTINU
     E":STOP                       :rem 53
1015 OPEN 1,1,1,"CHECK INFO FILE":rem 254
1020 GOSUB 9950                    :rem 26
1025 FOR R=1 TO 25                 :rem 121
1030 INPUT"{DOWN}CHECK NO.: ";C$(R,1):IF
     {SPACE}C$(R,1)="STOP" THEN 1055
                                   :rem 159
1035 INPUT"{4 SPACES}PAYEE: ";C$(R,2)
                                   :rem 238
1040 INPUT"{3 SPACES}AMOUNT: ";C$(R,3)
                                   :rem 75
1045 PRINT#1,C$(R,1);Z$;C$(R,2);Z$;C$(R,3
     )                             :rem 247
1050 NEXT                          :rem 5
1055 CLOSE 1:GOSUB 9600:GOTO 100 :rem 255
2000 REM SORT AND DISPLAY BY CHECK NO.
                                   :rem 155
2005 PRINT"{CLR}":GOSUB 9900       :rem 183
2010 GOSUB 8000:REM READ FILE      :rem 101
2015 S=1:GOSUB 9000:REM SORT BY NO.
                                   :rem 216
```

```
2020 PRINT TAB(5);"{CLR}CHECK LISTING"
                                    :rem 56
2025 PRINT TAB(3);"CHECK SEQUENCE":PRINT:
     PRINT                          :rem 117
2030 PRINT"CHECK/AMOUNT";TAB(14);"PAYEE"
                                    :rem 178
2035 FOR R=1 TO R1                  :rem 151
2040 V=VAL(C$(R,3)):V1=V1+V         :rem 252
2045 PRINT C$(R,1),C$(R,2),C$(R,3)
                                    :rem 232
2050 NEXT                            :rem 6
2055 PRINT:PRINT"TOTAL AMOUNT:";V1
                                    :rem 184
2060 GOSUB 9600:GOTO 100             :rem 27
3000 REM SORT AND DISPLAY BY PAYEE
                                    :rem 231
3005 PRINT"{CLR}":GOSUB 9900        :rem 184
3010 GOSUB 8000:REM READ FILE       :rem 102
3015 S=2:GOSUB 9000:REM SORT BY PAYEE
                                    :rem 131
3020 PRINT TAB(7);"{CLR}CHECK LISTING"
                                    :rem 59
3025 PRINT TAB(5);"PAYEE SEQUENCE":PRINT:
     PRINT                          :rem 142
3030 PRINT"PAYEE/AMOUNT";TAB(17);"CHECK":
     PRINT                          :rem 125
3035 FOR R=1 TO R1                  :rem 152
3040 PRINT C$(R,2),C$(R,1),C$(R,3)
                                    :rem 228
3045 NEXT R:PRINT:PRINT             :rem 235
3050 GOSUB 9600:GOTO 100             :rem 27
4000 REM FIND PAYEE AND AMOUNT      :rem 228
4005 PRINT"{CLR}":GOSUB 9900        :rem 185
4010 GOSUB 8000:REM READ FILE       :rem 103
4015 INPUT"{CLR}ENTER CHECK NO.";N$
                                    :rem 133
4020 FOR R=1 TO R1                  :rem 147
4025 IF N$=C$(R,1) THEN 4040        :rem 103
4030 NEXT R                          :rem 88
4035 PRINT "CHECK NO. ";N$;" NOT FOUND IN
      FILE":GOTO 4050               :rem 82
4040 PRINT"{2 DOWN}{2 SPACES}PAYEE :
     {SHIFT-SPACE}";C$(R,2)         :rem 172
4045 PRINT" AMOUNT : ";C$(R,3)       :rem 80
4050 GOSUB 9600:GOTO 100             :rem 28
5000 REM CHANGE FILE DATA           :rem 137
5005 PRINT"{CLR}":GOSUB 9900        :rem 186
5010 GOSUB 8000:REM READ IN FILE :rem 255
5015 PRINT"FILE IN MEMORY":GOSUB 9900
                                    :rem 184
5020 GOSUB 9950                      :rem 30
5025 INPUT"{DOWN}ITEM TO CHANGE";N$:IF N$
     ="STOP" THEN 5090              :rem 213
5030 FOR R=1 TO R1                  :rem 149
5035 IF N$=C$(R,1) THEN 5050        :rem 107
5040 NEXT                            :rem 8
5045 PRINT"{DOWN}ITEM ";N$;" NOT FOUND IN
      FILE":GOTO 5025               :rem 110
5050 PRINT"{2 DOWN}CHECK NO.: ";C$(R,1)
                                    :rem 194
5055 PRINT"{4 SPACES}PAYEE: ";C$(R,2)
                                    :rem 241
5060 PRINT"{3 SPACES}AMOUNT: ";C$(R,3)
                                    :rem 78
5065 PRINT:PRINT"ENTER CORRECTIONS:"
                                    :rem 107
5070 INPUT"CHECK NO.";C$(R,1)       :rem 107
5075 INPUT"{4 SPACES}PAYEE";C$(R,2)
                                    :rem 188
5080 INPUT"{3 SPACES}AMOUNT";C$(R,3)
                                    :rem 25
5085 GOTO 5025                      :rem 215
5090 OPEN 1,1,1,"CHECK INFO FILE"    :rem 5
5095 FOR R=1 TO R1                  :rem 160
5100 PRINT#1,C$(R,1)                 :rem 58
5105 PRINT#1,C$(R,2)                 :rem 64
5110 PRINT#1,C$(R,3)                 :rem 61
5115 NEXT R                          :rem 93
5120 CLOSE 1:GOSUB 9600:GOTO 100 :rem 252
6000 REM ADD DATA TO FILE            :rem 80
6005 PRINT"{CLR}":GOSUB 9900        :rem 187
6010 GOSUB 8000:REM READ FILE       :rem 105
6015 IF R1>=25 THEN PRINT"NO MORE DATA CA
     N BE{3 SPACES}ADDED TO FILE":GOTO 60
     80                             :rem 89
6020 PRINT"FILE IN MEMORY":PRINT:GOSUB 99
     00                             :rem 124
6025 GOSUB 9950:PRINT"{DOWN}ADDITION TO F
     ILE"                           :rem 79
6030 FOR R=R1+1 TO 25                :rem 40
6035 INPUT"{DOWN}CHECK NO.: ";C$(R,1):IF
     {SPACE}C$(R,1)="STOP" THEN 6060
                                    :rem 170
6040 INPUT"{4 SPACES}PAYEE: ";C$(R,2)
                                    :rem 239
6045 INPUT"{3 SPACES}AMOUNT: ";C$(R,3)
                                    :rem 85
6050 N=N+1:NEXT R                   :rem 203
6055 PRINT"MAXIMUM NUMBER OF CHECKS ENTER
     ED"                            :rem 213
6060 OPEN 1,1,1,"CHECK INFO FILE"    :rem 3
6065 R1=R1+N:FOR R=1 TO R1          :rem 148
6070 PRINT#1,C$(R,1):PRINT#1,C$(R,2):PRIN
     T#1,C$(R,3)                    :rem 160
6075 NEXT                            :rem 17
6080 CLOSE 1:GOSUB 9600:GOTO 100     :rem 2
7000 REM END OF PROGRAM              :rem 47
7005 PRINT "{CLR}PROGRAM{2 SPACES}TERMINA
     TED"                           :rem 53
7010 END                            :rem 159
8000 REM READ IN DATA FILE          :rem 153
8005 OPEN 1,1,0,"CHECK INFO FILE"    :rem 3
8010 FOR R=1 TO 25                  :rem 122
8015 INPUT#1,C$(R,1):INPUT#1,C$(R,2):INPU
     T#1,C$(R,3)                    :rem 170
8020 IF ST=64 THEN 8030             :rem 161
8025 NEXT R                          :rem 96
8030 CLOSE 1:R1=R                   :rem 190
8035 PRINT:PRINT R1;"RECORDS IN FILE"
                                    :rem 239
8040 RETURN                         :rem 172
9000 REM SORT                       :rem 245
9005 F=0:FOR R=1 TO R1-1            :rem 230
9010 IF C$(R,S)<=C$(R+1,S) THEN 9030
                                    :rem 59
9015 FOR E=1 TO 3                    :rem 63
9020 S$=C$(R,E):C$(R,E)=C$(R+1,E):C$(R+1,
     E)=S$                          :rem 136
9025 NEXT E:F=1                      :rem 66
9030 NEXT R:IF F<>0 THEN 9005        :rem 19
9035 RETURN                         :rem 177
9600 REM WAIT FOR RETURN KEYPRESS :rem 37
9605 PRINT:PRINT"HIT RETURN FOR MENU"
                                    :rem 77
9610 GET C1$:IF C1$="" THEN 9610     :rem 41
9615 IF C1$<>CHR$(13) THEN 9610      :rem 43
9620 RETURN                         :rem 177
9900 PRINT"REWIND TAPE AND TYPE{2 SPACES}
     {RVS}CONT{OFF}":STOP:RETURN    :rem 29
9950 PRINT"{CLR}{RVS}{3 SPACES}ENTER STOP
      TO END{6 SPACES}ENTRY{2 SPACES}ROUT
     INE{4 SPACES}{OFF}":RETURN :rem 239 ©
```

MacroDOS For Atari

Part 1

Jerry Allen

This utility will simplify Atari disk operations, allowing you to read the directory and erase files without losing the program in memory.

MacroDOS is an instant access disk utility package for a one- or two-drive DOS 2.0 system. MacroDOS uses only three pages of RAM and therefore can be permanently coresident in memory with the FMS. You can pretty well forget about MEM.SAV. And when you call DOS, you won't have to worry about losing your BASIC or machine language program when you return. The utility can also be used without a cartridge.

MacroDOS supports all the normal DUP functions excepting file and disk duplication, some of which can still be accomplished with the SAVE (binary file) command. Also, MacroDOS incorporates a new feature to DUP systems: hex or dec RUN and address entries, and a permanently available hex-to-decimal, decimal-to-hex converter. You'll have no more lost time looking for that subroutine, which must be around somewhere, or couldn't be loaded anyway because it conflicts with something that is in memory.

You will still be allowed the option of using Atari DUP, but now, before you take that step, the directory can be safely checked to confirm that MEM.SAV is indeed there.

A Safe Location

MacroDOS resides in memory after the FMS, where Atari DUP would normally load. The big difference here is that it pushes MEMLO up to stay out of the way of your programs. You will still have use of page 6, page 4, and even page 1. When SYSTEM RESET or BREAK is hit, MacroDOS will reinitialize itself unless you have exited to Atari DUP, which resets the old vectors.

Some of the MacroDOS operations differ slightly, but if you have used Atari DOS-DUP, there is really little to learn, and you may even find that the new operation is easier to master and execute.

When working with MacroDOS, you should be using DOS.SYS 2.0S in the same (or a smaller) configuration that comes on your master disk. If the listing for the machine language program (Part 2, next month) is used, you should be able to realign the program for larger versions of DOS.SYS using more buffer space. The program will check MEMLO and change everything accordingly.

The program included this month, however, is for BASIC users, and it's constrained to using a version of DOS.SYS which, after it has loaded, has a MEMLO of 7420 ($1CFC), or less. Use the direct mode command as follows to check if in doubt: PRINT PEEK(743)+256*PEEK(744). If your DOS.SYS has not been altered from the master disk, MEMLO will be 7420.

A Few Prompts To Learn

There are a few new prompts. First is the › prompt, which expects the return of a function command's first letter. The directory, format, and write DOS functions use the prompt D# and expect just a single number of 1–4, or just a RETURN, which defaults to drive 1. The format command also uses a ? to ask if you're sure, and looks for a Y or YES before proceeding.

Functions requiring a filename use FN?. The device name (D:, D1:, or D2:) must be included in the name. Rename (RNM) requires only one device name and none for the name after the comma. The @ prompt is used to mean "at" or "to" when an address input is required. Asterisk wild cards are still allowed.

MacroDOS Commands

[D]IR – used to read the disk directory. The second prompt requires a drive number of 1–4 or RETURN only for drive 1.

[R]NM – rename a file. As in Atari DUP, use the device name only with the old name (that is, D3:MAC*.*,AUTORUN.SYS).

[*]LK – lock a file.

[U]n* – unlock a file.

[F]MT – format a disk. Answer SURE? (?) with a Y. Give drive number.

[E]RS – erase file.

[C]RT – return to cartridge; BASIC or Assembler.

[S]AV – save binary file. Enter the filename at the prompt. Do not use commas. Enter the *from* address at the @ prompt. Then the *to* address at the next prompt. The numbers given can be hex or decimal or both, but must be preceded by a $ for hex or a period if decimal. This command allows appending to an existing file if a slash (/) is used after the last letter of the filename. RUN and INIT addresses must be added by appending to a file. POKE (or use command C in DEBUG) 736,737 ($2E0,$2E1) for RUN, and 738,739 ($2E2,$2E3) for INIT. Remember to POKE low, high. Then go to MacroDOS and append the addresses you just changed to the file. Do not hit SRESET between the POKEs and the SAVE or 736–739 will be cleared.

[L]OD – binary load.

[@]RN – run at address. Hex or decimal.

[W]DS – write DOS.SYS (only).

[$]>. – hex to decimal. Enter $ and # together. Range: $00 to $FFFF.

[.]>$ – decimal to hex. Enter a . and # together. Range: .0 to .65535.

[!]DS – escape to Atari DOS (DUP.SYS). Remember that without MEM.SAVE on a disk without write protection in drive 1, programs will be wiped out. After using this command, you'll have to reboot or load from Atari DUP using MEM.SAV. (I don't use the letter A because it's Atari's DUP DIR command and too easy to accidentally use. The ! forces you to shift, and therefore, to think a little more.)

In Part 2, we'll continue the discussion of MacroDOS features, and present the machine language source code.

If you don't want to type in the programs, send $3 and a disk or tape with an SASE mailer.

Jerry Allen
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Redondo Beach, CA 90278

MacroDOS

Refer to the "Automatic Proofreader" article before typing this program in.

