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**In this month's  
Learning Center:**

**Guessing Game for the VIC  
and C64**

**ATARI Physics Tutorial**

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P 57: BULLETIN BOARDS  
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MONITOR

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04

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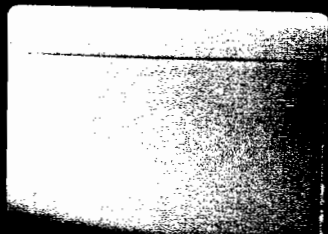
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# MICRO™

## April Highlights

**“communication** (kə-myōō'nə-kā'shən) *n.*... 1. The act of communicating; transmission.... 4. *Plural.* A means of communicating, especially: a. A system for sending and receiving messages, as by mail, telephone, or television.”

The American Heritage Dictionary may want to amend this definition to read “...by computer, mail, telephone, or television.” Certainly communication by computer offers many possibilities, limited only by our imaginations. “Eight million computer terminals will be in use in American homes by the end of this decade, many linked by information networks to businesses and other data bases,” according to J.S. Mayo of Bell Labs (see Bradley Coley’s article, “At the Front: The Micro Communications Revolution” p. 26). These terminals will be used for fun and for profit. Subscribers to information banks such as The Source and CompuServe will be able to receive electronic mail, news, weather, and sports; they will be able to teleshop *via* electronic catalogues, and get up-to-the-minute reports on the stock market. Job hunting will become more selective, bartering may return as a form of salesmanship, formal education may revert from the classroom to the home. The possibilities are infinite. Anyone who has a telephone or TV will have access to a world of information through networking.

To learn more about communications and the microprocessor, read Bradley L. Coley’s article mentioned above. He presents three theories for what will motivate the interactive and networking potential — home, office, and enterprise. Mr. Coley also discusses the home computer market, networking, and the field of “information for profit.” In “Dialing the Networks,” (pg. 38) Cliff Glennon maps out the essential steps needed for a MC6809-based home computer to communicate with The Source and CompuServe. He includes a short assembly-language program that implements some basic disk functions, and interfacing and control codes for the MC6850 ACIA. Terry

Peterson describes how to turn the Commodore SuperPET into a smart terminal for a mainframe. See “A Not-So-Dumb Terminal Program for the SuperPET” (pg. 31) for a machine-language program that uses the 6551 ACIA serial port for RS-232 I/O.

“PET-to-PET Communications” by F. Arthur Cochrane (pg. 47) provides a machine-language program to transfer an array from one PET to another *via* the user port. And “A Home-Built Communications Interface” by John Steiner (pg. 44) describes how to construct a communications interface. In-

### About the Cover

The original oil painting by Frank Wyman, *Time in Space*, creates an appropriate feeling of expansion and infinity — the feeling generated by today’s communications field.

Photo and painting by:  
Frank Wyman  
Wyman Art Studio  
Lowell, MA 01852  
(617) 459-7819

cluded is a simple, reliable, and inexpensive design for converting the interface to a telephone modem. “Multi-Microprocessed Tidbits” (pg. 50) shows you how to create a powerful device by running a 6502 and 6809 in the same computer simultaneously. Mike Rosing presents a general description of a specific task for which two processors were used, and discusses some of the problems you might encounter.

The communications section includes an article by our technical editor Phil Daley, who outlines a method MICRO is now using to communicate between the FOCUS, a 6809-based microprocessor (produced by our sister company The Computerist), and the Compugraphic Editwriter 7500. “In-House Communications” (pg. 54) is an informative tutorial that shows you how we use the FOCUS as a text editor, sending material in its final format to the Compugraphic for output.

### Business Applications

“Mutual Fund Charting for APPLE and

OSI,” by Ralph H. Green (pg. 98) enables you to make, update, and print mutual fund files on both OSI and Apple computers. The programs are written mostly in BASIC (except for a few commands peculiar to OSI) and are easily transportable to other micros. “Analysis of Bond Quotations on the APPLE,” by Donald C. Lewis (pg. 92) computes information about the performance of bonds. Data for these computations are available in the financial section of your newspaper. “LETTER-MASK: A Check-Protecting Algorithm” (pg. 102) is an Applesoft BASIC routine by Barton M. Bauers. In addition to number masking, this routine gives your checks additional security by spelling out the amount.

### Learning Center

Our new Learning Center opens the classroom door to discussions of momentum, number conversion, and programming concepts about flags and random numbers. “Conservation of Momentum for ATARI and COMMODORE” by Jerry Faughn (pg. 84) helps the beginning computerist examine the conservation law of momentum as applied to collision problems. “Is a Number a Number?” by Phil Daley (pg. 86) shows you how answers are affected by the base of the numbering system you use. “MASTER for VIC-20 and COMMODORE 64” by Loren Wright (pg. 70) is a simple guessing game for one or two players, based on the popular commercial game, and teaches you about flags and random numbers.

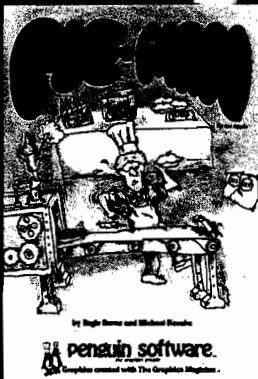
### And...

Of particular interest this month is the Information Sheet (pg. 57), which includes a list of Bulletin Boards throughout the US and elsewhere. A note of interest here: We received this list from a California data bank *via* a telephone modem connected to the FOCUS.

We hope you find the April issue of MICRO informative. Read, learn, and communicate!

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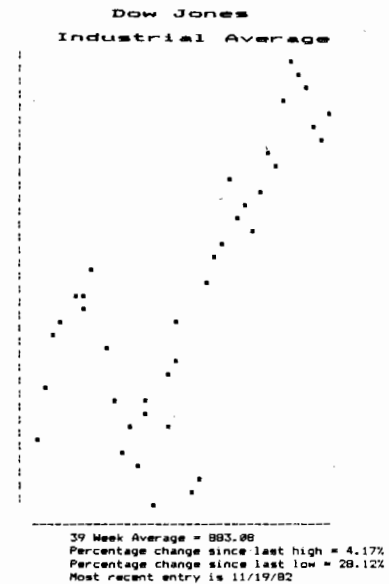
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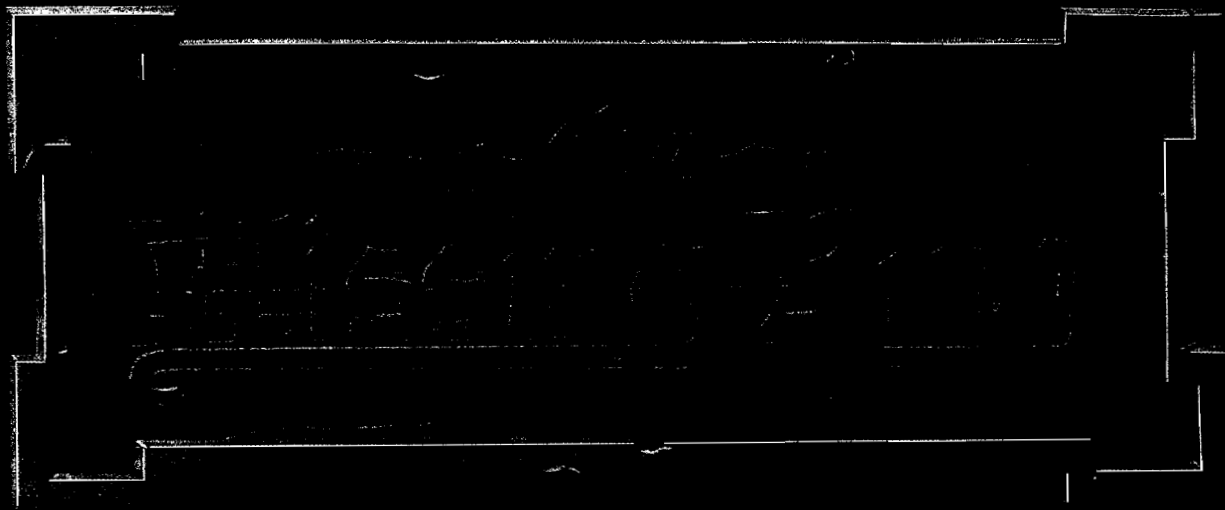
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### MICRO's Learning Center

As you can see by flipping through this month's issue, MICRO is changing — not in content, but in style. We're adding more color, more pictures, and more graphics. The only change in content is the addition of The Learning Center, which you'll find beginning on page 67.

#### Why a new section?

We know the material we offer each month is what you need — serious programming applications and techniques, and pertinent industry news — because you are a serious user. But we also know there are many new users who need tutoring and instruction. We've developed The Learning Center to help these computerists enhance their programming skills.

Many beginners purchase home computers such as the VIC-20, Commodore 64, Atari 400 or 800, TRS-80 Color Computer; most of the articles we publish will run on several of these systems, along with the Apple. We will provide the necessary conversions for running the programs on each machine. For instance, last month "MICROCalc" was offered for all Commodore machines and the Apple.

#### What will be in The Learning Center?

We plan to offer uncomplicated programs, accompanied by informative

text, that will answer your questions about programming. Why were certain lines inserted where they were? What approach is best for writing particular types of programs? What machine offers what characteristics?

#### Who will read it?

The Learning Center is not an attempt to turn MICRO into a magazine that covers all levels of computing for all levels of users. Instead it allows MICRO to reach the scope of its intended audience: serious, sophisticated users of all levels.

Even advanced users had to start somewhere. Many didn't want to play games or use canned software; they wanted to learn how to develop their own material. We hope readers following The Learning Center will pick up techniques and hints that will advance their programming capabilities and talents.

We'd like to receive feedback from our readers on this new section. Perhaps you have suggestions on topics or approaches. Maybe you could offer ideas on improvements. We would especially like to hear from those who feel they could contribute material to The Learning Center. Write to us soon; help us mold The Learning Center into a valuable and exciting part of MICRO.

*Marjorie A. Morse*

Marjorie Morse

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**Letterbox**

**OSI Questions**

Dear Editor:

I own an OSI C1P series II computer and a Radio Shack Lineprinter VII; this configuration introduces a second linefeed by the printer, therefore double-spacing each printed line.

Apparently Radio Shack computers have an interpreter that doesn't send a linefeed so the printer must provide one. I would appreciate it if your readers could offer some help. This printer performs well and I'd hate to exchange it because of this annoying problem.

Ray Audette  
46 Carre Provence  
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Dear Editor:

I've had nothing but trouble with my OSI C4P since the day I bought it. The trouble has been diagnosed as faulty memory. I was wondering if there is a memory program that can check the entire memory and locate the chip that is giving trouble. Also, what do you put in to check existing memory? How can you control the cursor (back up to rewrite)?

I've sent two letters to OSI and never received a reply. I can't even trade it for a newer one; even the dealer I bought it from won't take it on trade! Can any of your readers help me with this problem? (And, does anyone want to buy a C4P?)

Jeff Guernsey  
112 Overhill  
Salina, KS 67401

**Readers Help Out**

Dear Editor:

A few months ago you published my letter to tell your readers that I was interested in compiling a book of listed programs for use in microcomputer applications in medicine. I received let-

ters from all parts of America, Canada, South America, Europe, Israel, South Africa, and even a letter from China. There were early morning phone calls, picture postcards, packets of discs, bundles of listings; it was a tremendous response.

The outcome is that the book is now published by medical Software Co., Box 874, Center Moriches, New York 11934, price \$80.00. The volume contains medical application programs for patient scheduling, record retrieval, simple billing, utilization of equipment, simple statistics; standard deviation calculations and curve fitting routines.

Programs are still coming in and are being reviewed for the second volume which should be ready in April 1983. I want to thank everyone again for the tremendous response.

Derek Enlander, M.D.  
University Hospital  
New York, NY

**Updates and Microbes**

**Spell 'N Fix**

There have been some changes in the configuration that affect my review (Spell 'N Fix 55:102). The disk version has been optimized; disk and tape versions are no longer convertible. The new version is slightly faster and is compatible to *Color Scripts* disk files. Filespecs are now checked before disk access, so you can recover from accidentally mistyping a filename. Lastly, the disk version is available on protected disk, making backups a little more difficult.

John Steiner  
Riverside, ND

**Data Sheet Bug**

Apparently there is a bug in the BASIC decimal to hex number conversion program in the MICRO Data Sheet  
(Continued on page 10)

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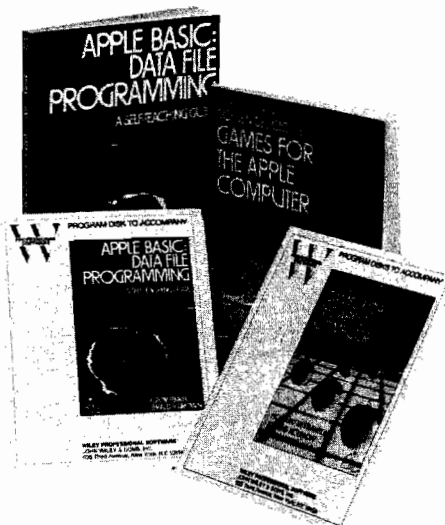
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# Updates & Microbes (continued)

#5 published in the September 1982 issue of MICRO.

As written, the program, run in either Applesoft BASIC or Commodore 4.0 BASIC, returns an @ instead of the initial nine for decimals in the range 36865 [\$9001] to 40959 [\$9FFF]. In fact, the program returns @@@@9 for decimal 39321 (\$9999).

The following new lines (in place of the existing lines) will correct the bug:

```
50 IF X > = 10 THEN PRINT
   CHR$(X + 55);
```

```
60 IF X < = 10 THEN PRINT
   CHR$(X + 48);
```

See listings 1 and 2 for both the original and corrected programs.

Wilmon B. Chipman  
Bridgewater, MA

### Listing 1

```
5 REM PUBLISHED VERSION
10 REM X < 65536
20 INPUT X
30 X = X / 4096
40 FOR J = 1 TO 4
50 IF X > 9 THEN PRINT CHR$(X + 55);
60 IF X < = 9 THEN PRINT CHR$(X + 48);
70 X = (X - INT(X)) * 16
80 NEXT J
```

### Listing 2

```
5 REM CORRECTED VERSION
10 REM X < 65536
20 INPUT X
30 X = X / 4096
40 FOR J = 1 TO 4
50 IF X > = 10 THEN PRINT CHR$(X + 55);
60 IF X < 10 THEN PRINT CHR$(X + 48);
70 X = (X - INT(X)) * 16
80 NEXT J
```

### Apple Slices Sliced

Two lines in the December Apple Slices column (page 66) were left out. Insert:

```
179 9568 65 9B 179 ADC LOWTR
180 956A 85 9B 180 STA LOWTR
```

Tim Osborn  
Manchester, NH

### Oops!

In "Print Control for Apple Printers" (58:24), the "#" signs were left off of the following lines of the program.

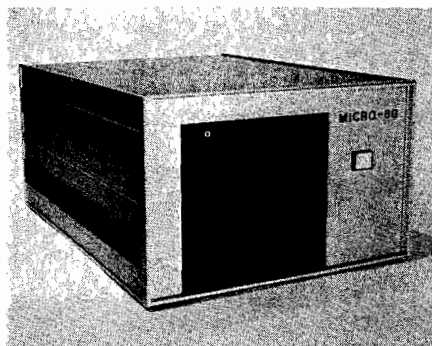
0300 A9 04	36	PRNTCTRL	LDA #4	5	PARAMS (# TO 4). COUNT THEM
030C C9 2C	41		CMP #COMMA	6	NEXT CHR ALSO COMMA?
031D 00 26	50	CONDOB	LDY #026	7	WHAT IS OUTPUT DEVICE ADDRESS?
0328 A0 00	56		LDY #0	8	THE ADDRESS ITSELF.
0335 A9 4D	62		LDA #HOOK	9	FINALLY POINT DOS' CSML ADDRESS
0359 C9 8D	79	PRINT1	CMP #CR	10	GOT A CARRIAGE RETURN?
0379 A9 00	97	PAGETEST	LDA #0	11	COME HERE AFTER CARR. RETURN
038B A9 00	105	STEPOVER	LDA #0	12	SKIP LINES TO GET TO NEXT PAGE
03A6 A9 C9	128		LDA #TITLE	13	SET BYTE OF TITLE
03B3 A9 00	125		LDA #0	14	HIGH BYTE OF PAGE# (SO MAX=255)

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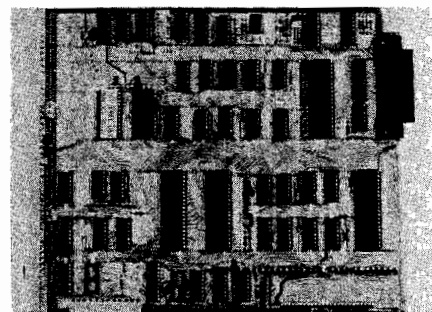
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This month's program, FORMULATE, lets VisiCalc users see the formulas that make up a worksheet all at once rather than one at a time on the edit line. If you do not use VisiCalc, you may still be interested in FORMULATE because it contains a general purpose BASIC subroutine to access individual DISK II sectors (lines 1140-1520).

FORMULATE will take any VisiCalc worksheet file and process it so that all values are stripped out and just the headings and formulas remain. The formulas are translated into headings so they will appear upon loading the file. The data is then saved under the original worksheet's name with ".FORMULAS" appended to the end of the name. The original worksheet file is unchanged, which preserves the data. When the .FORMULAS version of the worksheet is loaded (using the /SL command of VisiCalc), the formulas that make up the worksheet can be viewed all at once along with any headings contained in the worksheet. The ".FORMULAS" version of the worksheet can then be printed using the /P command.

When FORMULATE is run it will display each text file residing on the diskette in the last accessed disk drive one at a time. The user is asked to respond "Y" if the file displayed is the desired file and "N" if it is not. Once the file is selected, FORMULATE will perform its function, notifying the user when the function is completed.

### The Program

Lines 5-110 perform an initialization function to get the program ready for operation. Line 120 calls the sector read/write subroutine and reads the VTOC (sector 0, track 17). The subroutine at lines 1210 through 1230 initialize two machine-language subrou-

tines. Line 1430 is a machine-language program to locate the current DOS Input/Output Block (IOB) and place a pointer to the IOB in locations \$00 through \$01 so that the parameters can be updated by BASIC. Line 1440 is a subroutine that locates the IOB and calls RWTS to perform the operations specified in the IOB.

Line 1235 CALLs the locate-IOB subroutine. Lines 1240-1250 compute the modulo-256 of the buffer address and update the IOB to point to the desired buffer. Lines 1300 through 1390 form a subroutine that takes the desired track (TRK%) and sector (SEC%) and performs the operation specified by OP% (where 1 = Read, 2 = Write). Lines 140-320 read the catalog sectors searching for TEXT files.

Once the user selects a text file to FORMULATE, the program displays a message "PLEASE WAIT" and begins the main process of the program at line number 450. Line 450 opens the chosen file. Line 460 attempts to delete any .FORMULAS version that may already exist. If the delete function fails because the file does not exist yet then an error-code 6 will be produced ("FILE NOT FOUND"). This condition will be trapped by the ONERR GOTO 880 statement in line 440. Lines 880 through 990 form a general purpose error-handling routine. Error codes 5 and 6 are normal for this program and are handled by the error routine. For error code 6, processing picks back up at line 470. Error code 5 signals an end to the input file so the files are closed and a "FUNCTION COMPLETE" message is displayed.

Line 470 opens the .FORMULAS version. Lines 480 through 870 form the input/output loop where the worksheet is read in, analyzed, and the .FORMULAS file is written out. Lines 500 to 540 replace the normal Apple-soft INPUT statement. This is used to avoid the all too familiar "EXTRA IGNORED" problem.

Lines 560 through 750 form a loop, which is used to parse the input record one byte at a time. This loop is an example of finite state automation. It is used here to analyze the worksheet file in order to recognize which records are labels, commands, formulas, and input files that are not worksheet files at all (see line 790).

Lines 760 through 790 check to see in which node (state) the program emerges from the loop. If it emerges in node 6, then the input record was a value (not a computed value or formula). Since FORMULATE strips these from the .FORMULAS version, the program continues to read the next input record without writing anything to the .FORMULAS file.

Line 770 checks for a node 10 or 4, which means that the input record was a label. Since these are written as is, processing continues at the output line number 850. Line 780 checks for a node 8, which means the input record was the VisiCalc Global Column width command (/GC). Since FORMULATE outputs one of these records to the .FORMULAS version at the end of processing (see line 920) to set the columns to the width of the widest formula + 1, this record is skipped by jumping to line 480 to get the next input record.

Line 790 checks for a node < > 11, which indicates that the file is not a VisiCalc worksheet; a proper message is displayed and processing is discontinued.

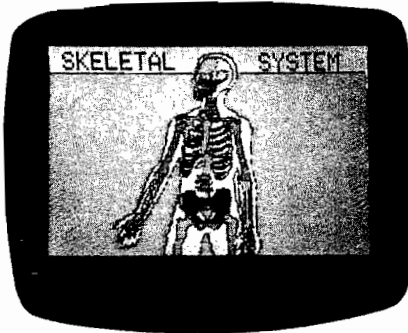
Lines 800 through 840 handle node = 9 (the input record is a formula). These lines simply split the formula into two pieces and place a quote (CHR\$(34)) into the proper position to make the formula a label. Lines 850 through 870 write the record out and jump back to 480 to get the next input record.

*(Listing begins on page 14)*



# FOR COMPLETE GRAPHICS: VersaWriter

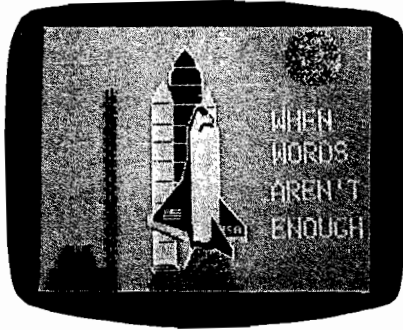
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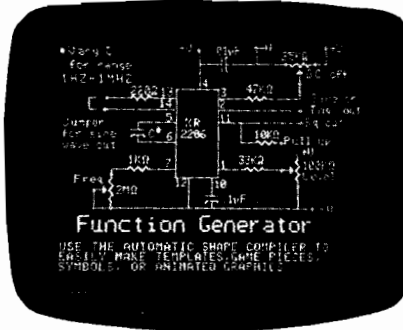
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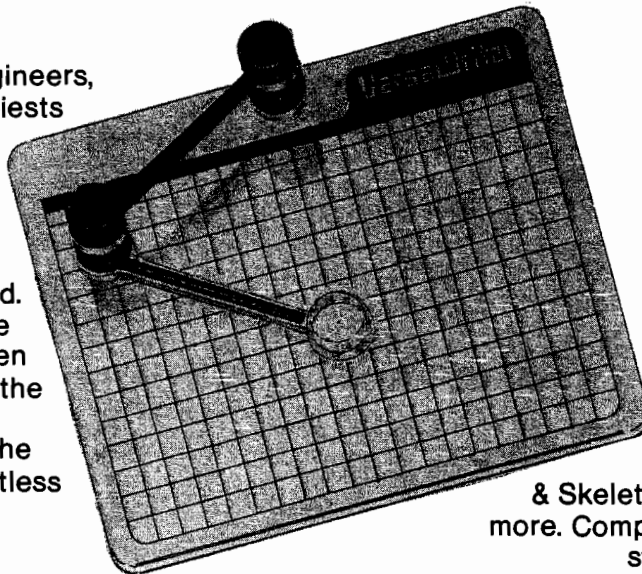


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Apple Slices Listing

```

1 BF = 32744:OP% = 1
5 HM = PEEK (115) + PEEK (116) *
  256: REM SAVE HIMEM
10 HIMEM: BF - 1:HI = 8: REM SET
  HIMEM AND LONGEST FORMULA
20 DIM FL$(105): REM TEXT FILE N
  AME ARRAY
30 GOSUB 1090: REM ESTABLISH ONE
  RR FIX
40 REM *****
50 REM ** FT%,FL% AND FS% ARE **
60 REM ** OFFSETS INTO THE **
70 REM ** CATALOG BUFFER **
80 REM *****
90 FT% = 13: REM FILE TYPE OFFSET
100 FL% = 14: REM FILE NAME OFFSET
110 FS% = 11: REM FILE STATUS OFFSET
120 TRK% = 17:SEC% = 0: GOSUB 121
  0: GOSUB 1300: REM INIT SECT
  OR R/W ROUTINE AND READ VTOC
130 HOME : HTAB 5: VTAB 5: PRINT
  "PLEASE WAIT - READING CATAL
  OG.....";
140 FOR J = 1 TO 15: REM NUMBER
  OF CATALOG SECTORS
150 TRK% = PEEK (BF + 1):SEC% =
  PEEK (BF + 2): GOSUB 1300: REM
  READ CATALOG SECTOR INTO BUFFER
160 FOR K = BF TO BF + 210 STEP
  35: REM 7 FILE DESCRIPTORS;
  35 BYTES EACH
170 FS = PEEK (K + FS%): REM SET
  FILE STATUS CODE
180 IF FS = 0 THEN J = 15:K = BF
  + 210: GOTO 310: REM END LOOP
190 IF FS = 255 GOTO 310: REM SK
  IP DELETED FILE
200 FT = PEEK (K + FT%)
210 IF NOT (FT = 0 OR FT = 128)
  GOTO 310: REM SKIP NON-TEXT
  FILES
220 NF = NF + 1: REM COUNT OF TE
  XT FILES
230 FL$ = "":SP% = 0: REM INITIA
  LIZE FILE NAME AND TRAILING
  SPACES COUNT
240 FOR L = K + FL% TO K + FL% + 29
250 NW$ = CHR$ ( PEEK (L))
260 IF NW$ = CHR$(160) THEN SP
  % = SP% + 1: GOTO 280
270 SP% = 0: REM RESET TRAILING S
  PACES COUNT
280 FL$ = FL$ + NW$: REM ADD NEW
  CHARACTER TO NAME
290 NEXT : REM L
300 FL$(NF) = LEFT$( FL$,30 - SP
  %): REM DROP TRAILING SPACE
  S AND SAVE IN FILE NAME ARRAY
310 NEXT : REM K
320 NEXT : REM J
330 IF NF = 0 THEN HOME : PRINT
  "THERE ARE NO TEXT FILES ON
  VOLUME ";: HIMEM: HM: END
340 FOR J = 1 TO NF
350 HOME : HTAB 5: VTAB 5: PRINT
  "IS ";FL$(J);" THE FILE"
360 HTAB 5: VTAB 7: PRINT "YOU D
  ESIRE ? ENTER Y(ES) OR N(O)
  ";: GET A$
370 IF A$ = "Y" THEN FL$ = FL$(J
  ):J = NF: GOTO 390
380 IF A$ <> "N" GOTO 340
390 NEXT : REM J
400 IF A$ <> "Y" THEN HOME : HTAB
  5: VTAB 5: PRINT "NO MORE TE
  XT FILES ON VOLUME": HIMEM:
  HM: END
410 CD$ = CHR$ (4)
420 HTAB 5: VTAB 9: PRINT "PLEAS
  E WAIT....."
430 POKE 34,10: REM SET TOP OF T
  EXT WINDOW
440 ONERR GOTO 880
450 PRINT CD$"OPEN ";FL$
460 PRINT CD$"DELETE ";FL$;".FOR
  MULAS"
470 PRINT CD$"OPEN ";FL$;".FORMULAS"
480 PRINT CD$: PRINT CD$"READ ";FL$
490 D$ = ""
500 FOR J = 1 TO 200
510 GET A$
520 IF A$ = CHR$(13) THEN LN =
  J - 1:J = 200: GOTO 540
530 D$ = D$ + A$
540 NEXT
550 NODE = 1
560 FOR J = 1 TO LN
570 MD$ = MID$( D$,J,1)
580 IF MD$ = ">" AND NODE = 1 THEN
  NODE = 2: GOTO 750
590 IF NODE = 1 AND MD$ = "/" THEN
  NODE = 5: GOTO 750
600 IF NODE = 1 THEN NODE = 11:J
  = LN: GOTO 750
610 IF NODE = 2 AND MD$ = ":" THEN
  K = J:NODE = 3: GOTO 750
620 IF NODE = 2 GOTO 750
630 IF NODE = 3 AND MD$ = CHR$(
  34) THEN J = LN:NODE = 10: GOTO 750
640 IF NODE = 3 AND MD$ = "/" THEN
  NODE = 4: GOTO 750
650 IF NODE = 3 THEN NODE = 6: GOTO 750
660 IF NODE = 4 AND MD$ = "F" THEN
  NODE = 6:J = J + 1:K = J: GOTO 750
670 IF NODE = 4 THEN J = LN:NODE
  = 10: GOTO 750
680 IF NODE = 5 AND MD$ = "G" THEN
  NODE = 7: GOTO 750
690 IF NODE = 5 THEN J = LN:NODE
  = 10: GOTO 750
700 IF NODE = 6 AND MD$ > "@" AND
  MD$ < CHR$(91) THEN J = LN
  :NODE = 9: GOTO 750
710 IF NODE = 6 AND MD$ = CHR$(
  34) THEN J = LN:NODE = 10: GOTO 750
720 IF NODE = 6 GOTO 750
730 IF NODE = 7 AND MD$ = "C" THEN
  NODE = 8:J = LN: GOTO 750
740 IF NODE = 7 THEN J = LN:NODE = 10
750 NEXT : REM J
760 IF NODE = 6 THEN GOTO 480: REM
  SKIP RECORD
770 IF NODE = 10 OR NODE = 4 THEN
  GOTO 850: REM WRITE AS IS
780 IF NODE = 8 THEN GOTO 480: REM
  SKIP "/GC" - PROGRAM PRODUC
  ES ITS' OWN
790 IF NODE = 11 THEN POKE 34,0
  : PRINT CD$: HOME : PRINT "T
  HIS DOES NOT APPEAR TO BE A
  WORKSHEET";: PRINT CD$: PRINT
  CD$"CLOSE": PRINT CD$"DELETE
  ";FL$;".FORMULAS": HIMEM: H
  M: END
800 REM NODE = 9 PASSES HERE
810 L = LN - K
820 IF L > HI THEN HI = L: REM
  SAVE LENGTH OF LONGEST FORMULA
830 LT$ = LEFT$( D$,K):RT$ = RIGHT$(
  D$,L)
840 D$ = LT$ + CHR$(34) + RT$
850 PRINT CD$: PRINT CD$;"WRITE"
  ;FL$;".FORMULAS"
860 PRINT D$
870 GOTO 480
880 CALL 768: REM ONERR FIX
890 ER = PEEK (222): REM SET ERR
  OR CODE
900 IF ER = 6 THEN PRINT CD$: GOTO
  470: REM NO FORMULAS FILE TO
  DELETE (CONTINUE)
910 POKE 34,0: REM RESET TEXT WI
  NDOW
920 IF ER = 5 THEN PRINT CD$: PRINT
  CD$"WRITE ";FL$;".FORMULAS":
  PRINT "/GC"; STR$( HI + 1):
  PRINT CD$: GOTO 1000
930 IF ER = 4 THEN PRINT "WRITE
  PROTECTED": GOTO 1040
950 IF ER = 10 THEN PRINT "FILE
  LOCKED": GOTO 1040
960 HOME : PRINT " ERROR CODE =
  ";ER
970 PRINT "IN LINE NUMBER "; PEEK
  (218) + PEEK (219) * 256
980 IF ER > 15 OR ER = 0 THEN PRINT
  "SEE PAGE 81 OF THE APPLESOF
  T": PRINT "BASIC PROGRAMMING
  REFERENCE MANUAL": GOTO 1040
990 PRINT "SEE PAGES 114 - 115 O
  F THE DOS MANUAL": GOTO 1040
1000 HOME : HTAB 5: VTAB 5
1010 PRINT "FUNCTION COMPLETED"
1020 HTAB 5: VTAB 7: PRINT "FILE
  ";FL$;".FORMULAS"
1030 HTAB 5: VTAB 9: PRINT "IS N
  OW SAVED ON DISK"
1040 POKE 216,0: REM TURN OFF
  ONERR GOTO INCASE OF TROUBLE
  W/CLOSE (AVOIDS POSSIBLE LO
  OP)
1050 PRINT CD$: PRINT CD$"CLOSE"
1060 HIMEM: HM: END : REM RESET
  HIMEM AND END
1070 REM
1080 REM ***** ONERR FIX *****
1090 FOR J = 768 TO 777: READ K:
  POKE J,K: NEXT : RETURN
1100 DATA 104,168,104,166,223,1
  54,72,152,72,96
1110 REM *****
1150 REM ** READ TRACK-SECTOR **
1160 REM ** SUBROUTINE **
1170 REM *****
1180 REM SEC%-SECTOR TO READ
1190 REM BF =BUFFER ADDRESS
1200 REM TRK%=TRACK TO READ
1210 FOR J = 33000 TO 33014
1220 READ I%: POKE J,I%
1230 NEXT
1235 CALL 33000: REM LOCATE THE IOB
1240 BH% = INT (BF / 256)
1242 BL% = INT ((BF / 256 - INT
  (BF / 256)) * 256 + .05) * SGN
  (BF / 256)
1244 PTR = PEEK (0) + PEEK (1) * 256
1250 POKE PTR + 8,BL%: POKE PTR +
  9,BH%: REM SET BUFFER ADDRESS
1260 RETURN
1270 REM *****
1280 REM * PTR-BEGIN. OF IOB *
1290 REM *****
1300 POKE PTR + 4,TRK%
1310 POKE PTR + 5,SEC%
1350 POKE PTR + 12,OP%: REM OPER
  ATION 1 = READ 2 = WRITE
1360 POKE PTR + 3,0: REM WILDCARD VOL
1370 CALL 33008: REM CALL LOCIOB+RWTS
1380 POKE 72,0: REM RESET PREG
1390 RETURN
1400 REM *****
1430 DATA 32,227,03,132,00,133,01,96
1440 DATA 32,227,03,32,217,03,96
1450 REM *****
1460 REM * 1ST DATA STMENT *
1470 REM * MACH. LANG. TO *
1480 REM * LOCATE THE IOB *
1490 REM * 2ND DATA STMENT *
1500 REM * LOCATE THE IOB *
1510 REM * AND CALL RWTS *
1520 REM *****
>H10:@SUM(B10...G10)
>G10:+G8-G9
>F10:+F8-F9
>E10:+E8-E9
>D10:+D8-D9
>C10:+C8-C9
>B10:+B8-B9
>A10:"NET
>H9:@SUM(B9...G9)
>A9:"TAXES
>H8:@SUM(B8...G8)
>G8:+G6-G7
>F8:+F6-F7
>E8:+E6-E7
>D8:+D6-D7
>C8:+C6-C7
>B8:+B6-B7
>A8:"GROSS
>H7:@SUM(B7...G7)
>A7:"EXPENSES
>H6:@SUM(B6...G6)
>G6:@SUM(G2...G5)
>F6:@SUM(F2...F5)
>E6:@SUM(E2...E5)
>D6:@SUM(D2...D5)
>C6:@SUM(C2...C5)
>B6:@SUM(B2...B5)
>A6:"TTL SALES
>H5:@SUM(B5...G5)
>A5:"MISC
>H4:@SUM(B4...G4)
>A4:"LABOR
>H3:@SUM(B3...G3)
>A3:"TIRES
>H2:@SUM(B2...G2)
>A2:"BIKES
>H1:"GRAND TTL
>G1:"JUNE
>F1:"MAY
>E1:"APRIL
>D1:"MAR
>C1:"FEB
>B1:"JAN
>H10:@SUM(B10...G10)
>G10:+G8-G9
>F10:+F8-F9
>E10:+E8-E9
>D10:+D8-D9
>C10:+C8-C9
>B10:+B8-B9
>A10:"NET
>H9:@SUM(B9...G9)
>A9:"TAXES
>H8:@SUM(B8...G8)
>G8:+G6-G7
>F8:+F6-F7
>E8:+E6-E7
>D8:+D6-D7
>C8:+C6-C7
>B8:+B6-B7
>A8:"GROSS
>H7:@SUM(B7...G7)
>A7:"EXPENSES
>H6:@SUM(B6...G6)
>G6:@SUM(G2...G5)
>F6:@SUM(F2...F5)
>E6:@SUM(E2...E5)
>D6:@SUM(D2...D5)
>C6:@SUM(C2...C5)
>B6:@SUM(B2...B5)
>A6:"TTL SALES
>H5:@SUM(B5...G5)
>A5:"MISC
>H4:@SUM(B4...G4)
>A4:"LABOR
>H3:@SUM(B3...G3)
>A3:"TIRES
>H2:@SUM(B2...G2)
>A2:"BIKES
>H1:"GRAND TTL
>G1:"JUNE
>F1:"MAY
>E1:"APRIL
>D1:"MAR
>C1:"FEB
>B1:"JAN
/GC16

```



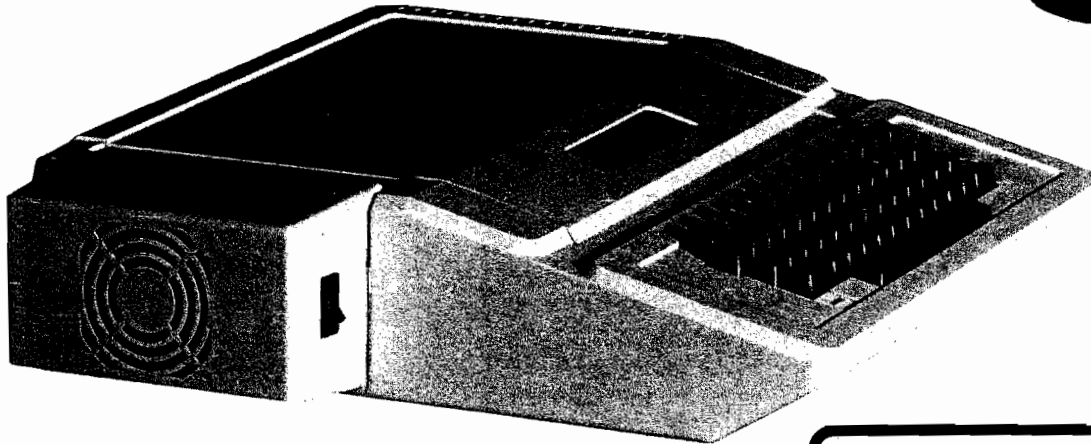
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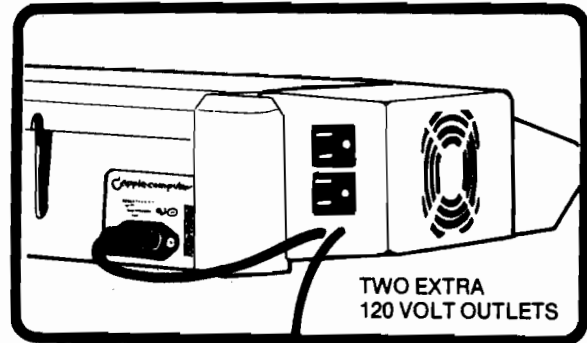
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## PET Vet

Loren Wright

### New Commodore-oriented Books

Without much fanfare the new edition of the *PET/CBM Personal Computer Guide* has arrived from Osborne/McGraw-Hill. The new edition, by Adam Osborne, Jim Strasma, and Ellen Strasma, has been published in two versions, called *PET Personal Computer Guide* and *CBM Professional Computer Guide*. The emphasis in the PET Guide is on the PET series of computers, the 4022 printer, and the 4040 Guide is on the PET series of computers, the 4022 printer, and the 4040 and 2031 disk drives. The CBM Guide concentrates on the 8032 and the 2001-B, with some mention of the SuperPET and the 8096. Peripherals covered include the 8050 and 8250 disk drives, and the 8024, 8023P, and 8300P printers. Both versions cover the 8010 modem and the 4010 voice synthesizer.

Listings in the PET Guide are presented in upper case/graphics, while the CBM Guide uses mixed case for its listings. More detail is given in the PET Guide on graphics programming, while the CBM pays more attention to numerical calculations and data formatting.

In general, the two books are very similar. They both have the same overall organization, and most of the material is duplicated. Much attention has been paid to updating, correcting, and clarifying material that appeared in the previous edition. One area in particular that received a lot of attention is the section on the CBM relative record system. The second edition of the PET/CBM Guide covered this topic very poorly, including errors and misleading information.

There is also much new material in the new book, including expanded memory maps and detailed information on fixes and upgrades for the various operating systems. In addition to the new material, more program examples are included. Author Jim Strasma offers, at an extra cost, a 'Help' disk, which includes longer demonstration

and utility programs. (It also includes "Bennett's Mail List," the subject of Strasma's six-part series in MICRO.)

The two books can serve both as tutorial texts for newcomers and as valuable references for more experienced programmers. I did notice a large number of typographical errors. The Strasmas have published errata lists in *The Midnite Paper*, and the next printing of the guides will correct them. With no comprehensive guide available yet for the Commodore 64, the PET Guide should do very well as a stand-in, since the C64's BASIC is the same as PET BASIC 2. It is too bad that Commodore no longer includes a comprehensive guide with its computers. This is one that every PET or CBM user should have.

Although it is published in the US by COMPUTE!, *Programming the PET/CBM* by Raeto Collin West deserves mention here. It is probably the most comprehensive and detailed description of the PET/CBM operating system available. Particular attention is given to how the system works on a machine-language level. Every BASIC command is explained in detail, with examples. Programs are provided to add extensions, such as TRACE and PRINT USING. There is also an extensive, well explained list of ROM routines. This book is not for the newcomer to programming, but I have found it an essential reference—a good companion to one of the Osborne/McGraw-Hill books.

### New Commodore 64 Software

C64 software is beginning to arrive so fast that I can't keep up with it. In my June column, I plan to cover word processors, including Script 64 (Richvale Telecommunications, 10610 Bayview Av., Richmond Hill, Ontario L4C 3N8, Canada), WordPro 3 (Professional Software, 51 Fremont St., Needham, MA 02194), and Paper Clip (Batteries Included, 71 McCaul St., Toronto, Ontario M5T 2X1, Canada).

Also received was a C64 version of KMMM Pascal. Author Willi Kusche

(Continued on page 18)

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## PET VET (continued)

has modified the program so that it dispenses with the BASIC ROMs, thereby making 10K extra available for programs. In addition, errors have been corrected, restrictions removed, and new string handling functions added. The programs operate with the C64's serial bus or with the CIE IEEE-488 interface (but apparently not completely with the C64-Link cartridge). As far as I know, it is the only Pascal available that can generate executable machine code. KMMM Pascal is available from AB Computers (252 Bethlehem Pike, Colmar, PA 18915) for \$85.

### Support for the Commodore 64

Commodore seems to be doing better at supporting the C64 than it has with previous machines. The Programmer's Reference Guide (described in my December column) arrived at dealers at the end of December. Many of the programs I mentioned then, including the sprite editor, character editor, and simple PET emulator, have been placed in the public domain by Commodore, so you should be able to obtain them from a dealer or users' group.

### Commodore's New Machines

As you may remember from a few months back, Commodore announced three new computers. These were the P, B, and BX series. It seems now that the P is the only one of these we're likely to see very soon. It is now called the Commodore 128, and I assume it will have the same 128K, expanded keyboard, and color-and-sound features originally announced. At the Consumer Electronics Show in January, Commodore was saying it would appear in 90 to 120 days.

Commodore showed off some other new products at that show in Las Vegas, but their arrival dates are even less certain. One product was a portable 64K machine, compatible with the Commodore 64. This '64 Series' computer will be available in three configurations: 1) with built-in single disk drive and built-in black-and-white monitor, 2) with single drive and color monitor, and 3) with dual drive and color monitor.

Commodore will soon be selling its own high-resolution color monitor, designed especially for the Commodore

64 and VIC-20, for \$299. Other products shown in prototype versions were a hand-held computer, a piano keyboard for the C64, a voice synthesizer cartridge with interchangeable 'voices' and vocabularies, and a touch-screen panel.

Look for my article in next month's "New Wave of Computers" where I will cover the technical details of the Commodore 64, the Commodore 128, and, I hope, the 64 series portable computers.

### TPUG Conference--May 14-15

The Toronto PET User Group (TPUG) is holding a large conference at the Castle Loma campus of George Brown College in Toronto the weekend of May 14-15. I have accepted an invitation to join Jim Butterfield, Steve Punter, Jim Strasma, and a number of other PET experts as a speaker. The presentations will cover a wide variety of topics and experience levels. In addition to the presentations, there will be a major copy session of the TPUG library, which now exceeds 100 disks. Finally, there will be commercial displays, including those from all the stores in the local Toronto area. For more information, write TPUG, c/o Chris Bennett, 381 Lawrence Avenue W., Toronto, Ontario M5M 1B9, Canada.

### Lincoln College Summer Computer Seminar

Lincoln College in Lincoln, IL is running a week-long seminar June 19-26. Faculty will include Jim and Ellen Strasma, Jim Butterfield, Len Lindsay, Keith Peterson, and a number of other experts on Commodore equipment. The cost, including room, board, and tuition, is \$350. If you don't have a Commodore computer you can bring, a limited number of rentals will be available for an additional fee. You will also be able to purchase a VIC for use in the seminar. For more information, write Jim Strasma at 1280 Richland Avenue, Lincoln, IL 62656.

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Paul S. Swanson

### Clearing Up the Rumors

Many rumors are circulating about new products from Atari. I have seen the 1200 — it is *not* just a rumor. There are also indications that another computer will be announced sometime this summer. But the rumors concerning a 48K Atari 600 no longer look credible since Atari is more likely to bring out a more advanced product; a computer that is between the 400 and 800 is not a step forward. Any statements not officially announced by Atari are probably inaccurate. I'll keep you up to date on significant official announcements.

### Missing the Right Cartridge Slot?

I have received a few letters from Atari 400 owners concerned about the right cartridge slot on the Atari 800. Since the Atari's newest computer, the 1200, has no right cartridge slot, and there is very little existing software that requires it, it is not likely that much future software will require it.

Another popular topic in letters is assembly language on the Atari. The Atari uses 6502 assembly language, the same used by Apple, Commodore, and others, so general 6502 books will be useful. A few topics concerning assembly language are specific to the Atari, so if your concerns deal with them, write a letter to me describing the specific application.

For example, one reader asked about creating a cassette bootable program. If you hold down the START button while you power up the computer, it will attempt to load and run a program from tape. The program on tape must be in machine language, which is where assemblers become important. Cassettes are a little more difficult to deal with than disks, primarily because there is no cassette operating system comparable to the disk operating time.

To create a cassette bootable program, you must understand what the computer does when it reads such a file. The steps that the computer executes in reading the file are:

1. The first record loads into the cassette buffer and the computer stores the first six bytes and saves them in various places. The first byte is not used. The second byte contains the number of records to load. Bytes 3 and 4 contain the address to start saving the program. The last two bytes are the initialization address.
2. The first record (apparently including the first six bytes) is moved from the cassette buffer into the indicated start address, then the rest of the records are read and placed in sequential memory locations following the first record.

3. The computer JSRs to the address of the byte immediately following the first six bytes (starting address plus six). You can use this to load more records into memory if you wish. Return by using an RTS command after clearing the carry (if there was no error), or setting the carry to indicate that there was an error during this routine.
4. The computer next JSRs to your initialization address (indirectly through bytes 5 and 6). In this routine, do whatever initialization you want, then place your actual starting address in DOSVEC (at \$000A). Use another RTS to end this routine.
5. Finally, the computer JMPs indirectly through DOSVEC to begin your application. At any time during the execution of your application, SYSTEM RESET is pressed and steps 4 and 5 are repeated.

There is a small bug in Atari's cassette boot routine. At the end of the routine that starts at the start address plus six (step 3), you must stop the cassette motor.

### Back to Graphics

Last month I promised some information on using IR modes 4 and 5, which are the character graphics modes that will be available as OS modes 12 and 13 on the Atari 1200. You can, on the 400 and 800, use these two modes if you define your own display list and a custom character set. For hints on how to create a character set, refer to my article in the October 1982 (53:87) issue of MICRO.

There is an important difference in forming each of the characters. You must locate the set on a 1K boundary the same way I describe in the article. However, the formats for each character will be interpreted differently for IR modes 4 and 5. In these modes, the bytes in the set are interpreted as bit pairs, which refer to color registers. Zero refers to the background register, one refers to register zero, two to register one, and three to either register two or register three. In all, you can have up to five colors on the screen with up to four in each character. The reference to registers two or three depends on whether the character is printed in normal or inverse video.

Both of these modes support 40-character lines. Mode 4 uses one scan line per line of format, so it is easily implemented from an IR mode 2 (operating system mode 0) screen, allowing you to access it as if it were a text screen. Mode 5 uses two scan lines per line of format, making it equivalent in resolution to an OS mode 7 map mode screen. You can also modify a text screen for this one, too, but you have only half of the characters available on a full screen, so you must take this into account.

Mixing some IR mode 2 text lines with mode 5 is relatively easy. If you alter the display list to make some of the lines mode 5 and leave others in mode 2, you can



PRINT to the screen as if it were the standard OS mode 0 screen using BASIC. The drawback is that the text lines will use register 2 for the background color and the luminance of register 1 for the letters, so the screen will either have stripes where the text lines go or, if you set register 2 to black, the graphics will have only four colors instead of five, and only three can be used in each graphics character.

Some experimentation with these two modes will explain quite a bit about how they work. I have included a listing at the end of this column that should get you started.

### Hardware

If you have a printer that works off the 850 interface, I have one note that may interest you, particularly if you write rather large programs. If the 850 is on when you start up the Atari, some memory is set aside to handle device R:. If you are not using the interface for anything except the printer, you do not need this device, nor do you need to have that extra memory subtracted from your program area. If the 850 is turned on only after the computer is turned on [i.e., the 850 is off when you turn the computer on], this memory is not set aside and device R: will not be available. Device P: is always enabled at power-up, so the printer will be available any time you have both the 850 and the printer turned on.

### Reference Books

In a recent column (56:19), I reviewed some reference books that you may want next to your Atari to help with your programming. Since then I learned that Educational Software, Inc. (4565 Cherryvale Avenue, Soquel, CA 95073) publishes references for beginners or experts on the Atari computers, as well as software that will help your programming. Their *Master Memory Map*, for example, is a good roadmap of the hardware and shadow registers in the Atari.

### A Closing Note on Character Graphics

When you are finished experimenting with modes 4 and 5, set up a standard text screen and POKE 64, 128, or 192 into location 623. This causes the character set to be interpreted in four-bit groups, effectively implementing a character graphics screen equivalent to OS modes 9, 10, and 11. Note that these are the GTIA modes, so this won't work on the older Atari computers that have CTIA chips instead of the GTIA chips.

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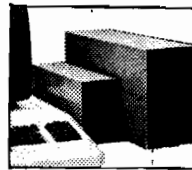
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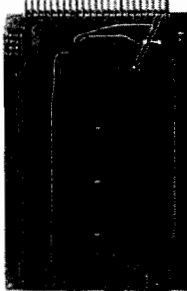
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**Here to Atari Listing**

```

10 REM ....Character Graphics.....
20 REM ....Using IR mode 4.....
30 REM .....
40 REM ....Paul S. Swanson.....
50 REM .....
60 REM *****
70 REM **Place character set on***
80 REM *** 1K boundary*****
90 REM *****
100 DIM X$(1):A=ADR(X$):B=INT(A/1024+1)
    *1024:DIM F$(B-A-1),CSET$(1024)
110 CSET$="@ "
120 CSET$(1024)="@ "
130 CSET$(2)=CSET$
140 REM *****
150 REM **Use CTRL characters for**
160 REM **the redefined characters**
170 REM *****
180 RESTORE 1000
190 C=513
200 READ N
210 IF N=256 THEN 300
220 CSET$(C,C)=CHR$(N)
230 C=C+1
240 GOTO 200
250 REM *****
260 REM **Declare a GR.0 screen,**
270 REM **then redefine its*****
280 REM **display list.*****
290 REM *****
300 GRAPHICS 0
310 DL=PEEK(560)+PEEK(561)*256
320 POKE DL+3,68
330 I=DL+6
340 N=PEEK(I)
350 IF N=65 THEN 430
360 POKE I,4
370 I=I+1
380 GOTO 340
390 REM *****
400 REM **Use standard PRINTs*****
410 REM **to display characters.**
420 REM *****
430 FOR I=0 TO 26
440 PRINT CHR$(I);
450 NEXT I
460 REM *****
470 REM **PRINT the inverse*****
480 REM *****
490 PRINT :PRINT
500 FOR I=0 TO 26
510 PRINT CHR$(I+128);
520 NEXT I
530 REM *****
540 REM **Tell the Atari where to**
550 REM **find the new characters**
560 REM *****
570 POKE 756,B/256
580 GOTO 580
960 REM *****
970 REM **The custom characters***
980 REM **One DATA per character***
990 REM *****
1000 DATA 5,5,5,5,5,5,5
1010 DATA 90,90,90,90,90,90,90
1020 DATA 175,175,175,175,175,175,175
1030 DATA 250,250,250,250,250,250,250
1040 DATA 165,165,165,165,165,165,165
1050 DATA 80,80,80,80,80,80,80
1060 DATA 0,0,0,0,1,5,21,85
1070 DATA 0,0,0,1,5,21,85,86
1080 DATA 0,0,1,5,21,85,86,90
1090 DATA 0,1,5,21,85,86,90,106
1100 DATA 1,5,21,85,86,90,106,170
1110 DATA 5,21,85,86,90,106,170,171
1120 DATA 21,85,86,90,106,170,171,175
1130 DATA 85,86,90,106,170,171,175,191
1140 DATA 86,90,106,170,171,175,191,255
1150 DATA 90,106,170,171,175,191,255,252
1160 DATA 106,170,171,175,191,255,252,240
1170 DATA 170,171,175,191,255,252,240,192
1180 DATA 171,175,191,255,252,240,192,64
1190 DATA 175,191,255,252,240,192,64,0
1200 DATA 191,255,252,240,192,64,0,0
1210 DATA 255,252,240,192,64,0,0,0
1220 DATA 252,240,192,64,0,0,0,0
9999 DATA 256
  
```

John Steiner

### Updates

In the December 1982 issue, I presented a short program on a single disk copy routine. A few people have written about a problem with the program crashing in line 200 with a filename error. Other people may run into this problem too, so I will pass along what might be the correction. In program line 130 the routine uses an IF...THEN construct to check for a valid file. If the file does exist and has not been killed, the extension is appended to the filename. A slashbar is also placed in the line as a delimiter; however, an extra space seems to have found its way into the listing. The line should read as follows:

```
130 IF LEFT$(N$(N),1) < > CHR$(  
  (0) AND LEFT$(N$(N),1)  
  CHR$(255) THEN FI$(K)=N$(N)+  
  "/" + EX$(N) : K = K$1
```

The slashbar should be the only character within the quotation marks. The "/" could be replaced with CHR\$(47) if you wish. The program would crash in line 200 because the extra space would cause the filename to be one character too long.

I received a letter from Walter Oller of Rapid City, SD, asking about the availability of software capable of handling bowling league team and individual record keeping. If you have software, or are aware of its existence, please let me know.

### The "F" Board

Last month I commented on the fact that the TDP System 100 has a slightly different circuit board from the standard CoCo. That statement is no longer true. Since December, Radio Shack has been delivering the computers with this new "F" board. Though the board has no "F" designation on it, it is replacing "E" board computers. If you have a late model

Color Computer, you can tell which board you have by lifting the door on the ROM port and looking inside. Computers with an "E" board or earlier have a shield around the processor and memory chips. The shield is almost the only thing visible in the earlier models. "F" board models shield only the RAM chips themselves, so when you look into the port, you can see components all the way through to the other side of the cabinet. The RAM shield is visible to the left of the port as you are looking in.

As I said last month, the computer will probably be offered as a 64K machine. Rumors abound as I am writing this that OS-9 will be available soon in a format licensed to Tandy Radio Shack.

CoCos with 16K are easily converted to 64K. You just have to remove several capacitors, replace the 4116's with 4164's, and move the jumpers from 16K to 64K positions. An additional jumper must be added to the points near the 6821 PIA.

If you have a 32K "F" board, call map type 1, the all RAM mode. The hand-wired modifications required on the earlier boards are no longer necessary.

### CoCo Operating Systems

The Radio Shack disk operating system is adequate for BASIC programming and contains many powerful features. There is much to be desired for the machine-language programmer, however. This is partially due to the fact that the system is not well documented. Only a few ROM calls are provided, and sophisticated applications require disassembly of the ROM just to locate and access the routines.

One solution to this can be found in a disk resident DOS. Some commercial programs use the technique, including Radio Shack's own Disk Scripsit. If you can write your own DOS, you will have no problem; but if you are like me, that would be a major hurdle. However, you can purchase disk resident operating

systems for the Color Computer. These systems and their utilities give the assembly-language programmer much more power than when using the standard DOS.

I was looking for a disk operating system for quite another reason, however. With many operating systems, files can be read or written by computers using the same DOS, even though they may be different brands. I would be able to send disks along with my articles that contain the text. The editor would then be able to read the file into the text editor for editing and eventual typesetting. The FLEX operating system is one of the more powerful systems available today. In addition, it is implemented on nearly all 6800 series processors. There are several versions of FLEX available, and at least two are implemented on CoCo. I have just purchased Frank Hogg's version and am learning how to use it to full advantage. See November (MICRO 54:23) for a more complete discussion of Frank Hogg's FLEX.

I wish I could say that this month's column was submitted in FLEX format. Unfortunately, a few hours after receiving and loading FLEX, my TDP-100 broke down. But I have already formed some strong impressions on the system in the first few hours.

FLEX is definitely best implemented on at least a two-drive system. I am waiting for a second drive unit, but it has not arrived yet. Working with the system and creating the first backup was enough to convince me that another drive is needed.

One feature of this version of FLEX is DBASIC, a \$40.00 program that allows you to use and convert Radio Shack software to FLEX format. The only feature of R/S disk BASIC that is not implemented is random access file capacity. This is not a limitation of FLEX, but of DBASIC. Another appealing feature is a way to call BASIC without accessing Extended BASIC. If you can live without extended BASIC routines, you can use the extra memory

## CoCo Bits *(continued)*

(over 39K) for your program.

If you have a monitor, you can use FLEX in a 64 × 32-line format. There are six choices of character and screen dimensions, starting with the standard 32 × 16 format. FLEX is initialized in a 51 × 24 format. A setup program can change that, plus many other power up standards.

There are many people who would like to have the versatility of a DOS but don't have the 64K capacity FLEX requires (or maybe they just don't feel like paying an additional one hundred dollars on a DOS). A viable alternative is Peter Stark's Star-DOS. Star-DOS will run on a 16K CoCo, and requires no modification of the computer. Many of the standard DOS features are implemented, and the user has an opportunity to get the feel of using and pro-

gramming a disk operating system without spending a lot of money. Star-DOS is priced at \$49.95. Unlike FLEX, Star-DOS reads and writes standard Radio Shack format disk files. In addition, a 55-page manual provides all the documentation needed to implement serious disk system applications in assembly language.

Both memory resident and disk resident commands are supported and, like FLEX, it is possible to improve on the DOS by writing your own command routines. If you would like to experiment with a DOS, you might be interested in Star-DOS.

More information is available on these programs from their authors:

Color Computer FLEX  
Frank Hogg Laboratories

The Regency Tower  
770 James St.  
Syracuse, NY 13203  
Star-DOS  
Star-Kits  
P.O. Box 209  
Mt. Kisco, NY 10549

Other disk operating systems are available for the Color Computer from Exatron Corporation and Cer-Comp, among others. I am not familiar with either of these systems. If you have experience with them and would like to pass it along, drop me a line. Next month I will take a closer look at some of the features of a typical DOS.

You may contact Mr. Steiner at 508  
Fourth Avenue NW, Riverside, ND 58078.

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# Communi

## The Growing Network

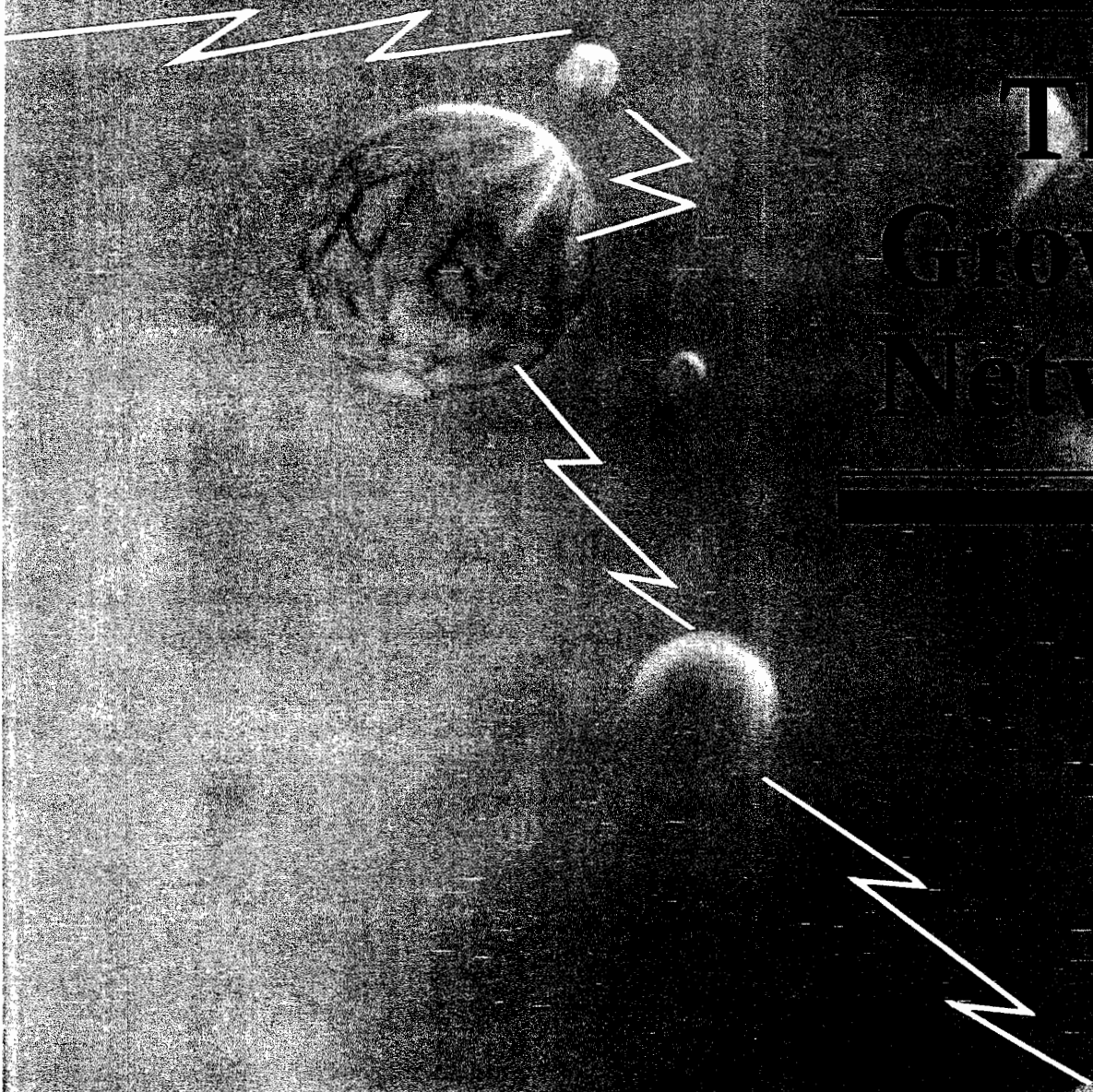


Illustration by Paul ...

Industry analysts, like their counterparts in economics, have to eat their predictions.

The market for most home computers fell so short of 3-year-old forecasts that, until recently, they called the "home" computer a misnomer, some concluding that there is no market for home computers.

Caught between the "video game gold rush" and the yet-to-come "home banking and teleshopping revolutions," what are we to think about the information society and the micro-on-every-desk predictions? What has become of the visionaries who a few years ago predicted that the eighties would usher in a truly participatory democracy where every home would be plugged into not only Pac Man and the boob tube, but the World Brain, as well?

Electronic lobbying, on-line community organizing, horizontal management, and "People's" data bases were supposed to be up and running by 1983. Technologically, the potential is here, the Utopians insist, but the leadership is not.

Separating fact from wish fulfillment, the predictions may be right about the hardware part of the revolution at least. However "unplugged" we may be as networkers intellectually and politically, the tools of social change are finally proliferating. Estimates for under-\$500 home computers show that in 1983 the market is exploding; it should be over \$1 billion this year.

"Eight million computer terminals will be in use in American homes by the end of this decade, many linked by information networks to businesses and other data bases," according to J.S. Mayo of Bell Labs. "The nature and location of work and education will thus be dramatically transformed. Eventually, the home/work/study center may replace the classroom and the office for a great many people."

Perhaps, but currently less than 5% of all personal computers sold are connected into any type of network, according to market research surveys. This backs up the industry assumption that current micro users could hardly care less about the personal improvement issues of electronic togetherness; they're into games. What, then, will drive the interactive and networking potential?

**Theory One**  
*The Home*

The answer can be found by looking

at the national investment, all corporate, in what is called "videotex." If you have a TV set or monitor, a telephone, and a connecting micro (better it be a black box with a few buttons saying YES, NO, BUY IT, CHARGE IT), that is called videotex. Major investors in videotex, such as Warner-Amex, Time Inc., CBS, Knight Ridder, have based their development on the assumption that the public will be interested only in "consumer" uses of information. They are convinced that now only entertainment (video games) and, later, teleshopping and home video banking are what the information revolution is all about.

According to one think tank, International Resource Development of Norwalk, Connecticut, one in four U.S. households will have installed in-

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tegrated video terminals and micros capable of accessing outside information by 1990. However, the information will consist simply of news, entertainment and transaction services. Modem-connected terminals, capable as they are of electronic mail and interpersonal networking, will be used primarily for consumption of advertising, news, and teleshopping, according to IRD and their clients, AT&T, GTE, etc., who are "racing to complete trials of new interactive home information."

Just how interactive is this revolutionary technology brought to us by Ma Bell and the corporate providers? It will enable (and I quote IRD) "the customer to use his TV screen as an 'electronic catalogue' on which he can view products and then place his order for them." So much for Ma Bell.

**Theory Two**  
*The Office*

It's not the home users that will drive the network information marketplace; it's the serious users of information and computer-mediated communications. This school of thought is backed by billions of dollars of vendor advertising and editorials in countless journals. Whether your office is downtown, on campus, or at home, that's the place for plugging into information power.

A recent article in *Personal Computing* entitled "Networking: A Powerful Tool for Personal Communication" catches the eye as you browse the newsstand. Pulse rising, you grab the magazine and read the subtitle: "It may be the most important trend on the horizon of personal computing." On the first page you read: "No longer will an individual computer be limited to its own data resources and computing power; information can be shared quickly, amplified, and amended at will by computer users who might otherwise have to wait for a weekly or a monthly meeting to make the same exchange."

Right on. At last it's being spelled out in print. But wait, the very next sentence says: "A local area network is what makes the power of personal computing for businesses and professionals seem real and practical."

For those who don't know what a local area network is, it means the latest in office automation efficiencies; machines "talking" to other machines, no matter how incompatible. But the incompatibility lies not in the machines themselves; technological advances are taking care of *that* problem rapidly. Senior executives simply see no compelling reason to have micros on their desks. Whether or not they are cyberphobe (afraid of computers) or technophobe (can't wait, can't type), the tried and true ways to communicate are safer and more artistic, suiting the style of upper management — impulsive and unstructured.

For years, office automation professionals have been trying to woo senior management generalists in large organizations, public and private, to their way of thinking. In the seventies, these professionals hyped Management Information Systems, but they flopped — strictly for the technical, DP types. Resurfacing as proponents of Decision Support or IRM (Information Resource Management), they have had no less trouble. Cybernetic missionaries in a pagan land. their ways of improving ex-

ecutive productivity fell on deaf ears.

Yet, the tide seems to be turning. According to Ed Robertson, office automation consultant to the major multinational corporations, "We finally have the technologies... that fit their decision-making style. Number crunching, however graphic and analytical, is not the grabber. Sophisticated ways to communicate with a wider Old Boys Network, beyond what they're used to trusting, is what will get them in the water." He adds a caveat: "Only a handful of corporations are managing information at the top less crudely. It will take a few years. In the meanwhile, please don't use the word 'workstation' for CEO offices. At least not to their faces."

### Theory 3

#### Enterprise

If it is not the enlightened home or the liberated office that will be the first to drive the network information marketplace in the next generation [two to three years], then what will?

Although we can see where the obstacles are at the top and the bottom of the power structure, we have only to look at the new wave of micro users to see from where the leadership is coming; the information hungry, the networkers who know they have to unite. Revolutionaries? Utopian Socialists? Hardly.

The Third Wave in networking comes once again from the entrepreneurial "middle" society. The same spirit that pioneered the opening of the West is motivating the opportunity seekers of today. We can see them surfacing in small business, law, accounting, education, medicine, and scientific research. They are people working within corporate structures.

#### Information for Profit

"On-line entrepreneurs of the world, unite!" may be the rallying cry in a world that is rapidly becoming peopled with opportunity seekers working on their own to market and distribute a wide variety of products and services through self-created networks.

Take the example of two consultants from Arthur D. Little Management Consultant Firm in Boston who were advising clients on electronic publishing and the data base business. These consultants saw a way to make a profit by putting together electronically two groups of people who badly needed each other: hi-tech corporations and

technically oriented professionals. Until now, the inefficient job market used classified advertising as its medium for reaching people.

Robert Kvall and George Sacerdote decided to apply their knowledge to this one obvious area of interactive recruiting, using an on-line service over Telenet and Timenet. Last Fall they started Connexions, a Cambridge, Massachusetts, company offering on-line help-wanted advertising. Job seekers can create a customized resume and send it electronically to the key person in the firm in which they are interested. On the other end, a company can tailor an advertisement by asking certain questions that will further screen the applicants. Only the corporations that the applicant selects get a chance to look at the information.

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**"Only a handful  
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Most of the major corporations in New England are advertising largely for DP, computer science, or electronic engineers through newspaper ads. Previously, there was no more efficient way. Connexions now makes it possible for both advertisers and subscribers to find each other and pay mutually for the service at each end — with anonymity and confidentiality.

Another successful, on-line, profitable venture is an existing private national association that helps small businesses. The Small Business Science Bureau (SBSB) in Worcester, Massachusetts, has recently established an international computer network in conjunction with the CompuServe Information Service that allows small businesses to send and receive information, electronic mail, software, and data.

### A "For Profit" Association

Members benefit from a wide variety of services: volume purchase discounts for products, supplies and health programs, management assistance, and new venture start-up assistance.

Based on a DEC 20 in Worcester, and linked to a gateway to the CompuServe network, a user can send mail to the other 35,000 subscribers. SBSB has made available discounted TRS-80s, which include a communications package that acts as both a dumb terminal and also allows one-key transmission of electronic mail and simple transmission of word processing text.

According to Harley Goodwin, VP for Computer Services at SBSB, members will find [and, indeed have already found] ingenious ways to make and save money through the network. Selling the network through cable TV franchises is one; transmitting direct mail lists is another. "We are collectively putting technology to work for small business and the opportunities are endless."

### Business Opportunities Network

Another computerized network creating business leads and bringing opportunities together is International Business Opportunities of Woodland Valley, California. IBO collects, screens, and evaluates businesses that are for sale nationally and services would-be investors and buyers. Through their own network of 25 brokers in key cities, potential matchups are referred based on various criteria. For example, if a member broker in New England uses IBO to find a new business in Florida for a buyer, and a member broker in Florida finds a business that fits the bill, both share the commission and pass along a slice to IBO. The company not only maintains the data base by means of continuous search through collective referrals, but it provides full service consulting to both parties, including venture financing.

Many entrepreneurs use The Source Telecomputing Corp. (Source of Silver Springs, MD) and CompuServe Consumer Information Service for communication among close user groups and for fun and profit. These networks continuously update information of broad public appeal, which can be accessed by any communications micro (dumb or videotex terminal) through local telephone calls. Along with other "information utility" networks, such as Dow Jones or Dialcom, they provide



electronic mail and private storage for a fee. Data bases are accessed by subscribers on a time charge basis. The Source now refers to these closed groups as Private Sectors, and openly solicits sponsors or information providers and groups to set up on-line DBS and electronic mail for publishing activities. The Source will pay royalties for the time your people spend on line. CompuServe calls them SIGs (Special Interests Groups) and publicizes them to attract other entrepreneurial group organizers.

These entrepreneurs are harbingers of things to come. Like the 1890's Gold Rush, the 1980's Information Mine is making money for the lease-holders (providers), the miners (vendors), and those who provide services for the life style that results.

One entrepreneur who does all three is Alan Carr, whose company, Information Inc., is making a profit via electronic mail and data base management in a unique way. His company's clients are Fortune 1000 companies and major industry associations that pay him \$64 a month per mail box account in return for his building and maintaining an information bank that can be easily accessed through The Source from anywhere. His clients feed him information, internally collected, and he gathers information they specify, externally, wherever he can find it. He's both an information broker and an electronic clipping service.

The end-products include interrogative data bases consisting of personalized material, public opinion, news features, survey highlights, etc. A popular service is the Issues Management file, the latest industry or corporate positions on various issues that management believes affects their organization. In its first year of operation, Information Inc. already has clients spending \$5,000-\$10,000 a month for the service, depending on the number of subscribers the organization supports.

**Information Brokers**

Would-be information brokers, on behalf of their clients, can access the Dow Jones News Retrieval Service (a subset of which can be accessed on The Source and CompuServe). This service has 60,000 subscribers paying \$1.20 per prime minute compared to The Source's 30,000 at \$.35 and CompuServe's 40,000 at \$.38.

Two recent entries into horizontal on-line information services are The Knowledge Index (from Dialogue) and

After Dark (from BRS). Between 6:00 p.m. and midnight, for as little as \$6 per hour, any personal computer operator with a modem and a password (for a \$50 registration fee) can access BRS and get the same in-depth, wide-ranging data files used by BRS Search Service subscribers (Fortune 500 corporations and reference librarians). These include technical and scientific abstracts, medical journals, government studies, business indexes, and general wire service and daily news. A home computer newsletter, electronic mail, shop at home service, and an instant software delivery service all come with the package.

The Knowledge Index, from 6:00 p.m. to 5:00 a.m. and weekends, is able to scan more than four million entries from over 10,000 journals and other publications, many updated daily. Compu-

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**...for as little as \$6  
per hour, any  
personal computer  
operator with a  
modem and a  
password can access  
the same data files  
used by Fortune 500  
corporations.**

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ters, electronics, engineering, law, medicine, agriculture, business, psychology, education, and a wide range of information from newspapers, magazines, and government publications are included. You don't get the full articles, only an abstract or summary. The Knowledge Index will take, on line, orders for printed copies of the full text of the articles. Any combination of key words plus any other words, phrases, or numbers that appear in titles, abstracts, author listings, etc., can be used for searching. This raises the search capability of finding specific information beyond that of the conventional information utilities. Connecting words (AND, OR, NOT) enable you to zero in on a topic and find the abstracts of articles dealing with the effects of coffee, sailing in the Straights of

Georgia, wind power as an investment, and the effects of stress on managers.

**Videotex and Teletex**

In addition to the major networking services, there are videotex and teletex companies offering information over the phone lines and through cable TV. This information is thin news and shopping information and has the advertiser in mind, not the consumer. Teletex offers strictly one-way communication transmitted into the TV set. In some instances you can call up a page and it appears on the TV screen. But you can't go back and find additional information beyond what's in the system. On the other hand, videotex is interactive; you can request information and it is searched and produced.

With ever more valuable, searchable, and specific information services coming on line, the market for them is growing rapidly. Yet it comprises less than a third of personal computer owners and a tiny fraction of the potential population. As this changes, new opportunities are springing up almost daily for those who are discovering that properly mined, refined, and packaged information is money.

Theory E says that enterprise is what will stimulate the network information marketplace in the eighties.

**Are you ready?**

How do you get an information network started? First find a large, active group that needs to communicate regularly. They may now have a newsletter, publish a calendar or bulletin board, or have an organization that acts as a clearing house for information. Each person should probably have a private network on a dial-up system. Members can have confidential electronic mail and develop data bases, and they can have a window to the outside world and access the popular data bases as well. The network bills the members and will either send you a royalty or you can charge for the content.

Communications Strategies in New York is developing a cooperative start-up venture firm to help launch such enterprises. Dial them at (212) 684-0534. Another source for advice is IncNet. Started by Inc. Magazine for medium-size business owners, the network is currently operating on The Source and Dialcom. So far, it's been an electronic cocktail party because of the lack of leadership. But it could become a hotbed of entrepreneurial activity if it gets organized. IncNet operates on a new,

computer conferencing software called PARTICIPATE from Participation Systems Inc. (PSI) of Winchester, MA.

## Beyond Electronic Mail

PSI's founder, Chandler Harrison Stevens, is associated with the Center for Information Systems Research at MIT. Stevens has long been an advocate of Many-to-Many Communications, his term for the key difference between computer conferencing (CC) and other forms of electronic mail (Telex, facsimile, computer-based messaging, voice store, and forward). What's the difference?

Electronic mail simply provides electronic delivery of fairly ordinary memos that are typed in at one end and come out at the other, or are placed in queue behind other preceding messages. CC allows complex interactions among a group of people by storing the communications on a system, in one place. Any part of the "discussion" can be retrieved at will. You can reconstruct an ongoing "meeting" or correspondence at any time and make comments about specific parts. Many conferences can be held simultaneously, each serving a different purpose, each stored in its own place on the system.

"The single file, lock-step delivery of electronic mail doesn't permit this kind of multi-layered group communication," explains Tom Cross of Cross Communications in Boulder, Colorado. "For the first time, we can begin to really track the progress of a project from inception to completion, allowing software management, new staff, or observers to participate at any point along the way."

Only a small number of corporations, government agencies, and non-profit organizations are using computer conferencing. For instance, the nation's electric utilities and nuclear equipment suppliers use CC to share experiences and update one another on proposed regulations flowing out of Washington since the Three Mile Island incident.

Ron Simard of the Electric Power Research Institute in Palo Alto, California, has organized CC for the International Nuclear Power Organization (INPO). He claims his is the largest CC in the world: over five hundred people globally. "Subject matter ranges from operating plant experiences and problems, their implications and what to do about them immediately, to government regulation and how to respond," says Simard.

## Electronic Jungle Drums

The Bechtel Corporation is using CC to help manage several massive construction projects around the world. One is in the deepest jungles of New Guinea where the largest gold mine in the world was found, along with copper and other valuable minerals. According to Susan Winterstein, coordinator of the project, "The communications between jungle, the managing office in Australia, and our headquarters here in San Francisco would have been a nightmare without computer conferencing. In addition, new people coming on to the project can be quickly updated by retrieving previous entries," she said.

Patricia Pfifer of United Technologies, and ex-telecommunications specialist for AT&T, refers to the research on cost-effectiveness of teleconfer-

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**PROPHET, a large  
timesharing service,  
is the central  
software link that  
makes possible  
several joint medical  
projects now going on  
at different locations.**

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encing: "Our studies show that one dollar of teleconferencing equals four dollars of face-to-face meetings and travel." Citing the fact that white-collar workers are the least watched in industry in terms of productivity, the AT&T study concluded that 50% of all business conducted could be through teleconferencing. "It should be, too," Pfifer adds. She cites these advantages:

1. Computer conferencing saves time, not just money (35% reduction in time to achieve the same results).
2. It's convenient. Everyone can follow up on meetings, receive new policies, facts, and product information simultaneously; new people may be added to the conference as needed without briefing; colleagues who would not normally attend the meeting can participate later.

3. It forces discipline (better listening, preparedness, prioritizing). The study showed that CC enhances information exchange, briefings, decision-making, problem-solving, and settling differences of opinion. More human than paper, CC makes possible personal support at many levels of the organization.

## Scientists Collaborate

Computers are changing the way scientists communicate. PROPHET, a large timesharing service sponsored by NIH (Biotechnology Resources Program) is the central software link that makes possible several joint medical projects now going on at different locations. Maintained by Bolt, Branek, and Newman (BBN) of Cambridge, Massachusetts, PROPHET allows the researchers to transmit results to investigators elsewhere via ARPANET, the research and development network sponsored by the government's Advanced Research Projects Agency. In addition to instant dissemination, it allows the researcher to produce three-dimensional models of molecules and run statistical analyses.

## In the Crystal Ball

What's ahead for the micro revolution? To date, what's happening in the home and the office (Pac Man, Visi-Calc) is hardly going to change our lives; it's what going to happen that will. Theory 3 (or E for Enterprise) will drive the PC home market as much as all the other incentives (besides entertainment) put together, if the current trend accelerates apace. Electronic cottage industries, as well as electronic publishing by national and regional associations, are springing up so fast that venture capitalists are swamped with investment opportunities.

On the office front, local area networks and electronic mail are coming into use and will change the way executives communicate. Whether this will contribute to the Information Society or the Misinformation Society is up to the executives, not the technology.

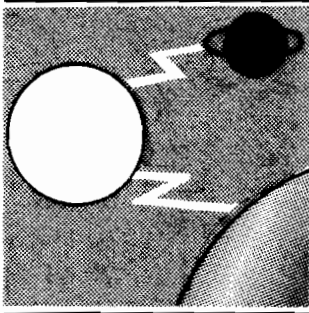
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Bradley "Pete" Coley is founder of Communications Strategies. His firm consults to information technology companies and new ventures. You may contact him at B.L. Coley Public Relations, 533 Second Ave., New York, NY 10016.

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# A Not-So-Dumb Terminal Program for the SuperPET

by Terry M. Peterson



**Turn the Commodore SuperPET into a smart terminal for a mainframe with this 6502 machine-language program. The program uses the 6551 ACIA serial port of the SuperPET for RS-232 I/O and requires no external hardware.**

Probably the PET's most endearing feature is its convenient screen editor. After I became familiar with this editor, I found ordinary line-oriented text editors all but impossible to use. I felt especially frustrated when using the PET as a dumb terminal to a time-shared computer. Obviously the screen editor is still in there — but how do you use it? Before the advent of the SuperPET I made several attempts to tap this resource in programs designed to work with IEEE RS-232 interfaces, but the results were never satisfying. When I saw the built-in RS-232 port of the SuperPET that uses the 6551 ACIA, I knew the marriage of the PET screen editor and my time-share system was at hand.

This article describes a 6502 RS-232 terminal program that sends edited lines to a host computer using the PET screen editor and the SuperPET's 6551 ACIA. SMARTERM handles conversion of PET-ASCII to true ASCII, as well as control and BREAK characters. The program has an optional character-by-character mode for use with remote screen editors and for other cases when line-by-line mode is undesirable. I've tied the program into the PET's 60 Hz jiffy IRQ interrupt for the input of characters from the host computer, so unexpected input isn't lost. This IRQ

patch also allows you to enter from the keyboard, the 8032 special screen formatting characters and send control and BREAK characters. The program does not buffer characters input from the RS-232 port; such buffering is unnecessary for operation up to (at least) 2400 baud as long as the host computer can be made to send several nulls after each carriage return. At 300 baud even the nulls are unnecessary.

The 6551 ACIA makes the programmer's job very easy. This chip takes care of trapping characters at the serial port and decoding them into an 8-bit parallel buffer called the received-data register. The programmer only has to establish such things as the baud rate, parity, and duplexing — and to fetch the bytes from the received-data register before they are overwritten by the next character. Sending characters is even easier — merely POKE the data into the transmit-data register and wait for the 6551 to signal that it has finished sending.

To the 6502 or 6809 in the SuperPET, the 6551 appears as the four memory registers \$EFFF through \$EFF3. \$EFFF acts as the receive- or transmit-data register depending on whether it is PEEKed or POKEd. \$EFF1 is the status register. It indicates the following: status of the receive and transmit

registers; occurrence of parity, framing, and over-run errors; and the status of the RS-232 control lines DCD and DSR. It also contains an IRQ flag (bit 7). If \$EFF1 is POKEd with anything the 6551 is reset (i.e., turned off). \$EFF2 is called the command register. Most of its bits determine the mode of operation of the 6551 with respect to the microprocessor, but some are used to set the RS-232 parity option. \$EFF3, the control register, is used to set the 6551's RS-232 operation with respect to baud rate, word length, and number of stop bits. Table 1 shows the bit settings for the various modes determined by the control and command registers, as well as the bit arrangement of the status register. For further information on the 6551, I recommend the data sheets found in the Synertek 1981-1982 Data Catalog.

Listing 1 shows the assembler source for the terminal program. I have provided extensive comments in the listing, so I will give only a rough outline of the program operation here. (The names in parentheses give the label on the source code line that begins the section described.) The first part of the program (START) is a subroutine that revector the IRQ through the received-character detect code, sets the necessary 6551 registers, and enables the 6551 IRQ interrupt. If desired, the RTS at the end of this part may be omitted in order to fall directly into the main program loop instead of returning to the calling routine (BASIC).

Next is the main program loop (INLOOP) that handles characters from the keyboard. After the main loop follows (QUIT), the code that restores the IRQ vector and resets the 6551. Next is (CHARIN), the subroutine to

fetch characters from the keyboard. Note that this subroutine alerts the user of char-by-char operation by a non-flashing cursor. (The complication in the code here is setting/clearing control mode for char-by-char output.) Then comes (TSTIRQ), the IRQ vector patch code to trap 6551 IRQ's followed by (INCHR), the code to convert incoming characters to PET-ASCII and, optionally, to display control codes as reversed-field letters. Next is

(CTRLTB), a table of the PET-ASCII equivalents for ASCII control codes. Finally there is (KEYTST), the post-jiffy interrupt code that examines each keystroke to test for special screen formatting, control (reverse), and BREAK (STOP) keys. Notice that BREAK is always "live" — that is, even in line-by-line mode the BREAK character is sent while the 'STOP' key is held down.

Listing 2 shows a sample BASIC

calling program. Note that this program could be modified to send a log-in sequence between the two SYSs.

If you have machine-language experience and the inclination you could easily extend the terminal program. For example, to add a disk log of your terminal session, take the following steps: 1. Add two JSR \$FFD2's to the machine language (one just after the line labeled INLOOP and the other between CHA100 and JMP \$E202), 2. OPEN a disk file in the BASIC calling program, and 3. CMD the disk file just before the final SYS into SMARTERM. (This procedure will work even at high baud rates!) To up-load disk files to the mainframe, OPEN the disk file, perform the first SYS, and then GET# bytes from the file, POKE them into 61424, WAIT 61425,16, and loop. Of course this looping could be speeded up if it were implemented in machine language: add an ST check to the main loop and SYS to the sequence LDX #1fn/JSR \$FFC6/JMP INLOOP after OPENing the disk file #1fn in BASIC.