```
MI 20  DIM H$(104):TRAP 95:OPEN #1,8,
       0,"D:AUTORUN.SYS":FOR N=1 TO 1
       6:READ H$:B=0
HO 30  FOR C=1 TO 99 STEP 2
DP 40  IF H$(C,C+2)="END" THEN GOSUB
       80:END
DH 50  A=16*(ASC(H$(C))-48-7*(ASC(H$(
       C))>57))
OB 60  A=A+ASC(H$(C+1))-48-7*(ASC(H$(
       C+1))>57):B=B+A
MG 70  PUT #1,A:NEXT C:GOSUB 80:NEXT
       N
FN 80  IF B<>VAL(H$(LEN(H$)-3)) THEN
       ? "ERROR AT LINE ";N*100:STOP
EJ 90  RETURN
EF 95  END
NB 100  DATA FFFFFC1C082020AE1E84F288
        8CE3028CE10284FFA280A00586F38
        4F4A03A9848B9A71F20B21E68A888
        10F3A9088D5A0320766200
IP 200  DATA 1EA004AD8005D9E21FF01C88
        10F8C944D06DA9068D5A0320741D2
        06A1EA21020761E20701E10F6B9E7
        1F48C9FEF00920951D5209
KE 300  DATA 68206C1E109CA93F20B21E20
        761EAD8005C959D08D20741D30E6A
        94420B21EA92320B21E20761EAD80
        058DED1F8DF41FA0064896
OC 400  DATA B9EC1F91F38810F860A94620
        B21EA94E20B21EA93F20B21E4C761
        EC957D01120741DC8B9F31F91F388
        D0F8206A1E10B1C94C5965
KH 500  DATA D03485FF20951D4E5A03206A
        1E20991EA9FFC5D4D004C5D5F0F32
        0B6DD20991E20701F20E61DF0E5AD
        E302F008200517A9005814
BD 600  DATA 8DE30260C953D03720951DA0
        FFC8B1F3C92FD007EE5A03A99B91F
        3C99BD0EE206A1EA9FF85D485D520
        951E20ED1E20951E206602
GK 700  DATA B6DD20ED1E20951E20701F10
        39C940D00620ED1E6CD400C943D00
        34C74E4C921D00EA940850CA91585
        0D2040154C9F17C9244940
AB 800  DATA D008200B1F20541F100AC92E
        D00620021F202D1F106FA903A210D
        008A200A909D002A9059D4203A91E
        9D4803A9059D4503A93740
EF 900  DATA 809D4403A9009D49032056E4
        302B60A90BD002A907A2109D4203A
        9029D4803A9009D4503A9D4D0D9A9
        0C10BA85D4A200A90B4938
OL 1000  DATA 9D4203A90110E3C003F0D1C
         088F0159848A9C520B21E2044DA6
         885D420541F68684CFC1CA5FFF0F
         720E61DADE102F0EF20086297
MC 1100  DATA 17D0EAA94020B21E20761EA
         C8005C02EF006C024F008D0BD200
         0D84CD2D92044DAA001B1F3C99BF
         01938E930C90A3002E9075889
IK 1200  DATA A20406D426D5CAD0F905D48
         5D4C810E160A000A201A9F035D44
         A4A4A4A20481FA90F35D420481FC
         A10EB3021C90A30026906531 1
BH 1300  DATA 693091F3C86020AAD920E6D
         8A000B1F3C8C98030F9297F8891F
         3C8A99B91F34C701EE6D4D002E6D
         5A210A5E09D4403A5E19D7399
CE 1400  DATA 450338A5D4E5E09D4803A5D
         5E5E14C8C1E204015A9FE8DE702A
         91F8DE802A9FC850AA91C850B603
         E9B9B5344A120243EAE205778
GO 1500  DATA 2E3EA4205344D7204E52C02
         0444FCC205641D39B5452C320544
         DC6205352C5204D4ED2202A4ED52
         04B4CAA205249C49B52454936
GN 1600  DATA 2A55462021232 4FE44313A2
         A2E2A9B44313A444F532E5359539
         BA991850CA91F850D4C941FE202E
         302FE1FEND0000000000003710
```

VIC And 64 TRACE

Roger Harris

Debugging is far easier if you can watch your program in execution. This program adds a valuable TRACE feature to your debugging toolkit.

Some versions of BASIC have a feature called TRACE, for debugging programs. Apple BASIC has a typical implementation: When the interpreter executes a program with TRACE enabled, the line number of each executed line will be printed on the screen. This allows you to observe the path being taken through your program.

This information can save a great deal of effort in locating logic errors—problems caused by improper program flow. In BASIC, such problems can be caused by using the wrong line number on a GOTO or GOSUB, or by using the wrong variable or conditional test in an IF statement. Tracing, you can determine the first point at which the program begins to behave oddly.

Commodore Upgrade BASIC, used by the VIC-20 and 64, does not have a TRACE. However, the BASIC program presented here will load a machine language (ML) routine which provides the same capability. When the program is run, the ML is read from DATA statements and POKEd into memory. After it's been loaded, you may delete the BASIC program with a NEW command. Now, enter or LOAD your program and RUN it normally.

Taking A TRACE

With the trace routine loaded, a SYS statement may be used to call a subroutine which will enable the trace. The SYS command is always followed by the address of a machine language routine. In this case, the address will depend on where the ML program was loaded, as I shall explain presently. There is another SYS address to disable the trace. You may enter either of the SYS statements before you RUN your program, or they can be statements within the program itself.

The trace produced by the routine will consist of a series of program line numbers, separated by spaces. This display will "wrap" at the end of screen lines, with no attempt to avoid splitting the numbers. Any PRINT output produced by your program will be intermixed with the line numbers.

An unusual feature of this trace is that it will show you the result of each IF statement executed. These results are indicated by printing a T or an F (true or false) after each line number that contained a conditional statement. Statements with multiple conditions will cause a T for each test which is true, or an F for the first condition which is false. It is often very important to know if the conditional part of a statement was executed; this feature gives you an easy way to verify that the program is making its decisions properly.

On the VIC or the 64, you can press the STOP key at any time when your program is running. You will get a message, BREAK IN 150, for example (meaning that the program stopped at line 150), and you will get the READY prompt. You may then resume execution with a CONT (continue) command. When the trace is enabled, you will occasionally find it necessary to use the STOP key to prevent the trace from scrolling off the screen too quickly. In some cases, you may want to add some STOP commands to your program. You can also edit your program to turn the trace on only at critical sections and turn it off for sections which are not under observation. When a program has been STOPped, by the STOP key or command, you may enter any immediate mode statement, such as a PRINT statement to display your variables (?A,B$,F), or a calculation. You may also change the value of variables with assignment statements (for example, X=4). You can still use

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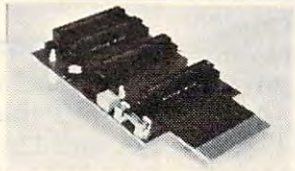

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CONTinue to resume execution, or you can GOTO a particular line number. However, the system will not allow you to CONTinue if you change the program, or if you enter a statement which causes a syntax error. If you edit a statement, you may still use the immediate mode GOTO, but you will have lost the previous value of any variables.

The trace function will not solve all your debugging problems, but obviously you must find a bug before you can fix it. When you can't find a bug by reading the listing, it's time to start investigating, to start TRACEing. You must determine what the program is *really* doing. The PRINT statement and STOP command are the BASIC programmer's primary debugging tools, but a trace is often the fastest way to find problems caused by failure to execute the proper instruction at the proper time.

The Loader Program

The program is a *relocating loader*, which will work on any VIC or 64. The program steals 248 bytes of memory from BASIC to load the machine language routine. The routine will not fit in the cassette buffer. Line 10 of the program PEEKs the current BASIC "limit of memory" from locations 55 and 56, and subtracts 248. (The number PEEKed from 56 is multiplied by 256 because it is the high byte of the two-byte address, and 55 is the low byte.) The address saved at 55 and 56 is the highest address, plus one, of memory available to BASIC. The initial address, minus 248, will be the new top of BASIC memory. Line 15 converts this address back to high byte and low byte. Line 20 POKEs these bytes back into 55 and 56, and does a CLR (clear variables) so that BASIC will recognize the new memory limit. The variable TRACE is then set in line 25 to be the new limit of BASIC. This will be the starting location for POKEing the machine language. If your program needs to allocate some memory for custom characters or screen buffers, you can set 55 and 56 to the required value before you run the loader; the routine will always be POKEd above the "current" limit.

This technique will also work on the 64, but you probably will not have to steal any of BASIC's memory; there is a 4K block of memory starting at 49152 which is not used by BASIC. Unless your program is already using that memory, you can change line 10 to set TRACE=53000 and completely omit lines 15, 20, and 25. 53000 is a particularly good location, since the number is fairly easy to remember, and the routine will use only the last 248 bytes of the 4K RAM. This will leave the beginning of that memory available for programs which use custom characters, sprites, or other ML routines.

Whatever TRACE is located will also be the SYS address which will enable the trace. TRACE plus 24 will be the SYS address which disables the trace. For example, on the unexpanded VIC, TRACE will normally be set to 7432, so SYS 7432 will turn on the trace, and SYS 7456 will turn it off.

All lines from line 30 down should be included in any version of the program. Line 50 of the program is the beginning of a FOR loop which READs the DATA statements. The trace routine is not inherently relocatable; it uses many absolute addresses. Fortunately, all the external (system) addresses used are the same on the VIC and the 64. This leaves only the problem of addresses of internal subroutines and working storage. The loader program does the relocation by checking for negative numbers in the DATA statements; a negative number indicates a place where a two-byte absolute address is required. The address generated will be the absolute value of the negative number, plus the initial value of TRACE. When all the data has been POKEd, the program re-POKEs two locations which are also dependent on TRACE.

As Always, SAVE Before RUN

As always when typing in programs, you must be careful to get all the numbers correct, and you should save a copy of the program before you run it. If any numbers are wrong in the DATA statements, the results will be unpredictable. When it is run, the program adds up the numbers from the DATA statements and compares the total to the correct sum. This will catch most errors, but it is not foolproof. If the sum is correct, the program will say TRACE READY and display the SYS addresses which will enable and disable the trace. Please be very careful when using any SYS statement; there is a high probability that your computer will "lock up" if you use a wrong SYS address. Such a state can only be fixed by turning the power off and then back on.

How Trace Works

The routine which enables the trace places a three-byte JMP (jump) instruction into locations 124, 125, and 126. This overlays the middle of the CHRGET subroutine, which is used by the interpreter to fetch characters from the BASIC program. The destination of the jump is the beginning of the trace handling routine. This technique is sometimes called a *wedge*.

When the trace routine is activated, each fetched character will arrive in the A register. If the byte is a space character, the routine jumps back to CHRGET to get the next. Otherwise, the character is pushed on the stack. Next, the program checks a flag which indicates the presence of a conditional statement. The routine then compares the current line number, stored by BASIC at locations 57 and 58, to the line number which

was last displayed. If a new line is being executed, the new line number is saved for future reference, and is converted from 16-bit binary to ASCII decimal characters for printing. (However, the routine does not output the line number if it is greater than 64000—BASIC puts a high value in the "current line" location when it is interpreting an immediate command.) Each character of the line number is output to the screen by calling the Kernal (operating system) subroutine CHROUT.

The routine then pops the fetched character from the stack, and checks if the character is the BASIC token (one-byte representation) for a THEN. If so, a flag is set. The presence of a THEN indicates a conditional statement which is about to be resolved. I originally thought that the next call to the trace routine could determine if the condition was true or false by checking for a change in the line number. However, BASIC will make one more call to CHRGET even if the condition is false. Therefore, the flag processing is designed to wait for one call before deciding whether to output a T or an F. If the line number has not changed by then, the condition was true.

The routine always returns the fetched character to the interpreter, with the status register (condition codes) set, as CHRGET normally does.

The routine which disables the trace does so by restoring CHRGET to its original state.

TRACE

Refer to the "Automatic Proofreader" article before typing this program in.

```
1 REM --- TRACE LOADER                    :rem 194
10 LM=PEEK(55)+PEEK(56)*256-248:REM LIMIT
   OF BASIC MEMORY - 248 = NEW LIMIT
                                          :rem 147
15 HI=INT(LM/256):LO=LM-HI*256:REM HIGH A
   ND LOW BYTES OF ADDRESS                :rem 42
20 POKE 55,LO:POKE 56,HI:CLR:REM SET NEW
   {SPACE}LIMIT                           :rem 225
25 TRACE=PEEK(55)+PEEK(56)*256:REM TRACE
   {SPACE}LOAD ADDRESS=NEW LIMIT          :rem 31
30 A=TRACE                                :rem 80
40 PRINT:PRINT"LOADING TRACE ROUTINE AT"
   {SPACE}A                               :rem 101
50 FOR D=1 TO 201:READ N:CS=CS+N:REM READ
    & CHECKSUM CODE DATA                  :rem 220
55 REM POSITIVE DATA IS NORMAL BYTE
                                          :rem 116
60 IF N>=0 THEN POKE A,N:GOTO 80          :rem 226
65 REM NEGATIVE DATA IS RELATIVE ADDR, CO
   DE 2 BYTES                             :rem 207
70 N=TRACE+ABS(N):HI=INT(N/256):LO=N-HI*2
   56:POKE A,LO:A=A+1:POKE A,HI           :rem 113
80 A=A+1:NEXT                             :rem 252
85 REM FIX JUMP VECTOR IN INIT CODE
                                          :rem 45
90 HI=INT((TRACE+37)/256):LO=TRACE+37-HI*
   256:POKE TRACE+5,LO:POKE TRACE+9,HI
                                          :rem 39
100 IF CS<>11307 THEN PRINT"DATA ERROR! C
    HECK DATA STATEMENTS!":STOP           :rem 18
```