Command Register (\$E2F2)	
Bit(s)	Function
0	Data Terminal Ready (1 = DTR true & rcvr enabled)
1	Receiver IRQ Enable (0 = enabled)
2-3	Transmitter Control
	00 = IRQ disabled, RTS false, Xmitter off
	01 = IRQ enabled, RTS true, Xmitter on
	10 = IRQ disabled, RTS true, Xmitter on
	11 = IRQ disabled, RTS true, Xmit BREAK
4	Echo mode (1 = echo received chars.)
5-7	Parity Control
	XX0 = ignore parity
	001 = odd parity
	011 = even parity
	101 = xmit '1' parity bit, ignore on received data
	111 = xmit '0' parity bit, ignore on received data
Control Register(\$E2F3)	
Bit(s)	Function
0-3	BAUD rate
	0000 = use external generator (not impl. on SuperPET)
	0001 = 50
	0010 = 75            1001 = 1800
	0011 = 109.92       1010 = 2400
	0100 = 134.58       1011 = 3600
	0101 = 150           1100 = 4800
	0110 = 300           1101 = 7200
	0111 = 600           1110 = 9600
	1000 = 1200          1111 = 19200
4	Receiver clock (1 = internal gen.)
5-6	Word length 00,01,10,11 = 8,7,6,5 bits respectively
7	Stop bits 0,1 = 1,2 stop bits (but see data sheet)
Status Register (\$E2F1)	
Bit(s)	Function
0	Parity error (1 = error)
1	Framing error (1 = error)
2	Overrun error (1 = error)
3	Received data (1 = true)
4	Transmitted data (1 = true)
5	[not]DCD (echos pin level, usu. inv. of RS232)
6	[not]DSR (as DCD)
7	IRQ (1 = interrupt requested)

Terry Peterson performs photovoltaic cell research at Chevron Research Company. He first used PETs at work to control and collect data from various laboratory experiments. Now addicted, he writes utility-type software and articles about the PET, CBM, SuperPET, VIC, C64, etc. He may be contacted at 8628 Edgehill Ct., El Cerrito, CA 94530.

**FOR YOUR CONVENIENCE  
THE LISTINGS FOR  
SMARTERM FOLLOW ON  
THE NEXT THREE  
RIGHT HAND PAGES**



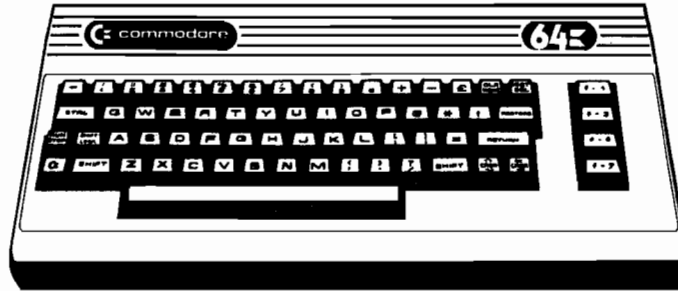
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Circle No. 38

SMARTERM Listing (continued)

```

LOC  CODE  LINE
7D6A      ;
7D6A      ; If CHMODE<128 input is line-by-line,
7D6A      ; otherwise characters
7D6A      ; as they are typed.
7D6A      CHARIN BIT CHMODE
7D6A 24 D3      BMI CHGET
7D6C 30 0A      JMP $FFC4
7D6E 20 CF FF      JSR $FFCF
7D71 C9 0D      CMP #D
7D73 D0 38      BNE CHDONE
7D75 4C 02 E2      CHA100 JMP $E202

7D78 20 E4 FF      CHGET JSR $FFE4
7D7B F0 FB      BEQ CHGET
7D7D C9 12      CMP #12
7D7F D0 06      BNE CHG100
7D81 20 95 7D      CHG050 JSR CRTPRT
7D84 4C 78 7D      CHG100 JMP CHGET
7D87 C9 92      CMP #92
7D89 F0 F6      BEQ CHG050
7D8B C9 22      CMP #22
7D8D F0 06      BEQ CRTPRT
7D8F A6 CD      LDX CRSPRT
7D91 F0 02      BEQ CRTPRT
7D93 29 1F      AND #1F
7D95 24 D3      CRTPRT BIT CHMODE
7D97 10 DC      JSR CHA100
7D99 20 9F 7D      JSR CRSFPL
7D9C 20 75 7D      JSR CHA100

7D9F      ; Turn on/off cursor at current position
CRSFPL PHA
7D9F 4B      TYA
7DA0 98      PHA
7DA1 4B      LDY $C6
7DA2 A4 C6      LDA ($C4),Y
7DA4 B1 C4      EOR #80
7DA6 49 80      STA ($C4),Y
7DAB 91 C4      PLA
7DAA 68      TAY
7DAB A8      PLA
7DAC 68      CHDONE RTS
7DAE 60      ; Code to handle interrupt-driven input of characters
7DAE      ; from the 6551 ACIA.
TSTIRQ LDA $EFF1
7DAE AD F1 EF      BPL TST60
7DB1 10 07      LDX $EFC0
7DB3 AE F0 EF      AND #8
7DB6 29 08      BNE INCHR
7DB8 D0 16      BIT $E813
7DBA 2C 13 E8      BPL IRQDON
7DBD 10 5D      BIT $E812
7DBF 2C 12 E8      CLI
7DC2 58      LDA #>KEYTST
7DC3 A9 7E      PHA
7DC5 4B      LDA #<<KEYTST
7DC6 A9 3F      PHA
7DCB 48      PHP
7DC9 08      PHA
7DCA 48      PHA
7DCB 48      PHA
7DCC 4B      PHA
    
```

SMARTERM Listing (continued)

```

LOC  CODE  LINE
7DDC 4C 55 E4      JMP $E455
7DD0      ; Process 6551 IRQ
7DD0      ;
7DD0      INCHR TXA
7DD1 C9 0D      CMP #D
7DD3 D0 07      BNE INCH02
7DD5 A9 91      LDA $91
7DD7 20 95 7D      JSR CRTPRT
7DDA D0 18      BNE INCH05

7DDC C9 20      INCH02 CMP #20
7DDE B0 18      BCS INCH10
7DE0 24 D2      BIT CTRLPR
7DE2 10 10      BPL INCH05
7DE4 69 40      ADC #40
7DE6 48      PHA
7DE7 A9 12      LDA #12
7DE9 20 95 7D      JSR CRTPRT
7DEC 68      PLA
7DED 20 95 7D      JSR CRTPRT
7DF0 A9 92      LDA #92
7DF2 D0 1D      BNE INCH30

7DF4 BD 1F 7E      INCH05 LDA CTRLTB,X
7DF7 F0 23      BEQ IRQDON
7DF9 D0 16      BNE INCH30

7DFB C9 41      INCH10 CMP #41
7DFD 90 12      BCC INCH30
7DFE C9 5B      CMP #5B
7E01 90 0C      BCC INCH20
7E03 C9 7F      CMP #7F
7E05 F0 15      BEQ IRQDON
7E07 C9 60      CMP #60
7E09 90 06      BCC INCH30
7E0B E9 20      SBC #20
7E0D 09 80      ORA #80
7E0F 49 80      EOR #80
7E11 20 95 7D      INCH20 EOR #80
7E11 20 95 7D      INCH30 JSR CRTPRT
7E14      ; Now fix screen editor pointers to ignore
7E14      ; input from RS232 port.
7E14      LDA $C6
7E16 A5 A4      STA $A4
7E18 A5 D8      LDA $D8
7E1A B5 A3      STA $A3

7E1C 4C 00 E6      IRQDON JMP $E600
7E1F      ; Table of PET-control
7E1F      ; Zero entry = ignore
7E1F      ; CTRLTB .BYTE 0,0,0,0,0
7E20 00      .BYTE 0,0,0,0,7
7E21 00
7E22 00
7E23 00
7E24 00
7E25 00
7E26 07
7E27 9B
7E28 09
7E29 11
    
```

Emulates these terminals exactly.

IBM 3101  
DEC VT100, VT52  
Data General D200  
ADDS Regent 20, 25, 40  
Hazel/line 1400, 1410, 1500  
Lear Siegler ADM-3A, ADM-5  
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- Hayes Smartmodem™ 300, & 1200
- Intra Computer PS10
- Mountain Computer CPS Card™
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## Your host computer won't know the difference!

Softerm provides an *exact* terminal emulation for a wide range of host computer systems. Special function keys, sophisticated editing features, even local printer capabilities of the terminals emulated by Softerm are fully supported. Softerm operates with even the most discriminating host computer applications including video editors. And at speeds up to 9600 baud using either a direct connection or any standard modem.

## Unmatched file transfer capability

Softerm offers file transfer methods flexible enough to match any host computer requirement. These include *character protocol* with user-definable terminator and acknowledge strings, block size, and character echo wait, and the intelligent *Softrans™* protocol which provides reliable error-free transmission and reception of data. The character protocol provides maximum flexibility for text file transfers. *Any* type file may be transferred using the Softrans protocol which provides automatic binary encoding and decoding, block checking with error recovery, and data compression to enhance line utilization. A FORTRAN 77 source program is supplied with Softerm which is easily adaptable to any host computer to allow communications with Softerm

using the Softrans protocol.

Softerm file transfer utilizes an easy to use *command language* which allows simple definition of even complex multiple-file transfers with handshaking. Twenty-three high-level commands include *DIAL, CATALOG, SEND, RECEIVE, ONERR, HANGUP, MONITOR* and others which may be executed in immediate command mode interactively or from a file transfer macro command file which has been previously entered and saved on disk.

## Built-in utilities

Softerm disk utilities allow DOS commands such as *CATALOG, INIT, RENAME, and DELETE* to be executed allowing convenient file maintenance. Local file transfers allow files to be displayed, printed, or even copied to another file without exiting the Softerm program. Numerous editing options such as tab expansion and space compression are provided to allow easy reformatting of data to accommodate the variations in data formats used by host computers. Softerm supports automatic dialing in both terminal and file transfer modes. Dial utilities allow a *phone book* of frequently used numbers to be defined which are accessed by a user-assigned name and specify

the serial interface parameters to be used.

## Online Update Service

The Softronics Online Update Service is provided as an additional support service at no additional cost to Softerm users. Its purpose is to allow fast turnaround of Softerm program fixes for user-reported problems using the *automatic patch facility* included in Softerm as well as a convenient distribution method for additional terminal emulations and I/O drivers which become available. *User correspondence* can be electronically mailed to Softronics, and *user-contributed* keyboard macros, file transfer macros, and host adaptations of the Softrans FORTRAN 77 program are available on-line.

## Most advanced communications software available

Just check Softerm's 300 page user manual. You simply can't buy a more sophisticated package or one that's easier to use. Available now for only \$150 from your local dealer or Softronics, Inc.

# SOFTRONICS

6626 Prince Edward, Memphis, TN 38119. 901-755-5006

Circle No. 18



SMARTERM Listing (continued)

```

LOC  CODE  LINE
7E2A  91      .BYTE $93,$BD,$12,$92
7E2B  93
7E2C  8D
7E2D  12
7E2E  92
7E2F  14
7E30  00
7E31  00
7E32  00
7E33  00
7E34  00
7E35  00
7E37  00
7E38  00
7E39  00
7E3A  00
7E3B  00
7E3C  00
7E3D  00
7E3E  00
7E3F  91
7E40  25
7E41  F0
7E42  6F
7E43  02
7E44  A6
7E45  CD
7E46  A6
7E47  D0
7E48  16
7E4A  A6
7E4B  98
7E4C  F0
7E4E  A2
7E50  DD
7E53  D0
7E55  BD
7E58  8D
7E5B  B0
7E5D  CA
7E5E  10
7E60  C9
7E62  F0
7E64  C9
7E66  F0
7E68  4C
7E6B  00
7E6B  00
7E6B  A9
7E6D  A6
7E6F  F0
7E71  BD
7E74  A9
7E76  BD
7E79  A9
7E7B  85
7E7D  D0
7E3F  91
7E40  25
7E41  F0
7E42  6F
7E43  02
7E44  A6
7E45  CD
7E46  A6
7E47  D0
7E48  16
7E4A  A6
7E4B  98
7E4C  F0
7E4E  A2
7E50  DD
7E53  D0
7E55  BD
7E58  8D
7E5B  B0
7E5D  CA
7E5E  10
7E60  C9
7E62  F0
7E64  C9
7E66  F0
7E68  4C
7E6B  00
7E6B  00
7E6B  A9
7E6D  A6
7E6F  F0
7E71  BD
7E74  A9
7E76  BD
7E79  A9
7E7B  85
7E7D  D0
; The following code is executed after
; each 'jiffy' interrupt. It tests for
; several 'special' keystrokes to allow
; enhanced screen editing, setting/clearing
; of control mode, and sending BRK's.
;
KEYTST LDA NDX
      BEQ REXIT
      LDA KEYD
      LDX CRSPRT
      BNE KEY05
      LDX SFST
      BEQ KEY05
      LDX #NKYS
      CMP KEYTAB,X
      BNE KEY04
      LDA RPLTAB,X
      STA KEYD
      BCS REXIT
      DEX
      BPL KEY02
      CMP #12
      BEQ CTLTGL
      CMP #3
      BEQ KEYBRK
      REXIT
      JMP IRQDDN
; Set or clear control mode
;
CTLTGL LDA #22
      LDX CRSPRT
      BEQ CTL100
      STA KEYD
      LDA #92
      CTL100 STA KEYD+1
      LDA #2
      STA NDX
      BNE REXIT

```

SMARTERM Listing (continued)

```

LOC  CODE  LINE
7E7F  7E7F  ; Send BRK for as long as operator holds down 'STOP'.
      ;
      KEYBRK LDA #0
      STA NDX
      LDA $9B
      CMP #SEF
      BNE KBKDDN
      LDA $EFF2
      ORA #4
      STA $EFF2
      BNE KEYBRK
      KBKDDN LDA $EFF2
      AND #SFB
      STA $EFF2
      BNE REXIT
      RPLTAB .BYT 27,'0123456789.' ;'ESC' & numeric pad
      .BYT 22
      .BYT 149
      .BYT 150
      .BYT 21
      .BYT 153
      .BYT $11
      .BYT $0E
      .BYT 25
      .BYT $91
      .BYT $8E
      .BYT $0F
      .BYT $8F
      .BYT $00
      .WORD 00
      .END
      ; ESC = erase to EOL
      ; '0' = insert line
      ; '1' = erase to beg.
      ; '2' = delete line
      ; '3' = scroll down
      ; '4' = crsr down
      ; '5' = enter text mode
      ; '6' = scroll up
      ; '7' = crsr up
      ; '8' = enter graphics mode
      ; '9' = set top of window
      ; '.' = set bot. of window
      NKYS = RPLTAB-KEYTAB ;# OF SPECIAL KEYS
      JIFFY .WORD 00
      .END

```

BASIC DRIVER FOR SMARTERM

```

100 POKE 53,7*16:CLR:
110 IF PEEK(32000)<>120 THEN LOAD "smrts".8: REM: protect code from basic
120 csc$="I 2 HOME]TEXT]I 24 DOWN]": REM: get code if necessary
130 PRINT "[RVS] S M A R T E R M 5 . 0 "
140 INPUT "[DOWN]mode ([RVS]):[OFF]line/[RVS]c[OFF]har.) I I 3 LEFT]";x$
150 md$="line-by-line";IF x$<>"1" THEN md$="char-by-char"
160 POKE 13*16+3,-255*(x$<>"1"): REM: set output mode flag
170 INPUT "[DOWN]display control chars (y/n) n I 3 LEFT]";x$
180 POKE 13*16+2,-255*(x$="y"): REM: set cntrl char flag
190 ccs$="invisible";IF x$="y" THEN ccs$="visible"
200 SYS 32000:
210 GOSUB 270:
220 ; REM: the following line could be replaced by auto-logout code
230 PRINT "[CLR]you should now attempt to logon.
240 IF st=19 THEN 130:
250 PRINT "[RVS]lost carrier.":END
270 PRINT csc$:[SET TOP]([CLR]):[RVS]mode: "md$;
280 PRINT TAB(30)"control chars: "cc$csc$[UP]":TAB(79)"[SET BOT]([HOME]";
      RETURN

```

# Dialing the Networks

by Cliff Glennon

## Essential steps for a MC6809-based home computer to communicate with the two major computer networks.

Have you ever come home without a newspaper and wished you had something to read? Are you tired of paying high prices for slow mail delivery? Subscribers to THE SOURCE and COMPUSERVE can get news, instant electronic mail, and a host of other valuable services delivered right to their home computers.

There are so many services offered by COMPUSERVE that a magazine is published to provide a convenient index to them. THE SOURCE sends out an executive manual that covers its services. I had the spelling in this article checked by THE SOURCE, and COMPUSERVE can give me the prices of stereo equipment.

I have heard it said that by the next decade a literate person will have to know computers to be able to communicate. This communication most likely will be over the telephone lines through computer services such as THE SOURCE or COMPUSERVE. If you want a taste of what it will be like to work at home and communicate to a large central computer system, it's all here. If you have a program that will not fit in your memory, you have access to all the memory and disk operating systems you can handle over your telephone.

### The Modem

Modem is a contraction for modulator-demodulator. Although I don't have one, the Originate-Answer type of modem is probably best. This

### Dialing

requires:

6809-based microcomputer

**Table 1: Summary of the MC6850 ACIA Command Register**

bits 0-1)	000000bb	Divides the system clock to provide output baud rates. 00 - Divide by 1 01 - Divide by 16 10 - Divide by 64 11 - Reset the ACIA The SWTPC MP-S2 is set up to use a divide by 16 when 300 baud is selected on the interface jumpers.
bits 2-4)	000bbb00	Word Length, Parity, Stop Bit Selections 000 - 7-bit word, even parity, 2 stop bits 001 - 7-bit word, odd parity, 2 stop bits 010 - 7-bit word, even parity, 1 stop bit 011 - 7-bit word, odd parity, 1 stop bit 100 - 8-bit word, no parity, 2 stop bits 101 - 8-bit word, no parity, 1 stop bit 110 - 8-bit word, even parity, 1 stop bit 111 - 8-bit word, odd parity, 1 stop bit I access both COMPUSERVE and THE SOURCE with a 7-bit word, even parity, 1 stop bit, %00001000 or 010.
bits 5-6)	0bb00000	Controls RTS output [pin 5], Break Transmission, Transmitter Interrupts 00 - RTS = 0, inhibits transmitter interrupt 01 - RTS = 0, enables transmitter interrupt 10 - RTS = 1, inhibits transmitter interrupt 11 - RTS = 0, inhibits transmitter interrupt, transmits Break I do not use these features.
bit 7)	b0000000	Controls Interrupts to the 6809 Processor 1 - enables interrupts when a letter is received 0 - disables interrupts when a letter is received I have used this feature in the past, but my Disk Operating System uses the interrupt vector and I hesitate to share that vector when I am using disk reads and writes. Also I found that using interrupts prevents control characters from being sent to the Services (e.g., a break or Control-P) by assigning a priority to incoming letters.

means that you can be the one to initiate the call (Originate) or that your computer can be called by another computer (Answer). I have an Originate-only modem, and this is sufficient to connect to the computer services.

My modem is a direct-connect, which means there is no acoustic coupler to add problems to the communications channel. I see no need to convert the electronic signals from the computer to sound, and convert the sound back to electronic signals to send over the phone lines. In addition, acoustic couplers are made for round phone speakers, and my phone handset is square. The phone company installed the USOC RJ-11C jack required by the

modem. This jack, as it turns out, is also required by my telephone answering machine and enables me to plug or unplug phone equipment easily.

The two Services require at least a 300-baud rate:

$$\text{baud} = (\text{approx.}) 10 \times \text{characters/second}$$

but also provide 1200-baud service. The future undoubtedly will be with the faster baud rates and a modem that could operate at such speeds would be an advantage.

### The Cable

If you construct your own modem-computer connector, you must trans-

late the modem manufacturer's terms to the computer manufacturer's terms. The name RS-232 is code for a loose agreement "standard" for connectors that original equipment manufacturers (OEMs) can use to attach their devices to a variety of computers. As long as a device follows the RS-232 standard, I can attach it to my SWTPC S09 computer. Here are the modem-to-computer conversions:

Modem Pin	Line Description	Computer (SWTPC MP-S2) Pin
(1)	Protective Ground	(1)
(2)	Transmitted Data	(3) < **note well
(3)	Received Data	(2)
(5)	Clear to Send	Not connected
(6)	Data Set Ready	(20) Clear to Send
(7)	Signal Ground	(7)
(8)	Data Carrier Detector	(12) SDCD

The first thing to notice in the list is that lines 2 and 3 are reversed in the two machines. This is a standard configuration and should be found in all modem-computer connections. The Data Carrier Detector line does not have to be connected for the MP-S2 interface to work. A very careful reading of the SWTPC documentation discloses that pin 20, the Clear-to-Send pin, should be connected to "the buffer full or data terminal ready line." All in all, only five lines need to be implemented.

The cheapest cable is ribbon cable. But a major disadvantage is that the signals on this cable radiate to interfere with any television sets in your house. If you live in an apartment, ribbon cable is out; you should have a cable custom made with the lines twisted and mylar shielded. Another alternative is to adapt an unused shielded cable.

DB-25 is the name for the 25 pin connectors used with RS-232 interfaces. They are male and female to indicate whether they are plugs or sockets. If you order the cable made, be sure you understand how the manufacturer wants the gender of the DB-25 connector specified. Serial interfaces usually require male DB-25 connectors; parallel interfaces need female connectors. Cable and connectors can be purchased from computer stores or hobby mail-order houses.

Attaching wires to the connectors is easy. A low-wattage soldering iron and 60/40 rosin-core solder is all that is necessary. A short length of heat-

**Table 2: The MC6850 ACIA Status Register**

bit 0)	0000000b	0 - Receiver Data Register empty 1 - Receiver Data Register full A character has been received and can be read from the Data Register
bit 1)	000000b0	0 - Transmitter Data Register full ** Note opposite meanings from bit 0 1 - Transmitter Data Register empty A character can now be sent
bit 2)	00000b00	0 - Data Carrier Detect is present 1 - Loss of Data Carrier If this line is connected
bit 3)	0000b000	0 - Clear to Send signal is detected 1 - No Clear to Send **** Note: this line must be connected for the 6850 to operate. If this line is high (\$08 in the Status Register), no data can be transmitted. This is pin 20 on the MP-S2 connector
bit 4)	000b0000	0 - No Framing Error 1 - Framing Error Faulty character synchronization
bit 5)	00b00000	0 - No Overrun 1 - Overrun More than one character was received before one was read
bit 6)	0b000000	0 - No Parity Error 1 - Parity in the received character is incorrect
bit 7)	b0000000	0 - Any interrupts enabled in the Control register 1 - Can also be read as output in this bit

shrinkable tubing is slipped over the wire before soldering. After the solder connection is made, this tubing is pulled down over the connection and shrunk to a tight fit by heat from the iron; or you can use plastic electrical tape if you prefer. A VOM can be used to check if there are any invisible breaks in the wire, if the right pin is connected, or if there is a short between wires. An inexpensive VOM is sufficient, because only resistance measurements are needed.

The next step is to write the program that allows the computer to talk on the telephone. A preliminary procedure is to study the device used in the computer interface to find out the commands it needs to operate. The device in my system is the Motorola MC6850 ACIA, or Asynchronous Communications Interface Adapter (I am curious to see what the spelling checker does with that!). To send a command to the 6850, a value (such as \$03) is placed in the Control Register. For example:

```
LDA $03    Load accumulator A with
           the 6850 Reset value
STA $E040  Control/Status Register
           address in my system
```

The commands are coded to fit into an 8-bit byte (see table 1). If table 1 seems complicated, remember that all you have to do is select one option in each of the categories to fit your needs and the 6850 does the rest! Thus, COMPUSERVE asks for a 7-bit ASCII word, even parity, one start, and one stop bit. All this is done with a \$09 or %00001001. After sending this command to the 6850, all data sent out by the computer to the modem conforms to this requirement, and data received is checked to see if it matches as well. Characters are transmitted and received simultaneously.

THE SOURCE looks for an 8-bit ASCII word, no parity, one stop bit. This is obtained with a \$15 or %00010101. I am able to connect on my SWTPC 6800 system using this command; but my 6809 system balks at this code and talks only on the \$09 code. Customer service at THE SOURCE told me that a 7-bit word could be used to communicate, but that an 8-bit word is required in their "local mode," which, I guess, is dialing from Washington D.C. My motto in this case is "what works, works," but I am sure I will have to find the source of the trouble someday.

Both services require full-duplex

operation, which means the service will echo a character sent by your equipment back to you. Note that you do not have to echo a character back to the service. Full-duplex operation is assumed in the attached program.

The computer processor is processing data at a megahertz-cycle clip, and the ACIA modem is running at only 300 baud, so a means must be provided to see if the slow pair is ready for another letter. This is provided by the status register, which tells us whether or not a letter has come in, or what some of the problems in the reception are. On my system, this register is read by an

```
LDA $E040  Reads the ACIA Status
           Register
```

The status register is summarized in table 2.

It is necessary only to check bits 0 and 1 for normal communications. If a parity option has been selected such as a \$05: 7-bit word; odd parity; and divide by 16, and the parity status register bit number 6 is not checked by a statement such as

```
LDA $E040  Read status
BITA $40   Check parity bit
```

then you are sending characters out with a parity bit set, but your own system is ignoring any parity bits received.

The final piece of information is how to read and write to the ACIA. The required statement is:

```
LDA $E041  Read Data Register
           or
STA $E041  Write to Data Register
```

## The Program

After loading the program, it prompts for a letter to begin initializing the ACIA. Enter any letter to start. Dial the computer service at this time and follow the sign-on procedures detailed in their instructions. To record any information, type a '~' or \$7E. To stop recording, enter another '~' or \$7E. To transmit a text file, type a '{' or \$7B. Do not be alarmed if the characters echoed back by the service during the transmission of a text file do not agree with the characters that are being sent. More than likely, when you review the file in the service's memory, it will agree with what you intended to send. But (and there must always be a "but")

a poor telephone line or static on the telephone line may garble the best transmissions. You must not touch the keyboard during transmission because this will end the transmission. Use this method to end the transmission, however, if the service sends out trouble messages such as

> illegal command

If the file TODAY.TXT is inadvertently closed, you can exit and restart the MODEM program without losing the telephone connection. Exit from the program by typing a '}' or \$7D.

## Problems

To locate a problem you must first isolate it by eliminating any areas of the connection that are not (or should not be) involved. Generally I assume anything that I have done is wrong, even though I know that I am right beyond a shadow of a doubt. This attitude has solved most of my problems quickly. Any manufactured and tested part is probably not the source of the problem.

Of course, I hope you do not have any problems with the program as it is printed here. It is designed for exchanging text messages. Binary transmissions, such as machine-language program exchanges, would require that parity and framing errors be detected. Error-correcting codes would also have to be employed to achieve 100% accuracy.

To paraphrase Professor James Burke in his CONNECTIONS series: The inventions that will probably be the most important are the ones that will improve communications.

*P.S. The SPELL program caught my "proprietary" and pointed out the correct "proprietary." "Asynchronous" passed by "synchronization" was unknown. The SPELL program also listed all the text formatter commands that are imbedded in the text (such as centering, etc.) as unknown words.*

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Circle No. 52

# Communications

## Glennon Listing

```

NAM MODEM
PROC
FLEX9 ENTRY POINTS
D406 FMS EQU $D406 FILE MANAGEMENT
CD24 PCRLF EQU $CD24 CARRIAGE RETURN
& LINE FEED
C018 INBUFF EQU $C018 INPUT INTO LINE BUFFER
C080 LINBUF EQU $C080 LINE BUFFER ADDRESS
CC14 BUFPOINT EQU $CC14 LINE BUFFER POINTER
CD20 GETFIL EQU $CD20 GET FILE SPECIFICATION
C01E PSTRNG EQU $C01E PRINT STRING
C015 GETCHR EQU $C015 INPUT 1 CHARACTER
CD3F RPTERR EQU $CD3F REPORT ERRORS
D403 FMSCLS EQU $D403 CLOSE OPEN FILES
C003 WARMS EQU $C003 EXIT TO FLEX9
ACIA ADDRESSES
E040 CNTRL EQU $E040 CONTROL/STATUS REGISTER
E041 DATA EQU $E041 DATA REGISTER
TERMINAL ACIA ADDRESSES
E004 TCNTRL EQU $E004 CONTROL/STATUS REGISTER
E005 TDATA EQU $E005 DATA REGISTER
PROGRAM ENTRY POINT
0000 8E 02 84 START: LDX #FCB THE FILE CONTROL
BLOCK (FCB) IS A 320 BYTE BLOCK USED BY
FLEX9 TO CONTROL DISK INPUT/OUTPUT.
0003 10 8E 02 72 LDX #FILSPEC A CONVENIENT
WAY TO INITIALIZE A FCB FOR USE BY
FLEX9.
0007 C6 0F LDB #15 15 LETTERS
0009 A6 A0 STLOOP LDA O,Y+ ARE WRITTEN
000B A7 80 STA O,X+ TO THE BLOCK.
000D 5A OECB
000E 2A F9 BPL STLOOP
0010 8E 02 84 LDX #FCB RESET ACX
0013 BD D4 06 JSR FMS OPEN THE FILE
0016 10 26 01 55 BNE ERROR ERROR TRAP
001A 8E 01 96 LDX #PROMPT PAUSE BEFORE
001D BD CD 1E JSR PSTRNG INITIALIZING ACIA
0020 BD CD 15 JSR GETCHR INPUT CHARACTER
0023 86 03 RESET LDA #3 RESET ACIA
0025 87 E0 40 STA CNTRL
0028 86 09 LDA #$09
002A 87 E0 40 STA CNTRL
002D 7F 02 71 CLR FLAG DISK WRITE FLAG
0030 8E 01 88 LDX #READMSG READY MESSAGE
0033 BD CD 1E JSR PSTRNG WRITE TO TERMINAL
INPUT A LETTER FROM THE TERMINAL
0036 86 E0 04 TERM LDA TCNTRL CHECK IF TERMINAL
0039 85 01 BITA #$01 KEY IS DEPRESSED
003B 27 33 BEQ PORT NO. GO SEE IF
MODEM HAS ANYTHING.
003D 86 E0 05 LDA TDATA YES. GET CHAR.
0040 81 7E CMPA #' ' TOGGLE DISK WRITE?
0042 26 18 BNE CKND NO. AND SKIP
D044 73 02 71 COM FLAG YES. FLIP SWITCH
0047 7D 02 71 TST FLAG DECIDE ON MESSAGE
004A 27 05 BEQ MSGOFF RECORD OFF
004C 8E 02 37 LDX #MSGON RECORD ON
004F 20 03 BRA MSG666 PUT ON TERMINAL
0051 8E 02 50 MSGOFF LDX #OFFMSG RECORD OFF
0054 BD CD 1E JSR PSTRNG REPORT IT
0057 8E 02 84 LDX #FCB RESTORE POINTER
D05A 20 14 BRA PORT GO CHECK ON PORT.
005C 81 7D CKND CMPA #'+' GIVE UP?
005E 10 27 01 00 BEQ DOEND YES.
0062 81 78 CMPA #'$' TRANSMIT A FILE?
0064 27 4D BEQ FILETRANS YES.
0066 F6 E0 40 OUTCH LDB CNTRL TRANSMITTER READY?
0069 C5 02 BITB #2
006B 27 F9 BEQ OUTCH NO. WAIT UNTIL READY
006D 87 E0 41 STA DATA READY, SEND DATA
INPUT A LETTER FROM THE MODEM.

```

```

0070 F6 E0 40 PORT LDB CNTRL DID ANYTHING
0073 C5 01 BITB #1 COME IN?
0075 27 BF BEQ TERM NO. GO CHECK TERMINAL.
0077 B6 E0 41 LDA DATA GET LETTER
THE FOLLOWING SCREEN IS NECESSARY TO
PREVENT A STRAY MISREAD CHARACTER FROM
ACTIVATING ANY OF THE 150 FUNCTIONS ON
THE SWTPC CT-82
007A 81 0D CMPA #$0D CARRIAGE RETURN?
007C 27 16 BEQ PORT1 OK
007E 81 0A CMPA #$0A LINE FEED?
0080 27 12 BEQ PORT1 OK
0082 81 08 CMPA #$08 BACKSPACE?
0084 27 0E BEQ PORT1 OK
0086 81 07 CMPA #$07 CHIMES?
0088 27 0A BEQ PORT1 OK
008A 81 20 CMPA #$20 OTHER CONTROLS?
008C 25 04 BLO WHAT NOT OK
008E 81 7E CMPA #$7E NOT ASCII?
0090 23 02 BLS PORT1 NOT OK
0092 86 7C LDA #' ' A SYMBOL TO INDICATE
THAT A BAD CHARACTER WAS RECEIVED.
0094 7D 02 71 PORT1 TST FLAG WRITE LETTER
TO DISK?
0097 27 0E BEQ PORT2 NO. SKIP
0099 34 02 PSHS A SAVE ACCA
009B 8E 02 84 LDX #FCB WRITE LETTER
009E BD D4 06 JSR FMS TO DISK.
00A1 10 26 00 CA BNE ERRDR ERROR TRAP
00A5 35 02 PULS A RESTORE ACCA
00A7 F6 E0 04 PORT2 LDB TCNTRL TERM READY?
00AA C5 02 BITB #S02
00AC 27 F9 BEQ PORT2 NO. WAIT
00AE B7 E0 05 STA TDATA SEND CHARACTER
00B1 20 83 BRA TERM AND GO CHECK TERMINAL.
TRANSMIT A DISK FILE
00B3 8E 01 84 FILETRANS LDX #TRANMSG PROMPT FOR FILE NAME
00B6 BD CD 1E JSR PSTRNG PRINT PROMPT
00B9 8E C0 80 LDX #$C080 LINE BUFFER ADDRESS
00BC BF CC 14 STX $CC14 BUFFER POINTER
00BF BD CD 1B JSR INBUFF INPUT FILE NAME
00C2 8E C0 80 LDX #$C080 LINE BUFFER ADDRESS
00C5 BF CC 14 STX $CC14 BUFFER POINTER
00C8 8E 03 C4 LDX #FCB2 NEW FILE CONTROL
BLOCK
00CB BD CD 2D JSR GETFIL ENTERS THE FILE
SPECIFICATION INTO THE
FILE CONTROL BLOCK
00CE 86 01 LDA #$01 OPEN FOR READ CODE
00D0 A7 84 STA O,X SET FCB
00D2 BD D4 06 JSR FMS OPENS THE FILE.
00D5 26 6D BNE ERRDR6 ERROR TRAP
READ EACH CHARACTER FROM THE FILE
00D7 8E 03 C4 READ_CHAR LDX #FCB2 POINTS TO FCB
00DA BD D4 06 JSR FMS LOADS ACCA WITH CHAR.
00DD 26 65 BNE ERRDR6 LOOKS FOR END OF FILE
ELIMINATE MORE THAN ONE CARRIAGE RETURN
TO PREVENT RETURNING TO COMMAND MODE IN
THE SOURCE.
00DF 81 0D CMPA #$0D CARRIAGE RETURN?
00E1 26 0C BNE NOT_CR NO.
00E3 70 02 70 TST CRFLAG WAS LAST A C.R.?
00E6 26 EF BNE READ_CHAR YES SKIP THIS
00E8 C6 FF LDB #FFF NO. BUT SKIP
00EA F7 02 70 STB CRFLAG ALL SUBSE-
00ED 20 03 BRA WAIT22 QUENT C.R.S.
00EF 7F 02 70 NOT_CR CLR CRFLAG CLEAR FLAG
00F2 F6 E0 40 WAIT22 LDB CNTRL CHECK FOR EMPTY
00F5 C5 02 BITB #S02 TRANSMITTER.
00F7 27 F9 BEQ WAIT22 NOT READY.
00F9 B7 E0 41 WAIT30 STA DATA SEND CHARACTER
00FC F6 E0 40 WAIT30 LDB CNTRL WAIT FOR ECHO
00FF C5 01 BITB #S01 FROM HOST
0101 26 14 BNE WAIT_OVER
0103 F6 E0 04 LDB TCNTRL ALLOW EXIT FROM
0106 C5 01 BITB #S01 LOOP
0108 27 F2 BEQ WAIT30
010A 26 73 BNE ERR66 TRAP ERROR
010C 8E 01 EE LDX #TRANSINT TRANSMISSION-

```

Glennon Listing (continued)

```

010F BD CD 1E      JSR PSTRNG   INTERRUPTED.
0112 8E 03 C4      LDZ #FCB2
0115 20 2D          BRA ERROR6

0117 B6 E0 41      WAIT_OVER   LDA DATA   PICK UP
                                     RETURNED CHAR
011A 81 00          CMPA #S00   ALLOW A CARRIAGE RET.
011C 27 0C          BEQ PASS_OVR
011E 81 0A          CMPA #S0A   ALLOW A LINE FEED
0120 27 08          BEQ PASS_OVR
0122 81 20          CMPA #S20   SCREEN IT
0124 25 10          BLO BAD_ECHO
0126 81 7E          CMPA #S7E   ASCII?

0128 22 0C          BHI BAD_ECHO
012A F6 E0 04      PASS_OVER   LDB TCNTRL  TERMINAL READY?
012D C5 02          BITB #S02
012F 27 F9          BEQ PASS_OVR NOT YET.
0131 B7 E0 05      STA TDATA   SEND TO TERMINAL
0134 20 A1          BRA READ_CHAR GET NEXT CHARACTER.

0136 86 7C          BAD_ECHO LDA #'I'  BAD ECHO INDICATOR
0138 F6 E0 04      BADBAD     LDB TCNTRL  TERMINAL READY?
013B C5 02          BITB #S02
013D 27 F9          BEQ BADBAD  NOT YET
013F B7 E0 05      STA TDATA   SEND TO TERMINAL
0142 20 93          BRA READ_CHAR TRY NEXT CHARACTER.

0144 A6 01          ERROR6     LDA 1,X     ERROR CODE
0146 81 08          CMPA #S08  END OF FILE
0148 27 03          BEQ CLOSE_SHOP YES THE ENO.
014A 80 C0 3F      JSR RPTERR  REPORT OTHER ERROR
014D 86 04          CLOSE_SHOP LDA #S04   CLOSE FILE CODE
014F A7 84          STA 0,X
0151 BD 04 06      JSR FMS     CLOSE FILE
0154 26 29          BNE ERR66
0156 8E 02 15      LDZ #TRANSCOMP END TRANSMISSION
0159 BD CD 1E      JSR PSTRNG  PRINT MSG
015C 8E 02 84      LDZ #FCB    RESTORE POINTER
015F 16 FE D4      BRA TERM    RETURN TO MAIN
                                     PROGRAM LOOP.

.
.
.
EXIT PROGRAM

0162 8E 02 84      DOENO     LDZ #FCB    TODAYS RECORD
0165 86 04          LDA #S4     CLOSE FILE CODE
0167 A7 84          STA 0,X     CLOSE THE FILE
0169 BD 04 06      JSR FMS
016C 7E CD 03      JMP WARMS   AND RETURN TO FLEX9

.
.
DISK OPERATION ERRORS

.
IF THE FILE TODAY.TXT EXISTS IT
MUST BE DELETED.

016F A6 01          ERROR     LDA 1,X     GET ERROR CODE
0171 81 03          CMPA #3     FILE EXISTS?
0173 26 0A          BNE ERR66   NO. REAL TROUBLE

.
LDA #12        DELETE FILE
0175 86 0C          LDA #12
0177 A7 84          STA 0,X
0179 BD 04 06      JSR FMS
017C 16 FE 81      BRA START   AND TRY AGAIN

.
ERR66         JSR RPTERR  REPORT ERROR
017F BD CD 3F      JSR FMSCLS  CLOSE ALL FILES
0182 8D 04 03      COM FLAG   CLEAR WRITE FLAG
0185 73 02 71      BRA TERM   CONTINUE TO RECEIVE
0188 16 FE AB      BRA TERM
018B 52 45 41 44  READMSG   FCC /READY/
0190 0A 00 00 00   FCB $0A,$0D,0,0,0,4
0196 54 59 50 45  PROMPT   FCC /TYPE ANY LETTER TO START/
01AE 0A 00 00 00   FCB $0A,$0D,0,0,0,4
01B4 45 4E 54 45  TRANSMMSG FCC /ENTER FILE SPECIFICATION FOR FILE
                                     TO BE TRANSMITTED./
01E8 0A 00 00 00   FCB $0A,$0D,0,0,0,4
01EE 49 4E 54 45  TRANSINT  FCC /INTERRUPT RECEIVED FROM
                                     TERMINAL./

020F 0A 00 00 00   FCB $0A,$0D,0,0,0,4
0215 54 52 41 4E  TRANSCOMP  FCC /TRANSMISSION FILE IS CLOSED./
0231 0A 00 00 00   FCB $0A,$0D,0,0,0,4
0237 20 20 20 2B  MSGON    FCC /++++ RECORDING ON ++++/
0250 20 20 20 2A  OFFMSG   FCC /**** RECORDING OFF ****/
026A 0A 00 00 00   FCB $0A,$0D,0,0,0,4
0270          CRFLAG   RMB 1     CARRIAGE RETURN FLAG
0271          FLAG    RMB 1
0272 02 00 00 00   FILSPEC  FCB 2,0,0,0,"TODAY",0,0,0,"TXT",0,0,0
0284          FCB    RMB 320   RECORD FILE
03C4          FCB2   RMB 320   TRANSMIT FILE
                                     END
0000          END START
-- NO ERRORS THIS ASSEMBLY.

```

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Circle No. 61

# A Home-Built Communications Interface

by John Steiner

**Circuitry and techniques to construct a communications interface. With modifications could be converted to a telephone modem. Simple, reliable, and inexpensive design.**

Communication between computers is rapidly becoming a common-place occurrence. More and more people are involved with electronic mail, time sharing, and data base activities. Mechanical radio teletype systems are being replaced by modern computer technology, and the Baudot code is being supplanted by ASCII. This article describes the construction and connection of a radio teletype modem. Techniques found here can be applied to any digital data communications application.

The modem can act as an interface with any serial RS-232-C device, but this article describes the process used to connect it specifically to the TRS-80 Color Computer. In this case the equipment being interfaced is an amateur radio transceiver; with some changes it would be possible to convert this device to a telephone-type modem.

The TRS-80 Color Computer has

proven to be an excellent communications terminal. It is inexpensive, easily programmed, and includes an RS-232 output connection. CoCo is well shielded from external sources of radio frequency interference and causes little of its own. After reading several articles in various periodicals and books, Ken Christiansen (W0CZ) and I decided we would like to experiment with radio teletype (RTTY). We selected a basic demodulator design from the National Semiconductor Data Book. The modulator is modified from a basic circuit by Rodney Colton (WA1SXW) in an article in *QST* magazine, September 1981.

In our research, we found several interesting articles and books. The bibliography lists those that were especially helpful to us in learning about RTTY. Ken and I were interested in communicating *via* two meters, so frequency offsets were designed around the VHF

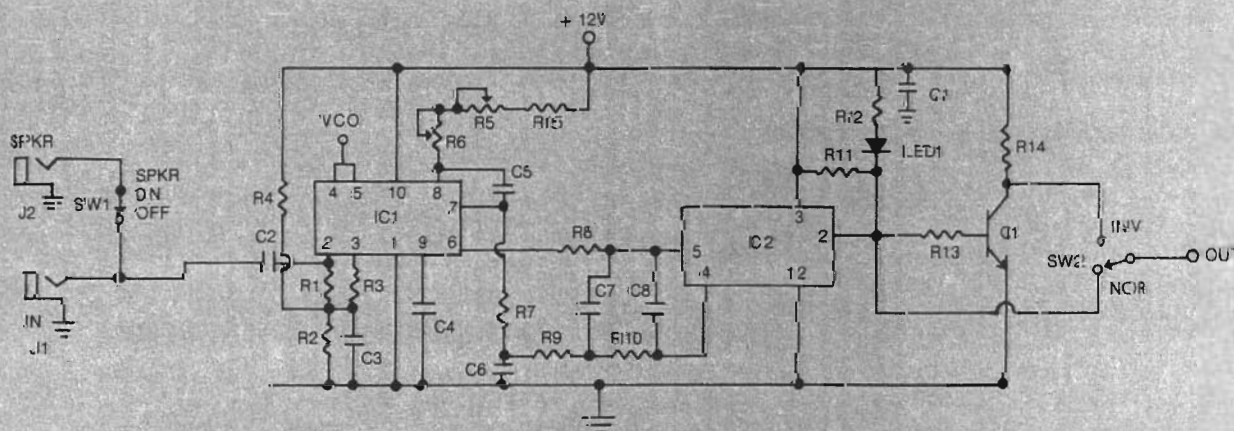
convention of 170 Hz frequency shift. The mark frequency is 2125 Hz and space is 2295 Hz. Also included is a voltage-regulator circuit that ensures stability of operation of the PLL circuits. The modems have been used occasionally on the high-frequency bands, but a lack of filtering hampers their performance. One of these units has been used with excellent results with audio filtering preceding the demodulator.

Total cost for all components, if purchased new, should be \$25 to \$35, depending on final configuration and cabinet. The modem is designed to be powered from a 14-volt or higher DC source. A simple supply can be built for under \$20, if one is not available. I use an inexpensive CB radio-power supply.

## Demodulator Circuit

The simple FSK demodulator uses a 565 phase-lock loop IC and is a modified circuit originally found in the NS data book. The circuit has excellent stability and has worked flawlessly for several months now. IC 1 (see figure 1) is the PLL. The circuit is adjusted with R5 and R6 to be between the high (mark) and low (space) frequencies.

Figure 1





Mark and space audio tones input to C2 cause the PLL output (pin 7) to be higher or lower than a reference voltage (pin 6). IC2, a comparator, compares the voltages and responds with a logic zero or logic one at the output (pin 2).

A few features have been added to the circuit to make it more versatile. R5 is mounted on the front panel and is a fine-frequency adjustment used to tune the PLL precisely to the input frequency. LED1 allows a visual indication of the data input. In practice, R5 is adjusted until the LED blinks with the changing data. Once the LED is blinking, you merely adjust for intelligible data on the CRT. Incorrect adjustment of R5 causes the LED to remain either on or off. Q1 is an inverter that reverses the state of the output logic, ensuring compatibility with any transmission standard. J2 is provided to connect an external speaker, making it easy to use the earphone jack on the transceiver and allowing you to monitor the incoming signal. SW1 can turn off the speaker once communication is established.

To adjust the demodulator, place a 2210 Hz signal on the input. Set R5 to midrange, then adjust R6 until the LED

changes state as you turn the potentiometer back and forth. Check to see that the LED changes state as you bring the audio frequency between mark and space frequencies. If you cannot adjust the output within range, you may have to change R15 slightly.

### Modulator Circuit

The modulator circuit uses a 566 PLL IC as a frequency generator. The input to the modulator is serial binary data from the computer. A high causes the mark frequency to be sent, and a low causes the space frequency to be sent. Q1 is an inverter that allows the logic to be inverted. If you have software that can complement the output data, these associated components can be removed. Q2 is a switch that is used to change output frequency. When the modulator is receiving a high, this switch is on. Frequency is determined by the specific adjustments of R7 and R8 and the voltage divider of R9 through R12. When the input goes low, Q2 shuts off, switching R7 and R8 out of the circuit. During space, R10 and the associated divider resistors determine the output frequency.

To adjust the circuit, ground the input. This switches R7 and R8 out of the

circuit. Adjust R10 for the space frequency at the output as measured on a frequency counter. Put +5 volts on the input and adjust R8 to midrange and tune R7 until the output is at the mark frequency. Ground the input again and recheck space frequency. You will notice some interaction between the mark and space controls. Only slight adjustments will be required. As with the demodulator, you may have to change the value of R9 slightly if you cannot get the potentiometers within range. The entire process of adjusting the modem takes much less time to do than it does to describe!

SW2, a tone on/off switch, has been included to kill the tone without actually powering down the modem. As the unit warms up, it drifts very slightly. Let it run for a few minutes before making adjustments. Any drift in the demodulator is taken care of easily with the front panel control. Once warm, it is completely stable. We have had no long-term drift problems with the circuit.

### Power Supply Regulator

The modem has a regulator circuit that helps stabilize the PLL circuits.

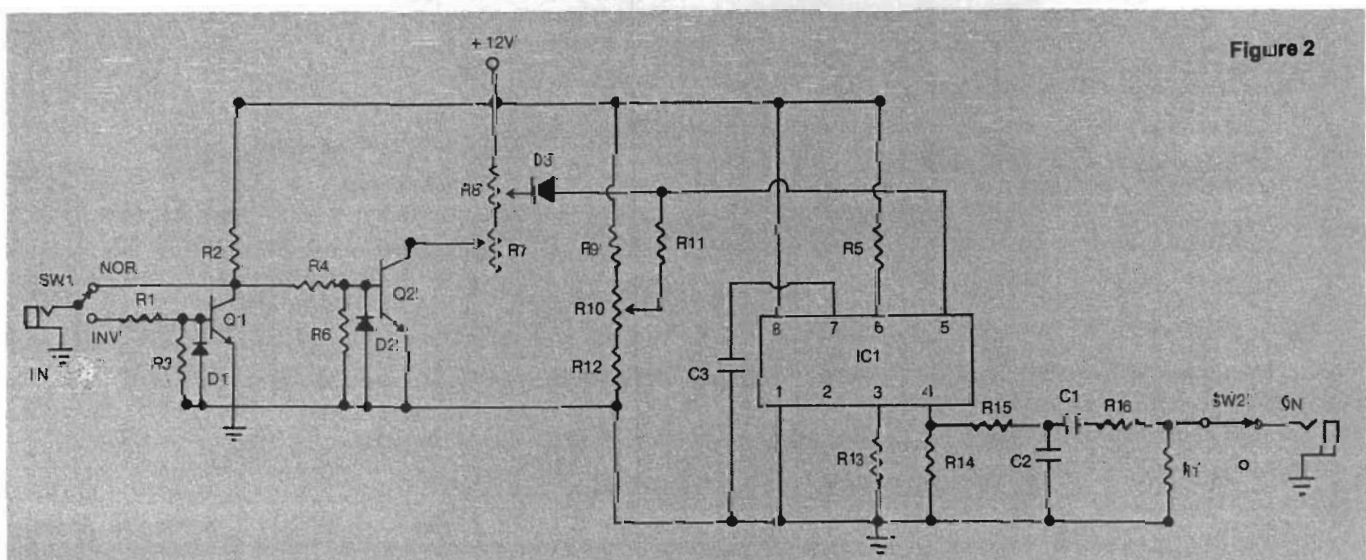


Figure 2

The heart of the circuit is a three-terminal IC — an LM 317 adjustable positive regulator. The circuit must have at least two volts more at the input than required at the output to retain regulation. The IC should be heat-sunk if you apply a very high input voltage. My regulator circuit gets its power from a 15-volt supply and does not run warm even without a heat sink. A power switch is included so that the main power supply can be left on for other purposes.

To adjust the circuit, connect a voltmeter to the output and adjust R1 until the meter reads 12 volts. Be sure to adjust the power supply output voltage before attempting to adjust the modem.

## Construction

None of the circuits are critical, and they can be wired on printed circuit or perf board as desired. We have had three units constructed using the same basic circuit; even though the layouts have been totally different, each has worked without any problems for several months. You should use a metal cabinet if you plan to run the unit in high RF fields. We have not noticed any particular RFI problems with our units. Jacks and cable connectors that match the appropriate connectors on the transmitting device are required.

## Interfacing the Modem

The connection between the Color Computer and modem is through the RS-232 jack marked SERIAL I/O on the rear panel of the computer. The easiest way to obtain the required four-pin DIN plug is to order the Radio Shack printer cable. If you cut it exactly in two, you will have two four-pin cables that can be used as I/O connections. The cable has color-coded conductors that are connected as follows:

Red to ground of modem

Green to output of demodulator

White to input of modulator

Yellow to positive voltage

Connection to the transmitter is *via* the audio output or external speaker jack. This connection goes between ground and the demodulator input. The modulator output connects between ground and the microphone or auxiliary input jack on the transceiver. In my particular installation, I ordered an external microphone for the handi-talkie, and installed a mini-stereo jack in it since I didn't want to drill into the case. As an added convenience, I connected the extra conductor in the stereo jack to the PTT line inside the microphone. This line is controlled by a switch on the modem marked XMIT, and allows me to remain in transmit without holding in the PTT switch.

When Ken and I completed the construction of the two modems, the only available software we knew about was Radio Shack's VIDEOTEX terminal program. This machine-language program operates at 300 baud ASCII with even parity protocol. Ken and I were assured of private transmissions as we were the only RTTY stations in the area with 300-baud capability. The modem operates at this speed with no problems, under normal two-meter reception conditions.

One evening I heard from a friend who spends much time on RTTY. He had just finished a contact with a station that was using a TRS-80C on 60 WPM Baudot, the standard used mostly on HF. Bill (W0LHS) told me that a radio ham was communicating with several individuals, all with color computers. He told of sending programs back and forth between terminals and informed me that the software they were using was called RTTYCW, written by K6AEP. Coincidentally Ken had just sent for a RTTY program he read about. His order to Clay Abrams Software was the same program — RTTYCW. It is capable of 60, 75, 100, and 110 WPM Baudot, as well as 50,

75, 100, 150, and 300 baud ASCII. The program will also send and receive morse code at 1 to 99 words per minute.

There are four message buffers and 12K transmit and receive buffers in a 32K CoCo. If you have a 16K machine, you are limited to a buffer size of about 4K. The transmit buffers can be loaded *via* tape, and all buffers can be saved to tape for loading at start-up time.

By loading a program saved in ASCII format into the transmit buffer, you can transmit that program to a receiver where it can be saved to tape. Then you can load the tape into the computer at a later time and resave it in standard format. If you want a hard copy of the text, all buffers can be sent to the printer. In short, I cannot say enough about the quality and capability of this software. It has all of the features I wanted when I thought of writing my own program.

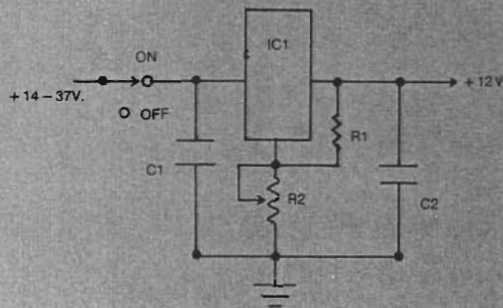
The Color Computer is easy to interface, and the simple modem circuit has provided me with many hours of fun and education. The easy-to-adjust circuit can be built in just a few hours at little expense. If you have any questions or problems with construction, you may contact me at the address below, or on the Color Computer NET. This net meets at 2000 hours UTC Sundays on 14.343 Mhz, and I try to check in regularly. If you write, please enclose a stamped, self-addressed envelope for a reply.

## Bibliography

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You may contact John Steiner at ARS WB0NFX, 508 Fourth Ave. NW, Riverside, ND 58078.

Figure 3



# PET-to-PET Communications

by F. Arthur Cochrane

## This article describes a machine-language program to transfer an array from one PET to another over the User Port.

I have developed a method to communicate data between two Commodore PETs. Two PETs (PET A and PET B) are needed for on-line data collection and simultaneous graphic display and real-time monitoring of a chemical separations process. The tasks for PET A are instrument set-up, data collection, and data storage on disk. Tasks for PET B are graphic display, and reading and storing information on disk. The data for each transfer between PETs are limited to 14 floating-point values. For this application communication was necessary in only one direction — from PET A to PET B.

### The Method

I employed the user port on the PET to transfer 8-bit data. Table 1 describes the user port signals. The CB2 and CA1 lines are used for handshaking the data. The sender sets the 8-bit port for output mode and the receiver for input mode.

Table 1: User Port Signals

PET Connections	Signal
A	Ground
B	CA1 - Input Handshake Line
C	Most Significant Data Line PA7
D	Data Line PA6
E	Data Line PA5
F	Data Line PA4
H	Data Line PA3
J	Data Line PA2
K	Data Line PA1
L	Least Significant Data Line PA0
M	CB2 - Output Handshake Line
N	Ground

The CB2 line from the sender is connected to the CA1 line of the receiver and acts as a Data Ready signal. The CB2 line from the receiver is connected to the CA1 line of the sender and acts as a Data Accepted signal. The wiring hookup is shown in figure 1.

I could have transferred the data from the BASIC program with PEEKs and POKEs. But for this application, I wrote a simple machine-language program that transfers data much faster and allows the PETs to spend most of their time collecting data and doing numeric calculations, and very little time with the PET-to-PET communication.

The data sent are the first 14 elements of the first dimensioned real array. This puts the restriction on the BASIC program that the first dimensioned array in the program is the one to be sent or received.

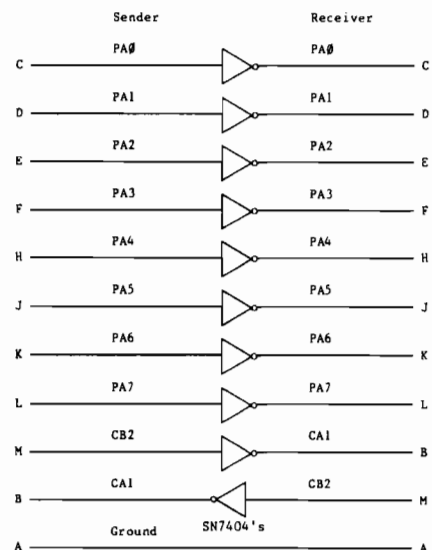
The set-up code for the sender (a SYS 637 command in the program listed) sets CB2 high, sets the data direction register for input, and clears CA1. When the sender wishes to send data, a SYS 634 is initiated in the sender code.

The set-up code for the receiver (a SYS 640 command in the program listed) sets CB2 high, sets the data direction register for input, and clears CA1. Also, the machine code changes the IRQ vector on the receiver to point to the machine-language routine that checks for a Data Ready signal from the sender.

The data are received in the receiver during the 60-Hz keyboard-scan routine, independent of action by the BASIC program. This is done by checking for a Data Ready from the sender each scan. If data are not ready, the normal keyboard scan functions as normal. If data are ready, the receiver code is executed, after which the keyboard-scan code continues. Because the data are received independently of the

BASIC program, the receiver program must be able to determine whether or not new data have been sent. This is done by using the zero element of the array as a flag. The receiver sets the zero element to zero, and the sender

Figure 1. PET to PET Connection



sets it to minus one. These numbers are chosen because PET BASIC takes a value of zero in decisions to be false and a minus one to be true. In an IF statement the receiver PET can check the zero element. If it is minus one, new data have been sent and can be copied to a safe location and the zero element flag can be reset to zero.

### Limitations

Although the sender PET can send information faster than the receiver PET needs it, in this application the sender spends most of its time collecting data and the receiver can plot them very quickly. This is not a problem if only the latest data are needed. If a future problem arises, additional coding in the program can be used to solve it. The additional machine code could check the zero element to see if it

is still minus one from the previous communication, in which case the receiver would not do the communication until it becomes zero.

The current program can be expanded only to send forty-nine elements of an array because the Y register of the 6502 microprocessor is used as a counter. This problem can be overcome by placing a two-byte counter in memory.

## Description of Programs

The first three instructions in lines 1090 to 1110 of the machine code (listing 1) form a jump table. The next group of instructions in lines 1130 to 1170 set up the PET as a sender. After that, lines 1190 to 1250 set up the PET as a receiver. The PET IRQ routine for the receiver starts in line 1280. Lines 1270 to 1320 look for the first Data Ready from the sender by checking the CA1 interrupt flag. The macro in line

1350 loops for the number of bytes to receive. The receiver code waits for a Data Ready, gets the data, and sends a Data Accepted. Line 1420 is the macro that loops for the number of bytes to send. The sender code writes the data, sends a Data Ready, and waits for a Data Accepted. Lines 1500 to 1550 detects a Data Ready or Data Accepted. Data are read or written in lines 1730 to 1820, using the array pointer.

This machine code is for BASIC 2.0 and loads into Cassette Buffer 1. To use the code with BASIC 4.0, the keyboard scan address must be changed from \$E62E to \$E455 and the return to BASIC READY from \$C389 to \$B3FF.

The sample BASIC listing consists of two programs. Lines 100 to 260 form a sender program, and lines 270 to 380 form a receiver program. After the machine code has been loaded into both PETs, the BASIC program (listing 2) is

run by the sequence given in the remarks in lines 120 to 160 of the program.

## Conclusion

This program shows how easy it is to expand the firmware of the Commodore PET to implement new functions. EPROMs can be added to the hardware for these expanded firmware programs. This program also shows how machine language can improve the speed of the PET, and have a program function independently of a BASIC program.

## Acknowledgements

The information contained in this article was developed during the course of work under Contract No. DE-AC09-76SR00001 with the U.S. Department of Energy.

You may contact Mr. Cochran at E.I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC 29808.

### Listing 1

```
0010 ;THE SENDER PET SENDS THE FIRST FIFTEEN (0-14) ELEMENTS OF
0020 ; THE FIRST DIMENSIONED ARRAY
0030
0040 ;THE RECEIVER PET RECEIVES DATA ALSO IN THE FIRST ARRAY
0050
0060 ; SYS 634 - SEND DATA
0070
0080 ; SYS 637 - SET UP SENDER PET
0090
0100 ; SYS 640 - SET UP RECEIVER PET
0110
0120 ;THE RECEIVER PET GETS DATA DURING THE KEYBOARD SCAN.
0130 ;THE RECEIVER PET CAN DETECT IF NEW DATA HAS BEEN RECEIVED
0140 ; BY CHECKING THE ZERO ELEMENT OF THE ARRAY. IF NEW DATA
0150 ; HAS BEEN RECEIVED THEN MOVE IT AND RESET THE
0160 ; ZERO ELEMENT.
0170
0180 ;IF THE PET HANGS UP AND THE STOP KEY DOES NOT FUNCTION
0190 ; USE THE KEY TO RETURN TO READY.
0200
0210 POINTER .DE 44 ;START OF ARRAYS
0220 IRQ .DE $90 ;PET IRQ VECTOR
0230 READY .DE $C389 ;WARM START OF BASIC
0240 PET.IRQ .DE $E62E ;PET IRQ ROUTINE
0250 PIAK .DE 59410 ;KEYBOARD PORT
0260
0270 ;HEADER BYTES/ELEMENT * ELEMENTS MOVED - ONE LESS
0280 ; 7 5 * 15 - 1
0290 COUNTER .DE 775-1 ;BYTES TO TRANSFER
0300
0310 HDATA .DE 59457 ;DATA WITH HANDSHAKE
0320 DDR .DE 59459 ;DATA DIRECTION REG
0330 AUXREG .DE 59467 ;AUXILLARY CONTROL REG
0340 PCREG .DE 59468 ;PERIPHERAL CONTROL REG
0350 IFREG .DE 59469 ;INTERRUPT FLAG REG
0360 DATA .DE 59471 ;DATA REG
0370
0380 ;SET REGISTER 3 FOR INPUT OR OUTPUT
0390 !!!SET.DIR .MD (...DIR)
0400 LDA #...DIR
0410 STA DDR
0420 .ME
0430
0440 ;SET BITS IN SPECIFIED REGISTER WHICH CORRESPOND WITH
0450 ;1'S IN MASK.
0460 !!!SET.BIT .MD (...MASK ...REG)
0470 LDA #...MASK
0480 ORA ...REG
0490 STA ...REG
0500 .ME
0510
0520 ;CLEAR BITS IN SPECIFIED REGISTER WHICH CORRESPOND
0530 ;WITH 1'S IN MASK.
0540 !!!CLR.BIT .MD (...MASK ...REG)
0550 LDA #...MASK
0560 EOR #!11111111 ;INVERT MASK
```

### Listing 1 (Continued)

```
0570 AND ...REG
0580 STA ...REG
0590 .ME
0600
0610 ;SET IRQ VECTOR TO NEW VALUE
0620 !!!SET.IRQ .MD (...VECTOR)
0630 SEI ;DISABLE IRQ'S
0640 LDA #L,...VECTOR
0650 STA *IRQ
0660 LDA #H,...VECTOR
0670 STA *IRQ1
0680 CLI ;RESTORE IRQ'S
0690 .ME
0700
0710 ;LOOP ROUTINE FOR SENDING AND RECEIVING
0720 !!!LOOP .MD (...FIRST ...SECOND ...THIRD)
0730 SEI ;DISABLE IRQ'S
0740 LDY #COUNTER ;SETUP POINTER TO A
...AGAIN JSR ...FIRST
0760 JSR ...SECOND
0770 JSR ...THIRD
0780 DEY ;DECREMENT THE COUN
0790 BPL ...AGAIN ;INCLUDES ZERO
0800 CLI ;RESTORE IRQ'S
0810 RTS
0820 .ME
0830
0840
0850 .BA 634 ;FIRST CASSETTE BUFI
0860 .CE ;CONTINUE IF ERRORS
0870
0880 .PR PET TO PET COMMUNICATION
0890
0900
0910 .PR STORE OBJECT CODE? (ONO, 1YES)
0920 OBJ .IN OBJ
0930 IFN OBJ
0940 .OS
0950 ***
0960
0970 .PR LISTING OUTPUT? (ONO, 1YES)
0980 LISTIT .IN LISTIT
0990 IFN LISTIT
1000 .LS
1010 .PR EXPAND MACROS? (ONO, 1YES)
1020 EXPAND .IN EXPAND
1030 IFN EXPAND
1040 .ES
1050 ***
1060 ***
1070
1080 ;JUMP TABLE
027A- 4C EC 02 1090 JMP SEND.MAIN ;SYS 634 FOR SENDING
027D- 4C 83 02 1100 JMP BEGIN.S ;SYS 637 FOR SENDER
0280- 4C 9E 02 1110 JMP BEGIN.R ;SYS 640 FOR RECEIVE
1120
```

Listing 1 (Continued)

```

1130 BEGIN.S      SET.BIT (%11100000 PCREG) ;SET CB2 HIGH
0283- A9 E0
0285- OD 4C E8
0288- BD 4C E8

1140              SET.DIR (%11111111) ;SET FOR OUTPUT

028B- A9 FF
028D- 8D 43 E8

1150              CLR.BIT (%00011100 AUXREG) ;DISABLE SHIFT REGIS

0290- A9 1C
0292- 49 FF
0294- 2D 4B E8
0297- 8D 4B E8

029A- AD 41 E8    1160      LDA HDATA          ;CLEARS CA1
029D- 60          1170      RTS
          1180
          1190 BEGIN.R      SET.BIT (%11100000 PCREG) ;SET CB2 HIGH

029E- A9 E0
02A0- OD 4C E8
02A3- 8D 4C E8

1200              SET.DIR (%00000000) ;SET FOR INPUT

02A6- A9 00
02A8- 8D 43 E8

1210              CLR.BIT (%00011100 AUXREG) ;DISABLE SHIFT REGIS

02AB- A9 1C
02AD- 49 FF
02AF- 2D 4B E8
02B2- 8D 4B E8

02B5- AD 41 E8    1220      LDA HDATA          ;CLEARS CA1
          1230      SET.BIT (%00000001 AUXREG) ;ENABLE LATCHING OF

02B8- A9 01
02BA- OD 4B E8
02BD- 8D 4B E8

1240              SET.IRQ (LOOK)          ;CHANGE PET IRQ VECTOR

02C0- 78
02C1- A9 CE
02C3- 85 90
02C5- A9 02
02C7- 85 91
02C9- 58

02CA- 60          1250      RTS
          1260
02CB- 4C 2E E6    1270      JMP PET.IRQ          ;TO PET IRQ ROUTINE
02CE- A9 02          LDA #%00000010
02D0- 2C 4D E8    1290      BIT IFREG
02D3- F0 F6          BEQ PETROUT          ;CA1 NOT SET SO NO DATA RE
02D5- 20 DB 02    1310      JSR REC.MAIN
02D8- 4C CB 02    1320      JMP PETROUT          ;FINISH UP PET IRQ ROUTINE
          1330
          1340 ;MAIN RECEIVER ROUTINE
          1350 REC.MAIN  LOOP (WAIT.CA1 RECEIVE SEND.CB2)

02DB- 78
02DC- A0 51
02DE- 20 FD 02
02E1- 20 27 03
02E4- 20 0A 03
02E7- 88
02E8- 10 F4
02EA- 58
02EB- 60

1360
1370 ;1. WAIT FOR DATA READY
1380 ;2. GET DATA & CLEAR CA1
1390 ;3. SEND DATA ACCEPTED
1400
1410 ;MAIN SENDER ROUTINE
1420 SEND.MAIN  LOOP (SENDER SEND.CB2 WAIT.CA1)

02EC- 78
02ED- A0 51
02EF- 20 1F 03
02F2- 20 0A 03
02F5- 20 FD 02
02F8- 88
02F9- 10 F4
    
```

Listing 1 (Continued)

```

02FB- 58
02FC- 60

1440 ;1. WRITE DATA & CLEAR CA1
1450 ;2. SEND DATA READY
1460 ;3. WAIT FOR DATA ACCEPTED
1470
1480
1490 ;WAIT FOR CA1 TO BE SET
02FD- A9 02    1500      WAIT.CA1  LDA #%00000010          ;MASK TO READ CA1
02FF- 2C 12 E8 1510      LOOP      BIT PIAK          ;TEST FOR PANIC KEY
0302- 10 29    1520      BPL ESCAPE          ;IF KEY THEN SIGN BIT S
0304- 2C 4D E8 1530      BIT IFREG
0307- F0 F6    1540      BEQ LOOP          ;LOOP IF CA1 NOT SET
0309- 60          1550      RTS
          1560
          1570 ;SEND DATA READY OR DATA ACCEPTED
030A- 20 16 03 1580      SEND.CB2  JSR TOGGLE.CB2
030D- EA          1590      NOP          ;DELAY SOME
030E- EA          1600      NOP
030F- EA          1610      NOP
0310- EA          1620      NOP
0311- EA          1630      NOP
0312- 20 16 03 1640      JSR TOGGLE.CB2
0315- 60          1650      RTS
          1660
          1670 ;SET CB2 TO REVERSE STATE
0316- A9 20    1680      TOGGLE.CB2 LDA #%00100000          ;MASK FOR CB2 OUTPUT COM
0318- 4D 4C E8 1690      EOR PCREG          ;TOGGLE BIT 5
031B- 8D 4C E8 1700      STA PCREG          ;WHICH CHANGES CB2 HIGHL
031E- 60          1710      RTS
          1720
          1730 ;SET DATA TO SEND OUT
031F- B1 2C    1740      SENDER  LDA (POINTER),Y
0321- 49 FF    1750      EOR #%11111111          ;INVERT FOR INVERTERS
0323- 8D 41 E8 1760      STA HDATA          ;CLEARS CA1
0326- 60          1770      RTS
          1780
          1790 ;STORE DATA RECEIVED
0327- AD 41 E8 1800      RECEIVE  LDA HDATA          ;CLEARS CA1
032A- 91 2C    1810      STA (POINTER),Y
032C- 60          1820      RTS
          1830
          1840
          1850 ;ESCAPE CODE IF PANIC KEY () PRESSED
032D- 58          1860      ESCAPE  CLI
032E- 4C 89 C3 1870      JMP READY          ;RETURN TO BASIC
          1880
          1890
          1900      .EN

END OF MAE PASS!

--- LABEL FILE: ---

AUXREG E84B      BEGIN.R 029E      BEGIN.S 0283
COUNTER 0051     DATA E84F      DDR E843
ESCAPE 032D     EXPAND 0001      HDATA E841
IFREG E84D      IRQ 0090      LISTIT 0001
LOOK 02CE      LOOP 02FF        OBJ 0000
PCREG E84C      PET.IRQ E62E      PETROUT 02CB
PIAK E812      POINTER 002C      READY C389
REC.MAIN 02DB   RECEIVE 0327      SEND.CB2 030A
SEND.MAIN 02EC  SENDER 031F      TOGGLE.CB2 0316
WAIT.CA1 02FD

//0000,0331,0331
    
```

Listing 2

```

100 REM PET TO PET TEST PROGRAM
110 REM SENDER PROGRAM
120 SYS 637:REM SET UP FOR SEND
130 PRINT "SEND CONT";STOP
140 DIM X(6):REM DEFINE ARRAY TO SEND
150 FOR I=0 TO 6:READ X(I):NEXT I:REM LOAD ARRAY
TO SEND
160 SYS 634:REM SEND DATA
170 END
180 DATA -1,1,2,3,4,5,6
190 REM
200 REM RECEIVER PROGRAM
210 SYS 640:REM SET UP FOR RECEIVING
220 PRINT "RECEIVE CONT";STOP
230 DIM X(6):X(0)=0:TB=34
240 FOR I=1 TO 6:X(I)=0:NEXT I
250 PRINT "CURRENT ARRAY ELEMENTS:"
260 FOR I=1 TO 6:PRINT X(I):NEXT I
270 IF X(0) THEN PRINT " ";FOR I=1 TO 6:PRINT X(I)
:NEXT I:PRINT "RECEIVED";X(0)=0
280 PRINT " ";TAB(TB);" ";TI#;
290 GOTO 270
    
```

# Multi-Microprocessor Tidbits

by Mike Rosing

**Running a 6502 and 6809 in the same computer simultaneously creates a powerful device. This article describes problems you might encounter and a general description of a specific task for which two processors were used.**

Watching two 300-baud lines simultaneously and recalling each record that comes over those lines is easy with a multiprocessing system. By using two Asynchronous Communication Interface Adaptors (ACIAs) connected to an Apple's Interrupt Request Line (IRQ) and a Stellation Two 6809 board, the data collection is done in background and the data display is done in foreground.

Some problems running two micros simultaneously include waking up, communication, and debugging. The major problem is finding a 6809 assembler for the Apple. At the time I purchased the Stellation Two board there was no software. Now you can get a very nice assembler and debugger from Stellation Two for about \$150.

I bought the assembler package that runs under the UCSD p-System from Softech Microsystems. It works on the Apple Pascal system but is difficult to transfer from the 8-inch floppy (with no paper work to tell how to read the disk) to the Apple 5 1/4-inch floppy. The assembler also has several bugs. For \$12,000 Softech will release the source listing but they won't fix the bugs for you!

The hardware consists of an Apple II with a 16K board in slot zero. The board was modified by breaking a tie and soldering a circle on the Apple 16K board to allow use of 2716 EPROMs. When the Apple is turned on the 2716 holds the reset vector enabling the Apple to become a dedicated machine.

The Stellation Two 6809 board has an EPROM slot built in so no modification of that board is necessary. The ACIAs are mounted on an Apple prototype board along with a few chips for buffers and logic for chip selection.

Each 300-baud line is terminated in a line receiver chip. The receiver outputs go to two Synertek ACIAs. After building the board with two crystals I learned that four ACIAs could be run with one crystal by using the clock outputs on the chips and programming the ACIAs correctly. It is possible to talk and listen to four serial lines using the multiprocessing system described here.

The wake-up routine for each computer is different. When Reset is pressed the 6502 is on and the 6809 is off. The 6502 executes the following code to turn the 6809 on (note that all interrupt lines are high before the 6809 is turned on):

```

SLOT EQU 70 ;6809 slot pos. (ex.)
IRQ02 EQU C080 + SLOT ;6502 IRQ line
HALT EQU C081 + SLOT ;6809 halt line
RESET EQU C082 + SLOT ;6809 reset line
NMI EQU C083 + SLOT ;6809 non-maskable
interrupt line
FIRQ EQU C084 + SLOT ;6809 fast interrupt ln
IRQ EQU C085 + SLOT ;6809 interrupt reqst ln
ROM EQU C086 + SLOT ;on bd ROM enable bit
for Stellation Two
SWAP EQU C087 + SLOT ;switches A15 to be
opposite or same
as 6502
;most significant bit of each location determines
what lines will do

LDA #0 ;ensure that
STA HALT ;6809 is
STA RESET ;off
    
```

```

STA IRQ02 ;6502 interrupt goes out invert gate
LDA #80 ;raise
STA FIRQ ;all 6809
STA IRQ ;interrupt
STA NMI ;lines
STA SWAP ;tells 6809 bd that A15 isn't flipped
;both CPU s view RAM the same way
STA ROM ;80 - ROM slot used, 00 - not used
STA HALT ;6809 on and
STA RESET ;going through reset procedure
    
```

When the 6502 reaches the last instruction the 6809 is on and running. The 6502 goes at about 1/5th its normal pace and the 6809 goes at full speed.

The 6809 wake-up routine is simple. As shown below, the 6809 defines its stacks, turns on the ACIAs and then unmask its IRQ line.

```

WAKEUP ORCC #50H ;mask interrupts
LDU #USRSTK ;set up
LDS #SYSSTK ;stack pointers
CLR STATUS ;set up
CLR STATUS + 4 ;ACIAs with
LDA #16H ;1 stop, 8 data bits
STA CNTRL ;300 baud
STA CNTRL + 4 ;no parity
LDA #1 ;receiver interrupt
STA CMD ;enabled
STA CMD + 4 ;transmitter disabled
CLR A ;set direct page
TFR A,DP ;same as Apple's zero pg
ANDCC #OEFF ;enable IRQ
    
```

The addresses used depend on the logic used to get to each ACIA. These can be set using equates at the beginning of the code file.

The background task of collecting data from two serial lines is accomplished using interrupts from the ACIAs to the 6502 and the IRQ line from the 6502 to the 6809. This allows the operator to view call data from two hours ago at the same time new calls are coming in.

Once eight bits have been collected, either ACIA pulls the IRQ low to the 6502. The 6502 vectors to the interrupt handler and checks each ACIA to see which one is requesting service. If both ACIAs are requesting service, then IRQ will not clear and the 6502 will vector to the interrupt handler again. At 300 baud there is no loss of data for an interrupt handler that takes less than 30

milliseconds. When the 6809 is the master computer, the 6502 runs at about 1/5th normal speed. An average instruction takes four clock cycles on the 6502. Taking  $5 \cdot 1E - 6$  seconds as a clock cycle and  $4 \cdot 5E - 6$  seconds as an instruction (on average), the total number of instructions before loss of data is  $3E - 2/2E - 5 = 1.5E + 3$ . The interrupt handler in my system uses only 50 instructions. This allows plenty of time for foreground.

The beginning of the interrupt handler for the 6502 is shown below. After saving the registers, each ACIA must be polled to find which one is requesting service. Reading the status register of the 6551 ACIA clears the interrupt. The most significant bit tells the 6502 if the interrupt came from the device polled.

```
INTRPT PHA      ;save
        TYA      ;all
        PHA      ;registers
        TXA
        PHA
        BIT P1STUS ;port 1 status checked
        BMI BOX1  ;if N bit set then ACIA 1
                   ;gave interrupt
        BIT P1STUS + 4 ;port 2 status checked
        BMI BOX2  ;if N bit set then ACIA 2
                   ;gave interrupt
        LDA ERMSG  ;if neither set then there
                   ;was an error
        JMP PRNTMSG ;so tell operator and
                   ;then stop
```

After saving the byte into the buffer and incrementing the buffer pointer, the 6502 pulls all registers from the stack and executes RTI. The error message at the end is for debugging purposes. The IRQ from the 6809 to the 6502 goes through an inverting gate; this caused some problems before discovery.

At the end of each serial line the computer sends a start of text (STX) and end of text (ETX) for each message. The 6502 reads an entire message from STX to ETX and saves this to an input buffer. Upon receiving an ETX, it saves the line number in a common location

and pulls the 6809 IRQ. The 6809 checks which line has sent a completed message and then processes that buffer. There are many choices for the 6809, so its interrupt handler is over 250 instructions. Since the 6809 is the master CPU it takes about the same time as 50 instructions on the 6502. The 6809 also has more foreground tasks to do than the 6502. Both programs fit in 2K EPROMs. The rest of memory is used for record storage.

The beginning of the 6809 interrupt handler is shown below. A mailbox system is used to tell the 6809 which buffer to take care of. Since the IRQ is masked on vectoring to the interrupt, levels of interrupt are not allowed without unmasking. Because the operation of two 300-baud lines is slow, no attempt was made to make this system that complex.

```
INTRPT LDA #80H ;raise
        STA IRQ  ;6809 IRQ line
        LDA IJOB ;box 1 or 2?
        STA TJOB ;save in case another
                   ;interrupt is coming in fast
        BNE BOX2 ;non zero for box 2, zero
                   ;for box 1
        LDD B1IB ;X reg is
        BRA GTBUF ;input buffer
        LDD B2IB ;pointer
        GTBUF EXG A,B ;swap byte sex (this is
                       ;important!)
        TFR D,X   ;now have input buffer ptr
        NEGB     ;go back to first char
        LDA B,X  ;get first char in buffer
```

The location IJOB is the mailbox. TJOB is a temporary storage location in case another interrupt is attempted from the other box. B1IB (Box 1 Input

Buffer) and B2IB are 6502 zero-page pointers that tell the 6502 where to put the next input character. The 6809 uses these as pointers to the input buffers as well as for the length of the message in the buffer. By incrementing the B register and leaving the X register

alone, it is easy to step through the input buffer. When B is zero, the end of the buffer has been reached. The memory is organized with two 256-byte buffers for the input messages. Above those are two 1K buffers for "live calls." These are 32 slots (one for each phone line), which are 32 bytes each. When a call is finished, the slot corresponding to that line is packed in BCD format into the top of memory. This region is actually a ring buffer that holds about 2400 calls. As more calls come in, old calls are lost.

The operator can examine either live calls or past calls by using menu commands. The 6502 constantly polls the keyboard in foreground and when a key is pressed the processor compares the key to the acceptable commands. The 6502 then jumps to the routine that gathers the data the 6809 foreground program needs. For example, searching past records for all calls to area code 307 requires the 6502 to put the message "AREACODE?" on the screen. The 6502 then reads the keyboard for the area code and saves it to a common zero-page location. The 6809 is constantly checking a common location known as a mailbox. As long as the mailbox is zero the 6809 foreground has little to do. Once the 6502 gets the area code into a common buffer it puts a job number into the mailbox. The 6502 then goes to an input routine that controls the paging of records (since only 24 lines are visible on the screen at a time).

---

**"When the 6809 is the master computer,  
the 6502 runs at about 1/5th normal speed."**

---

Buffer) and B2IB are 6502 zero-page pointers that tell the 6502 where to put the next input character. The 6809 uses these as pointers to the input buffers as well as for the length of the message in the buffer. By incrementing the B register and leaving the X register

The foreground codes for the 6502 and 6809 are similar. The 6502 scans the keyboard location to see if any key has been pressed. The 6809 scans a mailbox to see if any jobs have been requested. In the meantime the background is running via interrupts. The

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6809 foreground code is shown in the next code listing. Once the 6502 has collected all the data from the operator, it sends the 6809 a job number via a JOBBOX. The 6809 continuously scans the JOBBOX until a non-zero value appears via the 6502. It uses this job number as an index into a pointer table, and the job is executed as a subroutine. The code is written as relocatable, which really is not necessary for the job at hand. (This is only one of many ways to communicate between the two computers.)

```
JOBBOX EQU 4 ;zero pg for both
;6502 and 6809
START LDA JOBBOX ;any jobs?
BEQ START ;loop till there is
ASLA ;convert job number
;to offset
LEAX JMPVEC,PCR ;get tbl address into
;X reg
LDX A,X ;get relative offset
;into code
LEAY WAKEUP,PCR ;get actual start of
;code location
TFR Y,D ;relative offset plus
JSR D,X ;starting loc gives
;absolute position
BRA START ;look for next job
;never used
JMPVEC WORD DUMMY ;when assembled will
WORD JOB1 ;hold offsets into
WORD JOB2 ;file from zero pos
WORD JOB3 ;which was wakeup
;in this case
.....
```

Once the 6809 gets a job number it jumps to the routine requested. In this case it packs the area code sent by the 6502 into BCD format and then scans all of the ring buffer for calls matching that area code. On a match the record is unpacked onto the screen. When 24 records have been found the 6809 waits for the 6502 to send a go signal to keep looking. Once all of the ring buffer has been scanned, both 6502 and 6809 return to polling their respective memory locations for the next foreground job. Meanwhile the background is still recording information coming over the two lines.

The 6809 can scan for input lines, output lines, authorization codes, and status messages, as well as area code. Each of these are part of a call record. The routines that scan memory use some common subroutines for bumping from one record to the next in the ring buffer. The Stellation Two board can support a 4K EPROM, but only 2K is needed for this dedicated application.

Choosing what each processor should do is arbitrary. The system described here uses the 6502 for inter-active I/O operations and the 6809 for

all memory tasks. I find the 6809 easier to program than the 6502. Whether or not one microprocessor could do all the above as fast as two is not clear

The 6502 routine uses the 16K of RAM on the card as well as the 2K EPROM. By writing itself onto the RAM and then throwing the soft switch that allows the RAM to be read/write, the full 16K is available. The 6809 uses the bottom part of this RAM for its stack, leaving the 48K of RAM on the mother board for buffers. The code that does this follows:

```
RAMWRT EQU C089 ;write enable RAM cd
RAMRD EQU C08B ;read enable RAM cd
TRONST LDA #OFF ;will be zero
BEQ TRON2X ;on warm start
LDA RAMWRT ;write enable
LDA RAMWRT ;RAM cd while getting
;code from EPROM
LDA #0 ;clear index counter
TAY
STA 0 ;set zero pg ptr to start
;of ROM
LDA #0F8 ;which is F800
STA 1 ;up to FFFF
$1 LDA @0,Y ;get a byte from ROM
STA @0,Y ;copy into RAM!
INY ;bump counter
BNE $1 ;bump
INC 1 ;zero-page counter
BNE $1 ;until past FFFF
LDA #0 ;set RAM for warm
;reset
STA TRONST + 1 ;because we don't
;need to do this again
TRON2X LDA RAMRD ;read/write
LDA RAMRD ;enable RAM
;at this point the EPROM is not used
;but its code is running in RAM on the
;16K board. On a warm reset the
;above code is bypassed since the
;reset vector is unchanged but the
;branch instruction will see zero
```

Debugging the above system required putting out messages on the screen to state how far into its program each computer had gotten. When I put 6502 messages at the top of the screen and 6809 messages at the bottom, the problem point was found easily. Usually the problems I had were byte-sex related or mailboxes not at the same address. By clearly separating the tasks of the two processors, mistakes and bugs can be found relatively quickly.

The specific examples used above work. They are not necessarily the only way to do multiprocessing in a dedicated environment. If you spend time deciding what each computer should do, the power of multiprocessing will become apparent.

You may contact Mike Rosing at 4260 E. Evans Ave., Denver, CO 80222.

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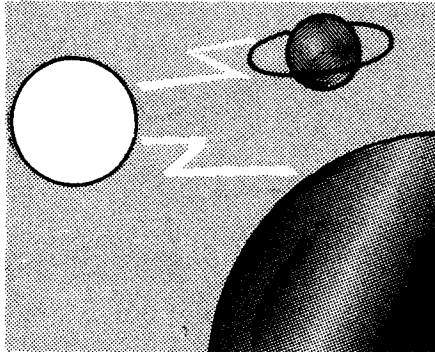


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# In-House Communication

by Phil Daley



MICRO has always been in the forefront of disseminating information useful to computerists of many types of systems. This necessitates our having different kinds of hardware, disks, and tape formats. In addition, the staff must know many different languages and dialects. To help overcome this drawback, we have established a centralized system that other computers can "talk" to and, eventually, receive from.

At MICRO, we have set up a system that utilizes a 6809 computer, the FOCUS, as the end source of all our files, and a word-processing system called TYPE+, written by Bob Tripp. An interface to a Compugraphic Editwriter allows us to transfer text files to the phototypesetter without human intervention, and to typeset those files without further editing. This is made possible by preprocessing the text files with the TYPE+ program.