```
110 PRINT:PRINT"TRACE READY.":PRINT:rem 3
120 PRINT" SYS"TRACE"= TRACE ON"  :rem 95
130 PRINT" SYS"TRACE+24"= TRACE OFF"
                                  :rem 47
140 END                           :rem 108
500 DATA 169,76,133,124,169,8,133,125,169
    ,0,133                        :rem 16
501 DATA 126,169,0,141,-245,141,-246,141
                                  :rem 160
502 DATA-247,96,169,201,133,124,169,58,13
    3                             :rem 79
503 DATA 125,169,176,133,126,96,201,32,20
    8                             :rem 25
504 DATA 3,76,115,0,72,173,-247,240,31,23
    8                             :rem 11
505 DATA -247,201,167,240,24,169,0,141,-2
    47                            :rem 59
506 DATA32,-211,208,4,169,84,208,2,169,70
                                  :rem 20
507 DATA 32,210,255,169,32,32,210,255,32,
    -211                          :rem 149
508 DATA 240,109,165,57,141,-243,141,-245
    ,165                          :rem 165
509 DATA 58,141,-244,141,-246,201,250,176
                                  :rem 221
510 DATA 89,169,0,141,-239,141,-240,141,-
    241                           :rem 101
511 DATA 141,-242,142,-238,162,15,14,-243
                                  :rem 203
512 DATA 46,-244,120,248,173,-239,109,-23
    9                             :rem 19
513 DATA 141,-239,173,-240,109,-240,141,-
    240                           :rem 92
514 DATA 173,-241,109,-241,141,-241,216,8
    8,202                         :rem 200
515 DATA 16,216,162,2,189,-239,72,74,74
                                  :rem 140
516 DATA74,74,32,-224,104,41,15,32,-224,2
    02                            :rem 96
517 DATA 16,236,169,32,32,210,255,174,-23
    8                             :rem 24
518 DATA 104,201,167,208,3,141,-247,201,5
    8                             :rem 11
519 DATA 176,3,76,132,0,96,165,57,205,-24
    5                             :rem 31
520 DATA 208,5,165,58,205,-246,96,205,-24
    2,208                         :rem 218
521 DATA 1,96,9,48,141,-242,76,210,255
                                  :rem 78 ©
```

Apple Variable Save

Jeff Brewster

Modifying lines in Applesoft BASIC programs can be time-consuming when variables are lost. Here is a machine language program to solve that problem. It saves and automatically resets pointers to variables, letting you easily interrupt programs for modification and debugging.

In Applesoft BASIC you will lose variables whenever a program is modified. This is especially troublesome during program development and debugging when many changes must be made and their effects determined. Each time a line is changed, it is necessary to reexecute the entire program due to the loss of variables. When the program involves long calculations or many operator INPUTS, this requirement makes program modification a slow, frustrating process.

By using this short machine language program "VARSAV," you can avoid much of this trouble. A running program can be interrupted with CTRL-C or RESET; program lines can be modified, added, or deleted; and execution can be resumed with the CONT or GOTO command. All the variables will still be there, ready to use (provided no unusual commands are entered which would disturb the stored variables or their pointers—these forbidden commands are discussed below).

Programming Considerations

This modification to BASIC is implemented by having Applesoft call VARSAV when keyboard input is required, instead of the usual routine KEYIN. VARSAV consists of two parts: the functional part of the program and a short initialization sequence which must be run to connect VARSAV to Applesoft. The initialization routine sets the KSW pointer at $38–$39 so that VARSAV is called when keyboard input is required; it also patches a new routine into the RESET sequence so that VARSAV remains connected even after a system RESET. START calls KEYIN to read the keyboard and then saves or restores certain pointers which tell Applesoft where variables are located in memory.

VARSAV occupies 96 bytes, including the seven-byte storage area RSAVE, and can be located anywhere in memory. The program is entered most quickly from the monitor (CALL-151) using the hex dump in Program 1. It is convenient to type in the program as written, list it to find errors, and then make any location-dependent changes.

The main program is in page 3 of memory (*pages* are 256-byte groupings), a usually vacant area, while allowing the initialization routine to reside at the top of page 2. This keeps the initialization sequence, which is used only once, out of valuable page 3 memory space.

VARSAV is conveniently implemented on a disk system by including a BRUN VARSAV instruction in the greeting program so that VARSAV will be loaded and run whenever the disk is booted. The use of VARSAV is straightforward and nearly transparent to the operator. You needn't grasp the program's operation to use VARSAV, so skip the next section if the details do not interest you.

Saving And Restoring Variables

Variables are stored by Applesoft in tables, starting at the end of the program and moving up in mem-

ory. Simple variables are stored in the lower segment of the variable space; array variables are in the upper segment. As new variables are defined, they are added to the end of the existing tables. String variables are actually stored in two places: the name of the string and a pointer are stored in the appropriate variable table (simple or array), while the string itself is stored at the top of available memory. New strings are added at the top of memory, working down, while their pointers are stored in the variable table, working up.

To keep track of the variables, Applesoft has four pointers in zero page ($69 to $70, 105 to 112 decimal) which define the start of the simple variable table, the start of the array variable table, the end of variable storage, and the start of string storage. Their functions are described more fully on page 140 of the *Applesoft II Reference Manual.*

The first pointer is set automatically to the end of the program by Applesoft when the program is loaded, or by entering or deleting a program line. This pointer can be changed to a higher value with LOMEM or a POKE, permitting the programmer to leave a space in memory between the program and the variable tables. The other pointers are not directly accessible.

At the beginning of a program, the second and third pointers are set equal to the first, while the fourth pointer is set equal to HIMEM. As variables are assigned by the program, the pointers are updated. Since variables are never deleted from the variable tables, the pointers never decrease in value during program execution. When a new line is entered, however, these pointers are reset to their initial (default) values, so that it appears to Applesoft that no variables have been defined. The variables and strings themselves are still in memory waiting to be used—Applesoft just doesn't see them.

If the pointers could be saved somewhere before they were reset, and then restored after the new line input, Applesoft would then be able to use the variables already assigned. This could be done by using the monitor M command (Move) to store the pointers in a convenient location, returning to BASIC to make program changes, and then using the monitor again to restore the variable pointers from the storage area before continuing execution. VARSAV simply performs these operations automatically via the routines SAVE (save pointers) and RESTOR (restore pointers) each time the keyboard is read.

The appropriate operation is selected by comparing the current value of the pointer to the end of variable storage ($6D–$6E) to the stored value of this pointer. If the stored value is less than the current pointer value, a SAVE operation is performed; a RESTOR operation occurs if the current pointer value is less than the saved value. Generally, this means that when the pointers are updated they are SAVEd the next time keyboard input is requested. RESTOR occurs after keyboard input only if the variable pointers have been reset to their default values.

VARSAV makes this comparison each time the keyboard is read unless the character entered is CTRL-C. In that case, a SAVE operation is performed regardless of the current value of the variable pointers. This exception is necessary in order to permit the variable tables to be cleared. To clear the variables, enter the CLEAR command (then carriage return) followed immediately by CTRL-C.

Program Modification And RESET

How to use VARSAV is best learned by considering the sample program "VARSAV Test" (Program 2). Assume that VARSAV is in effect and that VARSAV Test is RUN. Execution will halt at statement 110 with a SYNTAX ERROR due to the misspelled NEXT. At this point the storage area holds the default values of the variable pointers, while the pointers themselves contain the current values assigned by Applesoft. These values must be saved before changing line 110. Entering the following line (or hitting any key) will accomplish this:

```
110 NEXT I
```

As the first character of the line is entered, a SAVE operation is performed, preserving the variable pointers. When you hit RETURN, Applesoft will process the line, checking the first nonblank character to determine whether this is an immediate mode command or new program line input. Since the first character is a number, the line is treated as new line input, and Applesoft clears the variable pointers to their default values and stores the new line in memory.

Suppose the command GOTO 90 is entered next. When the G is entered from the keyboard, VARSAV will test the end of variable space pointer and determine that its (default) value is less than the stored value. This results in a RESTOR operation which sets the variable pointers back to their original (correct) values. The variables will be printed out as if there were no changes made in the program at all.

To further complicate things, the effect of the RESET key has to be reckoned with. As mentioned previously, VARSAV is called via the KSW vector at $38–$39. Applesoft makes an indirect jump to the address held by the KSW vector whenever keyboard input is required. VARSAV sets the KSW vector to point to itself instead of the normal input routine KEYIN.

When RESET is hit, a number of operations occur which set the Apple's video output, I/O vectors, and soft switches to defined states. The

RESET sequence ends with an indirect jump to the address held in the soft entry vector (SOFTEV) at $3F2–$3F3, which returns control to the current operating language. As part of the sequence, the KSW vector is changed to its default value (pointing to KEYIN), thus disconnecting VARSAV.

To counter this, VARSAV sets the soft entry vector to cause a jump to its own reset routine, which reconnects VARSAV via the KSW vector, and then exits normally to BASIC.

The task of setting these two vectors (KSW and SOFTEV) is even more complicated when DOS is present. DOS is also connected to Applesoft through the KSW vector, and calls to VARSAV must be routed through DOS. In addition, DOS must set its own pointers after a system RESET just as VARSAV must. Thus, VARSAV must pass the value of KSW to DOS, and warmstart DOS (and BASIC) after a system RESET.

As was mentioned, only the pointers, not the variables themselves, are lost when program changes are made. This is true only when the change does not lengthen the program. If the program is lengthened, the lower end of the variable table will be overwritten by program lines and permanently lost.

This problem is easily avoided by using LOMEM to establish a space in memory between the end of the program and the start of the variable tables. This space is then available for additional program line storage without disturbing the variables. A space of 256 bytes is adequate for about eight BASIC lines; such a space is easily allocated by using the following statement as the first line of each program:

```
1 LOMEM : PEEK (105) + PEEK (106)*256 + 256
```

If many changes are anticipated, the space can be made larger by increasing the last value in line 1. A more compact equivalent statement is:

```
1 POKE 106, PEEK (106) + 1
```

Again, the space can be increased in 256-byte increments by increasing the last value in the line.

Using VARSAV

Once VARSAV has been loaded into memory, start the program from the beginning to set the KSW and SOFTEV vectors. The program as presented can be started with CALL 755. If the program is relocated, start it using a CALL to the first byte of the program. Load or enter a BASIC program as usual (try Program 2 the first time). Before running the program, enter CLEAR followed by CTRL-C to initialize the storage registers; then set LOMEM at least several hundred bytes beyond the end of the program to allow room in memory for added program lines. This can be done by entering LOMEM from the keyboard, or by incorporating one of the statements found in the previous paragraph, into the program.

Start execution as usual with RUN or GOTO. The program can be interrupted at will, changed, and execution will still continue without any loss of variables. Problems with VARSAV will occur if commands are entered from the keyboard which alter the variable tables or their pointers. Changing HIMEM or LOMEM may do this. Changing LOMEM will have no effect unless followed by CTRL-C, in which case all variables are lost; changing HIMEM will affect only strings.

Of course, altering HIMEM or LOMEM can destroy variables whether VARSAV is in use or not, so these commands should never be used after variables have been assigned in a program. Another problem can result if a program is run when the pointer storage area of VARSAV contains garbage, or pointer values from another program. The CLEAR, CTRL-C sequence described above should always be used to clear the pointer storage area before running a program.

This could also be done automatically by placing the following line at the beginning of each program:

```
2 CLEAR : CALL 808
```

With these simple precautions in mind, VARSAV can make programming and debugging in Applesoft a more pleasant, a faster job.

Program 1: Hex Dump Of VARSAV

```
02F0- 00 00 00 A9 45 A0 03 8D
02F8- F2 03 8C F3 03 20 6F FB
0300- A9 0B A0 03 85 38 84 39
0308- 4C EA 03 84 F9 20 1B FD
0310- 85 FA C9 83 F0 12 A5 6E
0318- CD 50 03 90 18 D0 09 A5
0320- 6D CD 4F 03 90 0F F0 18
0328- A0 07 B9 69 00 99 4B 03
0330- 88 10 F7 30 0B A0 07 B9
0338- 4B 03 99 69 00 88 10 F7
0340- A4 F9 A5 FA 60 20 00 03
0348- 4C BF 9D 00 00 00 00 00
```

Program 2: VARSAV Test

```
10  REM  VARSAV TEST
20  LOMEM:  PEEK (105) +  PEEK (106) *
     256 + 256
30  CLEAR : CALL 808: REM  SAVE ROUTINE
      AT $328
40 A = 1:B = 2:C = 3
50 A$ = "A":B$ = "B":C$ = "C"
60  FOR I = 1 TO 10
70 ARRAY(I) = I
80  NEXT I
90  FOR I = 1 TO 10
100  PRINT ARRAY(I)
110 NESTI: REM  THAT'S RIGHT!
120  PRINT
130  PRINT A,B,C
140  PRINT
150  PRINT A$,B$,C$
160  REM  TRY CHANGING THIS LINE
```

©

Graphics 0 Text In Four Colors

Ted Baldwin

Add four-color text to your Atari screen displays. These five programs demonstrate the ANTIC 4 display mode and allow you to save redefined characters for use in other programs.

ANTIC 4 is a little-known Atari display mode. Similar to GRAPHICS 0, it is a character mode, with 40 columns and 24 lines per screen, and uses all 256 characters. However, it also has the capability to display characters in four colors.

This is a result of the way ANTIC 4 interprets the character pattern. GRAPHICS 0, for instance, reads the character pattern one bit at a time. Each bit corresponds to one pixel of the character on the screen. The 1 bits are displayed at a different brightness than the 0 bits. ANTIC 4, on the other hand, reads the pattern two bits at a time. Each bit-pair corresponds to one pixel of the character. There are four possible combinations of two bits: 00, 01, 10, 11. Each combination represents a different color. The color corresponding to the bit-pair 00 is stored at location 712; the color for the bit-pair 01 is at location 708; the color for bit-pair 10 is at 709; the color for bit-pair 11 is at 710.

Redefined Characters

Program 1 converts the display to ANTIC 4. Running the program will reveal one of the drawbacks of ANTIC 4: The normal character set is useless. The characters on the screen are garbled because the normal character patterns are not designed to be read in bit-pairs. In order to make any practical use of ANTIC 4, you must redefine the character set.

Program 2 does that. The bit pattern for each character is designed so that the characters will appear in different colors. Specifically, typing lowercase letters will display light blue uppercase letters; typing uppercase letters will display gray uppercase letters; typing a number will display that number in gray; typing a shifted number will display that number in blue-green.

Program 3 demonstrates the use of these characters in ANTIC 4. Be sure to run Program 2 before running Program 3. The program first displays normal GRAPHICS 0 text. Then it switches to ANTIC 4 and displays four-color text using the redefined character set. The colors are changed to orange, green, and blue-green on a pink background.

Program 4 saves the redefined character set to disk and should be run after Program 2. Program 5 loads the character set back in. Your own filename can be substituted in line 140 of both programs.

You can add four-color text to your own programs by using Program 5 to load the character set and Program 1 to switch to ANTIC 4. Besides making your programs more colorful, these routines enable you to highlight important messages.

Refer to the "Automatic Proofreader" article before typing these programs in.

Program 1: The Original Characters

```
ED 10 DL=PEEK(560)+256*PEEK(561)
GM 20 POKE DL+3,PEEK(DL+3)+2
IJ 30 FOR I=DL+6 TO DL+28
DM 40 POKE I,4
ON 50 NEXT I
```

Program 2: Redefining The Characters

```
DP 30105 REM FIND TOP OF RAM MEMORY
DC 30110 TOP=PEEK(106)
NC 30115 REM LOWER MEM TOP TO MAKE SAF
         E{8 SPACES}LOCATION FOR CHARA
         CTER SET
HO 30120 LOWTOP=TOP-5:POKE 106,LOWTOP
BD 30125 REM MOVE SCREEN MEMORY TO REF
         LEC{6 SPACES}T NEW MEM TOP
IK 30130 GRAPHICS 0:? "PlEaSe WaIt ":S
         ETCOLOR 4,4,4:SETCOLOR 1,0,2:
         SETCOLOR 0,8,8
NG 30135 REM Z IS POINTER TO SUBROUTIN
         E.{7 SPACES}CS IS CHAR. SET S
         TART ADDRESS
AD 30140 Z=30800:CS=256*(TOP-4)
IK 30145 REM READ IN COLOR #1 LETTERS
GI 30150 H=CS+264:J=H+207:L=30300:K=1:
         GOSUB Z
IM 30155 REM READ IN COLOR #2 LETTERS
AO 30160 H=CS+520:J=H+207:K=1.5:GOSUB
         Z
IL 30165 REM READ IN COLOR #0 LETTERS
NM 30170 H=CS+776:J=H+207:K=0.5:L=3056
         0:GOSUB Z
IG 30175 REM READ IN COLOR #1 NUMBERS
```

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```
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         OSUB Z
II 30185 REM READ IN COLOR #2 NUMBERS
JG 30190 H=CS+8:J=H+55:K=1.5:L=30650:G
         OSUB Z:H=CS+64:J=H+7:L=30560:
         GOSUB Z:H=CS+72:J=H+7:L=30640
         :GOSUB Z
BI 30200 H=CS+256:J=H+7:L=30560:GOSUB
         Z
HP 30205 REM READ IN COLOR #0 NUMBERS
IF 30210 H=CS+80:J=H+15:K=0.5:L=0:GOSU
         B Z:H=CS+104:J=H+7:GOSUB Z:H=
         CS+120:J=H+7:GOSUB Z:H=CS+224
         :J=H+23:GOSUB Z
IH 30220 H=CS+472:J=H+23:GOSUB Z
OA 30235 REM READ IN SPACE CHARACTERS
GD 30240 H=CS:J=H+7:GOSUB Z:H=CS+496:J
         =H+23:GOSUB Z
NK 30300 DATA 4,1,2,3,3,2,3,4
NM 30310 DATA 4,2,3,2,3,3,2,4
OC 30320 DATA 4,2,3,5,5,3,2,4
OH 30330 DATA 4,6,3,3,3,3,6,4
OF 30340 DATA 4,2,5,2,5,5,2,4
OJ 30350 DATA 4,2,5,2,5,5,5,4
OG 30360 DATA 4,2,5,5,3,3,2,4
OE 30370 DATA 4,3,3,2,3,3,3,4
NM 30380 DATA 4,2,1,1,1,1,2,4
PG 30390 DATA 4,7,7,7,7,3,2,4
OA 30400 DATA 4,3,3,2,6,2,3,4
OJ 30410 DATA 4,5,5,5,5,5,2,4
NO 30420 DATA 4,3,2,2,2,3,3,4
OA 30430 DATA 4,3,2,2,3,3,3,4
OB 30440 DATA 4,2,3,3,3,3,2,4
OG 30450 DATA 4,2,3,3,2,5,5,4
OG 30460 DATA 4,2,3,3,3,3,2,7
OD 30470 DATA 4,2,3,2,2,3,3,4
OO 30480 DATA 4,2,5,2,7,7,2,4
NN 30490 DATA 4,2,1,1,1,1,1,4
NP 30500 DATA 4,3,3,3,3,3,2,4
NO 30510 DATA 4,3,3,3,3,2,1,4
OA 30520 DATA 4,3,3,3,2,2,3,4
NP 30530 DATA 4,3,3,1,1,3,3,4
NN 30540 DATA 4,3,3,2,1,1,1,4
OF 30550 DATA 4,2,7,1,1,5,2,4
OE 30560 DATA 4,2,3,3,3,3,2,4
OB 30570 DATA 4,6,1,1,1,1,2,4
PE 30580 DATA 4,2,7,8,6,5,2,4
PC 30590 DATA 4,2,7,2,7,7,2,4
PB 30600 DATA 4,7,8,3,2,7,7,4
OF 30610 DATA 4,2,5,2,7,3,2,4
OC 30620 DATA 4,2,5,2,3,3,2,4
OH 30630 DATA 4,2,7,1,1,5,5,4
OC 30640 DATA 4,2,3,2,3,3,2,4
PA 30650 DATA 4,2,3,2,7,7,7,4
ON 30660 DATA 4,4,4,4,4,4,4,4
BG 30670 DATA 9,9,9,9,9,9,9,9
FH 30680 DATA 10,10,10,10,10,10,10,10
GA 30690 DATA 11,11,11,11,11,11,11,11
BO 30695 REM TELL ATARI CHAR.SET LOCAT
         ION
EL 30700 POKE 756,TOP-4
BE 30705 REM SETUP FOR ANTIC 4 DISPLAY
FF 30710 DL=PEEK(560)+256*PEEK(561):PO
         KE DL+3,PEEK(DL+3)+2:FOR I=DL
         +6 TO DL+28:POKE I,4:NEXT I
ND 30720 END
II 30795 REM SUBROUTINE TO READ DATA I
         NTO{6 SPACES}CHARACTER SET
OL 30800 FOR I=H TO J:READ G:ON G GOSU
         B Z+20,Z+30,Z+40,Z+50,Z+60,Z+
         70,Z+80,Z+90,Z+100,Z+110,Z+12
         0:NEXT I
FH 30805 IF L=0 THEN RETURN
IG 30810 RESTORE L:RETURN
JF 30820 POKE I,32*K:RETURN
NA 30830 POKE I,168*K:RETURN
MM 30840 POKE I,136*K:RETURN
AN 30850 POKE I,0:RETURN
MP 30860 POKE I,128*K:RETURN
MM 30870 POKE I,160*K:RETURN
GO 30880 POKE I,8*K:RETURN
JL 30890 POKE I,40*K:RETURN
CH 30900 POKE I,85:RETURN
FD 30910 POKE I,170:RETURN
FI 30920 POKE I,255:RETURN
```

Program 3: ANTIC 4 Demonstration

```
LG 5 GRAPHICS 0
KG 10 POSITION 15,10:? "{13 ■■■■■■■}"
OI 20 POSITION 15,11:? "■ ■ ■ ■ ■ ■ ■"
MK 30 POSITION 15,12:? "■{11 SPACES}■"
BN 40 POSITION 15,13:? "■  GRAPHICS ■"
MO 50 POSITION 15,14:? "■{11 SPACES}■"
AA 60 POSITION 15,15:? "■{5 SPACES}0
      {5 SPACES}■"
NC 70 POSITION 15,16:? "■{11 SPACES}■"
PE 80 POSITION 15,17:? "■ ■ ■ ■ ■ ■ ■"
LG 90 POSITION 15,18:? "{13 ■■■■■■■}"
DB 95 FOR I=0 TO 1000:NEXT I
IL 100 DL=PEEK(560)+256*PEEK(561):POKE
       DL+3,PEEK(DL+3)+2:FOR I=DL+6 T
       O DL+28:POKE I,4:NEXT I:POKE 75
       6,PEEK(106)+1
OP 110 SETCOLOR 4,4,2
LI 120 POSITION 15,10:? "{13 ,}"
EP 130 POSITION 15,11:? "{,}_■_■_■_■_■
       _{,}"
LM 140 POSITION 15,12:? "{,}
       {11 SPACES}{,}"
LO 150 POSITION 15,13:? "{,}
       {11 SPACES}{,}"
JD 160 POSITION 15,14:? "{,}  AnTiC $
       {,}"
MC 170 POSITION 15,15:? "{,}
       {11 SPACES}{,}"
ME 180 POSITION 15,16:? "{,}
       {11 SPACES}{,}"
FL 190 POSITION 15,17:? "{,}_■_■_■_■_■
       _{,}"
LP 200 POSITION 15,18:? "{13 ,}"
BC 210 FOR I=0 TO 2000:NEXT I:GRAPHICS
       0
```

Program 4: Save Character Set

```
FO 110 CHSET=PEEK(756)
IF 120 CHSET=CHSET*256
GE 130 TRAP 180
BC 140 OPEN #1,8,0,"D:CHSET":REM YOUR
       FILENAME HERE
JM 150 FOR I=0 TO 1023
GK 160 A=PEEK(CHSET+I):PUT #1,A
CA 170 NEXT I
GD 180 CLOSE #1
```

Program 5: Load Character Set

```
LB 105 POKE 106,PEEK(106)-4:GRAPHICS 0
JM 110 POKE 756,PEEK(106)
BL 120 CHSET=256*PEEK(106)
GE 130 TRAP 180
AO 140 OPEN #1,4,0,"D:CHSET":REM YOUR
       FILENAME HERE
JM 150 FOR I=0 TO 1023
PJ 160 GET #1,A:POKE CHSET+I,A
CA 170 NEXT I
GD 180 CLOSE #1
```

©

Atari TAB

Stephen Levy, Editor, COMPUTE! Books

Atari BASIC has no built-in TAB or SPC functions. Here are four ways you can set up TABs.

Although there are no TAB or SPC functions built into Atari BASIC, the functions do exist. It is true that these functions are somewhat less convenient than those found in other BASICs, but they are no less powerful.

Most Atari users overcome the need for a TAB by using the POSITION statement. The POSITION statement is similar to the TRS-80 command PRINT AT. The short program below will illustrate how the POSITION statement works.

```
10 PRINT CHR$(125)
20 FOR X=0 TO 20
30 POSITION X,X:PRINT X
40 NEXT X
```

Two zero page locations are useful when the TAB function is needed. The following program accomplishes the same task as the previous program, but uses a POKE to location 85.

```
10 PRINT CHR$(125)
20 FOR X=0 TO 20
30 POKE 85,X:PRINT X
40 NEXT X
```

The number POKEd into 85 is the actual column to which the cursor is moved. If the cursor is at column 30 and the computer encounters a POKE to 85 less than 30, the cursor will move to the next line. The cursor will not move to the specified location until something is actually printed on the screen.

The second useful page zero location is 201. Location 201 contains a 10 when the Atari is turned on, which means that the tabs have been set to 10. By POKEing another number into this location, we can change the tab settings. Placing a comma after a PRINT statement will cause the next PRINT statement to print at the next available tab stop.

Try this:

POKE 201,15:PRINT "COMPUTE!","Magazine"

Notice how the words have been separated. The next example will help you understand how different numbers POKEd into 201 will affect the tab stops. The program will accept only numbers from 4 to 29.

```
10 PRINT CHR$(125)
20 TRAP 20:PRINT "HOW MANY SPACES BE
   TWEEN TAB STOPS";:INPUT TAB
30 IF TAB<4 OR TAB>30 THEN 20
40 POKE 201,TAB
50 PRINT :PRINT "POKE 201,";TAB
60 COL=PEEK(85):PRINT COL,
70 IF COL+TAB>38 THEN 90
80 GOTO 60
90 PRINT :GOTO 20
```

If you POKE 201,1 the computer will leave three spaces. Likewise, POKE 201,2 will leave four spaces. POKE 201,0 will cause problems when the next PRINT statement with a comma is encountered.

Spaces

Perhaps the simplest method of leaving spaces between prints is to put spaces within quotes. This may be the preferred method when spacing is used just a few times within a program. However, when this method is needed often within a program and the number of spaces will vary, it may be convenient to create a string of 38 spaces. Once the string is created, you need to call only the number of spaces required.

```
10 DIM SPC$(38):SPC$="  ":SPC$(38)=SP
   C$:SPC$(2)=SPC$
20 PRINT "15";SPC$(1,15);"spaces"
```

Nicely Formatted Names

Let's assume you wish to create a listing of names, nicely formatted on the screen. You can use any one of the methods discussed here. Each program

below uses one of these methods, but all create the same screen display.

Program 1: TAB Using POKE 201

```
10 PRINT CHR$(125):POKE 201,13
20 DIM NAME$(10),ADDRESS$(25)
30 PRINT "NAME","{3 SPACES}ADDRESS"
50 PRINT
60 FOR A=1 TO 4
70 READ NAME$,ADDRESS$
80 PRINT NAME$,ADDRESS$
90 NEXT A
100 END
110 DATA ADAMS,12 MAIN STREET
120 DATA ARTHUR,1515 SUNNY STREET
130 DATA SMITHSON,100 CIRCLE DRIVE
140 DATA WEEKS,2 DONNA LANE
```

Program 2: TAB Using A String Of Spaces

```
10 PRINT CHR$(125)
20 DIM SPC$(38),NAME$(10),ADDRESS$(2
   5)
30 SPC$=" ":SPC$(38)=" ":SPC$(2)=SPC
   $
40 PRINT "NAME";SPC$(1,12);"ADDRESS"
50 PRINT
60 FOR A=1 TO 4
70 READ NAME$,ADDRESS$
80 PRINT NAME$;SPC$(LEN(NAME$),12);A
   DDRESS$
90 NEXT A
100 END
110 DATA ADAMS,12 MAIN STREET
120 DATA ARTHUR,1515 SUNNY STREET
130 DATA SMITHSON,100 CIRCLE DRIVE
140 DATA WEEKS,2 DONNA LANE
```

Program 3: POSITION Example

```
10 PRINT CHR$(125)
20 DIM NAME$(10),ADDRESS$(25)
40 PRINT "NAME":POSITION 18,1:PRINT
   "ADDRESS"
50 PRINT
60 FOR A=1 TO 4
70 READ NAME$,ADDRESS$
80 PRINT NAME$:POSITION 14,A+2:PRINT
    ADDRESS$
90 NEXT A
100 END
110 DATA ADAMS,12 MAIN STREET
120 DATA ARTHUR,1515 SUNNY STREET
130 DATA SMITHSON,100 CIRCLE DRIVE
140 DATA WEEKS,2 DONNA LANE
```

Program 4: POKE 85 Example

```
10 PRINT CHR$(125)
20 DIM NAME$(10),ADDRESS$(25)
40 PRINT "NAME";:POKE 85,18:PRINT "A
   DDRESS"
50 PRINT
60 FOR A=1 TO 4
70 READ NAME$,ADDRESS$
80 PRINT NAME$;:POKE 85,15:PRINT ADD
   RESS$
90 NEXT A
100 END
110 DATA ADAMS,12 MAIN STREET
120 DATA ARTHUR,1515 SUNNY STREET
130 DATA SMITHSON,100 CIRCLE DRIVE
140 DATA WEEKS,2 DONNA LANE
```

Garbage Collection On Commodore Computers

Part 1

Jim Butterfield, Associate Editor

There's a sneaky event lying in wait for you within most Commodore machines. It's called garbage collection, *and it will show up, seemingly unpredictably, in any of several ways. Your program may seem to run slowly or erratically in "spurts." The program may have frequent pauses, each of which lasts several seconds. Worst of all, the program may pause for much longer periods of time—a minute, ten minutes, or even longer—and will seem to have "crashed." The user might be tempted to turn the machine off, thinking that it has failed.*

The garbage collection phenomenon isn't limited to Commodore machines, of course. Much of what is said here may be applied to other computers. The specific remedies that will be given for VIC, 64, PET, and CBM can be adapted to suit the different logic of other machines. Conversely, not all Commodore machines have garbage collection problems; for example, machines identifying themselves as 4.0 won't have these delays.