Author-submitted and in-house articles and programs are written on whatever computer is available and appropriate to the task at hand. Then they are sent to the FOCUS using the Stylograph text editor, entry mode. This program takes the text or listing in from the serial port and stores it line by line in the 6809 RAM (see listing 1), then the file is saved to disk. The Stylograph

text editor imposes two restrictions on the listings: the first character on a line cannot be a "#", and the input buffer on the Flex operating system must not exceed 128 characters, including the carriage return. A line that is too long results in a carriage return being unaccepted, and the remainder of the file continuing to overflow the buffer. Although you will have quite a mess on the screen, you need only delete the current line to enable a normal SAVE operation.

The TYPE+ program includes a word processor that has the several Editwriter keyboards encoded to special keys on the FOCUS, enabling screen display of all the special Editwriter functions. In addition to the preprocessing function, we use the FOCUS as an additional Compugraphic terminal for normal typesetting input.

Since the Editwriter uses different ASCII codes for display than a standard computer, and has several dozen extra keys and codes, it is necessary to convert many of the standard codes in the text file to the non-standard Editwriter format. In addition, the display uses standard ASCII whenever possible, so the normal keys have to be converted from standard display to Editwriter display when transferring the file.

The standard file includes special Editwriter information so that the Compugraphic will understand what to do with the file when it arrives. Such things as font number and type size have to be specified at the beginning of the file and whenever any of the parameters have to be changed. A SEARCH and REPLACE function substitutes the required Editwriter codes for each regular character that has to be changed. For instance, the Editwriter will not accept the double quote ("). Each occurrence of the " is replaced by lower

precedent 0 (  $\begin{matrix} P \\ \downarrow \\ R \end{matrix} 0$  ). This ensures that the quote will appear as the proper code when the transfer takes place.

The most complicated change involves the 0. The SUN-MOON listing in January (MICRO 56:36) used the variable O extensively throughout the listing. When I proofread the listing, I couldn't see any difference in the O and the 0 (although the production people could). I thought that anyone trying to key in the program would be unable to notice the distinction.

I learned that the Compugraphic has a command called "Flash Only," which means that the character is printed but the paper is not advanced. This allows over-striking: the / is printed without advancing and then the 0 is printed on top of it. Simple in theory, unfortunately it turns out that this causes the slash to appear too low in the 0 to look natural. However, another command on the Compugraphic allows a character to be raised or lowered any number of points (plus or minus a point of lead  $\begin{matrix} P \\ \downarrow \\ L \end{matrix}$ ). With this command, you can raise the slash in the zero to the center. The final substitution becomes: replace 0: with minus a point of lead, flash only, /, plus a point of lead, 0.

After adjusting the non-allowable characters to Compugraphic character codes, and the line lengths to the proper size for publication, a short program called TRANSFER is invoked to LIST the program to the Editwriter where it is entered as a file. The interface to the FOCUS has the Editwriter thinking that someone is typing the file into the keyboard instead of being sent through the serial port. The received file is then rejustified and saved to disk to be output in the normal manner when needed.

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- \* 3 NOVEM 1982 - MODIFIED TO CMD - PRD

\* EQUATES

```

CD03 WARMS EQU $CD03
CD42 GETHEX EQU $CD42

F829 VKIN EQU $F829
F82C VKSTAT EQU $F82C
E549 STDIN EQU $E549

F815 MRSTAT EQU $F815

E180 ADATA EQU $E180
E181 ASTAT EQU ADATA+$01
E182 ACMD EQU ASTAT+$01
E183 ACTRL EQU ACMD+$01
    
```

```

C100                                ORG $C100

C100 BD CD42 APPLE2 JSR GETHEX GET USER'S BAUD RATE
C103 CC 0B18 LDD #0B18 1200 BAUD
C106 8C 1200 CMPX #1200 IF NOT 1200
C109 27 02 BEQ NOADJ THEN DEFAULT TO
C10B 06 16 LDB #16 300 BAUD
C10D 8D 1F NOADJ BSR VAINIT
C10F 30 8D 000D LEAX INPUT,PCR
C113 BF E54A STX STDIN+1
C116 30 8D 002D LEAX STATUS,PCR
C11A BF F816 STX MRSTAT+1
C11D 7E CD03 JMP WARMS GO BACK TO FLEX

C120 BD F829 INPUT JSR VKIN NO
C123 25 01 BCS RTEST
C125 39 RTS

C126 8D 0D RTEST BSR VRCVR
C128 25 03 BCS KTEST
C12A 4D TSTA
C12B 27 F3 BEQ INPUT IGNORE NULLS
C12D 39 KTEST RTS
C12E FD E182 VAINIT STD ACMD
C131 B6 E180 LDA ADATA READ OLD DATA
C134 39 RTS

C135 34 04 VRCVR PSHS B
C137 53 COMB SET CARRY TO INDICATE
NO DATA (YET)

C138 F6 E181 LDB ASTAT
C13B C4 08 ANDB #08
C13D 27 06 BEQ NODATR
C13F B6 E180 LDA ADATA
C142 84 7F ANDA #7F STRIP PARITY
C144 5F CLRB CLEAR CARRY INDICATES DATA RCVD
C145 35 84 NODATR PULS B,PC

C147 BD F82C STATUS JSR VKSTAT
C14A 24 03 BCC RETURN
C14C BD F815 JSR MRSTAT
C14F 39 RETURN RTS

END APPLE2
    
```

We are currently working on a program that will take a previously defined glossary and make all the necessary changes to the text file automatically. This will increase our productivity and, at the same time, decrease our typographical errors (when the bugs are out).

### The Bulletin Board

The MICRO Bulletin Board System is working well and we have many regular callers. The BBS runs on our Apple II, but may be called by anyone with a modem. It normally runs four days a week, Monday through Thursday from 5:00 p.m. to 8:00 a.m. We are moving our offices and do not have the new phone number yet, but will let you know in our May issue. Anyone may call the system, but only subscribers are issued passwords for writing on the system. There are several useful programs that users may download onto their own systems, and we hope to have a selection for different machines before too long. If anyone has a program (personal or public domain) they would like to see get wider distribution, send it to us (via the BBS) and we will put it on-line.

Articles also can be received through this system and we have on-line capabilities with COMPUSERVE and THE SOURCE. An author can download to them and we can retrieve the file. (We received part of Clifford Glennon's communication article this way.) There are a few bugs to be worked out to make this a viable alternative; the lower-to-upper-case conversion and maximum file-length restriction are two.

You may contact Phil at MICRO, P.O. Box 6502, Chelmsford, MA 01824.

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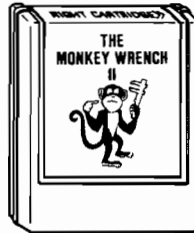
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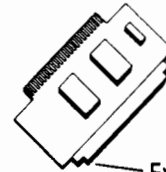
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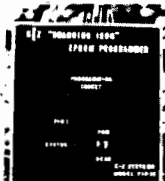
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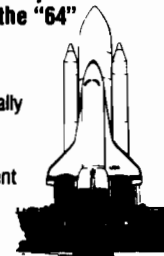
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# APPLE, Mountain, and Data Capture

by H. Bruce Land, III

The CPS Multifunction Card from Mountain Computer (\$180 to \$240) and Data Capture 4.0/80, CPS Version (\$90) from Southeastern Software, can provide your Apple Computer with a complete RS-232 I/O port with five true handshake lines, a parallel printer output port, clock and calendar, and battery backup. You can have a smart terminal, hardware, and software by using only one of the Apple's few slots and some of its limited power supply — all for as little as \$270.

## The Hardware

The Mountain Computer card ROM contains a system configuration program that allows you to determine how the card will function. From a menu you can set baud rate, parity, number of data bits, and number of stop bits. You can even use a 5-bit ASCII; and you can set the appropriate functions for the parallel port.

By choosing items from the menu, you can select which slot the Apple "thinks" the card is in, regardless of its actual location. For example, you can place the card in Slot 2 but address the printer as Slot 1, the modem as Slot 3, and the clock as Slot 4. These assignments can be reset by software so that other real cards can reside in these slots.

The serial output can automatically change lower case to upper case if you don't have a lower-case adapter for your Apple, and it can echo characters back to the sender. The serial output also can define a control character to function as an escape character, set or clear the high-order bit, supply auto-line feeds, set line length, do automatic paging for pages of any size, and add a carriage-return delay.

Once you configure the system, the parameters are stored in the permanent CMOS memory and you can ignore them until you want to make changes.

Additional high-level software supplied with the unit allows you to turn the Apple monitor into an analog clock complete with sweep second hand. The CPS Lister program allows you to make formatted Applesoft program listings, properly spaced, with the date and time printed at the top of each page, page numbers, and with no printing over the perforations on continuous paper. If you often forget which is your most recent listing, then these dated and timed listings are for you.

## The Software

When you use Applesoft with a normal serial I/O card and type data to a modem, every time you hit RETURN Applesoft says 'SYNTAX ERROR' because it thinks you're erroneously entering a BASIC statement. Install the Mountain CPS card, enter a couple of control codes, and your Apple will function as a dumb terminal. You can talk to another computer through your keyboard, and it can display messages on your CRT. Although you can communicate, at this level of operation you can't send a message to the printer, store it in memory, or save it on disk.

Enter Data Capture 4.0, 40/80 column, CPS version. This combination is not the only one available, but it's the only one I've found that does the whole job. With the CPS card and Data Capture, your Apple can be a computer one moment and a smart terminal the next. You can compose your message off-line and then burst it over the line at up to 1200 baud to another computer, a time-sharing system, or even to a mainframe computer. You can

hold a received message in memory, edit it, save it to disk or cassette, and print it at your leisure.

Run Data Capture and press ESC. You will see the following menu:

C)atalog	disk
D)delete	text
I)nsert	text
L)ist	text
M)erge	from file
P)rint	text
Q)uit	program
S)end	text
T)oggle:	
	A)lternative drive (1/2)
	B)aud rate
	C)apture (on/off)
	D)uplex (full/half)
	L)ocal carrier (on/off)
	S)pecial characters (on/off)
W)rite to file	

Any of these functions can be selected and executed while you are off-line. When you are on-line you can send a signal to place the other computer on "hold," select and execute commands from the menu, and then resume communication on the other computer. While the computers are talking to each other, status lines display the operating mode and tell you how many lines of text have passed through your Apple.

If the capture mode is off, nothing is saved; if it is on, both sides of the transmission are saved as a text file in a RAM buffer. At any time you can write the text to a disk file for later use; and at any time the buffer can be partially or fully cleared (deleted), relisted, saved, or printed. Additional text can be merged from disk to buffer and then sent to the other computer. You can send and receive text, numerical data,

and program listings, and you can transfer programs directly to another Apple. (Note: Data Capture does not work in auto-dial or auto-answer mode with the CPS card.)

Some mainframes require special key codes that the Apple normally cannot generate without Data Capture (for example, the UNIX system I've been using requires a true delete code and an underline). The Apple keyboard generates a backspace and the hardware interprets this as a backspace/delete. Data Capture allows you to redefine portions of the Apple keyboard to generate any ASCII code you may need, including any of the control codes.

Both the CPS card and Data Capture come with more documentation than you'll ever read, but it is comforting to know that it's there in case you want to do something different. My printer is a Selectric typewriter and my modem is homemade, so I needed the extra documentation.

You may wonder why Data Capture is so expensive. The task it must perform is tricky. The Apple cannot talk to two I/O devices at the same time. It

cannot send data from the keyboard to both the modem and the display at the same time. Data Capture has so much to do in so short a period of time that it uses machine code for an intricate routine that 1. looks at the keyboard; 2. if data is available there, checks to see whether or not the data is a control character; 3. if not, stores the data in a RAM buffer; 4. sends it to the display; and 5. sends it to the modem. While this is happening, Data Capture must, in effect, look over its shoulder and check the modem to see if it is sending a character to the Apple, decide whether or not this is a control character, and if not, store the character in the buffer and send it to the display.

Meanwhile Data Capture must format each character into the proper word length, control stop bits, baud rate, etc. — all on data moving at speeds up to 1200 baud.

Unlike the high-speed software that handles the bits and the bytes, the software that services the menu is in Applesoft, and you can modify it without difficulty. To get the attention

of a big system running under UNIX, I had to change the length of the BREAK command and make it repeat twice. This was easy to do in BASIC.

Data Capture is not copy protected, so if you want to talk to several different systems with different requirements, you can prepare a disk for each, and avoid frequent software modifications.

To sum up, the Apple and the CPS card and Data Capture make a fine team. Together, they can handle anything at 1200 baud or less, and they do it in a friendly fashion.

Note: You can buy the CPS Multi-function Card from Mountain Computer, Inc., 300 El Pueblo Road, Scotts Valley, CA 95066, (408) 438-6650. Data Capture 4.0/80, CPS Version, can be obtained from Southeastern Software, 6414 Derbyshire Drive, New Orleans, LA 70126, (504) 246-8438.

You may contact the author at 6916 Park Place, Baltimore, MD 21227.

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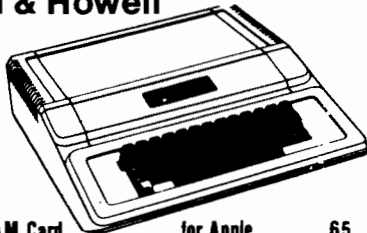
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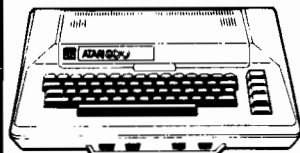
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# Unleash the AIM "A" Block

by Tom Lillevig

Memory is a valuable commodity on the AIM 65. This article shows how to recover some memory space and provides suggestions for uses.

Your first look at the address map for the AIM 65 reveals a 36K block of space available for those helpful additions every computer user needs. If, however, you add a couple of 16K RAM boards and a video interface, you soon discover that 36K isn't as much space as you thought.

If you take a closer look at the address map you will see a design that saved Rockwell some money in manufacturing, but cost you the use of valuable memory space. Four interface devices, which require a total of less than 256 bytes of memory, have been allotted an entire 4K block! I refer, of course, to the PIA, RIOT, and VIAs that inhabit the "A" block. This article discusses a simple method to unleash much of the "A" block and several applications for the available space.

The reason that the four devices in the "A" block take up so much memory is that the enable signals are produced by loose decoding. The AIM 65 schematic shows that the enables come from decoder Z19 and are derived from CSA and address lines A10 and A11. This method of decoding allocates 1K of memory space to each device. A better method, first proposed by Larry

Figure 1: AIM-65 modification.

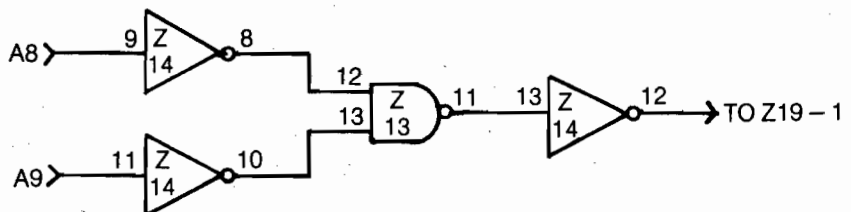
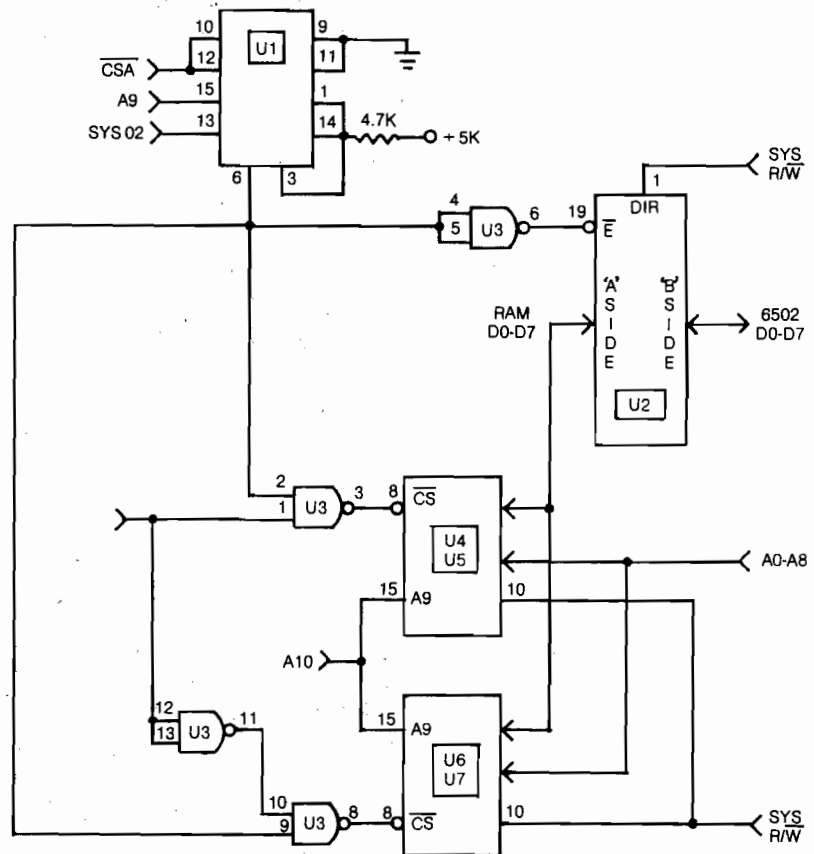


Figure 2: Adding 2114 RAM to "A" block.



U1:7485  
U2:74LS245  
U3:74LS00  
U4-U7:2114 RAM

ADDRESSES  
U4,U5: AA00-ABFF  
AE00-AFFF  
U6,U7: A200-A3FF  
A600-A7FF

Westergren in the computer club newsletter *Interchange*, squeezes each device into a space of 256 bytes, thus freeing up 3K of usable memory. Larry's method requires the addition of one IC, so I decided to see if the decoding could be done using spare gates on the AIM.

See figure 1 for my update of Larry's idea. The NAND gate and inverters are all spare devices, and no circuit cuts are required. The connection to Z19-1 deactivates the existing "A" block enables to the I/O devices, except when both A8 and A9 are at zero. This

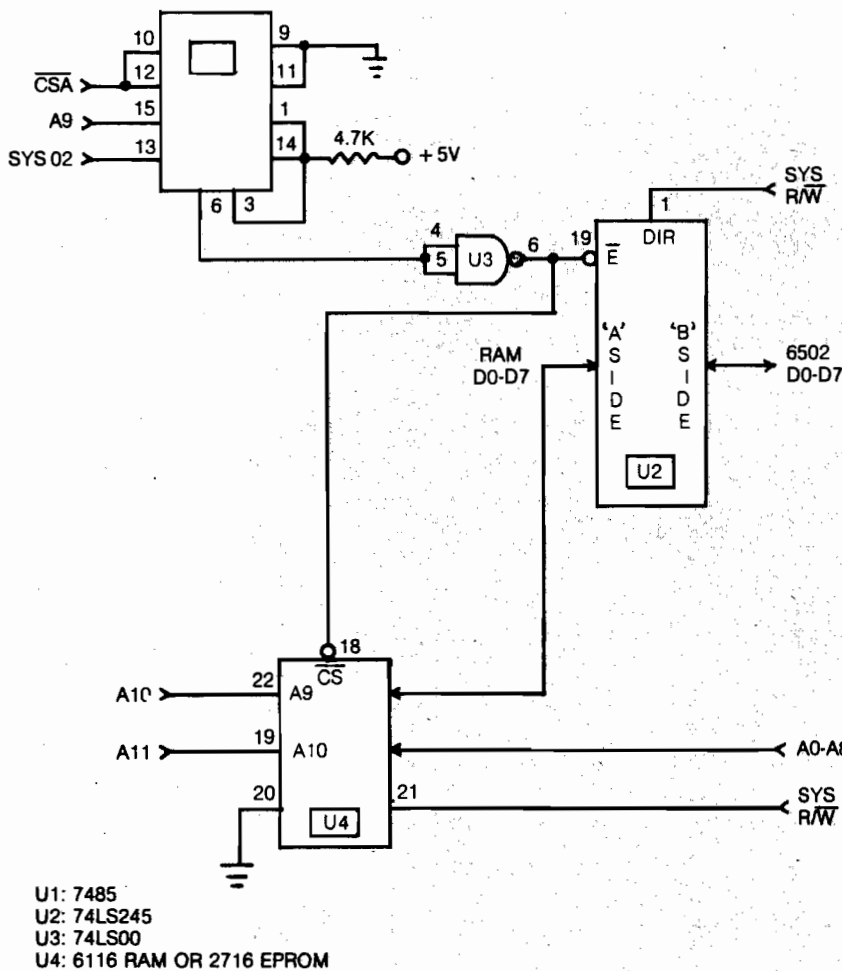
modification makes address blocks \$A100-\$A3FF, \$A500-\$A7FF, \$A900-\$ABFF, and \$AD00-\$AFFF available.

Now that these blocks are free, what can be installed? Since each slot is only 768 bytes wide, RAM addition does not appear to be a good choice. If, however, you can live with four separate blocks of 512 bytes, then you can wire four 2114's to provide 2K of memory with no waste or overlap [see figure 2]. The RAM blocks occupy addresses \$A200-\$A3FF, \$A600-\$A7FF, \$AA00-\$ABFF, and \$AE00-\$AFFF. As shown in figure 3, a 6116 RAM or 2716

EPROM could be installed instead of the 2114's.

The rest of the available space can be decoded further to provide enable lines for a variety of devices. The circuit in figure 4 illustrates a simple method for deriving eight enables from the remaining blocks. The enables may be used for any chips that require 128 bytes of memory space, or less. PIAs, VIAs, and real-time clocks are just a few example of devices that will fit nicely.

Figure 3: Adding 6116 RAM or 2716 EPROM to "A" block.

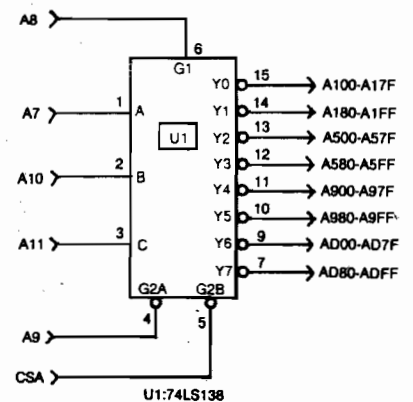


ADDRESSES: A200-A3FF,  
 A600-A7FF, AA00-ABFF, AE00-AFFF

Tom Lillevig is a Senior Training Representative at Rockwell-Collins. He is also secretary of the Cedar Valley Computer Association, an organization that includes nearly 500 AIM 65 owners. You may contact Mr. Lillevig at 130 Carnaby Dr. NE, Cedar Rapids, IA 52402.

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Figure 4: Decoding for spare enable lines.





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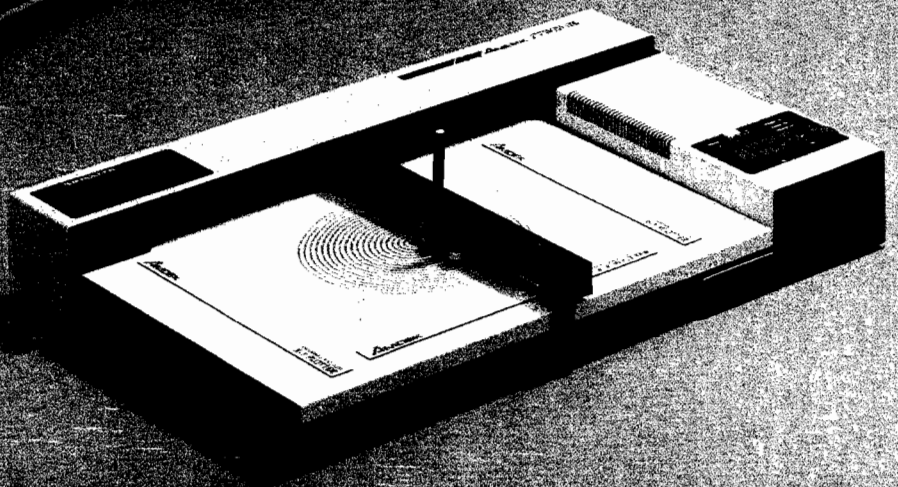
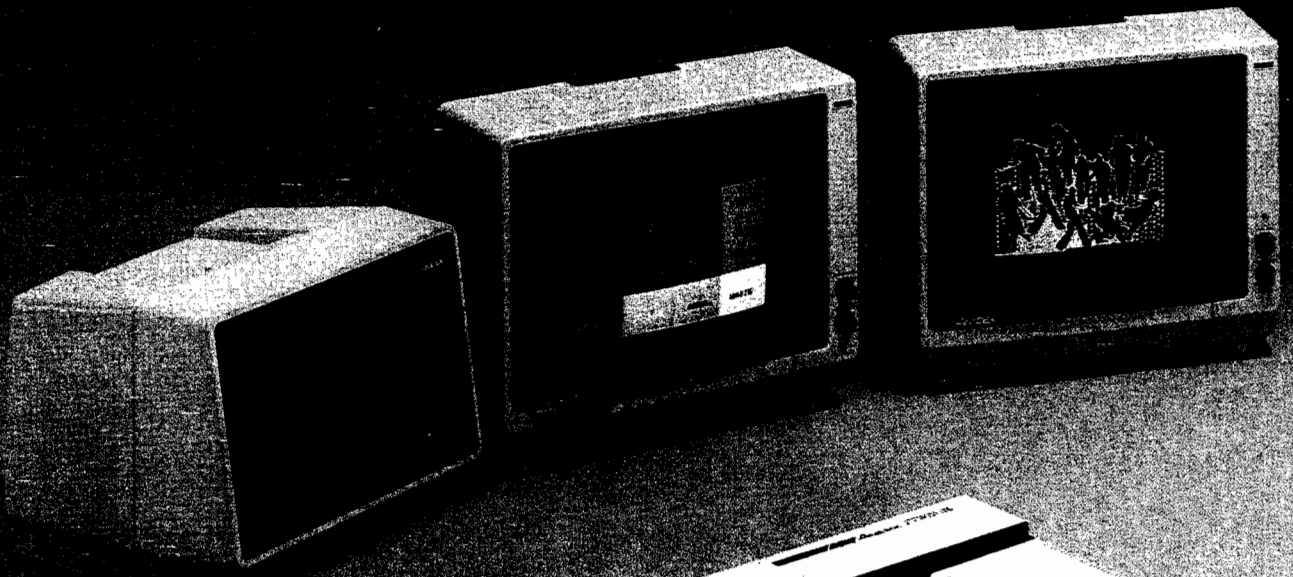
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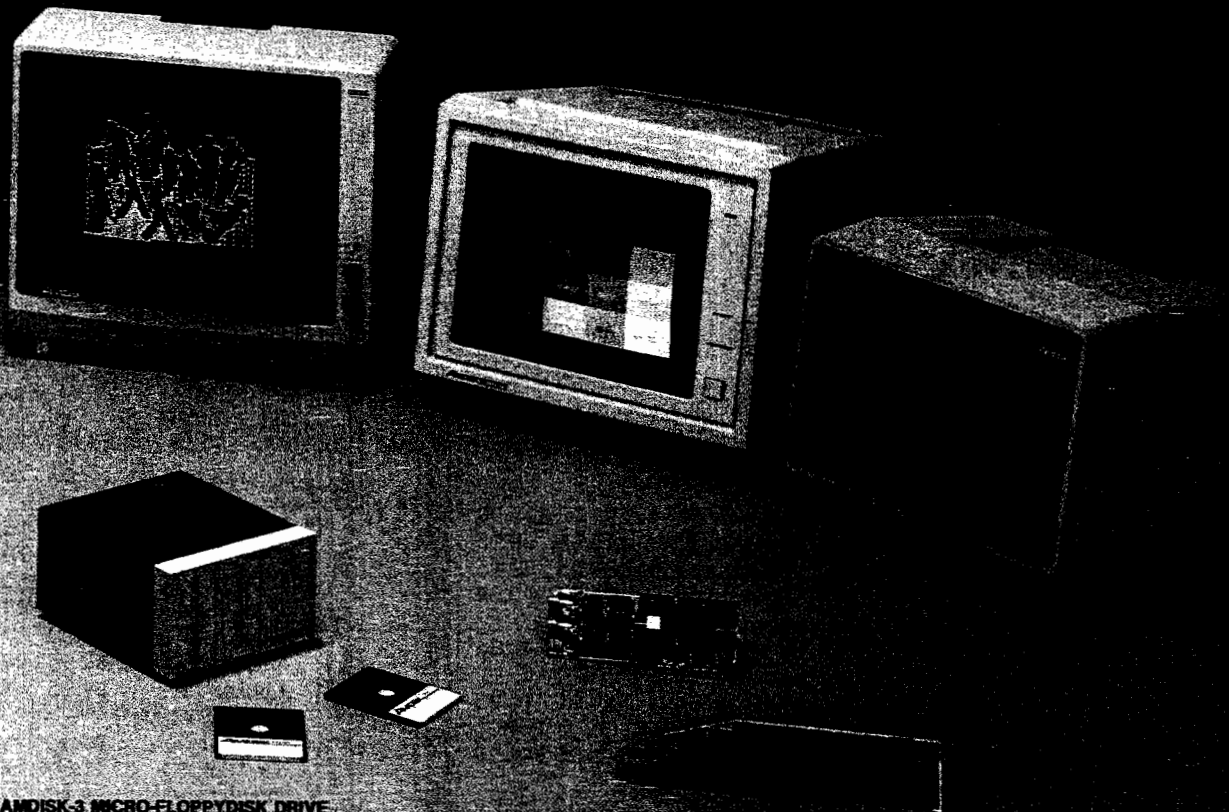
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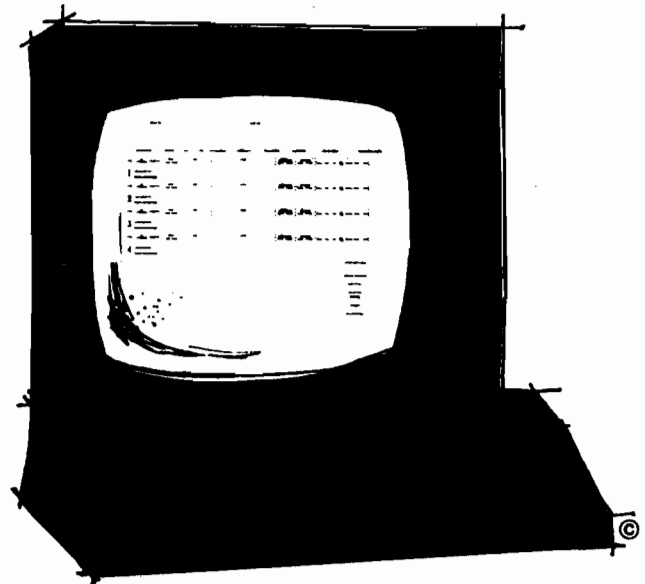
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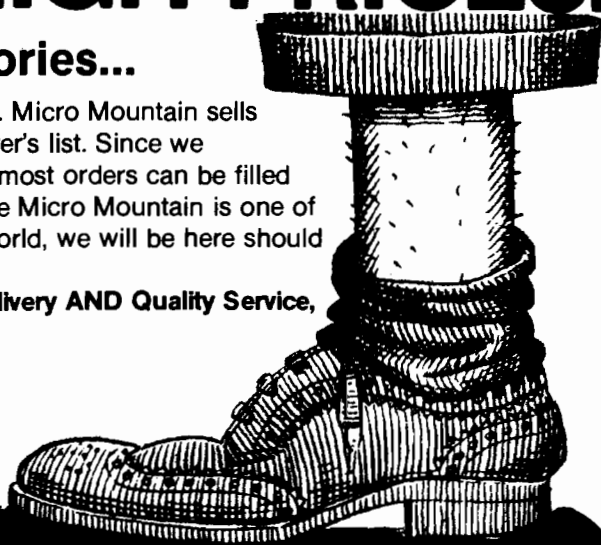


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# MASTER for VIC-20 and COMMODORE 64

by Loren Wright

*Apple Listing appears on page 82*

MASTER is a simple guessing game for one or two players. The commercial version of this game involves colored pegs. One player constructs a pattern of four colored pegs behind a screen, and it is up to the other player to guess the concealed pattern. The first player provides the second player with clues, telling him how many pegs have been guessed in the right position, and how many pegs are the right color but in the wrong position. The second player continues to guess until he has discovered the colors and correct positions of all four pegs. The number of guesses is the score, and the player with the lower score wins. The computer uses letters instead of pegs, but the rules are the same. In fact, the MASTER program offers you a choice of three different game versions, and you can modify the program to play even more games.

## Running the Program

Position the tape to load the program MASTER. Hold down the shift key and press RUN/STOP. When the program is loaded, the screen will clear and the message '1 OR 2 PLAYERS?' will be displayed at the top. For the moment, select '1'. The two-player game is described later. Next you are offered a menu of game difficulty levels. Press '1', '2', or '3' to select a game. (You can change your choice for the next game, if you want.) The rules appropriate to the game you have selected are then displayed. The rules are printed here for reference.

In the EASY game, only A, B, C, and D are allowed, and no letter may be repeated in the secret pattern. Your guesses may include repeated letters, though. In the MID game, only A, B, C, and D are allowed, but these letters may be repeated in the pattern. In the HARD game, A, B, C, D, E, and F are allowed, and letters may be repeated.

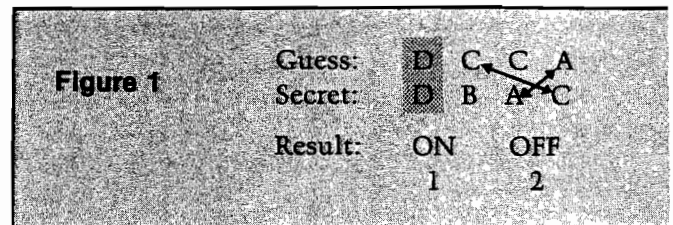
Press any key (except RUN/STOP) to continue. The computer now generates, at random, a secret pattern. The screen will clear and appear as below:

SELECT LETTER ON OFF

> ■

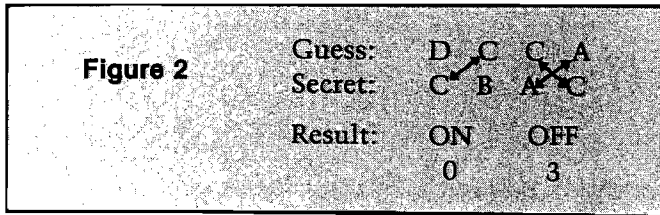
The flashing-square cursor appears right after the '>'. Only '?', '←', and the letters allowed in the game will be accepted from the keyboard. (The RUN/STOP key does work, though!) Acceptable characters will be printed on the screen; unacceptable ones will have no effect. As soon as you enter the fourth letter in your guess pattern, the program will process it. Until you enter that fourth character, though, you may change your mind. Press '←' to restart your guess. If at any time you want to give up, the '?' key will print the secret pattern and let you start over with a new game and pattern.

When you enter the fourth item in your guess pattern, the computer matches it against the secret pattern. In the 'ON' column is the number of letters guessed correctly, and in the right position; in the 'OFF' column is the number guessed right, but in the wrong position. Understanding the matching process will help you learn to play the game better. For instance, if you guessed 'D C C A', and the secret pattern is 'D B A C', the computer will return a '1' in the 'ON' column and a '2' in the 'OFF' column.



The 'D' is in the correct position (indicated by the shading), but the 'C' and the 'A' (matches indicated with arrows), while they do exist in the

secret pattern, were guessed in the wrong position. Only one of the C's in the guess is counted, since there is only one C in the secret pattern. If the secret pattern were 'C B A C' instead, the program would return '0' in the 'ON' column and '3' in the 'OFF' column. Both C's in the guess are now counted.



When you have guessed the secret pattern correctly, you will be congratulated and told the number of guesses you took. Then the program is restarted with selection of the game level.

As you play more and more games, you will begin to develop systems to help you guess the pattern as quickly as possible. One technique that is sometimes useful is substituting one character at a time.

### Two-person Game

The two-person option allows a second player to input a secret pattern instead of having the computer come up with one. The player who will be guessing should look away from the screen while the other player inputs a pattern. The program tests for the letters allowed but it does not check for repetitions. Be sure to follow the repetition rule in effect. To go back to the one-person version press RUN/STOP, type RUN and press RETURN. This time answer '1' for the number of players.

---

## Programming Techniques in MASTER

---

### Random Numbers

In the one-player version of MASTER, the program is able to come up with a different secret pattern of letters each time the game is played. How is this done? The secret is in random numbers. BASIC is able to generate random numbers using the RND function.

A random number is one that is obtained without any predictability or repeatability. Rolling a die, flipping a coin, and spinning a roulette wheel are all means of obtaining random numbers in the real world.

Many programming applications require a source of random numbers. For statistics programs they can provide sample data to test a model, and

in physics they can be used for applications such as demonstrating the behavior of gas particles.

Many game programs require random numbers. These may be used in the form of playing cards, dice, or locations of hidden treasures. In the 1-player version of MASTER, random numbers are used to generate the secret pattern of letters.

The BASIC function RND generates pseudo-random numbers in the range between 0 and 1. Pseudo-random means each succeeding number depends to some extent on the previous one. As a result, after many thousands of numbers, the sequence will start over. This makes statistics involving very large samples sometimes difficult, but it usually causes no problem in games, which use considerably fewer numbers.

The only problem we must avoid is generating the same sequence of random numbers every time the program is run. The technique used in MASTER is to be sure the RND function has a different starting number or 'seed' each time. This is accomplished with the statement 'I=RND(-TI)' in line 8040 as part of the initialization sequence. Using a negative number as the argument for RND causes a function of the argument to be used as the seed to start the sequence of random numbers. TI is the value of an internal clock that starts at zero when the computer is turned on and increments every sixtieth of a second. Since you are very unlikely to start the program at exactly the same moment each time, you are practically assured of getting a different seed each time. If you use a negative constant instead of -TI in line 8040, you will generate the same sequence of random numbers each time. Run the program this way and you will be able to astound your friends with your psychic powers!

Now that we have a sequence of random numbers, how do we turn this sequence into the letter patterns for MASTER? Line 1020 does it all in one BASIC expression: RN=INT(RND(1)\*N+1), where N is number of letters allowed in the game. See figure 3 for a graphic illustration of how four random numbers are converted into the four letters of a secret MASTER pattern. RND(1) produces numbers in the range of 0 to 1, but this does not include either 0 or 1 themselves. First we multiply the number by the number of letters allowed in the game. If we allow four letters (N=4), then we multiply the random numbers by four to get numbers in the range 0 to 3.999.... Next we add 1 to make it 1 to 4.999.... Then we use the BASIC INT function to remove whatever is to the right of the decimal point, leaving us with 1, 2, 3, or 4. These numbers are never actually converted to letters. Instead, the letters the player types for a guess are converted to numbers.

Figure 3	BASIC Function	Element #			
		1	2	3	4
	RND(1)	.555877482	.689094948	.828839479	.0619696133
	*4	2.22350993	2.75637979	3.31535792	.247878453
	+1	3.22350993	3.75637979	4.31535792	1.24787845
	INT( )	3	3	4	1
	LETTER	C	C	D	A

The same technique can be used to get random numbers over any range. For dice, multiply by six, take the integer, and add 1. For playing cards, multiply by 52, take the integer, and add 1. (Converting 1 to 52 into suits and ranks is another problem!)

### Flags and Logic

One of the most powerful features of a computer is its ability to make decisions. MASTER uses the computer's decision-making ability throughout its program.

Every decision boils down to deciding whether an expression is true or false. The BASIC IF...THEN construction decides whether an expression is true or false. If the expression after the IF is true, then whatever appears on the line after the THEN is executed. If the expression is false, then the rest of the line is skipped and execution continues with the next line.

BASIC doesn't actually handle the words 'true' and 'false.' Instead, it assigns -1 to represent 'true' and 0 to represent 'false'. When evaluating expressions, any non-zero result is considered 'true'. To see this in action try the following example:

```
10 INPUT "A=" ;A
20 INPUT "B=" ;B
30 IF A = B THEN PRINT "TRUE": GOTO 50
40 PRINT "FALSE"
50 PRINT A = B
60 GOTO 10
```

Run this program. Type in a value for A, press RETURN, type in a value for B, and press RETURN. If the number you entered for A equals the number you typed for B, then 'TRUE' will be printed, followed by -1. Otherwise 'FALSE' is printed, followed by 0. The number -1 or 0 is the value BASIC assigned to the expression 'A = B'. Line 180 in MASTER checks to see if the number of correct position matches (PM) is equal to the number of letters (NN) in the pattern. If so, the player has correctly guessed the pattern and the

congratulation routine 6000 is executed before starting a new game by returning to line 100.

Now enter the following program example that demonstrates the use of a flag.

```
10 INPUT A
20 IF A THEN PRINT "TRUE": GOTO 40
30 PRINT "FALSE"
40 GOTO 10
```

Try a few numbers. Every number except 0 will result in 'TRUE' being printed. Entering 0 will produce a 'FALSE'. The 'A' in line 20 is evaluated just like any other expression. If it is non-zero then it is considered true.

A flag is a convenient device in a program. It can be either set (true or -1) or clear (false or 0). BASIC doesn't have a special variable type for flags, but either integer or floating point variables may be used that way. MASTER uses several variables as flags: RP, RQ, and the arrays PF( ) and PG( ). RP is set or cleared in the game selection routine (in line 7100, 7200, or 7300), depending on the game chosen. In line 1030, if RP is set (= -1) then lines 1040-1080, which prevent duplicate letters in the pattern, are skipped. RQ stays cleared unless a duplicate letter is found. If the flag is set, then the program returns to 1020 to determine a new number. Each element of the secret pattern has an element in the flag array PF( ), and each element in the guessed pattern has an element in the flag array PG( ). See the discussion under "Processing a Guess" for details of how these flags are used.

Another interesting use of a flag is in the display of the congratulation message (6080-6150). A FOR...NEXT loop is used to alternate the variable I between -1 and 0. The flag I is tested in lines 6090 and 6120. If the flag is set, then the reverse-field character is printed. When the flag is clear, the following message is printed in normal characters. This produces the alternating reverse-field effect.

The program has to make decisions in a number of other places, evaluating an expression

to determine what to do next. The IF...THEN statement is used most commonly for decision making, but ON...GOSUB and ON...GOTO are also used. ON...GOSUB is used in line 110 to decide whether to generate a random pattern in a 1-player game, or to let a player input a pattern.

### Processing a Guess

As explained earlier, the match count is determined by first checking for exact position matches and then going through to check for out-of-position matches. No element in either the secret or guess pattern may be used more than once in a match.

To avoid re-using pattern elements in matches, we need to program a way to "cross off" pattern elements that have been used in a match. In addition to the two arrays of the elements themselves, two corresponding flag arrays are used.

At the beginning of the matching process, all the flags are cleared, or set to zero (3010-3030). As each match is detected, the flags corresponding to the matched elements are set (in lines 3050 and 3550). The flags are checked in lines 3520 and 3540. If the flag is set, then the matching process is skipped and the next element is checked. In addition, when a match is found in line 3550, the higher numbered elements in the guess pattern are skipped by setting the loop index J to its maximum value, NN. The NEXT J statement in line 3560 sees J equal to its maximum value and is fooled into thinking it's through with the specified repetitions. Control passes to the NEXT I statement in line 3570.

This process is graphically demonstrated in figure 4. I is the index into the secret pattern, while J is the index into the guess pattern. The boxes indicate the two elements currently being compared, PM is the number of position matches,

and OM is the number of out-of-position matches. A shaded box indicates a match and a diagonal line through an element indicates that it has been used in a match already. First, the position matches are checked. The result is 1, with the D's in the first position crossed off. In the program, the flags PF(1) and PG(1) are set to -1.