An Example

Try this on your computer:

```
100 DIM A$(800)
110 FOR J=1 TO 800
120 A$(J)=CHR$(65)
130 NEXT J
140 PRINT "X"
150 PRINT FRE(0)
160 PRINT "Y"
```

It will take a few moments to perform the loop in lines 110 to 130. You would expect this. But unless you know about garbage collection, you won't expect much of a delay in the last three lines; after all, they are just PRINT statements.

Try it. If there's a delay between printing X and Y, that's a garbage collection pause.

To illustrate the odd nature of garbage collection, try this: Change line 120 to read A$(J) = "A"—this is the same thing, of course, since CHR$(65) is the letter A. But this time the delay disappears when you run the program.

Why It Happens

When a program assigns a value to a string variable, it may do so in either of two ways. If the string exists completely within the program, it will be used "where it lies"; there's no need to make a copy. For example, a program statement such as 500 X$ = "HELLO" will use the string HELLO right out of the program where it lies. Similarly, the statements: 800 DATA COFFEE and 900 READ R$ will cause the string COFFEE to be used from within the DATA statement; it won't be moved to any other place in memory. There doesn't seem to be a name for this kind of string: I'll use the term *static string* to refer to a string used directly from its place within a program.

On the other hand, some strings can't be used this way. If I create a string with an INPUT statement or by using a string manipulation command such as STR$( ) or CHR$( ), the computer must find a place to put this newly formed string. This kind of string must be packed away into a *string storage area*. I'll use the term *dynamic string* to refer to strings of this type.

Now, let's suppose that a running program creates a dynamic string with the statement INPUT A$. The user types in the string—say, EBENEEZER—which will be packed into the string

storage area. Later, the program loops and asks for more input with INPUT A$, and the user now types in MARY. MARY, too, gets packed into the string storage area; but even though Ebeneezer is no longer needed (he's been replaced by Mary), the old string is not erased. Instead it lies dead in memory—as garbage.

Let's talk for a moment about the string storage area. It's located near the top of available BASIC memory: above the program, above the variables, and above the arrays. Dynamic strings are placed at the top of this area. As more and more strings are created, they work their way downward. Often, many discarded strings will be left behind—Ebeneezer and his friends—yet no attempt is made to reclaim the wasted space.

This type of thing continues until the dynamic strings bump into the top of BASIC, variables, and arrays. At that time, the waste space must be cleaned up; hence, "garbage collection."

Bad Timing

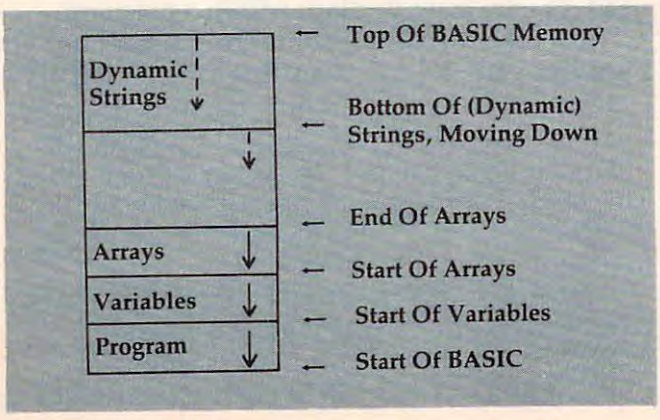
Garbage collection can take up a lot of time; more about this in a moment. Worse, it's hard to predict when it will strike. It's difficult to code in a JUST A MOMENT message when you don't know when that moment will arrive.

You can force a garbage collection by using the FRE(0) function. In order to measure free memory space, the BASIC interpreter must repack the strings. But doing this may not buy you much. You'll find that doing a garbage collection saves you no time on the next one. If the illustrative program above is still in your computer, restore the original line 120 and RUN. When the program is complete—pause and all—type GOTO 140. You'll find that the second collection takes just as long as before, even though we know there's no garbage to be collected.

You may estimate garbage collection timing by using this crude rule of thumb:

G.C. Time = (Number of dimensioned strings) times (Number of dynamic strings) divided by ten; Answer is in milliseconds.

Caution: This is a very crude formula. The actual time varies from machine to machine and is also dependent on average string length. If we work out this formula in terms of the example, we'll get 800 times 800 divided by 10, giving 64,000 milliseconds or slightly over a minute. Don't worry if your machine gave you a noticeably different time. It's the principle that counts here; and anything over a few seconds is too long. We must learn how to reduce this time drastically.



Causes Of Garbage Collection

All we need to do is learn not to leave waste strings lying around; no waste space, no need for garbage collection. That's easy for me to say, but it will take another article to go into the details of how to do it.

The following rules hint at the details that I'll give in the second part of this article:

1. Don't move strings around. It's tempting to move strings when your program is doing a sorting job. Don't do it; instead of moving strings, move an "index" array.

2. If you transfer strings into and out of computer memory in "blocks," set the unused strings to "null"; for example, A$(X) = " ". When your strings are at a minimum—just before reading in the next block—force a quick collection with FRE(0).

3. Identify the garbage-making areas of your program. The most common is a GET or GET# loop which builds longer strings through concatenation. By fiddling with pointers immediately before and after such operations, you can perform a "local" garbage cleanup with great savings of time.

4. Some arrays may be changed to numeric instead of string—for example, "April 6, 1984" may be stored as numeric 19840406. Reducing strings reduces garbage collection time.

5. If all else fails: When garbage collection seems imminent, write all strings to disk and clear them from memory; force a quick collection; read all the strings back in.

Details on all this next time.

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Programming 64 Sound
Part 1

John Michael Lane

This in-depth look at sound for the 64 provides you with practical methods for controlling the 64's SID chip from BASIC. This two-part article starts off with a brief discussion of sound and music in general.

Sight and sound are two essential components of successful computer games. Though the methods used to produce visual images differ from one computer to another, it is not too hard to produce an image that looks something like what you want. When designing space games, it's really easy, because just about anything can look like a spaceship.

Producing sound, however, can be quite a different matter. How can you produce the sound of a laser gun when dealing with such unfamiliar concepts as frequency, waveforms, and envelopes? (Actually lasers don't make any noise, but you know the sound I mean.)

Without a pretty expensive test setup, it can seem impossible to produce exactly the sound you're looking for. The only recourse is trial and error. Still, if you understand a little about the physics of sound and how it relates to the sound generator you're using, you can produce creditable results.

Real Sound

Sound is produced when physical objects vibrate. Vibrations are then set in motion in the air and travel through the air as sound waves to our ears. Sound, in its purest form, has only two physical attributes, *frequency* and *amplitude*. Frequency, the number of vibrations per second, is usually measured in cycles per second, or *hertz*. The higher the frequency or *pitch* of the sound, the higher a note sounds to our ears.

We've probably never heard a tone that consisted purely of one frequency. Physical objects also create vibrations at frequencies which are multiples of a fundamental frequency. The presence and quantity of these overtones determine the tonal quality, the *color* or *timbre*, of the sound. It's this tonal quality that determines whether a noise we hear sounds like a banjo or a drum (although there are other factors which we'll get to in a minute).

Different instruments and objects produce these overtones in varying amounts. Some produce strong overtones which are even multiples of the fundamental frequency. Some produce tones which are rich in the odd multiples. There really is no limit to the variety of tonal qualities that exist in the real world.

On some organs, and on some music synthesizers, you can specify the exact amount of each overtone you want included in each sound. On the synthesizer included in the Commodore 64, this is handled through the different types of waveforms that can be selected. But how does a waveform relate to tonal quality?

Waveforms

Figure 1 shows a sine wave at the fundamental frequency (all pure tones are sine waves) and at the first overtone or second harmonic. Notice that when we add the two waveforms together, the result no longer exactly resembles a sine wave. In Figure 2 we have continued adding sine waves of

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Figure 1:
Fundamental And Sound Harmonics Combined

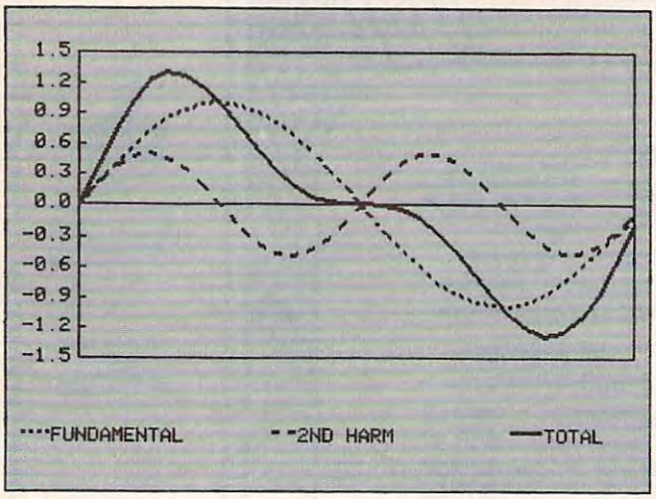
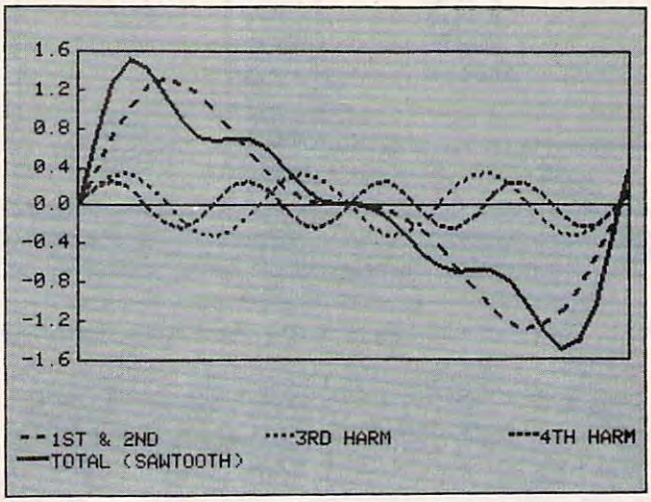


Figure 2:
Adding Third And Fourth Harmonics Brings Out Sawtooth



higher harmonics. You can see now that the resulting total waveshape is beginning to resemble a sawtooth, one of the waveforms available from the Commodore 64's Sound Interface Device (SID). If we kept adding the higher harmonics until we reached infinity, we would have a perfect sawtooth.

So the shape of the wave actually defines the harmonic content of the sound. Since all pure tones are sine waves, the shape of the wave generated by a sound synthesizer is actually assembled from sine waves that are multiples of the fundamental frequency.

The Commodore 64's SID has a choice of three basic waveforms and *white noise*, which is a collection of random frequencies. The three waveforms are a triangular wave, a rectangular pulse wave, and a sawtooth wave. The rectangular pulse wave also has a variable pulse width or *duty cycle*, which allows you additional freedom to vary the color of the sound produced. None of these waveshapes corresponds exactly to the sound produced by any instrument. It is also impossible to duplicate the complex harmonics of a real instrument simply by choosing one of these three waveforms. They do, nevertheless, give you the flexibility to produce a wide variety of color content, and you can get close to the particular sound you're seeking.

The harmonic content of the triangular wave diminishes very quickly, and the color of the wave consists almost entirely of the fundamental frequency. The sawtooth wave is the richest in terms of harmonics and the square wave falls in between. However, since the pulse width of the pulse wave can be varied, it can also contain a great variety of harmonic content.

Sound Envelopes

Earlier we said that sound consists of two qualities, frequency and amplitude. We've discussed primary frequency and how harmonic overtones are defined by the shape of the wave, but what about amplitude or loudness?

We don't mean how loud the sound is simply in the sense of volume, but rather how quickly the sound rises to its full strength and how quickly it dies down again to silence.

If you play an organ, you know that the sound of a note almost immediately reaches its full strength after you press the key and just as quickly dies down when you release the key. To our ears, it's just about instantaneous.

This is quite different from plucking a guitar string, where the sound quickly (but not quite instantaneously) reaches its full height and then slowly dies down, so that the tone continues several seconds after the note was struck. Violins, xylophones, banjos, and woodwinds all are different in the way that the sound rises, is sustained, and then dies down. Generally, these qualities are referred to as the *envelope* of the sound.

Figure 3: Waveform Shapes

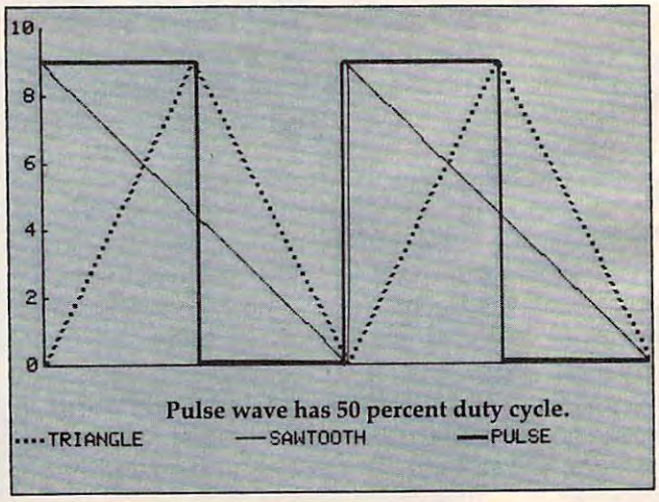
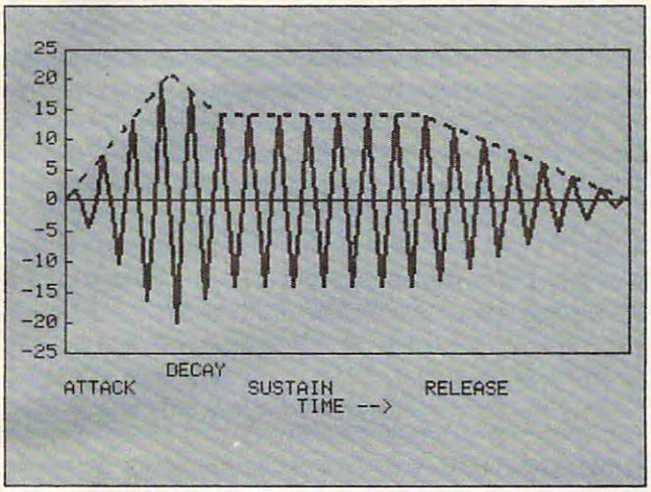


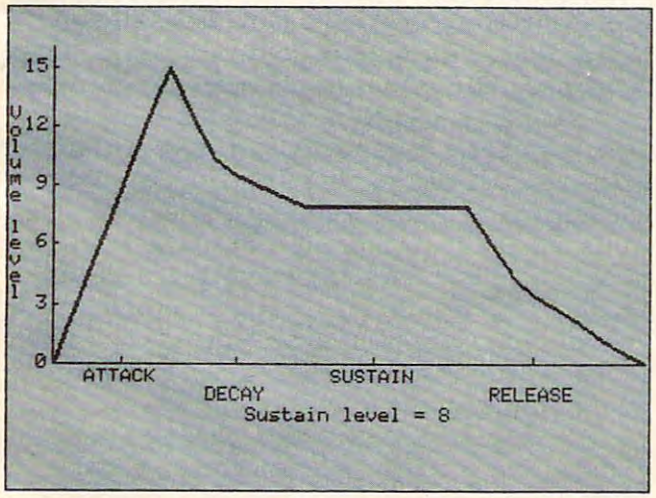
Figure 4:
The Envelope Defines The Height Of Individual Waveforms



If you look at Figure 4, you will see how a sound looks if you could feed it into an oscilloscope. We can see the shape of the wave. The shape of the envelope defines the characteristics of a sound in a manner very similar to the way that harmonic content defines a sound.

The Commodore 64 uses a four-part sound envelope (see Figure 5). The first phase, called the attack, is the length of time it takes for the sound to reach its full volume. The second phase is the decay. During this phase, the sound decreases from the peak achieved during the attack phase to the level set for the sustain phase. During the third or sustain phase, the volume remains constant. In the final phase, the release, the volume decreases to zero.

Figure 5:
Attack/Decay/Sustain/Release Envelope



Not all sounds have this four-part volume envelope. Some have only an attack and release phase, and some (like the organ) have only the sustain phase. We can achieve all these on the Commodore 64 simply by setting the other phases to zero.

Table 1: ADSR Envelope Values

VALUE	ATTACK RATE	DECAY RATE	RELEASE RATE
0	2 ms	6 ms	6 ms
1	8 ms	24 ms	24 ms
2	16 ms	48 ms	48 ms
3	24 ms	72 ms	72 ms
4	38 ms	114 ms	114 ms
5	56 ms	168 ms	168 ms
6	68 ms	204 ms	204 ms
7	80 ms	240 ms	240 ms
8	100 ms	.3 sec	.3 sec
9	.25 sec	.75 sec	.75 sec
10	.5 sec	1.5 sec	1.5 sec
11	.8 sec	2.4 sec	2.4 sec
12	1 sec	3 sec	3 sec
13	3 sec	9 sec	9 sec
14	5 sec	15 sec	15 sec
15	8 sec	24 sec	24 sec

The Commodore's SID allows us to set the attack, decay, and release phases to any one of 15 values or to zero. The times that correspond to the 15 values can be seen in Table 1. The times vary from milliseconds to seconds. Please note that the table does not include times for the sustain phase. The SID allows you to set a sustain volume level, but you must control the length of the sustain by opening and closing a *gate*. That gate is bit 0 of the fourth register in the SID chip. We'll cover this in greater detail later.

To turn the sound *on* in the SID chip, you must open the *gate*. As soon as the gate is opened, the sound level begins to rise at a rate determined by the attack. Once the peak level is reached, the sound begins to decline to the level set for the sustain. The rate at which it declines is defined by the decay.

However, if the sustain level is set at 15 (the highest choice), the decay phase is essentially meaningless because the sustain level and the peak of the attack phase are the same. Thus the decay phase has nowhere to decay to.

Once the decay phase is complete, the sustain cycle will continue as long as the gate is open. Once the gate is closed, the release phase begins and the volume falls from the level set for the sustain phase to zero. So, how long is the sustain phase?

Obviously, the sustain phase lasts as long as the time that the gate is open minus the time required for the attack and decay phases. If you close the gate too soon, you may have no sustain phase at all. If you close it really early, you'll cut short your decay or attack and decay phases as

Figure 6: Standard Four-Part Envelope

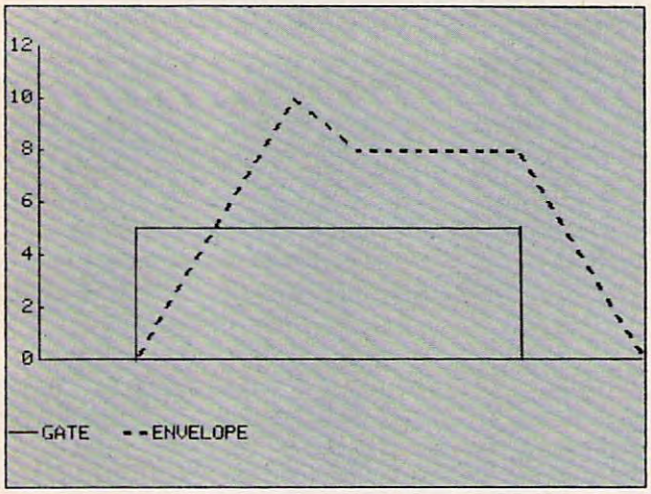


Figure 6a: Organ-like Envelope

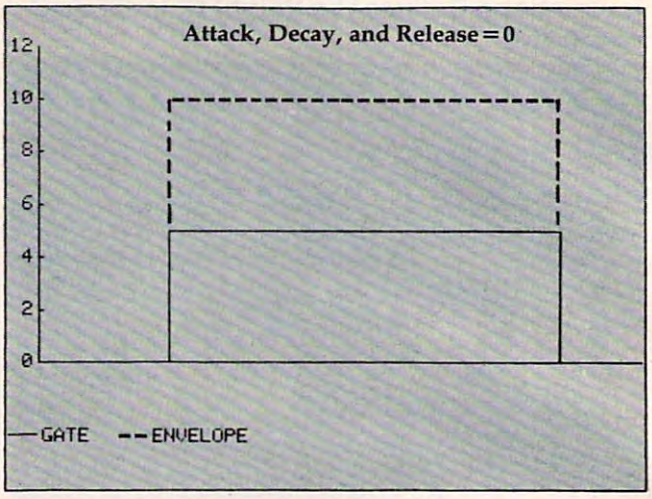


Figure 6b: Piano-like Envelope

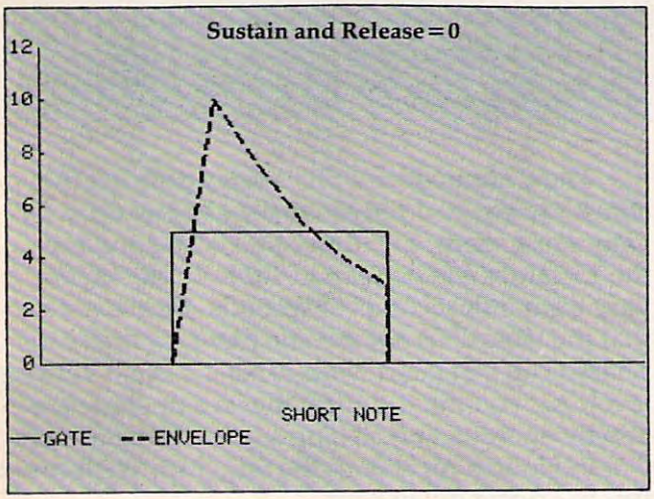
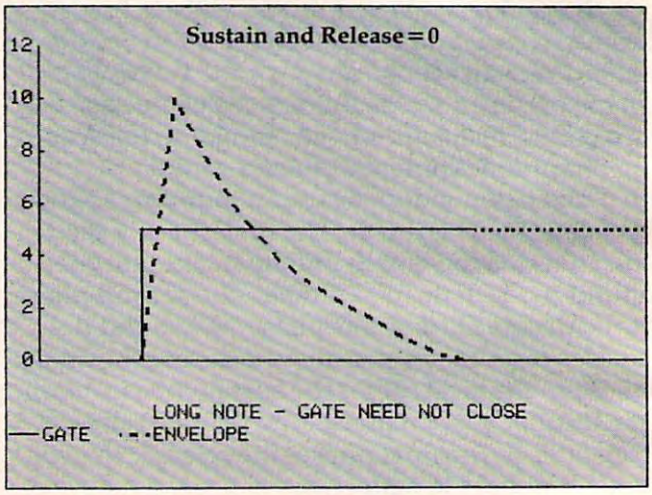


Figure 6c: Piano-like Envelope



well. Figure 6 shows several combinations of attack, decay, and release values and how they interact with the gate to produce the sound envelope.

Programming Sound

The SID is really a quite amazing chip. It takes just 29 registers in your computer's memory, and with those 29 registers (actually you won't even use them all) you can produce a great variety of sounds. We'll call them *registers*, but they're actually a row of 29 bytes of memory.

For our purposes, we'll consider only the first 21 registers in the SID chip. We'll also briefly consider the twenty-fifth register, which sets the volume (no volume, no sound).

The first 21 registers break down into three groups of seven. That's because the SID has three voices, and the seven register groups perform almost the same function for all three voices. That makes it far easier—all we have to learn is how to program seven registers.

Table 2 gives the functions of the seven register groups. Registers 0 and 1 hold the frequency. Register 0 contains the least significant byte, and register 1 the most significant byte. With two registers you can record only numbers less than 65512. That sounds pretty high, but the frequency contained in the two registers relates to the internal oscillator (clock) of the Commodore 64 and does not translate to the frequency we are familiar with in terms of cycles per second (hertz). To translate into hertz, you must multiply the frequency contained in the two registers by .059605. This means that the highest frequency the SID can produce is 3904 hertz. The frequency can go as low as zero, but the sound system in your TV set probably won't reproduce a frequency of less than 50 hertz (or 840 to the SID).

The easy way to load the frequency into the two registers is to use this program segment:

```
100 S=54272 :REM (STARTING ADDRESS OF SID
    CHIP)
110 F0=FR/.059605:REM FR=FREQUENCY IN CYC
    LES/SECOND
120 F2=INT(F0/256):F1=F0-256*F2
130 POKE S,F1:POKE S+1,F2
```

If you already know the frequency in terms

Table 2:
Map Of Sound Interface Device (SID) Registers

```
ADDRESS  REG #   BIT 7   BIT 6   BIT 5   BIT 4   BIT 3   BIT 2   BIT 1   BIT 0
=================================================================================
                              VOICE ONE
FREQUENCY REGISTERS
54272     0      [<------        FREQUENCY     LOW ORDER BYTE            ------>]
54273     1      [<------       FREQUENCY     HIGH ORDER BYTE            ------>]
PULSE WIDTH REGISTERS
54274     2      [<------       PULSE WIDTH     LOW ORDER BYTE           ------>]
54275     3      [<------BITS 7-4 NOT USED---->][ HIGHEST 4 BITS OF PULSE WIDTH]
CONTROL REGISTER
54276     4      [NOISE][PULSE ][SAWTH.][TRIANG][ TEST ][ RING ][ SYNC ][ GATE ]
ATTACK/DECAY REGISTER
54277     5      [<----   ATTACK VALUE    ---->][<---     DECAY VALUE       --->]
SUSTAIN/RELEASE REGISTER
54278     6      [<----   SUSTAIN LEVEL   ---->][<---    RELEASE VALUE      --->]

                              VOICE TWO
FREQUENCY REGISTERS
54279     7      [<------        FREQUENCY     LOW ORDER BYTE            ------>]
54280     8      [<------       FREQUENCY     HIGH ORDER BYTE            ------>]
PULSE WIDTH REGISTERS
54281     9      [<------       PULSE WIDTH     LOW ORDER BYTE           ------>]
54282     10     [<------BITS 7-4 NOT USED---->][ HIGHEST 4 BITS OF PULSE WIDTH]
CONTROL REGISTER
54283     11     [NOISE][PULSE ][SAWTH.][TRIANG][ TEST ][ RING ][ SYNC ][ GATE ]
ATTACK/DECAY REGISTER
54284     12     [<----   ATTACK VALUE    ---->][<---     DECAY VALUE       --->]
SUSTAIN/RELEASE REGISTER
54285     13     [<----   SUSTAIN LEVEL   ---->][<---    RELEASE VALUE      --->]

                              VOICE THREE
FREQUENCY REGISTERS
54286     14     [<------        FREQUENCY     LOW ORDER BYTE            ------>]
54287     15     [<------       FREQUENCY     HIGH ORDER BYTE            ------>]
PULSE WIDTH REGISTERS
54288     16     [<------       PULSE WIDTH     LOW ORDER BYTE           ------>]
54289     17     [<------BITS 7-4 NOT USED---->][ HIGHEST 4 BITS OF PULSE WIDTH]
CONTROL REGISTER
54290     18     [NOISE][PULSE ][SAWTH.][TRIANG][ TEST ][ RING ][ SYNC ][ GATE ]
ATTACK/DECAY REGISTER
54291     19     [<----   ATTACK VALUE    ---->][<---     DECAY VALUE       --->]
SUSTAIN/RELEASE REGISTER
54292     20     [<----   SUSTAIN LEVEL   ---->][<---    RELEASE VALUE      --->]

VOLUME REGISTER
54296     24     [-NOT COVERED IN THIS ARTICLE-][<----  VOLUME CONTROL    ---->]
```

of the SID chip, you can omit line 110.

The next two registers contain the pulse width of the rectangular pulse wave. This value is a 12-bit number with the eight least significant bits stored in register 2, and the four most significant stored in bits 3–0 of register 3. The four remaining bits of register 3 are not used. If you are using something other than a rectangular pulse wave, you don't have to worry about these two registers.

The pulse width can take a value from 0 to 4095, which corresponds to a range of 0 to 100 percent for the duty cycle. A value of 2048 implies a 50 percent duty cycle and generates a square wave. If these two registers are set to zero and the rectangular pulse wave is selected, no sound will be produced.

The following program segment can be used to set the pulse width.

```
140 P0=DC*4095/100:REM DC=DUTY CYCLE IN %
150 P2=INT(P0/256):P1=P0-256*P2
160 POKE S+2,P1:POKE S+3,P2
```

We should add here that a duty cycle of 10 percent will sound exactly the same as a duty cycle of 90 percent. For some advanced applications the two may sound different, but for a solitary rectangular pulse wave voice, there will be no difference.

Next month we'll get into more complicated music programming. ©

Apple Input And Menu Screens

Dan Jordan

The screen formatting and menu display techniques demonstrated here will make your Apple programs easier to use.

Menus and formatted screens are two excellent ways to make programs more user-friendly. The two programs included here are simple examples of these techniques.

The "Menu Screen" routine (Program 1) generates a menu and uses a selection bar to help the user choose program functions. To create the illusion of movement by the selection bar, lines 370–390 blot out the existing bar, and lines 310–340 place a new bar on the next line.

The "Input Screen" routine (Program 2) prints a form on the screen and indicates, by the length of the inverse blank field, the amount of data to be entered. A subroutine can be added to check for field length, if desired. The correction routine (lines 500–570) lets you correct a data section without affecting any other part of the program.

PRINT CHR$(7) rings a bell, prompting the user to answer a question printed on the screen.

Using GET rather than INPUT saves keystrokes in answering these screen prompts (the RETURN key need not be hit to enter data that is input with a GET).