Next, the out-of-position matches are checked. Since the first elements in each pattern have already been used, the comparison begins with the second elements. No match is found for the B, so the search continues with the third element of the secret pattern and the second element of the guess pattern. When the match is found with the fourth guess element, these two are crossed off, and the out-of-position match counter OM is incremented. A match is found immediately for the fourth secret pattern element, so the remaining two elements are skipped, and the counter incremented again. One position match and two out-of-position matches are reported to the player.

If you are still confused about how this works, try a different pattern and construct a table similar to figure 4. You might also try running through the program lines with an example.

## Customizing your MASTER Game

### Adding an EXPERT Level

Because of the way MASTER is written it is easy to add your own version to the game. As an example of how to do this, let's add an EXPERT game to the three choices we have already. Add or substitute the following lines to the program supplied.

```
2100 PRINT "[RVS]"CHR$(T + 64)"[OFF]";
7050 PRINT "[CD][2 CR][RVS]1[OFF]  EXPERT"
```

**Figure 4**

	Secret Pattern					Guess Pattern				PM	OM
I					J						
1	<del>D</del>	B	A	C	1	<del>D</del>	C	C	A	1	0
2	<del>B</del>	<del>B</del>	A	C	2	<del>B</del>	<del>C</del>	C	A	1	0
3	<del>B</del>	B	<del>A</del>	C	3	<del>B</del>	C	<del>C</del>	A	1	0
4	<del>B</del>	B	A	<del>C</del>	4	<del>B</del>	C	C	<del>A</del>	1	0
2	<del>B</del>	<del>B</del>	A	C	2	<del>B</del>	<del>C</del>	C	A	1	0
2	<del>B</del>	<del>B</del>	A	C	3	<del>B</del>	C	<del>C</del>	A	1	0
2	<del>B</del>	<del>B</del>	A	C	4	<del>B</del>	C	C	<del>A</del>	1	0
3	<del>B</del>	B	<del>A</del>	C	2	<del>B</del>	<del>C</del>	C	A	1	0
3	<del>B</del>	B	<del>A</del>	C	3	<del>B</del>	C	<del>C</del>	A	1	0
3	<del>B</del>	B	<del>A</del>	C	4	<del>B</del>	C	C	<del>A</del>	1	1
4	<del>B</del>	B	<del>A</del>	<del>C</del>	2	<del>B</del>	<del>C</del>	C	<del>A</del>	1	2

# LEARNING CENTER

```
7070 T = VAL(T$):IFT < 1ORT > 4THEN7060
7080 ONTOSUB7100,7200,7300,7600
7600 N = 8:RP = - 1:G(1) = 8:G(2) = 12:G(3) = 16:
      G(4) = 20:G(5) = 25
7610 PRINT"[CLR]EXPERT GAME:"
7620 GOSUB7400
7630 PRINT"[CD][2 CR]MORE THAN ONCE"
7640 RETURN
```

This version of the game allows the first eight letters of the alphabet. The operation of the game itself is controlled by the values of N and RP in line 7600. The rest of the program changes involve adding the game to the menu and displaying the rules. The value of N determines the number of letters allowed in the game. RP is a flag, which, if set, allows repeats of letters in the pattern (see the "Flags" section above). The array G( ) holds the cut-off numbers of guesses for each congratulation message. Adjust these values and program the appropriate messages, as in the example above, and you will be able to add your own game version.

### *Congratulation Messages*

As part of the initialization routine, six congratulation messages are defined in lines 8060 and 8070. You can change these messages, as well as the cut-off values G( ) defined in lines 7100, 7200, and 7300.

### *Number of Elements in Pattern*

The number of elements is four for all versions of the game described so far. This number can be changed to practically any number, the only limitations being the width of the display and the amount of memory in your VIC-20. The number of elements in the pattern is determined by the value of NN in line 8050 of the initialization routine. Change line 8050 to read: 8050 NN = 3. Now run the program. Notice that everything works as before, except only three letters are generated in the secret pattern, and only three are expected in each guess.

To program more elements in the pattern, two additional changes must be made, both in line 8040:

```
8040 FD$ = "[BLK][SPC]":BK$ = "[CL]"
      :CR$ = CHR$(13):CF = 204
```

With this change, five or six elements can be accommodated without disturbing the rest of the display. Substitute for line 8050, as above: 8050 NN = 5 or 8050 NN = 6. One solution for longer patterns is to print the clues on the next line:

```
180 PRINTTAB(34)"[BLK][SPC]"PM;OM
```

Another solution is to further compress the letters in the guess:

```
8040 FD$ = "[BLK]":BK$ = "[CL]"
      :CR$ = CHR$(13)
      :CF = 204
```

Patterns of 11 or more elements require a DIM statement in the initialization routine. For example,

```
8050 NN = 11:DIMR(NN),GU(NN),PF(NN),PG(NN)
```

along with one of the display adjustments above, sets up the game for 11 elements.

---

## Program Description

---

Initialization (10): Subroutine 8000 sets up a number of constants, and subroutine 7500 gets the number of players.

Program mainline (100-200): Subroutine 7000 gets the skill level for the game and displays the instructions for the game. Subroutine 5000 waits for a key to be pressed before continuing with the main program.

Line 110 uses the ON...GOSUB structure to determine whether to call subroutine 1000, which generates a random pattern, or subroutine 4000, which allows one player to input a pattern. NP can have only two values, 1 or 2. On 1, subroutine 1000 is called; on 2, subroutine 4000 is called.

GN is used to count the number of guesses. Line 130 calls subroutine 2000, which prints the header on the screen and receives the first guess. The second and subsequent guesses return to line 140 where the same subroutine is called at 2020, to avoid having the header reprinted for each guess.

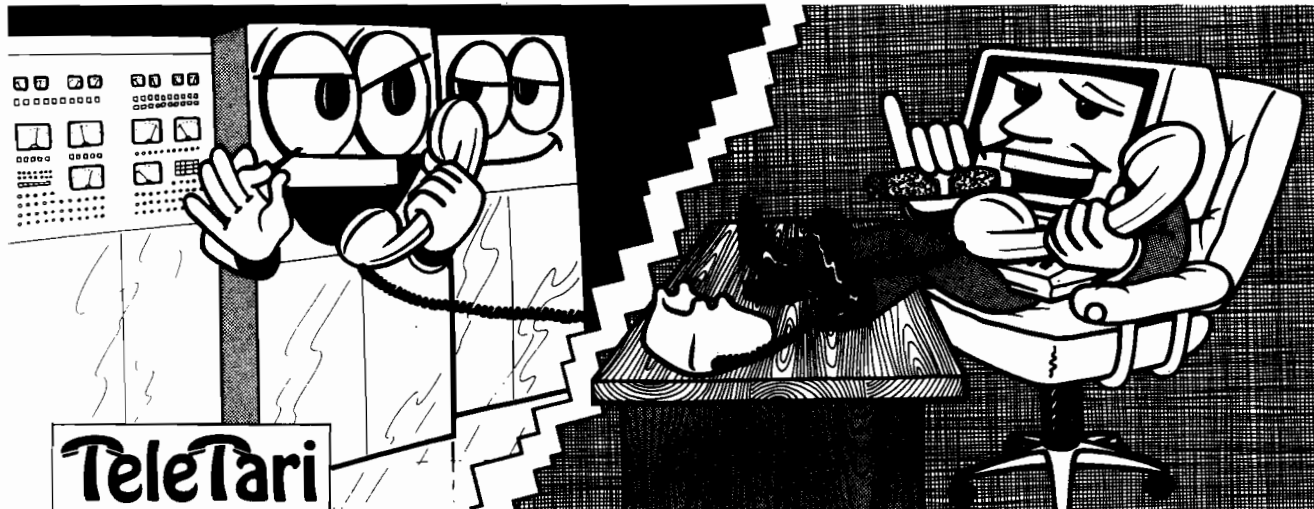
A '?' indicates that the player has given up. A call is made to subroutine 9000, which prints out the secret pattern. GOTO 100 starts the player out with a new game.

Next the guess must be processed. Before each call to the processing routines, the match counters PM and OM are zeroed. Subroutine 3000 processes the guess, first checking for position matches and then for out-of-position matches. If PM (the number of position matches) equals NN (the number of elements in the pattern), then the player has guessed the pattern. Subroutine 6000 is the congratulations routine.

Line 190 prints out the results of the matching, with the position matches under the heading 'ON' and the out-of-position matches under the heading 'OFF'. When the TAB(12) expression is

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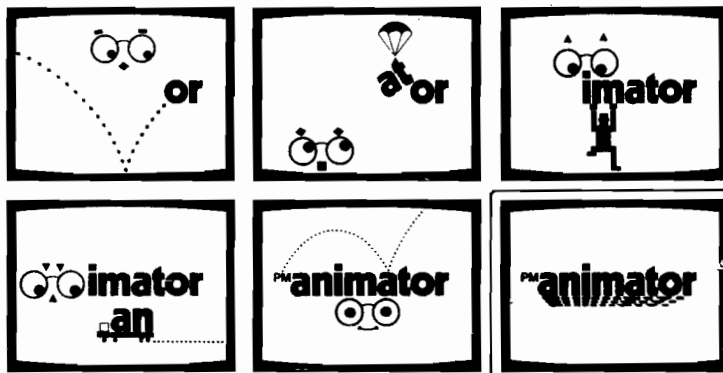
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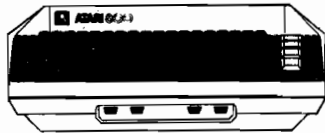


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## LEARNING CENTER

encountered in a PRINT statement the cursor moves to the twelfth character position on the screen.

The guess counter GN is incremented and the program loops back to 140 for another guess.

Generate Random Numbers (1000-1110): This routine is called at the beginning of each one-player game to generate the secret pattern. In the supplied version of the game NN is always 4, so four numbers are generated. Line 1020 returns in RN an integer between 1 and the number of letters allowed in the game (N). If RP is non-zero, then repeats are allowed in the pattern. Lines 1040-1080 are skipped and RN is copied into R(I), the current element of the pattern. If repeats are not allowed (RP=0), then each RN must be checked against the previous elements in the pattern R( ). In line 1040 RQ is set to 0 to indicate that no element has been found so far to match RN. If I=1 then there aren't any numbers in the pattern and we can skip to 1090 and accept this RN. The FOR...NEXT loop on J (lines 1050-1070) goes from 1 to the previous element (I-1). If RN is found to match an existing element (RN=R(J)) then RQ is set to -1 to indicate a match has been found and J is set to I-1 to terminate the FOR...NEXT loop. If no match is found, then the loop continues through all the previously assigned elements. RQ is tested in line 1080: if it is non-zero, then another RN must be calculated (return to 1020); if it is still zero, then we can accept the RN and install it in the current element R(I) of the pattern. The outside FOR...NEXT loop (1010 to 1100) continues until all of the elements required in the pattern have been calculated.

Process Guess (2000-2130): As discussed above under the program mainline, this routine is usually called at 2020, but the first time the call is made to 2000 to print the heading 'SELECT LETTER ON OFF'.

The routine consists of a big FOR...NEXT loop, where I starts with a value of 1 and ends with the value NN, the number of elements in the pattern. Within this loop, characters from the keyboard are accepted or rejected. The GET function returns with a character from the keyboard. If no key has been pressed, then the string T\$ is assigned a null value. As long as T\$ continues to be a null string, the program will keep looping on line 2060. As soon as a key is pressed, the program continues at line 2070. Normally, when the GET function is used, the cursor does not flash. POKEing a 0 into CF (a constant set to 204 in the initialization) starts the cursor flashing; POKEing a 1 turns it off. It must be turned off between GETs to avoid depositing cursor characters in unwanted places.

Two special characters '←' and '?' are tested. On

'←', the loop is terminated by setting I to NN and executing a NEXT statement. The GOTO 2030 starts the loop over again. If we had failed to terminate the loop (by omitting the I=NN and NEXT statements) the user would be able to crash the program by repeatedly hitting the '←' key. BASIC keeps track of each FOR...NEXT loop in an area of memory called the stack. If we don't terminate a loop, that information continues to occupy space on the stack. Repeated calls to 2030 with the '←' key will continue to build up new FOR...NEXT information on the stack until there is no room left. At this point the program crashes with an ?OUT OF MEMORY ERROR. The '?' character is dealt with similarly. The FOR...NEXT loop is terminated and a RETURN is made to the program mainline.

Other characters are converted in line 2100 to their numeric codes with the ASC function. The code for the letter A is 65, so subtracting 64 converts letters into numbers beginning with 1. If T is less than 1 or greater than the number of letters allowed in the pattern, then BK\$ (a constant defined as two [CL] characters) is printed and the program branches to 2050 to GET another character. If the character is accepted, then the appropriate colored letter block OB\$(T) is printed and the number T is stored in the current element of the guess pattern GU(I). RETURN takes the flow back to the mainline.

Matching Routines (3000-3580): These routines are described in more detail in the main text under the section "The Matching Process."

3010-3030 clear the flag arrays PG( ) and PF( ) by setting them to zero. 3050-3070 advance, position by position, through the secret pattern R( ) and guess pattern GU( ) arrays checking for matches. If a match is found, the position match counter PM is incremented and the corresponding flags are set to -1.

Line 3500-3580 check all the other possibilities for matches. The flags are used to cross off elements as they are matched. Some economy is achieved by skipping over crossed-off elements (lines 3520 and 3540) and by terminating the inside loop as soon as a match is found (J=NN at the end of line 3550).

Input Pattern with Two Players (4000-4160): After the instructions are displayed, this routine accepts letters one-by-one until the pattern is filled. It is similar to the guess-processing routine (2000-2130). Instead of filling the guess array, the secret pattern array R( ) is filled. See the description above for details.

ANY KEY WHEN READY (5000-5020): The string CN\$ is a constant defined in the initialization routine. The result is to print the





# LEARNING CENTER

message 'ANY KEY WHEN READY' at the bottom of the screen. The one-line GET loop must receive a key before a RETURN.

Congratulation Routine (6000-6190): 6010-6060 use the number of guesses GN to determine the congratulation message. The array G( ) is set up for each version of the game in 7100, 7200, or 7300. The messages MS\$( ) are set up as constant strings during initialization. By comparing GN to each cutoff value G( ) with the < = (less than or equal to) operation, the subscript MS for the array MS\$( ) is determined.

Lines 6070-6180 display the congratulation screen, alternating the message and the number of guesses between reversed and normal characters. The use of I as a flag is discussed above under "Flags." If I = -1 then the [RVS] character is printed. Its value alternates between -1 and 0.

The string functions STR\$ and MID\$ applied to GN in line 6130 make the display of the number of guesses more attractive. The STR\$ function converts the number GN to a string of characters. Positive numbers leave a space in front of the numeric characters that normally would be occupied by the '-' character. To get just the numeric part of the string the MID\$ is used in a special way to get all the characters from the second position on. Normally the items included in the parentheses after MID\$ are the name of the string, the character position to start, and the number of characters to extract. If just the first two items are included, then the remainder of the string is the result. Specifying 2 for the second parameter converts the string of the number of guesses to the same string without the leading space.

Line 6140 is a FOR...NEXT loop that does nothing between the FOR and the NEXT! By adjusting the number after the TO, you can achieve a delay in the program of nearly any desired time. Here it controls the rate of the flashing.

The GET function is used in line 6170 in a way opposite to its use in 2050, 4090, 5000, and 7060. As long as no key is pressed (T\$ does not equal ""), the message continues to flash. When a key is pressed, the RETURN instruction is executed.

Select Game and Display Instructions (7000-7440): 7010-7040 display a menu listing the different games available. Line 7060 awaits a key, which is converted to a number and tested against the range of the menu in line 7070. If the key is out of range, then the program branches back to 7060 for another key. The ON...GOSUB instruction in line 7080 calls 7100 if T is 1, 7200 if T is 2, or 7300 if T is 3.

Each of these set-up-and-display routines establishes N (the number of letters allowed in the

game), RP (the flag determining whether or not repeats are allowed), and G( ) (the array of guess number cutoff values for the congratulation messages). Then the name of the game is displayed. Next subroutine 7400, which displays parts of the instructions common to all games, is called. Finally, the rule regarding repeats is printed in the proper place.

Subroutine 7400 first prints the colored letter blocks corresponding to the number of letters allowed (N). If the number allowed is four, the first four letter blocks are printed. Then the portion of the directions common to all versions of the game is printed.

Get Number of Players (7500-7520): This subroutine is called once when the program is first run. It uses subroutine 5010 (5000 without the ANY KEY WHEN READY message) to GET a key. Only 1 or 2 is accepted and the value is returned in NP.

Initialization (8000-8080): Sets up constants used in the program. See variable usage table for descriptions of the variables.

Print Pattern on Give-up (9000-9040): The secret pattern is printed out in the appropriate colored letter blocks, using the secret pattern array R( ). Subroutine 5000 is used to wait for a key before starting a new game.

## Running MASTER on other Commodore Computers

The program will run as it is on a Commodore 64. For PET Computers, change the value of CF from 204 to 167 (line 8040). Also, omit the color control codes.

### MASTER Listing

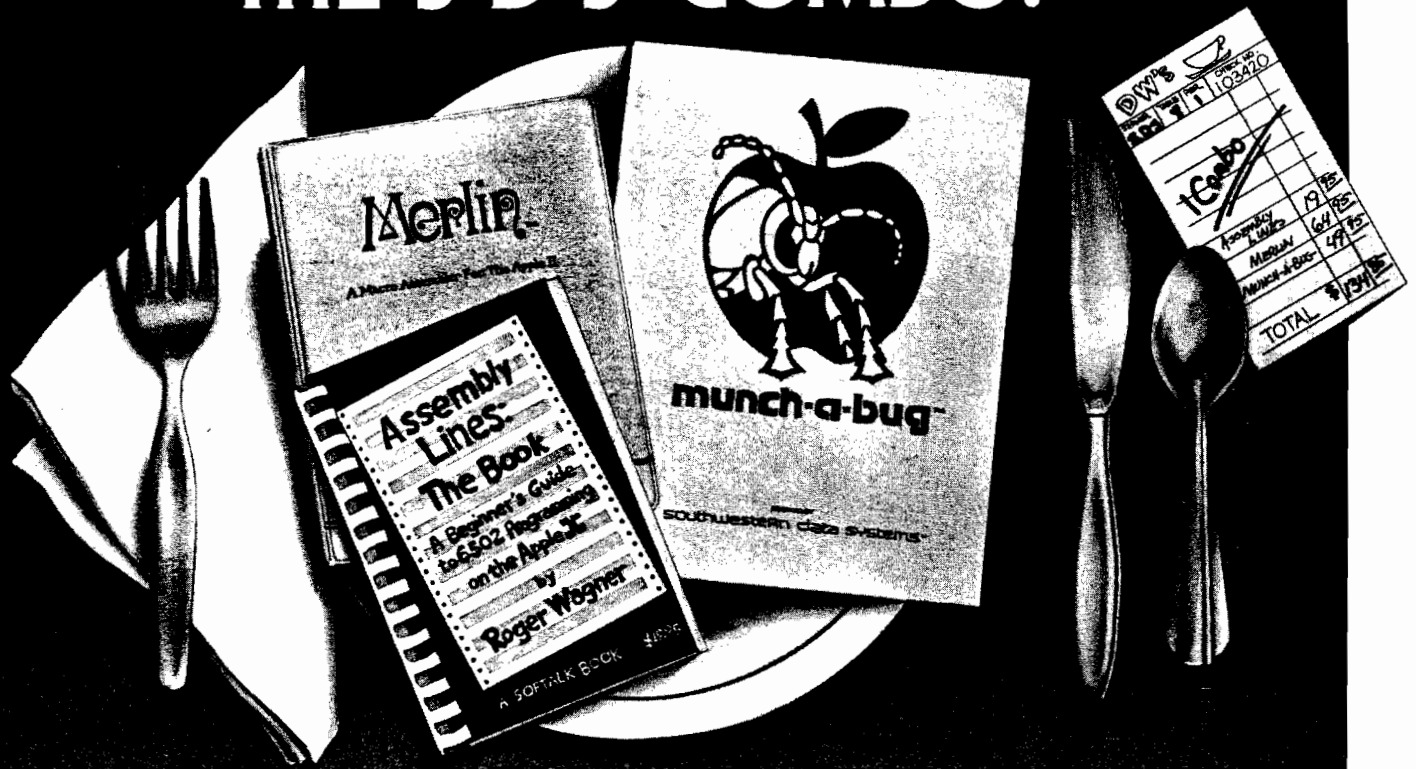
```
10 GOSUB 8000:GOSUB7500:REM SET UP CONSTANTS,
   SELECT # OF PLAYERS
100 GOSUB7000:GOSUB5000:REM SELECT GAME LEVEL,
   WAIT FOR KEY
110 ON NP
   GOSUB 1000,4000:
   REM RANDOM OR PLAYER-INPUT PATTERN
120 GN=1
130 GOSUB2000:GOTO150:REM HEADER, ENTER GUESS
140 GOSUB2000:REM ENTER GUESS (NO HEADER)
150 IF T$=""
   THEN GOSUB 9000:
   GOTO 100
160 PM=0:OM=0
170 GOSUB 3000:
   REM PROCESS GUESS, RETURN PM,OM
180 IF PM=NN
   THEN GOSUB 6000:
   GOTO 100
190 PRINT TAB(12);"[BLKJ] "PM:OM
200 GN=GN+1:
   GOTO 140

1000 REM GENERATE RANDOM NUMBERS
1010 FOR I=1 TO NN
1020 RN=INT(RND(1)*N+1)
```

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Circle No. 40

**MASTER Listing (continued)**

```

1030 IF RP
      THEN 1090
1040 RQ=0:
      IF I=1
      THEN 1090
1050 FOR J=1 TO I-1
1060 IF RN=R(J)
      THEN RQ=-1:
           J=I-1
1070 NEXT J
1080 IF RQ
      THEN 1020
1090 R(I)=RN
1100 NEXT I
1110 RETURN
2000 REM PRINT HEADER
2010 PRINT "[CLR][RVS][PUR]SELECT LETTER
      [OFF] ON OFF[CD]"
2020 REM PROCESS GUESS
2030 FOR I=1 TO NN
2040 PRINT FD$:
2050 POKE CF,0
2060 GET T$:
      IF T$=""
      THEN 2060
2070 POKE CF,1
2080 IF T$="←"
      THEN PRINT CR$"[CU]          [CU]":
           I=NN:
           NEXT :
           GOTO 2030
2090 IF T$="?"
      THEN I=NN:
           NEXT :
           GOTO 2140
2100 T=ASC(T$)-64:
      IF T<1 OR T>N
      THEN PRINT BK$;:
           GOTO 2040
2110 PRINT OB$(T):
2120 GU(I)=T
2130 NEXT I
2140 RETURN

3000 REM CLEAR FLAGS
3010 FOR I=1 TO NN
3020 PF(I)=0:
      PG(I)=0
3030 NEXT I
3040 REM CHECK FOR POSITION MATCHES
3050 FOR I=1 TO NN
3060 IF R(I)=GU(I)
      THEN PF(I)=-1:
           PG(I)=-1:
           PM=PM+1
3070 NEXT I
3500 REM CHECK FOR OTHER MATCHES
3510 FOR I=1 TO NN
3520 IF PG(I)
      THEN 3570
3530 FOR J=1 TO NN
3540 IF PF(J)
      THEN 3560
3550 IF R(I)=GU(J)
      THEN OM=OM+1:
           PF(J)=-1:
           PG(I)=-1:
           J=NN
3560 NEXT J
3570 NEXT I
3580 RETURN
4000 REM INPUT PATTERN
4010 PRINT "[CLR]ONE PLAYER ENTERS"
4020 PRINT " PATTERN"
4030 PRINT "WHILE OTHER PLAYER"
4040 PRINT " LOOKS AWAY"
4050 PRINT "[CD]ENTER PATTERN:"
4060 FOR I=1 TO NN

```

**MASTER Listing (continued)**

```

4070 PRINT FD$:
4080 POKE CF,0
4090 GET T$:
      IF T$=""
      THEN 4090
4100 POKE CF,1
4110 IF T$="←"
      THEN PRINT BK$:
           I=NN:
           NEXT :
           GOTO 4060
4120 T=ASC(T$)-64:
      IF T<1 OR T>N
      THEN 4080
4130 PRINT OB$(T):
4140 R(I)=T
4150 NEXT
4160 RETURN
5000 PRINT CN$:
5010 GET T$:
      IF T$=""
      THEN 5010
5020 RETURN

6000 REM CONGRATULATIONS
6010 IF GN=1
      THEN MS=1:
           GOTO 6070
6020 IF GN<=G(1)
      THEN MS=2:
           GOTO 6070
6030 IF GN<=G(2)
      THEN MS=3:
           GOTO 6070
6040 IF GN<=G(3)
      THEN MS=4:
           GOTO 6070
6050 IF GN<=G(4)
      THEN MS=5:
           GOTO 6070
6060 MS=6
6070 PRINT "[CLR]";
6080 FOR I=-1 TO 0
6090 IF I
      THEN PRINT "[RVS]";
           PRINT "[HOME][RED]"MS$(MS)
6100 PRINT "[CD][PUR]YOU TOOK [CYN]";
6110 PRINT "[CD][PUR]YOU TOOK [CYN]";
6120 IF I
      THEN PRINT "[RVS]";
6130 PRINT MID$(STR$(GN),2);"[OFF]
      [PUR] TRIES!"
6140 FOR J=1 TO 200:
           NEXT J
6150 NEXT I
6160 PRINT CN$:
6170 GET T$:
      IF T$<>""
      THEN RETURN
6180 GOTO 6080
7000 REM PROCESS INITIAL CONDITIONS
7010 PRINT "[CLR]SELECT GAME:"
7020 PRINT "[CD][CR][CR][RVS]1[OFF] EASY"
7030 PRINT "[CD][CR][CR][RVS]2[OFF] MID"
7040 PRINT "[CD][CR][CR][RVS]3[OFF] HARD"
7050 GET T$:
      IF T$=""
      THEN 7060
7070 T=VAL(T$):
      IF T<1 OR T>3
      THEN 7060
7080 ON T
      GOSUB 7100,7200,7300
7090 RETURN
7100 N=4:RP=0:G(1)=3:G(2)=5:G(3)=7:
      G(4)=10:G(5)=15
7110 PRINT "[CLR]EASY GAME:"
7120 GOSUB 7400

```

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**MASTER Listing (continued)**

```

7130 PRINT "[C][R][C][R]ONLY ONCE"
7140 RETURN
7200 N=4:RP=-1:G(1)=4:G(2)=6:G(3)=8:
      G(4)=12:G(5)=18
7210 PRINT "[C][R]MID GAME:"
7220 GOSUB 7400
7230 PRINT "[C][R][C][R]MORE THAN ONCE"
7240 RETURN
7300 N=6:RP=-1:G(1)=5:G(2)=7:G(3)=10:
      G(4)=15:G(5)=20
7310 PRINT "[C][R]HARD GAME:"
7320 GOSUB 7400
7330 PRINT "[C][R][C][R]MORE THAN ONCE"
7340 RETURN
7400 PRINT "[C][R][C][R]";
      FOR I=1 TO N:
        PRINT OB$(I) " ";
      NEXT I:
      PRINT " ALLOWED"
7410 PRINT "[C][R][C][R]EACH MAY BE USED"
7420 PRINT "[6 C][RVS][C][OFF] TO CLEAR GUESS"
7430 PRINT "[C][RVS][C][OFF] TO GIVE UP[HOME]"
      "[C][C][C][C]"
7440 RETURN
7500 PRINT "[C][R][RVS]1[OFF] OR [RVS]2
[OFF] PLAYERS?"
7510 GOSUB 5010:
      IF T$<"1" OR T$>"2"
      THEN 7510
7520 NP=VAL(T$):
      RETURN
  
```

**MASTER Listing (continued)**

```

8000 REM SET-UP OF CONSTANTS
8010 OB$(1)="[RVS][BLK][C][OFF]";
      OB$(2)="[RVS][RED][C][OFF]";
      OB$(3)="[RVS][CYN][C][OFF]";
8020 OB$(4)="[RVS][PUR][C][OFF]";
      OB$(5)="[RVS][GRN][C][OFF]";
      OB$(6)="[RVS][BLU][C][OFF]"
8030 CN$="[HOME][20C][C][C][RVS]ANY KEY
WHEN READY"
8040 NN=4:
      FD$="[BLK] >";
      BK$="[C][C][C]";
      CR$=CHR$(13):
      CF=204:
      I=RND(-TI)
8060 MS$(1)="A PSYCHIC!";
      MS$(2)="EXCELLENT!";
      MS$(3)="VERY GOOD!";
8070 MS$(4)="GOOD";
      MS$(5)="FAIR";
      MS$(6)="TRY, TRY, TRY AGAIN!"
8080 RETURN
9000 REM PRINT PATTERN ON GIVE-UP
9010 PRINT CR$"[C][RVS]GIVE UP?
[OFF] PATTERN IS:"
9020 FOR I=1 TO NN:
      PRINT " >"OB$(R(I)) "[OFF]";
      NEXT I
9030 GOSUB 5000
9040 RETURN
  
```

**MASTER for the APPLE**

```

10 GOSUB 8000: GOSUB 7500
100 GOSUB 7000: GOSUB 5000: ON N
      P GOSUB 1000,4000:GN = 1: GOSUB
      2000: GOTO 150
140 GOSUB 2020
150 IF T$ = "?" THEN GOSUB 9000
      : GOTO 100
160 PM = 0:OM = 0: GOSUB 3000: IF
      PM = NN THEN GOSUB 6000: GOTO 100
190 HTAB 22: PRINT PM" "OM"
      "NN - (PM + OM):GN = GN +
      1: GOTO 140
1000 FOR I = 1 TO NN
1020 RN = INT ( RND (1) * N + 1)
      : IF RP THEN 1090
1040 RQ = 0: FOR J = 1 TO I: IF R
      N = R(J) THEN RQ = 1
1070 NEXT J: IF RQ THEN 1020
1090 R(I) = RN: NEXT J: RETURN
2000 HOME : PRINT "SELECT LETTER
      ON OFF WRONG"
2020 PRINT : POKE 34,1: FOR I =
      1 TO NN
2040 PRINT ">"; GET T$: IF T$ =
      CHR$(8) THEN HTAB 1: CALL
      - 868:I = 1: GOTO 2040
2080 IF T$ = "?" THEN I = NN: GOTO
      2120
2090 T = ASC (T$) - 64: IF T < 1
      OR T > N THEN PRINT CHR$(
      8);: GOTO 2040
2100 INVERSE : PRINT T$;: NORMAL
      : PRINT " ";GU(I) = T
2120 NEXT I: RETURN
3000 FOR I = 1 TO NN:PF(I) = 0:P
      G(I) = 0: NEXT I: FOR I = 1 TO
      NN: IF R(I) = GU(I) THEN PF(
      I) = 1:PG(I) = 1:PM = PM + 1
3060 NEXT I: FOR I = 1 TO NN: IF
      PG(I) THEN 3570
  
```

```

3530 FOR J = 1 TO NN: IF PF(J) THEN
      3560
3550 IF R(I) = GU(J) THEN OM = 0
      M + 1:PF(J) = 1:PG(I) = 1:J = NN
3560 NEXT I
3570 NEXT I: RETURN
4000 HOME : PRINT "ONE PLAYER EN
      TERS PATTERN": PRINT "WHILE
      OTHER PLAYER LOOKS AWAY.": PRINT
      : PRINT "ENTER PATTERN.": FOR
      I = 1 TO NN
4070 PRINT ">";
4090 GET T$: IF T$ = CHR$(8) THEN
      HTAB 1: CALL - 868:I = 1: GOTO 4070
4120 T = ASC (T$) - 64: IF T < 1
      OR T > N THEN 4090
4130 PRINT CHR$(95);:R(I) = T:
      NEXT I: RETURN
5000 VTAB 23: HTAB 10: FLASH : PRINT
      " ANY KEY WHEN READY";: GET
      T$: NORMAL : RETURN
6000 TEXT : HOME : VTAB 5: FLASH
      : FOR I = 1 TO 6: IF GN < G(
      I) THEN MS = I:I = 6
6030 NEXT I: PRINT MS$(MS) " ";: NORMAL
      : PRINT "YOU TOOK "GN" TRIES
      !": GOSUB 5000: RETURN
7000 HOME : VTAB 5: PRINT "SELEC
      T GAME.": PRINT : PRINT : INVERSE
      : PRINT "1";: NORMAL : PRINT
      " EASY";: PRINT : INVERSE : PRINT
      "2";: NORMAL : PRINT " MIDL
      E": PRINT : INVERSE : PRINT
      "3";: NORMAL : PRINT " HARD"
      : PRINT :G(6) = 50000
7060 PRINT "WHICH?";: GET T$: T =
      VAL (T$): IF T < 1 OR T > 3
      THEN 7060
7080 ON T GOSUB 7100,7200,7300: RETURN
  
```

```

7100 N = 4:RP = 0:G(1) = 2:G(2) =
      4:G(3) = 6:G(4) = 8:G(5) = 1
      1: HOME : PRINT "EASY GAME:"
      : GOSUB 7400: VTAB 5: HTAB 1
      8: PRINT "ONLY ONCE": RETURN
7200 N = 4:RP = 1:G(1) = 2:G(2) =
      5:G(3) = 7:G(4) = 9:G(5) = 1
      3: HOME : PRINT "MIDDLE GAME
      ": GOSUB 7400: VTAB 5: HTAB
      18: PRINT "MORE THAN ONCE": RETURN
7300 N = 6:RP = 1:G(1) = 2:G(2) =
      6:G(3) = 8:G(4) = 11:G(5) =
      16: HOME : PRINT "HARD GAME:
      ": GOSUB 7400: VTAB 5: HTAB
      18: PRINT "MORE THAN ONCE": RETURN
7400 PRINT : PRINT " ";: FOR I =
      1 TO N: INVERSE : PRINT CHR$(
      64 + I);: NORMAL : PRINT "
      ";: NEXT I: PRINT "ALLOWED":
      PRINT : PRINT "EACH MAY BE
      USED": VTAB 15: PRINT " <-
      TO CLEAR GUESS": PRINT : PRINT
      " ? TO GIVE UP": RETURN
7500 HOME : PRINT : PRINT " ";:
      INVERSE : PRINT "1";: NORMAL
      : PRINT " OR ";: INVERSE : PRINT
      "2";: NORMAL : PRINT " PLAYERS?"
7510 PRINT " WHICH?";: GET T$:N
      P = VAL (T$): IF NP < 1 OR
      NP > 2 THEN 7510
7530 RETURN
8000 NN = 4:MS$(1) = "A PSYCHIC":
      MS$(2) = "EXCELLENT!";MS$(3)
      = "VERY GOOD!";MS$(4) = "GO
      OD";MS$(5) = "FAIR";MS$(6) =
      "TRY, TRY, TRY AGAIN": RETURN
9000 TEXT : HOME : PRINT "GIVE U
      P?": PRINT "PATTERN IS.": FOR
      I = 1 TO NN: PRINT ">";: INVERSE
      : PRINT CHR$(64 + R(I));: NORMAL :
      PRINT " ";: NEXT I: GOSUB 5000: RETURN
  
```

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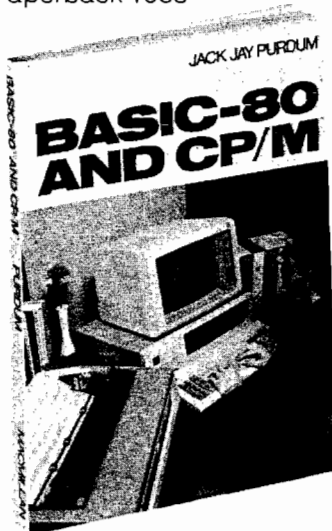
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I.C. #027

# Conservation of Momentum for ATARI and COMMODORE

by Jerry Faughn

Conservation laws, such as the conservation of momentum, are among the most important concepts covered in an introductory level physics course. This program examines the conservation of momentum as applied to collision problems. Two cars are sent toward each other to collide under a variety of conditions selected by the viewer. Programs such as this can be a valuable instructional tool used in a physics class, either as a demonstration or as an interactive tutorial program for a student. But, you don't have to be a physics student to have fun playing around with it.

One of the parameters that the viewer must choose is a value for the coefficient of restitution. This number can range between the extremes of zero and one. If the coefficient of restitution is selected to be one, the collision is said to be perfectly elastic. That is, when the objects collide there is no distortion or bending of the objects. Such conditions obviously do not prevail in the real world of collisions between cars, but they can and do occur in collisions between atoms and subatomic atomic particles.

In the real world, collisions between very rigid objects, such as billiard balls, are highly elastic. At the other extreme are collisions for which the coefficient of restitution is zero; these are called perfectly inelastic collisions. Such collisions are characterized by the two objects sticking together and moving as a unit after the collision. This program can handle elastic and perfectly inelastic collisions as well as the broad spectrum between these two extremes.

Two typical trial situations that you might want to examine use the following parameters. Trial one: coefficient of restitution = 1, mass of blue car = 20, mass of orange car = 4. Trial two: coefficient of restitution = 0, mass of blue car = 10.

This program used player-missile graphics and is explained via remarks within the program.