Program 1: Menu Screen Routine

```
170  CLEAR
190  HOME
200  PRINT "********* MENU ***********"
210  PRINT "1-STEP NUMBER 1"
220  PRINT "2-STEP NUMBER 2"
230  PRINT "3-STEP NUMBER 3"
240  PRINT "4-STEP NUMBER 4"
250  PRINT "5-STEP NUMBER 5"
260  PRINT "6-STEP NUMBER 6"
270  PRINT : PRINT
280  PRINT "HIT (RETURN) TO SELECT --OR
     --"
290  PRINT "HIT ANY OTHER KEY TO CHANGE
      SELECTION"
300 I = 2
310  VTAB I
315  HTAB 17
320  INVERSE
330  PRINT "      ";
340  NORMAL
350  GET X$
360  IF X$ =  CHR$ (13) THEN Y = I - 1:
      GOTO 490
370  VTAB I
380  HTAB 17
390  PRINT "      "
400 I = I + 1
410  IF I >  = 8 THEN I = 2
420  GOTO 310
490  VTAB 14
500  ON Y GOTO 1000,2000,3000,4000,5000
     ,6000
1000  REM STEP NO.1 PROCEDURES
1010  PRINT "STEP NO. 1"
1020  GOTO 7000
2000  REM STEP NO.2 PROCEDURES
2010  PRINT "STEP NO. 2"
2020  GOTO 7000
3000  REM STEP NO.3 PROCEDURES
3010  PRINT "STEP NO. 3"
3020  GOTO 7000
4000  REM STEP NO.4 PROCEDURES
4010  PRINT "STEP NO. 4"
4020  GOTO 7000
5000  REM STEP NO.4 PROCEDURES
5010  PRINT "STEP NO. 5"
5020  GOTO 7000
6000  REM STEP NO.6 PROCEDURES
6010  PRINT "STEP NO. 6"
6020  GOTO 7000
7000  END
```

Program 2: Input Screen Routine

```
180  CLEAR
190  DIM A$(5,100)
200  HOME
210  PRINT "*****NAME & ADDRESS INPUT *
     ****"
220  PRINT "1-NAME----------"
230  PRINT "2-ADDRESS LINE 1"
240  PRINT "3-ADDRESS LINE 2"
250  PRINT "4-CITY STATE ZIP"
260  PRINT "5-TELEPHONE NO.-"
270  FOR I = 2 TO 6
280  VTAB I
290  HTAB 17
300  INVERSE
310  PRINT "                    "
320  NORMAL
330  NEXT I
335 X = 1
340  FOR I = 2 TO 6
345  VTAB I: HTAB 17
350  INPUT A$(I - 1,X)
360  NEXT I
370  PRINT : PRINT  CHR$ (7)
380  PRINT "DO YOU WISH TO MAKE A CORRE
     CTION (Y OR N)?";
390  GET X$
400  IF X$ = "Y" THEN  GOTO 500
410  IF X$ = "N" THEN  GOTO 450
420  VTAB 7: GOTO 370
450  PRINT  CHR$ (7);
460  PRINT "DO YOU HAVE ANY MORE TO ENT
     ER (Y OR N)?";
470  GET X$
480  IF X$ = "N" THEN  GOTO 1000
485  IF X$ = "Y" THEN X = X + 1: GOTO 2
     00
490  VTAB 8: GOTO 450
500  PRINT  CHR$ (7);
510  PRINT "ENTER LINE NUMBER YOU WISH
     TO CORRECT";
520  GET Y
530 Y = Y + 1
540  VTAB Y
550  HTAB 17
560  INPUT A$(Y - 1,X)
570  VTAB 7
580  GOTO 370
1000  REM  PRINT OR SAVE TO DISK
1010  END
```

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.

Braces And Special Characters

The exception to this typing rule is when you see the braces, such as DOWN}. Anything within a set of braces is a special character or characters that cannot easily be listed in 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 braces 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, {5■} 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.

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'll 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:

VIC And 64

When You Read:	Press:		See:
{CLR}	SHIFT	CLR/HOME	
{HOME}		CLR/HOME	
{UP}	SHIFT	↑ CRSR ↑	
{DOWN}		↑ CRSR ↑	
{LEFT}	SHIFT	← CRSR ←	
{RIGHT}		← CRSR ←	
{RVS}	CTRL	9	
{OFF}	CTRL	0	
{BLK}	CTRL	1	
{WHT}	CTRL	2	
{RED}	CTRL	3	
{CYN}	CTRL	4	
{PUR}	CTRL	5	

When You Read:	Press:		See:
{GRN}	CTRL	6	
{BLU}	CTRL	7	
{YEL}	CTRL	8	
{F1}	f1		
{F2}	f2		
{F3}	f3		
{F4}	f4		
{F5}	f5		
{F6}	f6		
{F7}	f7		
{F8}	f8		
←	←		
↑	SHIFT	↑	

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}
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Apple II / Apple II Plus

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

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.

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CAPUTE!

Modifications Or Corrections To Previous Articles

VIC Worm Of Bemer

The listing for the VIC version of this game from the April issue (p. 74) contains Commodore 64 color codes which are not available on the VIC. These cause no serious problems, but the [<6>] or [<8>] character should be omitted in lines 7715, 7730, and 10000.

Super Directory For 64 And IBM

Commodore 64 users have found that using "Super Directory" (Program 1, p. 173) from the April issue to load and run programs can cause problems if the program selected uses the BASIC function RND. An overflow error will be encountered because Super Directory alters a memory location used in calculating random numbers. Brian T. Bennett has discovered that the problem can be solved by changing line 1150 to:

```
1150 POKE 139,128:GOTO 5000
```

The IBM version (Program 4, p. 176) cannot be used to load and run programs from a disk with the write-protect notch covered. This is due to the way DOS handles the Write-Protect Error. Note also that the program as presented will work only with DOS 2.0 or 2.1.

TI Mozart Machine

Music aficionados may have detected a sour note in the tunes played by the TI version of this program from the January issue (Program 4, p. 168). The solution is to change the next to the last DATA element in line 480 from 287 to 587. Thanks to Kevin M. Norberg for this correction.

Atari Roader Improvements

Mike La Fave offers the following revision to this game from the March issue (Program 3, p. 70) to allow you to steer your racer with a joystick instead of the keyboard:

```
220 P=STICK(0):IF P=11 THEN N=N-1:GOTO
    240
230 IF P=7 THEN N=N+1
```

Also, Keith Christleib suggests the following additions to include an engine sound as the car speeds down the track:

```
201 SOUND 3,135,2,9
315 SOUND 3,0,0,0
```

64Key Relocated

Reader Mike Levesque notes that the "64Key" program from the February issue (p. 160) uses the same area of memory as the DOS Wedge program supplied with the 1541 demo disk. To use these two valuable utilities together, he suggests changing the following lines:

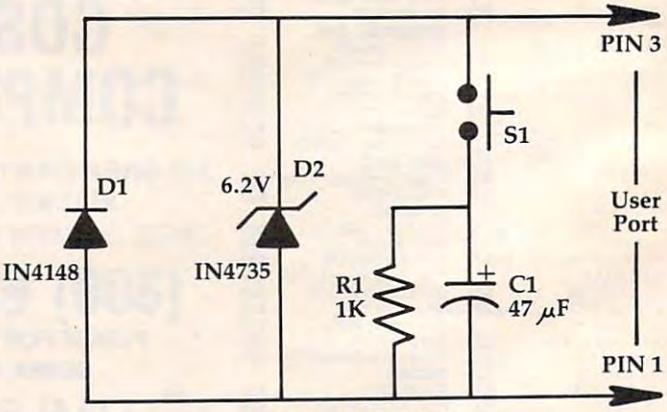
```
20 FOR I=51789 TO 51967
50 IF X<>23734 THEN PRINT "THERE IS AN
   ERROR IN YOUR DATA STATEMENTS":END
60 PRINT"SYS 51789 TO ACTIVATE":END
```

Next, change the DATA element 205 to 202 in the following lines: 100, 120, 130, 140, 150, 190, 220, 300, and 320. Finally, remove the ,0 from the end of line 430 and delete line 440. These changes relocate 64Key to the area immediately above the Wedge, allowing the two to coexist in harmony and still leaving locations 49152–51788 free for other uses.

64 Explorer RESET Switch

Columnist Larry Isaacs recommends a revision of RESET switch circuit for the 64 featured in his March column (p. 172). Larry based his design on the schematic diagram of the 64 included in the *Programmer's Reference Guide*. However, the actual circuitry in the 64 has since been slightly modified and, as a result, it is no longer safe to ground the RESET line directly. Although Larry has used his switch for several months without incident, it presents some risk of damaging the chips inside the computer, and you should consider this before attempting to use the switch on your computer.

As an alternative, Lester Iwamasa of Custom Concepts, who pointed out the danger of using the original circuit, has provided the following circuit which performs a RESET without the possibility of damage to the computer:



64 RESET SWITCH

If you're not up to building this circuit yourself, you can obtain it for $21.95, plus $2.00 shipping, from:

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The Automatic Proofreader
For VIC, 64, And Atari

Charles Brannon, Program Editor

At last there's a way for your computer to help you check your typing. "The Automatic Proofreader" will make entering programs faster, easier, and more accurate.

The strong point of computers is that they excel at tedious, exacting tasks. So why not get your computer to check your typing for you?

With "The Automatic Proofreader" nestled in your VIC-20, Commodore 64, or Atari computer, every line you type in will be verified. It displays a special code, called a *checksum*, at the top of the screen. The checksum, either a number (VIC/64) or a pair of letters (Atari), corresponds to the line you've just typed. It represents every character in the line summed together. A matching code in the program listing lets you compare it to the checksum which the Proofreader displays. A glance is all it takes to confirm that you've typed the line correctly.

Entering The Automatic Proofreader

Commodore (VIC/64) owners should type in Program 1. Program 2 is for Atari users. Since the Proofreader is a machine language program, be especially diligent. Watch out for typing extra commas, or a letter O for a zero, and check every number carefully. If you make a mistake when typing in the DATA statements, you'll get the message "Error in DATA statements" when you RUN the program. Check your typing and try again.

When you've typed in The Automatic Proofreader, SAVE it to tape or disk at least twice *before running it for the first time.* If you mistype the Proofreader, it may cause a system crash when you first run it. By SAVEing a copy beforehand, you can reLOAD it and hunt for your error. Also, you'll want a backup copy of the Proofreader because you'll use it again and again—every time you enter a program from COMPUTE!.

When you RUN the Proofreader, the program will be POKEd safely into memory, then it will activate itself. If you ever need to reactivate it (RUN/STOP—RESTORE or SYSTEM RESET will disable it), just enter the command SYS 886 (VIC/64) or PRINT USR(1536) for the Atari.

Using The Proofreader

Now, let's see how it works. LIST the Proofreader program, move the cursor up to one of the lines, and press RETURN. If you've entered the Proofreader correctly, a checksum will appear in the top-left corner of your screen.

Try making a change in the line and hit RETURN. Notice that the checksum has changed. All VIC and 64 listings in COMPUTE! now have a number appended to the end of each line, for example, :rem 123. *Don't enter this statement.* It is just for your information. The rem is used to make the number harmless if someone does type it in. It will, however, use up memory if you enter it, and it will cause the checksum displayed at the top of the screen to be different, even if you entered the rest of the line correctly.

The Atari checksum is found immediately to the left of each line number. This makes it impossible to type in the checksum accidentally, since a program line must start with a number.

Just type in each line (without the printed checksum), and check the checksum displayed at the top of the screen against the checksum in the listing. If they match, go on to the next line. If they don't, there's a mistake. You can correct the line immediately, instead of waiting to find the error when you RUN the program.

The Proofreader is not picky with spaces. It will not notice extra spaces or missing ones. This is for your convenience, since spacing is generally not important. Occasionally proper spacing is important, but the article describing the program will warn you to be careful in these cases.

Nobody's Perfect

Although the Proofreader is an important aid, there are a few things to watch out for. If you enter a line by using abbreviations for commands, the checksum will not match up. This is because the Proofreader is very literal: It looks at the individual letters in a line, not at tokens such as PRINT. There is a way to make the Proofreader check such a line. After entering the line, LIST it. This makes the computer spell out the abbreviations. Then move the cursor up to the line and press RETURN. It should now match the checksum. You can check whole groups of lines this way. Atari users should beware of using ? as an abbreviation for PRINT—they're not the same thing in the Proofreader's eyes.

The checksum is a sum of the ASCII values of the characters in a line. VIC and 64 owners may wonder why the numbers are so small, never exceeding 255. This is because the addition is done only in eight bits. A result over 255 will roll over past zero, like an odometer past 99999. On the Atari, the number is turned into two letters, both for increased convenience and to make the Proofreader shorter. For the curious, the letters correspond to the values of the left and right nybbles added to 33 (to offset them into the alphabet). This number is then stored directly into screen memory.

Due to the nature of a checksum, the Proofreader will not catch all errors. Since $1+3+5=3+1+5$, the Proofreader cannot catch errors of transposition. In fact, you could type in the line in any order, and the Proofreader wouldn't notice. Anytime the Proofreader

seems to act strange, keep this in mind. Since the ASCII values of the number 18 (49+56) and 63 (54+51) both equal 105, these numbers are equal according to the Proofreader. There really is no simple way to catch these kinds of errors. Fortunately, the Proofreader will catch the majority of the typing mistakes most people make.

If you want the Proofreader out of your way, just press SYSTEM RESET or RUN/STOP—RESTORE. If you need it again, enter SYS 828 (VIC/64) or PRINT USR(1536) (Atari). You must disable the Proofreader before doing any tape operations on the VIC or 64.

Hidden Perils

The Proofreader's home in the VIC and 64 is not a very safe haven. Since the cassette buffer is wiped out during tape operations, you need to disable the Proofreader with RUN/STOP—RESTORE before you SAVE your program. This applies only to tape use. Disk users or Atari owners have nothing to worry about.

Not so for VIC and 64 owners with tape drives. What if you type in a program in several sittings? The next day, you come to your computer, LOAD and RUN the Proofreader, then try to LOAD the partially completed program so you can add to it. But since the Proofreader is trying to hide in the cassette buffer, it is wiped out!

What you need is a way to LOAD the Proofreader after you've LOADed the partial program. The problem is, a tape load to the buffer destroys what it's supposed to load.

After you've typed in and RUN the Proofreader, enter the following lines in direct mode (without line numbers) *exactly* as shown:

```
A$="PROOFREADER.T": B$="{10 SPACES}": FOR
   X = 1 TO 4: A$=A$+B$: NEXTX

FOR X = 886 TO 1018: A$=A$+CHR$(PEEK(X)):
   NEXTX

OPEN 1,1,1,A$:CLOSE1
```

After you enter the last line, you will be asked to press record and play on your cassette recorder. Put this program at the beginning of a new tape. This gives you a new way to load the Proofreader. Anytime you want to bring the Proofreader into memory without disturbing anything else, put the cassette in the tape drive, rewind, and enter:

OPEN1:CLOSE1

You can now start the Proofreader by typing SYS 886. To test this, PRINT PEEK(886) should return the number 173. If it does not, repeat the steps above, making sure that A$ ("PROOFREADER.T") contains 13 characters and that B$ contains 10 spaces.

You can now reload the Proofreader into memory whenever LOAD or SAVE destroys it, restoring your personal typing helper.

Incidentally, you can protect the cassette buffer on the Commodore 64 with POKE 178,165. This POKE should work on the VIC, but it has caused numerous problems, probably due to a bug in the VIC operating system. With this POKE, the 64 will not wipe out the cassette buffer during tape LOADs and SAVEs.

Program 1: VIC/64 Proofreader

```
100 PRINT"{CLR}PLEASE WAIT...":FORI=886TO
    1018:READA:CK=CK+A:POKEI,A:NEXT
110 IF CK<>17539 THEN PRINT"{DOWN}YOU MAD
    E AN ERROR":PRINT"IN DATA STATEMENTS.
    ":END
120 SYS886:PRINT"{CLR}{2 DOWN}PROOFREADER
     ACTIVATED.":NEW
886 DATA 173,036,003,201,150,208
892 DATA 001,096,141,151,003,173
898 DATA 037,003,141,152,003,169
904 DATA 150,141,036,003,169,003
910 DATA 141,037,003,169,000,133
916 DATA 254,096,032,087,241,133
922 DATA 251,134,252,132,253,008
928 DATA 201,013,240,017,201,032
934 DATA 240,005,024,101,254,133
940 DATA 254,165,251,166,252,164
946 DATA 253,040,096,169,013,032
952 DATA 210,255,165,214,141,251
958 DATA 003,206,251,003,169,000
964 DATA 133,216,169,019,032,210
970 DATA 255,169,018,032,210,255
976 DATA 169,058,032,210,255,166
982 DATA 254,169,000,133,254,172
988 DATA 151,003,192,087,208,006
994 DATA 032,205,189,076,235,003
1000 DATA 032,205,221,169,032,032
1006 DATA 210,255,032,210,255,173
1012 DATA 251,003,133,214,076,173
1018 DATA 003
```

Program 2: Atari Proofreader

```
100 GRAPHICS 0
110 FOR I=1536 TO 1700:READ A:POKE I
    ,A:CK=CK+A:NEXT I
120 IF CK<>19072 THEN ? "Error in DA
    TA statements. Check typing":END

130 A=USR(1536)
140 ? :? "Automatic Proofreader now
    activated."
150 END
1536 DATA 104,160,0,185,26,3
1542 DATA 201,69,240,7,200,200
1548 DATA 192,34,208,243,96,200
1554 DATA 169,74,153,26,3,200
1560 DATA 169,6,153,26,3,162
1566 DATA 0,189,0,228,157,74
1572 DATA 6,232,224,16,208,245
1578 DATA 169,93,141,78,6,169
1584 DATA 6,141,79,6,24,173
1590 DATA 4,228,105,1,141,95
1596 DATA 6,173,5,228,105,0
1602 DATA 141,96,6,169,0,133
1608 DATA 203,96,247,238,125,241
1614 DATA 93,6,244,241,115,241
1620 DATA 124,241,76,205,238,0
1626 DATA 0,0,0,0,32,62
1632 DATA 246,8,201,155,240,13
1638 DATA 201,32,240,7,72,24
1644 DATA 101,203,133,203,104,40
1650 DATA 96,72,152,72,138,72
1656 DATA 160,0,169,128,145,88
1662 DATA 200,192,40,208,249,165
1668 DATA 203,74,74,74,74,24
1674 DATA 105,161,160,3,145,88
1680 DATA 165,203,41,15,24,105
1686 DATA 161,200,145,88,169,0
1692 DATA 133,203,104,170,104,168
1698 DATA 104,40,96
```

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NEWS & PRODUCTS

64 Data Base

ABS Software has announced *Compufile*, a relative data base for the Commodore 64.

Compufile has 20 user-defined fields, user-defined reports, multiple levels of search and sort abilities, and a user-changeable format. Multiple data bases can be stored on a single disk. The system will automatically correct many error conditions, and can deliver records in sequential file form so they can be accessed by word processors.

The program is menu-driven, and runs in machine language. A directory of all data bases contained on a disk is automatically displayed on the screen at the start. More than 50 pages of documentation are available, and templates are included to aid in creating general interest data bases.

Compufile sells for $39.95 on disk.

ABS(olute) Software
1780 Austin Highway
San Antonio, TX 78218
(512) 826-9698

Apple Time Management System

Creative Peripherals Unlimited, Inc., has announced *Time-Trax, The Time Management System* for the Apple II, II+, and IIe computers.

The system is a time- and date-oriented appointment and scheduling program which plugs into the computer's game port and provides another port for game paddles. It is powered by the computer when turned on and by two AA batteries (not included) when the computer is off.

Up to 311 entries can be made in a single month, and up to 99 entries can be included on a single day. Important entries can be flagged. Annual entries can be made that will appear every year on the scheduled day and time, such as birthdays, policy renewals, and anniversaries. The program has search features, and will allow printouts of information.

Time-Trax is available for $99.95.

C.P.U., Inc.
1606 S. Clementine
Anaheim, CA 92802
(800) 854-8021 nationwide
(800) 432-7268 California

Atari Keyboard Graphics Labels

Graph-Fix, a set of 29 graphics labels for Atari keyboards, is available from Dovestar Creative Concepts.

The Mylar-coated labels are applied to the front face of each graphics key and fit all Atari models. They are intended to

simplify graphics programming by making control key graphics functions more identifiable.

Graph-Fix is available for $5.95.

Dovestar Creative Concepts
P.O. Box 2109
Dept. 9N
Nederland, TX 77627
(409) 727-5978

Versatile Print Package For Apple

Brøderbund Software has introduced *The Print Shop*, a disk-based software package that enables you to write, design, and print greeting cards, stationery, letterheads, signs, and even banners.

The menu-driven program requires an Apple II+ or Apple IIe with at least 48K memory. *The Print Shop* supports many popular printers, including the Epson, Apple Dot Matrix, Imagewriter, and C. Itoh Prowriter.

Messages can be written in one of eight different type styles available in two sizes, and in solid, outline, and three-dimensional formats. There are nine border designs, ten abstract patterns, and dozens of pictures and symbols to use.

There is a built-in graphics editor with which you can create your own designs. With only one pass through a printer, *The Print Shop* will produce a greeting card with inside and outside messages. The program will let you print out your writing with proportional spacing. Custom letterheads with personalized logos, full-page signs with graphics, banners of unlimited length with extra-large letters—all are available with the package.

The Print Shop comes with an assortment of pin-feed paper and matching envelopes in various colors, and has a suggested retail price of $49.95. Paper refills are available for $14.95.

Brøderbund Software
17 Paul Drive
San Rafael, CA 94903
(415) 479-1170

Software Buyers' Guide

The fourth edition of the *Software Express*, a 320-page guide with more than 800 programs for Apple, Atari, Commodore 64, VIC-20, and IBM PC and PCjr computers, is available from SKU, Inc.

The guide includes listings and descriptions of the best-selling and highest-rated software. The new edition has a section on computer peripherals and accessories, a glossary of 100 computer and data processing terms, manufacturer coupons worth $100 in discounts, and six tutorial articles on what to look for when buying software.

Software Express, published quarterly, is available for $9.95 per copy and on a subscription basis for $18.95 a year.

SKU, Inc.
2600 Tenth Street
Berkeley, CA 94710
(415) 848-0802

Educational Software For Atari, Commodore

Gladstone Electronics, Inc., has released *"Diskovery" Reading Words*, four software packages designed to help children increase their learning rate and improve school work, and two programs that help develop math skills.

The Alphabet Factory and *Match-Up* are designed for children from three to eight years old. *The Word Bird* and *Time Zone* are offered for children from six to twelve years old. The series of programs uses animated graphics, color, and sound to help motivate students in learning to read. An arcade-game format is used in each.

Adding Machine and *Take-Away Zoo* are the two math skill development packages.

Each of the programs is available on disk for $29.95 for Com-

modore 64 and Atari 400 and 800 computers.

Gladstone Electronics, Inc.
1585 Kenmore Avenue
Buffalo, NY 14217
(716) 874-5510

TI-99/4A Cartridge Expander

Navarone Industries produces the Cartridge Expander, which plugs into the game port of the TI-99/4A and allows up to three cartridges to be plugged in at one time.

The expander also contains a built-in reset button and a select switch that lets you change from one cartridge to another without plugging and unplugging cartridges.

The Cartridge Expander is available for $39.95.

Navarone Industries
510 Lawrence Expressway #800
Sunnyvale, CA 94086
(408) 866-8579

PCjr, Atari Audio Tutorials

Tutorials for new owners of PCjr and Atari 600XL and 800XL computers are available on audio cassette from FlipTrack Learning Systems.

How To Operate the IBM PCjr has two audio cassettes. The first cassette guides the user through start-up procedures; keyboard familiarization; simple BASIC programming; and the PCjr's color, sound, graphics, and mathematical capabilities, as well as cassette tape storage and use of a printer.

The second cassette includes information on how to manage disk storage and files with DOS. The lesson covers directory display, using tree-structured directories, checking disk storage space, and copying the formatting disks, as well as copying, renaming, and erasing files, and batch processing.

How To Operate the Atari 600XL and 800XL Home Computer is a tutorial on one audio cassette and one data cassette. The package teaches start-up procedures, keyboard familiarization, and how to take advantage of the Atari's color, sound, graphics, and mathematical capabilities. Step-by-step BASIC programming is also taught.

The tutorials use the Flip-Track cassette format, which permits the user to branch into optional special interest areas with the flip of a cassette.

The PCjr tutorial sells for $39.95, and the Atari tutorial is available for $19.95. They operate on standard cassette players.

FlipTrack Learning Systems
999 Main
Suite 200
Glen Ellyn, IL 60137
(312) 790-1117

Four Educational Games For 64, Atari

Spinnaker Software has four new educational software titles, two for the Commodore 64, one for the Atari, and one for both computers.

Grandma's House, directed toward children four to eight, is a game for the 64 and the Atari that lets youngsters create and furnish their own playhouse. The program helps children learn to design and create, and is available on disk for $34.95.

Ranch, ages five to ten, is available on cartridge for the 64. The program lets a player create and animate wild west scenes. Starting with a blank screen, the player populates it with a range of people, objects, and animals. You can copy, color, move, erase, or animate shapes. *Ranch* is

priced at $39.95.

Aegean Voyage, for ages eight to adult, has players navigate ships through the Aegean Sea, docking at islands to collect clues from the Oracles. By connecting the clues, players can find treasure. The game introduces many names from Greek mythology and emphasizes strategic thinking and deductive reasoning. The program is available for $39.95 on cartridge.

Adventure Creator, ages 12 to adult, lets players learn how to design an adventure game. Players have up to 100 rooms to fill with mazes, creatures, hazards, and treasures. The program also can have the computer design the world for the player. *Adventure Creator* is available on cartridge for the Atari computer for $39.95.

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

Atari, Apple Old West Game

Strategic Simulations, Inc., has created *Rails West*, a simulation of the Western railroad development of the late 1800s, for Apple and Atari computer systems.

Up to eight players may participate, choosing the scenario and level of play, among other options. Menus guide each player through such business decisions as buying and selling stocks and bonds, applying for loans, and floating securities. Economic conditions ranging from boom times to panics are important factors throughout the game.

Rails West is available on disk for $39.95.

Strategic Simulations, Inc.
883 Stierlin Road
Building A-200
Mountain View, CA 94043-1983
(415) 964-1353

The new Volksmodem adapter cable and software allow Atari users to access telecommunications services via a game port.

Atari Telecommunications Package

A Volksmodem adapter cable and software which will allow Atari computer users to gain access to telecommunications services via the game port are now available from Anchor Automation.

The new F Cable allows direct connection of the Volksmodem, a $79.95 telecommunications modem produced by Anchor, to the Atari 400, 600, 800, and 1200 microcomputers through game port 2 without using an Atari Model 850 Interface Unit.

The package has a suggested retail price of $39.95 and includes adapter cable with electronics, one software tape cassette, and one 6-foot telephone cable.

Anchor Automation, Inc.
6913 Valjean Avenue
Van Nuys, CA 91406
(213) 997-6493

Apple Educational Software

Letters and First Words is the latest program in the "Kids' Corner" line of software by C & C Software. The package contains three programs that help children learn to identify letters, recognize their associated sounds, and begin to spell simple words.

Animated graphics displays introduce letter recognition skills in A-B-C, the first program on the disk. The sound of the letter and both upper- and lowercase letters are shown.

Letter Sounds helps children strengthen their association of sounds with individual letters. Children pick the object that has the correct initial consonant, middle short vowel, or final consonant sound, depending on the skill level.

In the program Building Words, children learn how letters and their sounds work together to form simple words. Children progress from selecting a word to match a picture, to providing letters to complete the word. At the highest skill level, they are spelling simple words.

Letters and First Words is recommended for children in preschool through second grade. The complete package, including disk for Apple II+ or Apple IIe computers, documentation, and keyboard labels, is available for $40. Backup disks are available for $10.

C & C Software
5713 Kentford Circle
Wichita, KS 67220
(316) 683-6056

Jupiter Mission For Atari

Jupiter Mission 1999, an interactive space adventure game, has been released for Atari computers with 48K of memory and a disk drive, by Microcomputer Games, Inc., a division of The Avalon Hill Game Company.

You are aboard the *Space Beagle*, a ship sent to Jupiter to discover the source of mysterious radio signals. Once there, you encounter aliens and must uncover their secret plans.

Eleven interrelated programs on four disks make up the game, which includes arcade segments and a series of puzzles as a part of the adventure.

Jupiter Mission sells for $50.

Microcomputer Games, Inc.
4517 Harford Road
Baltimore, MD 21214
(301) 254-9200

Apple II Utilities Program

Disk O' Utilities, a programming utilities package for Apple II computers, has been introduced by Broadway Software on a DOS 3.3 disk.

Thirteen utilities are on the disk, allowing you to check the number of free sectors with every catalog, find hidden control characters in catalogs and listings, generate automatic line numbers, dump the screen to a printer, undelete files, and a variety of other programming functions.

Disk O' Utilities sells for $12.95 (add $1 for shipping and handling).

Broadway Software
642 Amsterdam Avenue
Suite 136
New York City, NY 10025
(212) 580-7508

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

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