*Editor's note: The Commodore 64 version uses the C64 Sprite graphics. The two movable-object-block graphics systems have a number of similarities, as well as differences.*

```

9 REM PRINT TITLE
10 GRAPHICS 18:SETCOLOR 4,2,2
20 POSITION 4,4:PRINT #61"CONSERVATION"
30 POSITION 9,5: ? #61"OF"
35 POSITION 6,6: ? #61"MOMENTUM"
40 FOR N=1 TO 1500:NEXT N
49 REM SET UP EXAMPLE COLLISION
50 GRAPHICS 0:SETCOLOR 4,14,4:SETCOLOR 2,8,4
60 POKE 752,1: ? "}"
70 ? "HERE IS AN EXAMPLE OF A COLLISION"
75 ? "LIKE YOU WILL SEE"
80 ? "THE BLUE CAR AND THE ORANGE CAR"
85 ? "HAVE EQUAL MASSES. BLUE HAS A SPEED"
86 ? "OF 2 M/S. ORANGE 4 M/S."
90 ? "COEFFICIENT OF RESTITUTION IS ONE.":FOR N=1 TO 1500:NEXT N
99 REM PARAMETERS FOR INITIAL COLLISION
100 COR=1:M1=50:M2=50:V1I=2:V2I=4
110 GO TO 500
200 GRAPHICS 16:SETCOLOR 4,14,4:SETCOLOR 2,8,4:REM INPUT PARAMETERS FOR NEXT COLLISION
204 POKE 752,1: ? "}"
207 TRAP 215
210 ? "WHAT COEFFICIENT OF RESTITUTION": ? "DO YOU WANT?":INPUT COR
211 IF COR<0 THEN GO TO 1000
212 IF COR>1 THEN GO TO 1000
213 GO TO 216
215 ? "INPUT A NUMBER 0 THRU 1":GO TO 210
216 TRAP 1050
217 ? "WHAT WILL BE THE MASS OF THE BLUE CAR? ":INPUT M1
218 IF M1<0 OR M1>50 THEN GO TO 1050
225 TRAP 1060
227 ? "WHAT WILL BE THE MASS OF?": "THE ORANGE CAR?":INPUT M2
228 IF M2<0 OR M2>50 THEN GO TO 1060
240 TRAP 1075
245 ? "INPUT VELOCITY OF BLUE CAR."
246 ? "USE POSITIVE NUMBERS BETWEEN 0 AND 10."
247 INPUT V1I
248 IF V1I<0 THEN GO TO 1075
249 IF V1I>10 THEN GO TO 1075
250 TRAP 1100
252 ? "INPUT VELOCITY OF ORANGE CAR."
253 ? "USE POSITIVE NUMBERS BETWEEN 0 AND 10.":INPUT V2I
254 IF V2I<0 THEN GO TO 1100
255 IF V2I>10 THEN GO TO 1100
260 HPO1=135-(V1I/(V1I+V2I))*85
265 HPO2=135+(V2I/(V2I+V1I))*85
270 GO TO 501
500 HPO1=50:HPO2=220:REM INITIAL HOR POS OF CARS
501 POKE 53248,HPO1:POKE 53249,HPO2
509 REM CHOOSE REGULAR PLAYFIELD AND COLOR OF CARS
510 GRAPHICS 23:SETCOLOR 4,10,4:POKE 559,62:POKE 704,116:POKE 705,40
515 SETCOLOR 0,0,4:COLOR 1:FOR Z=42 TO 50:PLOT 0,Z:DRAWTO 159,Z:NEXT Z:REM DRAW HIGHWAY
520 I=PEEK(1106)-32:REM RESERVE SPACE FOR P/M GRAPHICS
530 POKE 54279,I:REM PLACE ADR IN P/M BASE ADDRESS REGISTER
540 POKE 53278,0:REM SET COLLISION REGISTER TO ZERO
550 POKE 53277,3:REM ENABLE P/M GRAPHICS
559 REM IF CAR 1 IS MUCH MORE MASSIVE THAN CAR 2, CAR 1 IS TWICE NORMAL SIZE
560 IF M1/M2>5 THEN POKE 53256,1:POKE 53257,0:GO TO 600
570 IF M2/M1>5 THEN POKE 53256,0:POKE 53257,1:GO TO 600:REM SEE NOTE ON STATEMEN T 560
580 POKE 53256,0:POKE 53257,0
600 J=I+256+1024:REM LOCATION OF PLAYER 0
610 FOR Y=J+120 TO J+127:REM READ IN SHAPE OF CAR1
620 READ Z:POKE Y,Z:NEXT Y
630 DATA 0,255,129,223,223,223,125,255,0,255,125,251,251,125,255,0
640 J=I+256+1280:REM MEM LOCATION OF PLAYER 1
650 FOR Y=J+120 TO J+127:READ Z:REM READ IN SHAPE OF CAR 2
651 POKE Y,Z:NEXT Y
652 RESTORE
660 FOR X=1 TO 220:REM MOVE CARS TOWARD EACH OTHER
670 PO1=HPO1+V1I*X/5
680 PO2=HPO2-V2I*X/5
690 POKE 53248,PO1:POKE 53249,PO2
700 IF PEEK(53260)<>0 THEN GO TO 720:REM CHECK FOR COLLISION
710 NEXT X
720 V2F=M1*(COR*V1I-COR*(-V2I)+V1I)+M2*(-V2I):REM FIND VELOCITY OF EACH CAR AFTE R COLLISION
730 M=M1+M2:POKE (53260),0
740 V2F=V2F/M
750 V1F=V2F-COR*V1I-COR*V2I
760 FOR X=1 TO 500:REM MOVE CARS AFTER COLLISION
770 POKE 53249,PO2+V2F*X/5
780 POKE 53248,PO1-V1F*X/5
790 IF PO2+V2F*X<20 THEN GO TO 900:REM STOP MOVEMENT
800 IF PO2+V2F*X>245 THEN GO TO 900
810 IF PO1-V1F*X<20 THEN GO TO 900
820 IF PO1-V1F*X>270 THEN GO TO 900
830 NEXT X
900 POKE 53277,1:REM TURN OFF P/M GRAPHICS
910 GRAPHICS 16:SETCOLOR 4,14,4:SETCOLOR 2,8,4:REM SET UP SCREEN FOR DISPLAY OF VELOCITIES
920 POKE 752,1: ? "}"
930 ? "FINAL VELOCITY OF BLUE CAR IS ":(INT(V1F*100))/100
940 ? "FINAL VELOCITY OF ORANGE CAR IS ":(INT(V2F*100))/100
950 ? "IF YOU WOULD LIKE TO TRY?": "ANOTHER COLLISION PRESS SPACE BAR"
960 IF PEEK(764)<>33 THEN GO TO 960
970 GO TO 200
1000 ? "COEFFICIENT MUST BE BETWEEN ZERO AND ONE.":FOR N=1 TO 50:NEXT N:GO TO 210
1050 ? "MASS MUST BE A POSITIVE NUMBER"
1051 ? "BETWEEN 1 AND 50":FOR N=1 TO 50:NEXT N:GO TO 217
1060 ? "MASS MUST BE A POSITIVE NUMBER"
1061 ? "BETWEEN 1 AND 50":FOR N=1 TO 50:NEXT N:GO TO 227
1075 ? "VELOCITY MUST BE A POSITIVE NUMBER."
1076 ? "BETWEEN 0 AND 10":FOR N=1 TO 50:NEXT N:GO TO 245
1100 ? "VELOCITY MUST BE A POSITIVE NUMBER "
1101 ? "BETWEEN 0 AND 10":FOR N=1 TO 50:NEXT N:GO TO 252

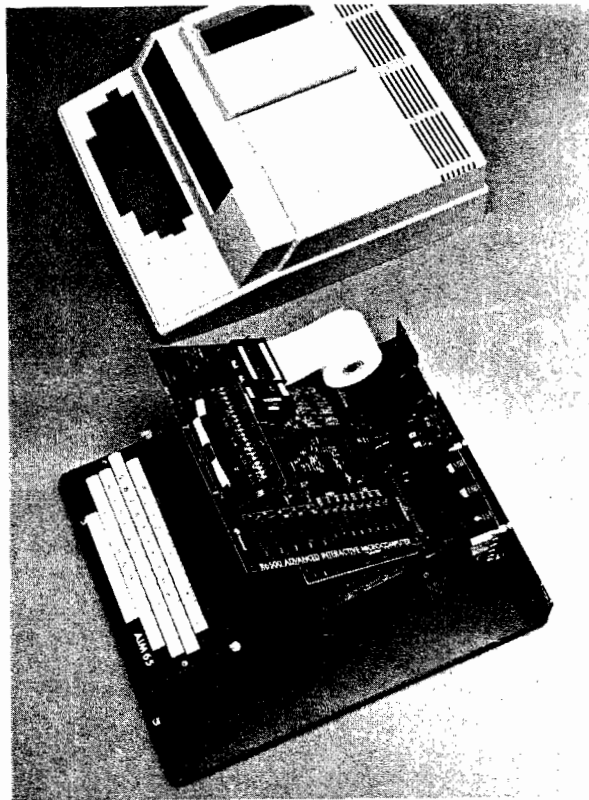
```



```

1 REM CONSERVATION OF MOMENTUM
2 REM BY JERRY FAUGHN
3 REM C64 VERSION BY LOREN WRIGHT
10 GOSUB4000
15 PRINT"CONSERVATION OF MOMENTUM"
20 PRINT"CONSERVATION OF MOMENTUM"
25 PRINT"CONSERVATION OF MOMENTUM"
30 FOR I=1 TO 2000:NEXT
35 PRINT"IS THERE IS A SAMPLE COLLISION?"
40 PRINT"THE MASSES OF THE TWO CARS"
45 PRINT"ARE EQUAL."
50 PRINT"THE SPEED OF THE RED CAR IS"
55 PRINT"TWICE THAT OF THE BLUE CAR"
60 FOR I=1 TO 2000:NEXT
65 CR=1:M1=50:M2=50:V1=2:V2=4
70 GOTO10
100 REM PROGRAM MAIN LINE
110 PRINT"WHAT COEFFICIENT OF RESTITUTION?":INPUT (VALUE 0 TO 1):CR
120 IF CR<0 OR CR>1 THEN110
130 PRINT"WHAT IS THE MASS OF THE BLUE CAR?":INPUT (VALUE 1 TO 50):M1
140 IF M1<1 OR M1>50 THEN130
150 PRINT"WHAT IS THE MASS OF THE RED CAR?":INPUT (VALUE 1 TO 50):M2
160 IF M2<1 OR M2>50 THEN150
170 INPUT"VELOCITY OF BLUE CAR (0 TO 10)":V1
180 IF V1<0 OR V1>10 THEN170
190 INPUT"VELOCITY OF RED CAR (0 TO 10)":V2
200 IF V2<0 OR V2>10 THEN190
205 REM SET STARTING POSITIONS SO THAT
206 REM COLLISION OCCURS AT SCREEN CENTER
210 H1=174-(V1*(V1+V2))/150
220 H2=174-(V2*(V1+V2))/150
230 GOSUB3000:GOSUB1000
235 GOSUB2000:POKEV+21,0
240 PRINT"FINAL VELOCITY OF BLUE CAR IS ";INT(VA*100+.5)/100
250 PRINT"FINAL VELOCITY OF RED CAR IS ";INT(VB*100+.5)/100
260 GOSUB2000
270 GOTO100
1000 REM PERFORM COLLISION
1010 REM EXPAND EITHER CAR IF 5X HEAVIER
1020 Z1=0:IF M1>M2 THEN Z1=1
1030 Z2=0:IF M2>M1 THEN Z2=2
1040 POKEV+29,Z1+Z2
1050 POKEV+30,0
1100 REM ADVANCE CARS UNTIL COLLISION
1110 X=0
1120 P1=H1+V1*X/5
1130 P2=H2+V2*X/5
1140 Q1=0:IF P1>255 THEN P1=255:Q1=1
1150 Q2=0:IF P2>255 THEN P2=255:Q2=2
1160 POKEV,P1:POKEV+2,P2:POKEV+16,Q1+Q2
1170 IF PEEK(V+30) THEN POKEV+30,0:GOTO1210
1180 X=X+1
1190 GOTO1120
1200 REM FIND FINAL VELOCITIES
1210 VB=M1*(CR*V1-CR*(V2)+V1)+M2*(CR*(V2)-V1)
1220 VB=VB/(M1+M2)
1230 VA=VB-CR*V1-CR*V2
1300 REM MOVE CARS UNTIL ONE REACHES EDGE
1310 X=0
1320 PB=P2+VB*X/5
1330 PA=P1+VA*X/5
1340 PD=PB+Q2=0:IF PB>255 THEN PD=255:Q2=2
1350 PC=PA+Q1=0:IF PA>255 THEN PC=255:Q1=1
1360 POKEV,PC:POKEV+2,PD:POKEV+16,Q1+Q2
1370 IF PA<24 OR PB>323 THEN H=500
1380 IF PB<24 OR PA>323 THEN H=500
1390 GETT$:IF T$<>"" THEN H=500
1400 X=X+1
1410 GOTO1320
1500 RETURN
2000 PRINT"PRESS ANY KEY TO CONTINUE"
2010 GETT$:IF T$="" THEN H=210
2020 RETURN
3000 REM SET UP SCREEN
3010 PRINT"POKEV+33,0
3020 PRINT"POKEV+33,0"BL:BL#
3030 POKEV,H1:POKEV+2,H2:POKEV+16,-((H2>255)*2+(H1>255))
3040 POKEV+21,3
3050 RETURN
4000 REM SET UP CONSTANTS & SPRITES
4010 V=53248:BL#=""
4020 B=192*64
4030 REM CLEAR SPACE FOR TWO SPRITES
4040 FOR I=0 TO 127:POKEB+I,0:NEXT
4050 REM READ PATTERNS FROM DATA
4060 REM AND STORE IN MEMORY
4070 FOR I=0 TO 26:READA:POKEB+I,A:NEXT
4080 B=192*64
4090 FOR I=0 TO 26:READA:POKEB+I,A:NEXT
4100 REM SET UP POINTERS, COLORS, & Y POS
4110 POKEV+39,6:POKEV+40,2
4120 POKEV+2040,192:POKEV+2041,193
4130 POKEV+1,149:POKEV+3,149
4140 POKEV+21,0
4150 POKEV+33,0:POKEV+32,1
4160 RETURN
5000 DATA 2,31,0,28,14,0,127,255,128,255,231,240,255,249,240,255
5010 DATA 231,240,127,255,128,28,14,0,62,31,0
5020 DATA 15,135,192,7,3,128,31,255,224,254,127,240,249,255,240,254
5030 DATA 127,240,31,255,224,7,3,128,15,135,192

```



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- Go for high quality with our ACE-100 Enclosure. It accommodates the AIM 65 perfectly, without modification, and features easy access two board add-on space, plus a 3" x 5" x 17" and a 4" x 5" x 15.5" area for power supplies and other components. \$186.00.
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MICRO™

# Is a Number a Number?

by Phil Daley

On your toes now. Here is a quick quiz: How much is  $7 + 5$ ? a) 12, b) 14, c) C, d) all of the above, e) I don't know. If you answered d, then you may skip the rest of this article, unless you made a lucky guess.

The answer depends upon the base of the number system you are working in. Normally, when you are working with everyday decimal numbers, you are using the base of 10. That means that each place to the left (or right) of the decimal point represents a power of ten. The first place to the left of the decimal point represents how many  $10^0$ 's there are in that number. For instance, a '7' indicates  $7 * (10^0)$ . Since  $10^0 = 1$ ,  $7 * 1 = 7$ . The number  $7 = 7!$  When working with base 10 numbers things seem pretty easy, but humor me and follow along; it will get tougher.

What about 17? The 1 represents  $1 * 10^1$ , or 10. Add the 7 and you get 17. Each place farther to the left of the decimal point increases the power of 10 —  $10^2$ ,  $10^3$ ,  $10^4$  ... etc. This gives you the one's place, ten's place, hundred's place, and so on.

What happens when you use a base that is different than 10 — for instance 16? I choose 16 as an example since it is the basis of the hexadecimal system, which computer people use all the time as it is a more convenient system with which to work. Now the first place to the left of the point represents  $16^0$ , or ones. Sounds familiar, right? However, how many numbers can be counted until you have to carry over to the next place? In decimal you count to 9 and then carry one to the ten's column. In hexadecimal you count to 15 before the carry to the next column. This is going to cause trouble. What happens after 9? You use letters! The first six letters of the alphabet represent the numbers 10-15. Counting in hexadecimal goes 1, 2, ... 8, 9, A, B, C, D, E, F, 10, 11 etc.

The second place to the left counts as  $16^1$ , or 16's, the third place ( $16^2$ ), 256's, and the fourth place ( $16^3$ ), 4096's. This is normally as high as you need to go on microcomputers.

How much is  $7 + 5$  (in base 16)? Now you see how answer C derives. Standard convention uses the \$ sign to indicate hexadecimal numbers. What

does \$5CE equal? The answer is  $5 * 256 + 12 * 16 + 14 * 1$ . 1486 in base 10.

A computer doesn't really understand hexadecimal. A hardware circuit in the computer has only two states — on and off or high and low. These are represented by 1's and 0's. Since you can count only to one before you have to carry to the next place, this is working with base 2 numbers. Binary numbers are the code that microcomputers understand; unfortunately they are not recognized easily by humans and are, therefore, prone to error in reading and typing. It is simple to transpose two digits in a number like %1110010101100110. The % sign is standard to indicate a binary number. So that number is equivalent to 58726 in base 10. ( $1 * 32768 + 1 * 16384 + 1 * 8192 + 0 * 4096 + 0 * 2048 + 1 * 1024 + 0 * 512 + 1 * 256 + 0 * 128 + 1 * 64 + 1 * 32 + 0 * 16 + 0 * 8 + 1 * 4 + 1 * 2 + 0 * 1$ ). Not the easiest conversion.

A number like %1000000000000000 is equivalent to 32768 in base 10, which is not too memorable. In hexadecimal, it's equivalent to \$8000. Now perhaps you can see why computer people use hexadecimal. When talking about a microcomputer's memory map, pages of memory are used as a convenient way to locate various usages. For instance, in 6502 computers page 0 is used by the system for pointer storage (due to zero page addressing), page 1 is used for the system stack, and page 2 is sometimes used for the input buffer. In decimal, that would convert to page 0 = 0 to 255, page 1 = 256 to 511, and page 2 = 512 to 767. Hexadecimal notation is much easier to remember — page 0 = \$0 to \$FF, page 1 = \$100 to \$1FF, and page 2 = \$200 to \$2FF.

Even if you can't see much use for the different numbering systems now, when you start to work with machine language you may wonder why anyone works with base 10. This program converts any base (2, 8, 10, 16) into all the others. The routines do the conversions the same way you would do them by hand; you can learn the conversion method as you type in the program.

This program should run on any computer with

# DTACK

10

## The 68000 DREAM MACHINE



### WE (SORT OF) LIED:

Motorola has been promoting its advanced microprocessor chip as a vehicle for large, complex systems **exclusively**. Now, the 68000 does work well as the heart of big, complex systems. But their promotional literature implies that one can **only** build big, complex systems with the 68000, and that is dead wrong (in our opinion). Nevertheless, the public (that's you!) perception of the 68000 follows Motorola's line: **Big systems. Complex systems.**

Our boards are **not** complex and not necessarily big (starting at 4K). Our newsletter is subtitled "The Journal of Simple 68000 Systems." But since the public has become conditioned to the 68000 as a vehicle for FORTRAN, UNIX, LISP, PASCAL and SMALLTALK people naturally expect all these with our \$595 (starting price) simple attached processor. **Wrong!**

We wrote our last ad to **understate** the software we have available because we wanted to get rid of all those guys who want to run (multi-user, multi-tasking) UNIX on their Apple II and two floppy disks. Running UNIX using two 143K floppies is, well, absurd. The utilities alone require more than 5 megabytes of hard disk.

### HERE'S THE TRUTH:

We **do** have some very useful 68000 utility programs. One of these will provide, in conjunction with a suitable BASIC compiler such as PETSPEED (Pet/CBM) or TASC (Apple II), a five to twelve times speedup of your BASIC program. If you have read a serious compiler review, you will have learned that compilers cannot speed up floating point operations (especially transcendentals). Our board, and the utility software we provide, **does** speed up those operations.

Add this line in front of an Applesoft program:

```
5 PRINT CHR$(4);"BLOADUTIL4,A$8600":CALL38383
```

That's all it takes to link our board into Applesoft (assuming you have Applesoft loaded into a 16K RAM card). Now run your program as is for faster number-crunching or compile it to add the benefit of faster "interpretation". Operation with the Pet/CBM is similar.

### 68000 SOURCE CODE:

For Apple II users only, we provide a nearly full disk of **unprotected** 68000 source code. To use it you will have to have DOS toolkit (\$75) and ASSEM68K (\$95), both available from third parties. Here's what you get:

1) 68000 source code for our Microsoft compatible floating point package, including LOG, EXP, SQR, SIN, COS, TAN, ATN along with the basic four functions. The code is set up to work either linked into BASIC or with our developmental HALGOL language. 85 sectors.

2) 68000 source code for the PROM monitor. 35 sectors.

3) 68000 source code for a very high speed interactive 3-D graphics demo. 115 sectors.

4) 68000 source code for the HALGOL threaded interpreter. Works with the 68000 floating point package. 56 sectors.

5) 6502 source code for the utilities to link into the BASIC floating point routines and utility and debug code to link into the 68000 PROM monitor. 113 sectors.

The above routines almost fill a standard Apple DOS 3.3 floppy. We provide a second disk (very nearly filled) with various utility and demonstration programs.

### SWIFTUS MAXIMUS:

Our last advertisement implied that we sold 8MHz boards to hackers and 12.5MHz boards to businesses. That was sort of true because when that ad was written the 12.5MHz 68000 was a very expensive part (list \$332 ea). Motorola has now dropped the price to \$111 and we have adjusted our prices accordingly. So now even hackers can afford a 12.5MHz 68000 board. With, we remind you, **absolutely zero wait states**.

'Swiftus maximus'? Do you know of any other microprocessor based product that can do a 32 bit add in 0.48 microseconds?

### AN EDUCATIONAL BOARD?

If you want to learn how to program the 68000 at the assembly language level there is no better way than to have one disk full of demonstration programs and another disk full of machine readable (and user-modifiable) 68000 source code.

Those other 'educational boards' have 4MHz clock signals (even the one promoted as having a 6MHz CPU, honest!) so we'll call them **slow learners**. They do not come with any significant amount of demo or utility software. And they communicate with the host computer via RS 232, 9600 baud max. That's 1K byte/sec. Our board communicates over a parallel port with hardware AND software handshake, at 71K bytes/sec! We'll call those other boards **handicapped learners**.

Our board is definitely not for everyone. But some people find it very, very useful. Which group do you fit into?

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# LEARNING CENTER

Microsoft BASIC. It was written on an Apple and has two machine-dependent lines. Line 40 clears the screen and vertically tabs down the screen 10 lines. Line 340 clears the screen and homes the cursor. You should substitute the clear screen command for your computer in those two lines. The lower case is purely for cosmetic reasons and, if you have only upper case, then that's what you will get. The REMarks may be ommitted.

Octal numbers are halfway between hexadecimal numbers and binary numbers. They are easier to use than decimal numbers for binary thinking, but they are not commonly used. The standard notation for octal numbers is  $\ddot{o}$  (with two dots above), not always found on computer terminal keyboards. I assigned them the # sign so that the program can tell the numbers apart.

When entering numbers into the program to be converted, the program assumes all numbers to be decimal, unless you prefix the number with a special sign — \$ for hexadecimal, % for binary, and # for octal. The program does no checking for proper input; you will get some very strange results if you input illegal numbers.

Hopefully, the next time you see a binary or hexadecimal number, you will understand what they are all about.

## Program Description

- [10] DIMensions the arrays to store the individual digits of the numbers.
- [20-30] Set up the functions to get integer divisions and remainders.
- [40-90] Present the introductory screen information and prompt for the number to be converted. A < return > quits the program.
- [110, 170, and 230] check to see what type of number you entered.
- [120] Converts octal to decimal.
- [180] Converts binary to decimal.
- [240] Converts hexadecimal to decimal.
- [350] Converts negative decimal to positive decimal.
- [370] Converts decimal to hexadecimal.
- [440] Converts decimal to octal.
- [530] Converts decimal to binary.
- [710-790] Prints the results and waits for a return to start over.
- [800] A subroutine to convert numbers larger than 9 into the A-F hexadecimal letters.
- [840] A subroutine to divide A by N, assign Q(I) the integer division result, and return with A equal to the remainder.
- [860] A subroutine to assign Q\$(I) and Q(I) arrays each digit of the input number.

### Number Conversion Listing

```

10 DIM Q(20),Q$(20)
20 DEF FN A(X) = INT ( X / N) : REM
   Int function
30 DEF FN B(X) = X - FN A(X) *
   N: REM Mod function
40 HOME : VTAB 10
50 PRINT "This program converts
   numbers into other bases."
60 PRINT "Input your number in t
   he following form:"
70 PRINT "<DECIMAL> or <-DECIMAL
   >, <$HEXIDECIMAL>,"
80 PRINT "<#OCTAL> and <%BINARY>."
90 PRINT : INPUT A$: IF LEN (A$
   ) = 0 THEN END
100 A = VAL (A$)
110 IF LEFT$(A$,1) < > "#%" THEN 170
120 REM Convert Octal to Decimal
130 A$ = RIGHT$(A$, LEN (A$) - 1)
140 IF LEN (A$) < 6 THEN A$ = "
   0" + A$: GOTO 260
150 N = 6: GOSUB 860
160 A = Q(1) * 32768 + Q(2) * 409
   6 + Q(3) * 512 + Q(4) * 64 +
   Q(5) * 8 + Q(6): GOTO 340
170 IF LEFT$(A$,1) <> "%#" THEN 230
180 REM Convert Binary to Decimal
190 A$ = RIGHT$(A$, LEN (A$) - 1)
200 IF LEN (A$) < 16 THEN A$ = "
   0" + A$: GOTO 260
210 N = 16: GOSUB 860
220 A = Q(1) * 32768 + Q(2) * 163
   84 + Q(3) * 8192 + Q(4) * 40
   96 + Q(5) * 2048 + Q(6) * 10
   24 + Q(7) * 512 + Q(8) * 256
   + Q(9) * 128 + Q(10) * 64 +
   Q(11) * 32 + Q(12) * 16 + Q(
   13) * 8 + Q(14) * 4 + Q(15) *
   2 + Q(16): GOTO 340
230 IF LEFT$(A$,1) <> "%#" THEN 340
240 REM Convert Hex to Decimal
250 A$ = RIGHT$(A$, LEN (A$) - 1)
260 IF LEN (A$) < 4 THEN A$ = "
   0" + A$: GOTO 260
270 N = 4: GOSUB 860
280 FOR I = 1 TO 4
290 IF Q$(I) < "A" THEN 310
300 Q(I) = ASC (Q$(I)) - 55: GOTO 320
310 Q(I) = VAL (Q$(I))
320 NEXT
330 A = Q(1) * 4096 + Q(2) * 256 +
   Q(3) * 16 + Q(4)
340 HOME
350 IF A < 0 THEN A = 65536 + A
360 ASAAVE = A
370 REM Convert Decimal to Hex
380 N = 4096:I = 1: GOSUB 840
390 N = 256:I = 2: GOSUB 840
400 N = 16:I = 3: GOSUB 840
410 Q(4) = A
420 N = 4: GOSUB 800:H$ = A$
430 A = ASAAVE
440 REM Convert Decimal to Octal
450 N = 32768:I = 1: GOSUB 840
460 N = 4096:I = 2: GOSUB 840
470 N = 512:I = 3: GOSUB 840
480 N = 64:I = 4: GOSUB 840
490 N = 8:I = 5: GOSUB 840
500 Q(6) = A:O$ = ""
510 N = 6: GOSUB 800:O$ = A$
520 A = ASAAVE
530 REM Convert Decimal to Binary
540 N = 32768:I = 1: GOSUB 840
550 N = 16384:I = 2: GOSUB 840
560 N = 8192:I = 3: GOSUB 840
570 N = 4096:I = 4: GOSUB 840
580 N = 2048:I = 5: GOSUB 840
590 N = 1024:I = 6: GOSUB 840
600 N = 512:I = 7: GOSUB 840
610 N = 256:I = 8: GOSUB 840
620 N = 128:I = 9: GOSUB 840
630 N = 64:I = 10: GOSUB 840
640 N = 32:I = 11: GOSUB 840
650 N = 16:I = 12: GOSUB 840
660 N = 8:I = 13: GOSUB 840
670 N = 4:I = 14: GOSUB 840
680 N = 2:I = 15: GOSUB 840
690 Q(16) = A
700 N = 16: GOSUB 800:B$ = A$
710 PRINT "Decimal="
720 PRINT ASAAVE" ("ASAAVE - 65536")"
730 PRINT : PRINT "Hexadecimal="
740 PRINT H$
750 PRINT : PRINT "Octal="
760 PRINT O$
770 PRINT : PRINT "Binary="
780 PRINT B$
790 PRINT : INPUT "Press
   <return> ";A$: GOTO 40
800 A$ = "" : FOR I = 1 TO N
810 IF Q(I) > 9 THEN C$ = CHR$(
   (Q(I) + 55): GOTO 830
820 C$ = STR$(Q(I))
830 A$ = A$ + C$: NEXT : RETURN
840 Q(I) = FN A(A):A = FN B(A)
850 RETURN
860 FOR I = 1 TO N
870 Q$(I) = MID$(A$,I,1)
880 Q(I) = VAL (Q$(I))
890 NEXT : RETURN

```

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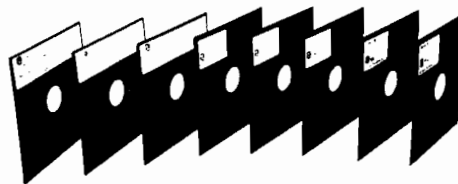
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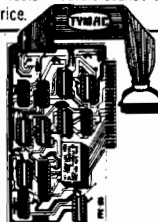
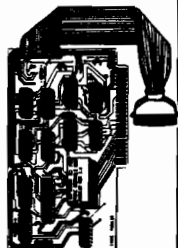
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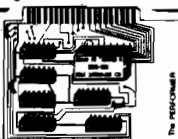


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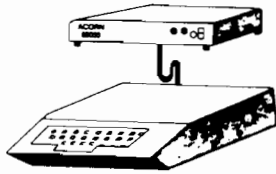


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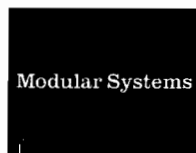
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## LEARNING CENTER

# A Beginner's Computer Glossary

**Mnemonic** — A technique intended to assist human memory; an abbreviation or acronym that is easy to remember. A symbolic representation (e.g., ADD or SUB).

**Modem** — Acronym for MOdulator/DEModulator. A chip or device that converts data from a form that is compatible with data processing equipment to a form compatible with transmission facilities and *vice versa*. It is often used to interface a digital device to a telephone line.

**Module** — A device or piece of equipment that is interchangeable with other components.

**Monitor** — 1. To control operation of several unrelated routines. 2. A black and white or color CRT display.

**Mother Board** — A circuit board used to connect other processor boards, such as CPU cards, cassette interfaces, and memory cards, to name a few.

**Nanosecond** — A billionth of a second.

**Nesting** — Placing a routine or program segment within a larger routine or program segment.

**No Operation (NOP)** — Tells computer to deliberately leave a blank to allow insertion of data or information at a later time without rewriting.

**On Line** — A system or device in a system that is controlled by the central processing unit. (Off line means the equipment is not under control of the CPU.)

**Operation Code (Op Code)** — A command, usually given in machine language.

**Optimize** — Arranging instructions or data in the storage area so that a minimum amount of machine time is spent accessing the instruction or data.

**Port** — The entry channel to which a data set is attached. It is in the central computer, and each user is assigned one port.

## Part 2

**PROM** — Programmable Read-Only Memory. Generally, any type of memory not recorded during packaging, but can be programmed in later.

**Queue** — A line or group of items waiting to be processed..

**RAM** — Random Access Memory. Provides immediate access to any storage location in memory. Information may be written in or read out quickly.

**Register** — 1. A device for the temporary storage of one or more words to facilitate arithmetical, logical, or transferral operations. 2. The hardware for storing one or more computer words. 3. A term used to designate a specific computer unit for storing a group of bits or characters.

**ROM** — Read-Only Memory. A memory that is programmed in during packaging. There are many types of ROMs. Information is stored permanently (or semi-permanently) and is read out, but not altered, in operation.

**Routine** — 1. A sequence of machine instructions. 2. A set of coded instructions in proper sequence that tells the computer to perform an operation or series of operations.

**"Smart" terminal** — A rudimentary smart terminal consists of a CRT, keyboard, serial communication I/O device, and a microcomputer. It may use peripheral memory devices such as a tape cassette. A "smart" terminal provides built-in capability not alterable by the user; an "intelligent" terminal is user programmable.

**Subroutine** — A program that defines operations and which may be included in the main routine.

**Text Editor** — Facilities designed into a computer program to allow keyboarding of text without a format. Once placed in storage, it can be edited and justified to the required specifications.

**Variable** — A symbol whose numeric value changes from one repetition of a program to the next, or changes within each repetition of a program.

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Circle No. 51

# Analysis of Bond Quotations on the APPLE

by David C. Lewis

**A program to compute information regarding the performance of bonds. Data for computations is available in financial sections of many newspapers.**

The bond-analysis program presented here grew out of the realization that I was spending a lot of time with my calculator and a sheet of paper, punching buttons and making notes. It occurred to me that it should be possible to develop a program that prompts the inputs required, does the calculations quickly without any superfluous intervention on my part, and presents the data intelligently. This program meets my requirements.

Three things are necessary to understand this program: you should know a little about the bond market and bond market quotations, you should understand some (by no means all) of the basic criteria that are used to analyze bonds, and you should know quite a lot about string-handling operations. This last item may surprise many microcomputerists. However, for reasons I will explain later, analyses of bond market quotations rapidly become a case study in string-handling procedures.

## Financial Background

Before getting into a program to analyze bonds you should understand what bonds are, and what the quoted numbers relating to bonds are. These basic concepts and data are used to develop an approach to the analysis of any particular bond and the bond-analysis program. Basically bonds are a type of promissory note or IOU that many corporations, municipalities, and state and local governments use to finance their projects. To get a feel for

the numbers and diversity of bonds simply turn to the financial page of your local newspaper; generally you will see only the corporate bonds that traded recently (i.e., yesterday in a daily paper). Municipal, state, and federal government bonds often are not reported, and corporate bonds that are not bought or sold on any day are not reported that day.

Typically, bonds are issued in units of \$1,000. The issuer promises to pay the buyer a fixed percentage of the face value of the bond each year until some date in the future, at which time the issuer will redeem the face value of the bond. Thus, a 10% bond of 1983 would yield its buyer \$100 in 1982 and he would get back the full amount (\$1,000) in 1983.

Although a bond may have a nominal value of \$1,000, its actual price may fluctuate substantially. While no one should pretend to understand all the factors that make the bond market go up or down, many people think that prevailing interest rates have a pronounced effect on the market. Thus, to induce a prospective bond buyer to actually buy a bond, that bond must offer the investor a return on his investment comparable to what he could realize by putting his money elsewhere. If someone purchased a 30-year bond in 1960 that yielded 7%, he

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**Bond Quotations  
requires:**

**Microcomputer with  
Microsoft BASIC**

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would receive \$70 per year from the bond. If it were necessary to sell that bond in a market where investors could routinely get 14% on their investments, the original buyer would have to reduce the sales price to \$500 so the buyer would realize 14% on his purchase. If the buyer couldn't get 14% then he wouldn't buy the bond. Of course, this line of reasoning would not apply if the bond came due in the next few years, since the buyer could anticipate getting \$1,000 in return for whatever he paid for the bond. For example, if someone paid \$800 today for a bond that came due in 1983, then the buyer would realize a profit of \$200 in 1983, or a return of 25% on his investment. Thus, it is possible to make (or lose) money on bonds in two ways — from the interest payments and from capital appreciation or depreciation.

Often I have heard my broker speak of the "yield-to-maturity" of a bond. This is the sum of the yield on a bond due to its interest and the capital appreciation portion of the bond. If a 10% bond came due in 1990 and was currently selling for \$500, then the yield related to the interest income is  $(\$1,000 \cdot 10\% / \$500 = 20\%$  and the pro-rated capital appreciation on the bond is  $(\$1,000 - \$500) / [(1990 - 1982) \cdot \$500] = 5.5\%$ , so the yield-to-maturity is  $20\% + 5.5\% = 25.5\%$ .

Yields-to-maturity can be misleading since they include two different types of yields. The interest income is available at least yearly and can be reinvested and compounded. The yield due to capital appreciation, however, is prorated straight line from now to maturity — there is no compounding. For example, if a bond were bought for \$100 and matured 20 years later for \$1,000, the prorated yield due to



capital appreciation is  $((\$1,000 - \$100)/(\$100 \times 20 \text{ years})) = 45\%$  per year. However, if the bond were to pay roughly 12% interest each year, and if that interest could be compounded without taxes, the investor would realize the same capital appreciation. This subtlety is particularly important in analyzing zero-coupon bonds. These bonds generally are sold at much less than face value and pay no annual interest. All of the yield on coupon bonds is a result of capital appreciation. When comparing zero-coupon bonds and other types of investments, it is important to consider the yield on a zero-coupon bond (or any capital accumulation yield) and some type of "deflated" basis in which the lack of opportunity to compound your earnings is factored.

### Financial Calculations

The program here prompts user inputs and accepts inputs as they are typically published in the literature (i.e., fractional numbers are accepted for price and interest, and the true price is computed based on the price quoted in the newspaper. The program computes the following indices:

1. Interest paid per year in dollars.
2. Number of years from the current year to the year of the bond's maturity.
3. Simple yield based on interest.
4. Yield due to straight-line capital appreciation (i.e., no compounding).
5. Straight-line yield to maturity (i.e., the sum of items 3 and 4 above).
6. The equivalent yield if the capital appreciation could be compounded.
7. Compounded yield to maturity (i.e., the sum of items 3 and 6 above).

Finally, the program presents an annotated listing of each of the seven items listed above and offers the option of providing a hard copy of the program output.

### Getting the Data

A principal resource for data regarding bonds is your newspaper. If you look in the financial section of your paper, generally you will see a statement such as:

XYZ INC 9 5/8 02 61 1/2

This means the particular bond issue put out by XYZ Inc. has a yield of 9 5/8% on the face value of the bond (\$1,000), will be redeemed in the year 2002 ('02'), and was bought for \$615. Note that the quoted price is a factor 10

times smaller than the price shown in the newspaper (i.e., 61 1/2), and interest and price quotations are typically (although not always) given in fractions of 1/8, and only the last two digits of the year of redemption of this or any other bond is quoted. Clearly, some massaging of the input data is necessary before the computer can compute the various yields, dates, returns, etc.

### Programming Considerations

The main problem associated with developing the program was creating some mechanism to allow the user to input data as it is typically quoted. Microcomputerists familiar with DATA and INPUT statements know they accept either strings or decimal numbers; Apple will not immediately understand numbers like 9 5/8. To get a microcomputer to accept and manipulate what might be referred to as "fractional numbers" it is necessary to input the data as a string and develop a way to evaluate that string.

The subroutine developed to evaluate the string inputs is shown in figure 1. The routine is structured to interpret a string by first evaluating the denominator of the fractional number, then the numerator, then the integer, and using that information to compute the type of decimal number with which the computer can deal. If no fraction is sensed for a number (i.e., if no "/" is sensed) then the string is evaluated as a number. This option is necessary since bond data is sometimes quoted in integer and even decimal form.

amined is a "/", it is compared to the ASCII representation of "/" (i.e., CHR\$(47)). If a "/" is sensed, then the program knows it is examining a fraction, and that the MID\$(I\$,N,1) statement has stepped its way from right to left across the denominator. To sense the value of the denominator, the program simply backs the MID\$(I\$,N,x) up one character and defines a new string from that character to the right end of the string using the RIGHT\$(I\$,N-1) statement. Then it takes the VAL( ) of that substring to get a real number for the denominator.

To get a real number for the numerator the MID\$(I\$,1,N) statement is used to search the string for a "space." Thus, you expect a space between the integer portion of the fractional number and its fractional portion. As with the search for the "/", the ASCII representation of each character in the string is compared with CHR\$(32), the ASCII representation for a space. When CHR\$(32) is sensed, the MID\$(I\$,N,2) statement has stepped to the beginning of the numerator of the fractional input. To get the value of the numerator, a new substring of I\$ is defined that includes the entire fractional portion of I\$ and then takes the VAL( ) of the substring. Since the VAL statement evaluates the string up to the first non-numerical character (in this case the "/"), what is returned is the numerator of the fraction in the string. The fractional part of the input string is evaluated by dividing the numerator of the denominator. It's that simple.

## One problem was getting the computer to accept and manipulate fractions.

The subroutine uses virtually all the string-handling operations available in MicroSoft BASIC. Apart from some variable setting operations, the first step in the routine is to determine the number of characters (called N) in the string using the LEN( ) statement. Subsequently, each character in the string is examined, starting with the rightmost character, to see if it is a "/". To break out each character in the string the MID\$( ) statement is used where N, the number of characters in I\$, is obtained by counting from the right of the string, and 1 indicates that PI\$ is only 1 character. To determine whether or not the character being ex-

Evaluating the integer portion of the input string is straightforward when you know which character constitutes the start of the numerator. Simply establish a new string, starting from the left, and use the LEFT\$( ) statement, whose length is the difference between the length of the input string and the string position of the first digit in the numerator. Then take the value, using the VAL( ) statement, of the new sub-string. If you simply take the VAL( ) of the input string you will get some strange number that includes the integer and numerator characters. For example, if the VAL statement were used on the string 57 3/8, the computer

would read 573 [i.e., all numbers up to the first non-numeric character, skipping over spaces].

Once the integer and fractional portions of the input string have been evaluated, it is easy to develop a number the computer can use — just add the two numbers.

The subroutine described above will evaluate fractional data inputs. To complicate life, bond interest and price data is sometimes given in integer or decimal form. The subroutine deals with this contingency by determining whether or not it finds a "/"; if none is found after stepping across the input string, the program evaluates the number using VAL( ) on the entire input string.

Another programming problem, which also involves strings, relates to the formatting of the output display. The quantities that are calculated by the program are routinely calculated and displayed to nine significant figures. However, there is generally no reason to evaluate a bond's performance to more than three or four significant figures. Displaying all the significant digits adds little to the utility of the program and can make the results harder to read and understand. For example, if the number of significant digits displayed can be limited, it is possible to get the results of the calculations all on the same line as the captions, thus improving the readability of the display.

I limited the number of significant digits displayed by converting the numerical results of the calculations to strings, using the STR\$( ) statement, and then using the LEFT\$( ) statement to take the four most significant figures. This simple approach is *not* a rounding operation; rather, it is a truncation.

### The Bond Program

The program is designed to accept data in the sequence data generally appears in financial periodicals, and also in the formats that are commonly used [i.e., fractional numbers].

The interest is computed in dollars, paid per year, and assumes the bond has a face value of \$1,000. Thus, the interest is \$1,000 times the interest rate.

The total capital yield is simply the difference between the value of the bond at maturity and its purchase price divided by the purchase price. To get a prorated portion of this yield simply divide the total capital yield by the number of years to maturity. This calculation assumes that the price of a bond will steadily approach its mature value on a straight-line basis; it makes no allowance for market conditions.

The program computes a "net" yield by summing the yields due to interest payments and the yield attributed to the prorated capital appreciation of the face value of the bond. As noted previously, these are two rather different yields since "yield-to-

maturity,' while often quoted, is of questionable significance.

There is a fundamental difference between annual interest payments and the prorated straight-line yield that might be attributed to capital appreciation. In particular, the capital appreciation cannot be compounded. To get a better estimate of the yield that can be attributed to capital appreciation, compute the equivalent annual yield that, if compounded, would offer the same net capital appreciation as the simple uncompounded capital yield discussed above. This yield is always less than the uncompounded capital yield.

Next sum the equivalent compounded capital yield and the interest payments to give a more realistic yield-to-maturity.

After completing the calculations outlined above, you may want to make a hard copy of the results, complete another analysis, or quit. The program is set up for an MX-80 operating with a GRAPPLER. The printer portion of the program may have to be adapted for different printers.

Dave Lewis is a scientific project officer in the Department of Navy's Office of Naval Research. He manages a variety of electronic warfare and surveillance programs, when he is not trying to beat the bond market. You may contact Mr. Lewis at 7417 Westwood Park Lane, Falls Church, VA 22046.

```

10 GOTO 390
30 REM
40 PRINT ****BONDS****BONDS****
   BONDS****: RETURN
60 REM
80 I = 0: N = LEN (I$): IF N = <
   1 GOTO 350
110 FOR Q = 1 TO N - 1: V = N - Q
   : PI$ = MID$( I$, V, 1): IF PI
   $ = CHR$( 47) GOTO 220
150 IF PI$ = CHR$( 32) GOTO 270

160 REM
170 NEXT : IF I = 0 GOTO 350
190 REM
200 RETURN
220 REM
230 Z$ = RIGHT$( I$, Q): A = VAL
   ( Z$): GOTO 160
270 REM
280 B = VAL ( RIGHT$( I$, Q): FI =
   B / A: DI = N - Q: D$ = LEFT$(
   I$, DI): I = VAL ( D$): I = I +
   FI: GOTO 160
350 REM
360 I = VAL ( I$): GOTO 190
390 REM
400 HOME : GOSUB 30: VTAB 5: PRINT
   ENTER DAY DATE ;: INPUT D
   D: PRINT ENTER MONTH(1 OR 2
   DIGITS) ;: INPUT MD: PRINT
   ENTER YEAR(LAST 2 DIGITS);
   : INPUT YD: HOME : GOSUB 166
   0: GOSUB 30

```

```

560 REM
580 VTAB 5: PRINT NAME OF BOND
   ;: INPUT TI$: PRINT ENT
   ER INTEREST ;: INPUT BI$: I$
   = BI$: GOSUB 60: BI = I / 10
   0: PRINT ENTER YEAR OF MATU
   RITY(2 DIGITS) ;: INPUT YM$
   : YM = VAL ( YM$): PRINT ENT
   ER BOND PRICE ;: INPUT PR$:
   I$ = PR$: GOSUB 60: PR = I: HOME
   : GOSUB 1660: GOSUB 30: VTAB
   5: PRINT TI$: ;: PRINT
   PRINT BI$: ;: PRINT
   YM$: ;: PRINT
   PR$
950 PRINT : D = 1000 * BI: PRINT
   DOLLARS PAID/YEAR = $;: PRINT
   D: DY = YM - YD: IF DY = > 0
   GOTO 1060
1050 DY = 100 + DY
1060 PRINT YRS TO MATURITY=: PRINT
   DY: Y = (BI / PR) * 10000: Y$ =
   STR$( Y): Y1$ = LEFT$( Y$, 4
   ): Y1 = VAL ( Y1$): PRINT YI
   ZLD=: PRINT Y1: ;: PRINT $
   : YTM = ((100 - PR) / (PR * D
   Y)) * 100: T$ = STR$( YTM): T
   A$ = LEFT$( T$, 4): T1 = VAL
   ( T A$): PRINT CAP YLD PER YR
   =: ;: PRINT T1: ;: PRINT $: TY
   = Y + YTM: T$ = STR$( TY): T
   1$ = LEFT$( T$, 4): T1 = VAL
   ( T1$)

```

```

1320 PRINT YIELD TO MATURITY=:
   : PRINT T1: ;: PRINT $: ZZ =
   100 / PR: Z1 = ( LOG ( ZZ) ) /
   DY: Z2 = (( EXP ( Z1) ) - 1) *
   100: Z2$ = STR$( Z2): Z3$ = LEFT$(
   Z2$, 4): Z3 = VAL ( Z3$): PRINT
   COMPOUND CAPTL YLD=: ;: PRINT
   Z3: ;: PRINT $: CY = Y + Z2: Y
   $ = STR$( CY): Y1$ = LEFT$(
   Y$, 4): Y1 = VAL ( Y1$): PRINT
   COMPOUNDED YIELD TO MATURIT
   Y=: ;: PRINT Y1: ;: PRINT $: VTAB
   20
1570 REM
1580 PRINT WANT TO CONTINUE? Y
   ES/NO/PRINT;
1590 INPUT C$: Z$ = LEFT$( C$, 1)
   : IF Z$ = CHR$( 89) GOTO 17
   70
1620 IF Z$ = CHR$( 80) GOTO 183
   0
1630 IF Z$ = CHR$( 78) GOTO 189
   0
1640 PRINT ?;: GOTO 1590
1660 REM
1680 HTAB 30: PRINT DD: ;: PRINT
   /;: ;: PRINT MD: ;: PRINT /;: PRINT
   YD: RETURN
1770 HOME : GOSUB 30: GOSUB 1660
   : GOTO 560
1830 PRINT PR#1: PRINT S: PRINT
   PR#0: GOTO 1570
1890 HOME : VTAB 12: HTAB 14: PRINT
   FINIS: END

```

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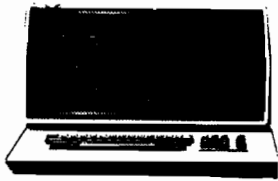
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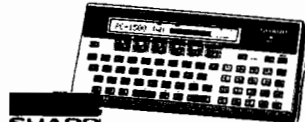
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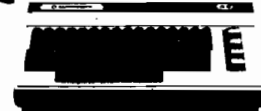
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# Mutual Fund Charting

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## Two programs to make, update, and print mutual fund files on both OSI and Apple Computers

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Buy low, sell high! Sound advice for any investor but not easy to achieve. The microcomputer has opened a new avenue for the small investor to quickly store and then easily display collected data in a manner that can assist materially in decision making — a vital requisite to successful investing.

Mutual funds and money market funds are investment vehicles tried by many, including this author. Inspiration for the program described here came from an article in *Creative Computing* (May 1981) that presented a computer-assisted method of investment analysis developed in part by Richard J. Fabian, a registered financial advisor in the state of California. Authors Browning and Clemmens enlarged upon this procedure using a SWTPC 6800 computer system.

A mutual fund tends to follow the rise and fall of stock market averages. A money market fund, on the other hand, remains more stable. Exchanging the stock fund for the money market fund and *vice versa* minimizes the effects of falling prices but takes advantage of rising prices. The investor must follow stock market trends by charting selected mutual funds and stock market averages over a 39-week period. When the current price moves through the 39-week average an exchange signal

is generated. That is, when the trend is downward, change to the money market fund; when the trend is upward, change to the mutual stock fund.

The program generated for this article attempts to duplicate the approach used by Browning and Clemmens, but is adapted to the OSI-065D operating system on a C4P-MF and an Epson MX-80 printer. One part of the program, "FILCHG," enables you to update data files for each Friday's closing price or when the fund makes a distribution (dividend and/or capital gains). The other part of the program arranges data from the data files for the printer to display in chart form.

Data files must be established first, then changed later. "FILCHG" provides this option in lines 80-120. The funds and averages I selected are defined as string variables (line 40) to be recalled by either part of the program. To initially set up the data files the latest 39 consecutive weeks of prices are gathered from financial pages of major newspapers. Option A is selected (line 120) and the program loops to line 490 where separate files are identified in a printout to the screen (lines 150-180). The file to be initialized is selected in line 200. The value of X (line 210) assigns the file to be worked to the variable, N\$.

Next, control passes to a subroutine at line 690. Thirty-nine numerical items are entered in an array, the file is written (line 440), and program control returns to line 80. A new file to be initialized can be selected again until all files are filled.

Previous and current distributions of the fund must be considered to ac-

curately reflect current price trends. If a distribution occurs during these 39 weeks it must be subtracted from all earlier entries. Note that when a data item is a distribution (see line 730), program control goes to line 840. This subroutine subtracts the entered amount from each previous price, adjusts the loop counters, and returns to the data-gathering loop at line 760. When all data is entered, the file is written (lines 440-470). A new file now can be opened and this process repeated or the program terminated, depending on the choice selected in line 120.

Once files are established, you can update the files each week or at regular intervals by selecting option B (line 120). The program then moves to line 140 for a screen clear and printout of the mutual fund data-file choices (lines 150-200). When a choice is made (line 200), the next statement defines N\$ for the subroutine at line 310. Here the disk file is opened and data is taken off the disk and placed into array A.

If the data is a price change, it is entered at lines 390-400 as a string (to accommodate the '/' symbol used for exiting the loop). This string is changed to a number and multiplied by 100 for storing on disk which eliminates trailing zeros. Line 430 discards the oldest data and enters the new data in the 39-item array. The program now loops back to line 400 for a new entry or the exit ('/') symbol. When no new item is to be entered, the 39 data items are returned to disk (line 450). Line 470 prompts the user that the file is closed and waits for any key press, after which the program returns to line 80 where the file choices are displayed again on the CRT. Another file may be updated or the program exited.

A final note on program "FILCHG" concerns entering a distribution. Line 350 asks if data is a distribution. If so, the amount is entered (line 370), subtracted from all entries in the current

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### Mutual Funds requires:

OSI with 065D or  
Apple II with one drive  
Dot-matrix printer needed for  
hardcopy printouts

---

# for APPLE and OSI

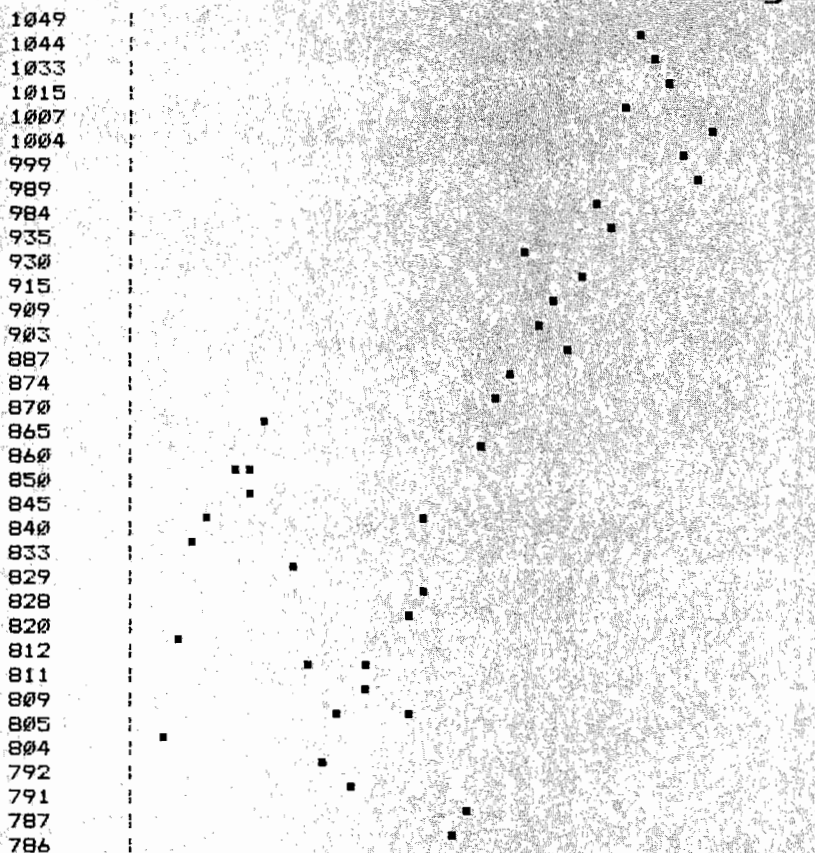
by Ralph H. Green

**Table 1: Sample Printout**

The following charts are plots of selected Mutual Funds and selected Stock Market indices for the past 39 weeks. All points are corrected for distributions made by the funds during the 39 weeks. All prices are the Friday closing price.

No investment strategy is indicated from this data.

## Dow Jones Industrial Average



39 Week Average = 883.08  
Percentage change since last high = 4.17%  
Percentage change since last low = 28.12%  
Most recent entry is 11/19/82

file, and the 39 updated items are returned to disk storage (lines 440-470).

The PRINT program plots the data by providing the necessary commands to the printer. The program uses the CRT as much as possible; the printer is

used only to plot the charts. The available choices are printed to the screen (line 1200). One subroutine accomplishes the printing task for all the charts. At line 200, the user inputs a number corresponding to his choice, after which the serial port is activated

(line 1410), the corresponding data file is opened (line 310), and the chart heading printed double-size. Line 320 transfers data from the disk and divides by 100 (line 1350), as mentioned earlier. At the same time the data is established in an array (A) and a companion array (B), which has an ascending number that corresponds to the order in which the data appears in the original file.

Since the printer can only advance, not reverse, you must arrange the data in descending order, highest to lowest. A "bubble sort" routine is used for this. Lines 1370-1400 sort the data in descending order with the (B) array number tagging along with its original data item. More on this later.

Line 1410 is a required printer command that sets the proper paper advance. Line 1420 begins the printing of the 39 data items. Lines 1420-1450 ensures that the digits printed at the left of the chart (the share price) have all necessary trailing zeros. CHR\$(124) is the vertical line and CHR\$(160) is the small square denoting a point on the chart. Lines 1450-1470 plot all points corresponding to a particular price by preventing a line feed until necessary. Also, the numbers in the (B) array are tabs for the print head to place the point at the proper week when the price originally occurred.

After all points are printed, the amount of paper advance is reset to a new value (line 1480) and the chart is underlined (line 1490). Some useful data is then calculated and printed in lines 1500-1570. Since the Dow Jones Industrial averages and the Standard and Poor's 500 stock averages are not computed in dollars, lines 1490-1520 route program control where desired.

With the exception of certain commands peculiar to OSI machines, the programs are written in BASIC easily transportable to other microcomputers.

(Continued on next page)

The commands are:

1. DISK!"IO ,03" and DISK!"IO ,02" to activate and deactivate the serial port.
2. DISK OPEN,6,"file" and DISK CLOSE,6 to open or close a data file.
3. DISK GET,X and PRINT#6 and INPUT#6 and DISK PUT, which are used with both sequential and random file access to and from the disk.
4. The screen clear routine.

Most other computer systems supporting data files and a serial port have appropriate commands to accomplish these tasks.

As Browning and Clemmens stress in their article, the investor should spend at least an hour or more each week updating the files and perusing financial columns in daily newspapers. Especially critical are times when exchange signals might be generated. Using this program does not ensure success, but it does serve as an additional tool for making investment decisions.

You may contact the author at 2130 16th Street, Greeley, CO 80631.

### Listing 1: Mutual Fund Charting

```
10 REM Pgm called FILCHG to update Mutual Fund Data Files
20 REM By Ralph Green for OSI
30 REM Translated for Apple ][ by Philip Daley
40 FOR I = 0 TO 9: READ B$(I): NEXT I
70 DIM A(40),B(40):D$ = CHR$(4)
80 HC = 0: HOME : VTAB 5: PRINT "This program enters:": PRINT
90 PRINT "(A) All 39 new values in a specified": PRINT "Mutual Fund data file, or
100 PRINT "(B) Updates with the newest data": PRINT " and discards old items in the file."
110 PRINT "(C) Print out graph of data ": PRINT " on screen or printer."
115 PRINT "(D) Exit
120 PRINT : PRINT "Which do you prefer? "; GET A$: PRINT A$: IF A$ = "A" THEN GOSUB 49 0: GOTO 80
123 IF A$ = "B" THEN GOSUB 140: GOTO 80
125 IF A$ = "C" THEN GOSUB 1000: GOTO 80
130 HOME : END
140 C$ = "update": GOSUB 150: GOSUB 310: GOSUB 340: GOTO 80
150 HOME : VTAB 5: PRINT "You are going to 'CS' your data file."
170 PRINT : PRINT "Choice for the data file is as follows:"
180 PRINT : FOR I = 0 TO 9: PRINT I;"-B$(I): NEXT I
200 PRINT : PRINT "What is your choice? "; GET A$: X = VAL(A$): IF X = 0 THEN HOME : END
```

```
210 N$ = B$(X): RETURN
310 PRINT D$"OPEN"N$: HOME : VTAB 5: PRINT "You are to 'C$" the"
*OSI REM DISK OPEN,6,N$: POKE 12076,3: POKE 12042,255
311 PRINT N$ " file."
320 PRINT D$"READ"N$: FOR I = 1 TO 39: INPUT A(I): NEXT I
*OSI REM INPUT#6,A(I)
330 PRINT D$"CLOSE": RETURN
340 IF X > 6 THEN 390
350 PRINT : PRINT "Do you have distribution information? "; GET A$: PRINT A$
360 IF A$ = "N" THEN 390
370 INPUT "Distribution amount? "; A$: Z = VAL(A$): FOR I = 1 TO 39: A(I) = A(I) - Z * 100
380 NEXT : GOTO 440
390 PRINT : PRINT "Enter new data item(s), use '/' to end."
400 INPUT "Data item="; Y$: IF Y$ = "/" THEN GOSUB 440: RETURN
410 Y = VAL(Y$): IF X > 6 THEN 430
420 Y = 100 * Y
430 FOR I = 1 TO 38: A(I) = A(I) + 1: NEXT : A(39) = Y: GOTO 400
440 HOME : VTAB 5: PRINT "Now saving data. Please wait for 'DONE' prompt."
450 PRINT D$"OPEN"N$: PRINT D$"WRITE"N$: FOR I = 1 TO 39: PRINT A(I): NEXT : PRINT D$"CLOSE"
*OSI REM DISKGET,J-1:PRINT#6,A(I):DISKPUT: NEXT:DISK CLOSE,6
470 PRINT : PRINT "DONE-Press any key to continue.": GET A$: PRINT : RETURN
*OSI REM DISK!"GO 252B"
490 HOME : VTAB 5: PRINT "This section enters all 39 new
500 PRINT "data entries in a specified file
510 C$ = "enter": GOSUB 150
690 PRINT : PRINT "Enter data for each of the 39 entries."
700 PRINT "If you have distributions to enter,
710 PRINT "when the 'Value?' prompt appears,
720 PRINT "enter 'D'."
730 PRINT : K = 0: FOR J = 1 TO 39: PRINT J " Value "; INPUT Z$: IF Z$ = "D" THEN GOSUB 840: GOTO 760
740 A(J) = VAL(Z$): IF X > 6 THEN 760
750 A(J) = A(J) * 100
760 K = K + 1: NEXT : PRINT : GOSUB 440: RETURN
840 PRINT : INPUT "Distribution amount? "; Z$: Z = VAL(Z$): FOR J = 1 TO K
850 A(J) = A(J) - Z * 100: NEXT : J = J - 1: K = K - 1: PRINT
860 PRINT "Continue with your entries.": PRINT : RETURN
899 DATA EXIT
900 DATA Fidelity Destiny Fund, Oppenheimer Special Fund, American Harbor Fund
901 DATA Sigma Investment Shares, Investment Company of America, Income Fund of America
902 DATA Dow Jones Industrial Average, NYSE Common Stock Index
903 DATA Standard & Poor's 500 Stock Average
1000 REM Pgm called PLOT
1010 REM Pgm to plot 39 week average of
1015 REM selected mutual funds
1020 HOME : VTAB 5: INPUT "Dates t date of entries? "; Z$
```

```
1030 PRINT : PRINT "Hardcopy? "; GET A$: PRINT A$: IF A$ = "Y" THEN PRINT D$"PR#1": HC = 1
*OSI REM DISK!"IO ,03"
1060 PRINT CHR$(27)"A" CHR$(133); CHR$(27)"2"
1070 PRINT "The following charts are plots of selected Mutual Funds
1080 PRINT "and selected Stock Market indices for the past 39 weeks.
1090 PRINT "All points are corrected for distributions made by the
1100 PRINT "funds during the 39 weeks. All prices are the Friday
1105 PRINT "closing price.": PRINT
1110 PRINT "No investment strategy is indicated from this data.
1180 PRINT D$"PR#0": IF HC = 0 THEN GET A$: PRINT
*OSI REM DISK!"IO ,02"
1200 C$ = "print": GOSUB 150: GOSUB 310
1350 T1 = 0: FOR J = 1 TO 39: IF X < 7 THEN A(J) = A(J) / 100
1360 T1 = T1 + A(J): B(J) = J: NEXT : A1 = A(39)
1370 R = 0: FOR J = 2 TO 39: IF A(J) < = A(J - 1) THEN 1400
1390 R = 1: S = A(J - 1): A(J - 1) = A(J): A(J) = S: S = B(J - 1): B(J - 1) = B(J): B(J) = S
1400 NEXT : IF R = 1 THEN 1370
1410 IF HC = 1 THEN PRINT D$"PR#1": PRINT : PRINT CHR$(27)"A" CHR$(129); CHR$(27)"2"
1420 A2 = A(1): A3 = A(39): FOR J = 1 TO 39: A$ = STR$(A(J)): IF X > 6 THEN 1450
1430 IF INT(A(J)) = A(J) THEN A$ = A$ + ".00": GOTO 1450
1440 IF INT(10 * A(J) + .05) / 10 = A(J) THEN A$ = A$ + "0"
1450 PRINT A$;: POKE 36,8: PRINT CHR$(124);
1460 POKE 36,B(J) + 9: PRINT CHR$(27)">" CHR$(160);
1465 PRINT CHR$(27)"=";
1470 IF A(J) = A(J + 1) THEN J = J + 1: GOTO 1460
1480 PRINT : NEXT : PRINT CHR$(27)"A" CHR$(133); CHR$(27)"2"
1490 FOR J = 1 TO 39: POKE 36,9 + J: PRINT "-";: NEXT : PRINT : IF X = 8 THEN 1510
1500 IF X > 6 THEN 1520
1510 POKE 36,15: PRINT "39 Week Average = $" INT(100 * (T1 / 39) + .5) / 100: GOTO 1530
1520 POKE 36,15: PRINT "39 Week Average = " INT(100 * (T1 / 39) + .5) / 100
1530 A4 = 100 * (A2 - A1) / A1: A5 = 100 * (A1 - A3) / A3
1540 POKE 36,15: PRINT "Percentage change since last high = ";
1550 PRINT INT(100 * A4 + .5) / 100 "%";
1560 POKE 36,15: PRINT "Percentage change since last low = ";
1565 PRINT INT(100 * A5 + .5) / 100 "%";
1570 POKE 36,15: PRINT "Most recent entry is "Z$: PRINT D$"PR#0"
1580 PRINT : PRINT "To continue, press any key.": GET A$: PRINT : RETURN
```

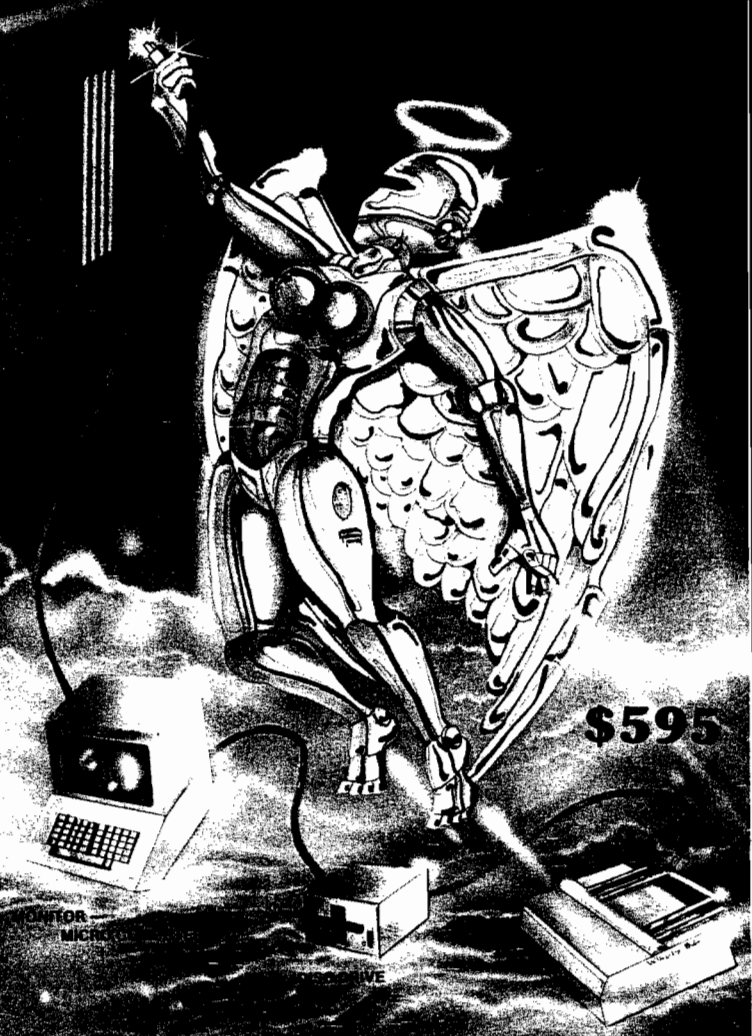


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# LETTERMASK: A Check Protecting Algorithm

by Barton M. Bauers, Jr.

In the August 1980 issue of MICRO (27:65), I discussed the tendency of binary computers to introduce small rounding errors when adding decimal numbers, and proposed a solution that programmers could implement to prevent these errors. In summary, decimal numbers between 0 and 1 cannot be represented exactly in binary mathematics, due to the limitation of precision (the number of places to the right of the decimal point) available to most computers. The solution involved storing all numbers within the program as integer numbers, and 'masking' them on output so they resumed their decimal form when printed. The function that converted the decimal values to integer for internal storage was:

```
DEF FN VL(X) = INT ((X + .0001) * 100)
```

where X was any real number with two decimal places, and VL(X) was its integer equivalent for internal purposes.

The intent of the article was to preclude this rounding error in handling money calculations, and I included an example of utilizing the subroutine MASK to create check-protection with leading and trailing asterisks (\*), as you see so often in computer-generated checks.

Subsequent programming requirements have led me to write a different kind of mask algorithm for check protection — one that spells out the amount when printed, much as you do when you write checks manually. This method is excellent for protecting checks from alteration because the spelled-out values are of varying lengths and are much more difficult to fraudulently change. I consider the word method of check protection preferable to the simple number mask and have created the subroutine 'LETTERMASK' for this purpose. Although

**In addition to number masking, this routine creates checks with the amounts spelled out, for additional security.**

---

**LETTERMASK**  
requires:  
**BASIC**

---

most computer-generated checks continue to use some version of the number-masking system (my own still do, in addition to the word masking), I hope the simplicity of the LETTERMASK subroutine will prompt programmers to add this extra protection to check-printing routines.

Almost all numbers can be represented with two sets of words. These are the words 'one, two, three, ..., eight, nine' and the words 'ten, twenty, thirty, ..., eighty, ninety.' I say *almost* all, because there are the numbers from 11 to 19, which, unfortunately, require a separate set of words. This oddity creates some minor programming complications, but it does not make the problem unsolvable.

For purposes of clarity, I refer to the first list (the words one through nine) as Word List A, the second list (the words ten through ninety) as Word List B, and the 'teens' list (11 through 19) as Word List C. In the program, these lists are referred to separately.

Subroutine LETTERMASK properly encodes any value from \$.00 to \$9,999.99, and returns a word string for that amount. The upper limit is arbitrary and could be changed without too much difficulty. Values below \$1.00, and the cents portion of any value, are returned as numbers. In addition, the routine replaces the standard ASCII 0 with the letter O to make the printout of the cents more readable. I

recommend that in all check-writing programs, 0's be replaced with O's to spare the bank and the recipient of the check having to decipher the value and, perhaps, from making an error. Many people confuse the number 0 with the number 8 if they are not familiar with the ASCII convention.

The format for the output of the subroutine is:

```
***[ONE..NINE THOUSAND] [ONE..  
NINE HUNDRED] [ONE..NINETY  
NINE] DOLLARS AND [00..99]  
CENTS***
```

The input to the subroutine is the variable AMT, which is created in your main program with the value you wish to have printed out as a lettermask. *This value must be an integer number* — no decimal places are to be shown. The subroutine will return with your masked number as variable T\$.

Subroutine LETTERMASK works quite simply. First it determines how many digits are in the integer number AMT that you present to the subroutine. Based on that value, one of six branches is taken (lines 20000 through 20040). The program then 'cascades' down from the most significant digit toward the cents part of the value, until the entire number has been converted. Note that REM statements have been used to separate the thousands, hundreds, tens, ones, and teens conversion routines. Using the thousands section (lines 20100 to 20130) as an example, follow the steps the program takes.

The computer evaluates the *Ath* element of the variable AMT (in this case *A* = 1, so it looks at the first, or leftmost, digit). The variable *K* is set to this value and a branch to line 20700 is taken to get the proper word list from Word List A. The string variable T\$, previously loaded with "\*\*\*\*", is now

(Continued on page 104)

Design & Illustration: Paul Stephenson



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lengthened with the proper word and the word "THOUSAND".

Hundreds and tens are created similarly, except if the tens digit happens to be a '1'. This means that the value for the tens and ones digits together could be any number from 10 to 19 and, unless the value of the ones digit were 0, the word "TEN" is not appropriate and the 'teens' list is required. A branch is therefore taken to line 20450 to determine whether or not a special word from Word List C is needed.

In the cents section, lines 20500 to 20610, the two rightmost digits are scanned to find any ASCII 0's so they can be converted to the letter O for clarity on printout. Note that at line 20520, if the number of cents is less than 10, then the leading zero is required and the letter O is put into variable QQ\$. At lines 20540 to 20580, the cents digits are scanned and then added to QQ\$. Line 20600 covers the

**LETTERMASK**

```

10 REM *****
20 REM *
30 REM *   LETTERMASK
40 REM *   BARTON M. BAUERS JR.
50 REM *
60 REM *****
70 REM *
80 REM *   RESERVED VARIABLES
90 REM *
100 REM *   REAL
110 REM *   A, AMT, K, J
120 REM *
130 REM *   STRING
140 REM *   AMT$, K$, Q$, QQ$, T$
150 REM *
160 REM *****
170 REM *
180 REM *   READ IN VALUE
190 REM *
200 REM *****
500 HOME
510 INPUT "ENTER NUMBER ";AMT
520 GOSUB 20000
530 PRINT T$
540 GOTO 510
20000 A = 0:K = 0
20010 AMT$ = STR$(AMT)
20020 J = LEN(AMT$)
20030 T$ = ""
20040 ON J GOTO 20500,20500,2040
    0,20300,20200,20100
20050 PRINT "NUMBER TOO LARGE ":
    T$ = "****VOID****": RETURN
20095 REM *****
20096 REM *
20097 REM *   THOUSANDS
20098 REM *
20099 REM *****
20100 A = A + 1
20110 K = VAL ( MID$( AMT$,A,1))
20120 GOSUB 20700
20130 T$ = T$ + K$ + " THOUSAND"
20195 REM *****
20196 REM *
20197 REM *   HUNDREDS
20198 REM *
20199 REM *****
20200 A = A + 1
20210 K = VAL ( MID$( AMT$,A,1))
20220 GOSUB 20700
20230 IF K$ = "" THEN 20300
20240 T$ = T$ + K$ + " HUNDRED"
    
```

instance when an amount being converted has cents only and no dollars. Finally, at line 20610, the entire string T\$ is completed with the addition of the proper cents mask.

To try subroutine LETTERMASK, type in the following lines of code after saving LETTERMASK to disk. (These lines are not part of the actual subroutine, so they should not be saved to disk.)

```
500 HOME
510 INPUT "ENTER NUMBER" ; AMT
520 GOSUB 20000
530 PRINT T$
540 GOTO 510
```

Type "RUN" and enter some numbers. The computer will print out a properly masked value that provides more safety than the numeric masks commonly used. Remember, all numbers read in must be integers.

When you print T\$ on a check, you have to be careful to either omit any

other information from that print line, because of the varying length of T\$, or you have to set up a method of spacing to allow for the unknown length. One method of doing the latter, if your checks will not permit the balance of the line to be blank, is to use the following convention:

```
xxx PRINT T$; SPC(yy - LEN(T$));
[Balance of line]
```

xxx refers to your line number, and yy to the distance from the leftmost character of T\$ to the leftmost character of the next item you wish to print on the same line. By my calculations LETTERMASK's longest word string is 71 characters.

A final note: Other than checking for a number that exceeds six digits, LETTERMASK does no error checking.

You may contact the author at 30 Hillock Drive, Wallingford, CT 06492.

#### LETTERMASK (continued)

```
20295 REM *****
20296 REM *
20297 REM * TENS
20298 REM *
20299 REM *****
20300 A = A + 1
20310 K = VAL ( MID$ (AMT$,A,1))
20320 GOSUB 20900
20330 IF K = 1 THEN GOTO 20400
20340 T$ = T$ + K$
20395 REM *****
20396 REM *
20397 REM * ONES
20398 REM *
20399 REM *****
20400 A = A + 1
20410 IF K = 1 THEN 20450
20420 K = VAL ( MID$ (AMT$,A,1))
20430 GOSUB 20700
20440 GOTO 20480
20445 REM *****
20446 REM *
20447 REM * TEENS
20448 REM *
20449 REM *****
20450 K = VAL ( MID$ (AMT$,A,1))
20460 IF K = 0 THEN 20480
20470 GOSUB 21100
20480 T$ = T$ + K$ + " DOLLARS AND "
20495 REM *****
20496 REM *
20497 REM * CENTS
20498 REM *
20499 REM *****
20500 K = VAL ( RIGHT$ (AMT$,2))
20510 QQ$ = ""
20520 IF K < 10 THEN QQ$ = "0"
20530 K$ = STR$ (K)
20540 FOR A = 1 TO 2
20550 Q$ = MID$ (K$,A,1)
20560 IF Q$ = "0" THEN Q$ = "0"
20570 QQ$ = QQ$ + Q$
20580 NEXT
20590 K$ = ""
20600 IF J < 3 THEN K$ = " ZERO
DOLLARS AND "
20610 T$ = T$ + K$ + QQ$ + " CENT
S****"
20620 RETURN
20621 REM *****
20622 REM * END
```

#### LETTERMASK (continued)

```
20695 REM *****
20696 REM *
20697 REM * WORD LIST A
20698 REM *
20699 REM *****
20700 ON K GOTO 20720,20730,20740,
20750,20760,20770,20780,20790,20800
20710 K$ = "": RETURN
20720 K$ = " ONE": RETURN
20730 K$ = " TWO": RETURN
20740 K$ = " THREE": RETURN
20750 K$ = " FOUR": RETURN
20760 K$ = " FIVE": RETURN
20770 K$ = " SIX": RETURN
20780 K$ = " SEVEN": RETURN
20790 K$ = " EIGHT": RETURN
20800 K$ = " NINE": RETURN
20895 REM *****
20896 REM *
20897 REM * WORD LIST B
20898 REM *
20899 REM *****
20900 ON K GOTO 20920,20930,20940,
20950,20960,20970,20980,20990,21000
20910 K$ = "": RETURN
20920 K$ = " TEN": RETURN
20930 K$ = " TWENTY": RETURN
20940 K$ = " THIRTY": RETURN
20950 K$ = " FORTY": RETURN
20960 K$ = " FIFTY": RETURN
20970 K$ = " SIXTY": RETURN
20980 K$ = " SEVENTY": RETURN
20990 K$ = " EIGHTY": RETURN
21000 K$ = " NINETY": RETURN
21095 REM *****
21096 REM *
21097 REM * WORD LIST C
21098 REM *
21099 REM *****
21100 ON K GOTO 21110,21120,21130,
21140,21150,21160,21170,21180,21190
21110 K$ = " ELEVEN": RETURN
21120 K$ = " TWELVE": RETURN
21130 K$ = " THIRTEEN": RETURN
21140 K$ = " FOURTEEN": RETURN
21150 K$ = " FIFTEEN": RETURN
21160 K$ = " SIXTEEN": RETURN
21170 K$ = " SEVENTEEN": RETURN
21180 K$ = " EIGHTEEN": RETURN
21190 K$ = " NINETEEN": RETURN
```

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## Interface Clinic

by Ralph Tenny

In my first article (MICRO 58:108) I presented various hardware and interfacing terms, one of which was "decoder." Functionally, a decoder can be made with a variety of techniques, but the usual approach is to use one or more ICs. The purpose of a decoder is to produce a unique signal that relates to (usually) a memory address appearing on the bus of a microcomputer.

Figure 1 shows a graphic representation of several 16-bit binary addresses like those produced by every instruction cycle of the typical 8-bit microcomputer (such as the 6502 or 6809).

	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
0FFF	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
1000	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1FFF	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
2000	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
3FFF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4000	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A000	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 1. A bit map of memory address lines showing which bits are on (logic one) when the microprocessor is running. Note that when an address field fills up (for example, address \$FFF), a higher-order address bit must be available to designate a larger address. In this case, the next address after \$FFF is \$1000, which turns on address line A12 for the first time.

The 16 address lines are arranged along the top in descending order of mathematical significance. That is, A15 represents  $2^{15}$ , A14 represents  $2^{14}$ , etc. Beneath these address lines are the binary representations of each of six hexadecimal addresses. That is, if the processor is pointing to address \$0FFF, the various address lines are at a logic 1 or logic 0 level, as shown in the figure. Similarly, the binary representations of the other addresses are shown. Note that if A11 were the highest-order address line available, the processor could reach only from \$000 to \$FFF, or a total of \$1000 (4096 decimal) unique locations. To completely address 4K-byte memory devices, such as 2732 or 2532 EPROMs, those memory devices must have 12 address lines.

If you want to read data from more than one 4K-byte EPROM, you must have additional address lines to divide the memory area into as many *different*

blocks of 4096 addresses as you have EPROMs. If you do not divide the memory this way, more than one EPROM will "answer" each time you try to read memory. Of course, if each EPROM has exactly the same contents, each one will return the same data and there is no problem. Since that is unlikely, you might find that one EPROM is trying to output 10011100 and another 00011111. The output circuit in each EPROM is fighting with the others, and the processor is trying to read digital trash! This situation is known as *bus contention*, and you can have contention at different times during the microprocessor operating cycles. A requisite of computer interfacing is to eliminate any possibility of

bus contention so you can predict what will happen at any time during computer operation.

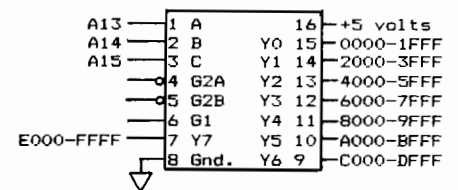
To eliminate bus contention you need to enable only one block of memory at a time, and a decoder is designed to do just that. Figure 2 shows the pinout for one popular decoder — the 74LS138. For those of you unfamiliar with part numbers, the series of IC part numbers beginning with 74 is a logic family called TTL (Transistor-Transistor Logic). This logic is about ten times faster than most microprocessors. TTL parts with LS in the number are lower power parts and are typically used as support devices for microprocessor systems.

The 74LS138 is a moderately complex IC and its operation is defined by the *truth table* shown in figure 3. A truth table defines what outputs result from certain input conditions, and this information allows logic designers to

understand how to use the device. Refer back to figure 2, noting certain input and output pin *signatures* (names), which also appear in the chart of figure 3. G1, G2, A, B, and C are all inputs, and all "Y"-named lines are outputs. Note also that the IC has two inputs prefixed with G2 — G2A and G2B. Both these lines are active low (denoted by the circle at the input in figure 2), which means that the lines have to be low for the device to operate. So, in figure 3, if *either* G2A or G2B are high (logic one), the input is disabled. Input G1 is active high (no circle), and so the decoder is disabled when G1 is low. One other common convention is used in figure 3: an "x" means "don't care."

Now examine figure 3 and interpret how a 74LS138 decoder works. In the first line G2 is shown high (that means *either* G2 line), then the device is disabled, and so all four other inputs are "don't care" since they cannot affect a disabled device. When the decoder is disabled, all outputs are high, or inactive. Similarly, in line 2 G1 is shown low, and so all other inputs are don't care and all outputs are high. In the remaining lines, G1 is high and *both* G2 lines are low, and so the decoder is enabled. In the enabled state, each of eight possible combinations of high and low on inputs A, B, and C results in a different *single* output line being low. In other words, changing input levels on inputs A, B, and C create eight unique signals that can be used to select different memory blocks and prevent memory bus contention. You might note one other item with regard to decoders: almost universally, memory devices are selected with ac-

Figure 2. The pin-out for one popular decoder, the 74LS138. See text for explanation of how the decoder operates.



tive low signals, and so almost all decoders have active low outputs.

Since a decoder responds to memory bus signals and then controls access to memory devices, such operation can be referred to as being

CS2, and R/W\*. The RESET\* line initializes the PIA during system startup [other lines will be discussed later]. Each of the 16 port lines can be set up under program control as either input or output lines by setting a bit in a

Figure 3. A truth table explains how a complex logic IC works; this truth table is for the 74LS138 decoder.

G1	G2	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
x	H	x	x	x	H	H	H	H	H	H	H	H
L	x	x	x	x	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	L	H	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	L	L	H	H
H	L	H	H	L	H	H	H	H	H	L	L	H
H	L	H	H	H	H	H	H	H	H	H	L	L

"memory mapped;" i.e., part of the memory space. In my first article I referred to a class of I/O (input/output) devices known as a PIA (Programmable Interface Adapter). PIAs reside directly on the processor bus and are selected and controlled by memory bus signals: they are called "memory mapped I/O" devices. A typical PIA is the MC6821 by Motorola. The Color Computer has two PIAs; one reads the keyboard, and one handles all other CoCo hardware — joysticks, cassette recorder interface, serial port, and the D/A [digital/analog] converter that synthesizes the sound tones. Since some of the interfacing experiments will be driven by these PIAs, you should examine the PIA and learn how to program it.

Figure 4 shows the pinout of the 6821 PIA. Note that there are 16 port lines (PA0-PA7; PB0-PB7), 8 data lines (D0-D7), plus RS0, RS1, CS0, CS1,

special register on the PIA. The three CS lines are chip select controls, which are usually driven by address decoders. The two RS (register select) lines are almost always driven by processor address lines, usually A0 and A1.

A 6821 PIA has six registers to control the entire operation of the device. Normally six registers would require three address lines so that each register could have a unique memory address. However, a simple trick allows six registers to be addressed with only two address lines (RS0 and RS1). The internal registers are allocated this way: each of the two 8-bit ports has three registers to control it. The Peripheral Register stores output data that drive the eight package pins associated with the port when the port is acting as an output port; or, if the port is an input port, the Peripheral Register stores in-

(Continued on next page)

V <sub>SS</sub>	1	40	CA1
PA0	2	39	CA2
PA1	3	38	IRQA*
PA2	4	37	IRQB*
PA3	5	36	RS0
PA4	6	35	RS1
PA5	7	34	RESET*
PA6	8	33	D0
PA7	9	32	D1
PB0	10	31	D2
PB1	11	30	D3
PB2	12	29	D4
PB3	13	28	D5
PB4	14	27	D6
PB5	15	26	D7
PB6	16	25	E
PB7	17	24	CS1
CB1	18	23	CS2*
CB2	19	22	CS0
V <sub>CC</sub>	20	21	R/W*

Figure 4. Pinout and register addressing scheme for the Motorola MC6821 Programmable Interface Adapter. Note that each output port shares an address with its Data Direction Register, and that Control Register Bit 2 controls which register is addressed. See text for further explanation.

RS1	RS0	CRA2	Location Selected
0	0	1	Output Port A
0	0	0	Data Direction Register A
0	1	x	Control Register A

RS1	RS0	CRB2	Location Selected
1	0	1	Output Port B
1	0	0	Data Direction Register B
1	1	x	Control Register B

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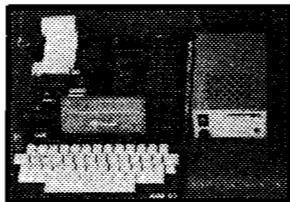
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## Interface Clinic (Continued)

put data to be read back into the processor. The Data Direction Register has one bit for each port bit. If any DDR bit contains a logic one, the corresponding port pin will be an output. Otherwise, with a logic zero in the DDR, the corresponding pin will be an input.

The addressing scheme that selects six registers with only two address bits works this way: the Control Register sets aside bit CR2 (corresponding to the processor D2 bit) as a flag. Under normal operation this flag is set to logic one, and reading or writing the other memory address transfers data to and from the I/O port. If the flag bit is a logic zero, then the other address reaches the Data Direction Register.

Under normal system startup, the RESET\* line is connected to the computer's master reset line, and a reset enters a logic zero into each of the six PIA registers. Since the DDR has all zeros, all 16 port lines automatically are set up as inputs. The eight PA lines have internal pull-up resistors, and so these lines go to a logic one. The eight PB port lines switch to a high impedance state; they can drift to any level unless they have an external pull-up or pull-down resistor on them. If no external signal is pulling on the Port A lines, a READ of Port A gives \$FF. Without external resistors, a READ of the B Port is indeterminate. If the DDR is written with all ones (\$FF), all the port lines immediately pull to logic zero, since the RESET left all zeros in the Peripheral Registers.

To make a controlled startup on the ports of a PIA, the following procedure should be followed to avoid surprises. First, \$04 (set bit 2 high) should be written to the Control Register to address the Peripheral Register, then the required initial output data should be written to the Peripheral Registers. Since the RESET left these lines set to input, nothing happens outside the device. Next, write \$00 to the Control Register to address the DDR and set logic one for each output pin required. Immediately, the output pins go to the initial values. Finally, write \$04 to the Control Register to restore normal configuration. I will deal with PIA programming in more detail later.



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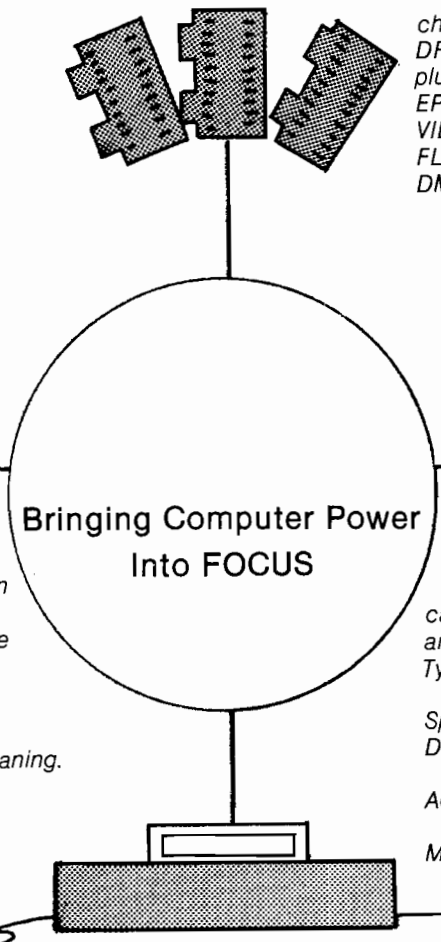
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# Reviews in Brief

**Product Name:** C64-Link  
**Equip. req'd:** Commodore 64  
**Price:** \$185 (Canadian)  
**Manufacturer:** Richvale Telecommunications  
10610 Bayview Avenue #18  
Richmond Hill, Ontario L4C 3N8  
Canada

**Description:** *C64-Link* is a module containing circuitry that provides the C64 with IEEE-488 bus compatibility, BASIC 4 commands, a machine-language monitor, and communications routines. It plugs into the 64's cartridge connector, and includes an edge-card connection (like the PET) for a PET-to-IEEE cable. Two programs are included on cassette. One moves the address of *C64-Link's* ROM from \$9000-\$9FFF to \$C000-\$CFFF, freeing more RAM for BASIC. The other copies the C64's BASIC ROMs into RAM and replaces the standard serial I/O routines with IEEE ones. No extra RAM is used, but BASIC 4 and the monitor are not available in this configuration.

**Pluses:** One package adds several desired C64 enhancements. Unit design is sturdy and clean. Software allows great flexibility.

**Minuses:** Module hangs out from back of C64 without any support. An accident may result in damage to the C64 or *C64-Link*. A new design will include supporting rubber feet.

**Documentation:** Manual includes summary of capabilities, description of provided software, detailed hook-up instructions for different equipment combinations, and documentation of BASIC 4 and monitor commands.

**Skill level required:** Beginner

**Reviewer:** Loren Wright

---

**Product Name:** Star-DOS  
**Equip. req'd:** TRS-80C Color Computer with disk and 16K memory  
**Price:** \$49.90  
**Manufacturer:** Star-Kits  
P.O. Box 209  
Mt. Kisco, NY 10549

**Description:** *Star-DOS* is a high-quality disk operating system for the Color Computer that is compatible with Radio Shack Disk BASIC. It features six memory-resident commands and three disk-resident commands. While this is a relatively slim menu, the most commonly needed commands are available. Also, the structure of *Star-DOS* is such that special commands can be added easily by the experienced programmer. Unlike the Radio Shack DOS, *Star-DOS* has 18 user-accessible functions that do most of the I/O needed to support assembly-language programs. For example, the programmer has available routines to read

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Circle No. 22

## Reviews in Brief *(continued)*

the keyboard, send characters to the screen, print strings to the screen, etc. The programmer need only develop the central core of his program, with a probable time saving of 50% or more. Also, several routines support disk operations, making it easy to build a custom system that does exactly what the owner requires.

**Pluses:** *Star-DOS* is inexpensive for a disk program, and is comfortable to use. It is also the only DOS that will run on either the 16K or 32K Color Computer. R/S BASIC compatibility means that a user need not buy a BASIC to have a higher-level language available, and he need not give up the refinements of R/S BASIC that support the special Color Computer hardware and its graphics.

**Minuses:** *Star-DOS* is new enough that it does not have a large stable of software that will run with it, but this is being remedied. The chief lack is an assembler. An editor/text processor/mailling list/mailling label package is available now.

**Skill level required:** This product is ideal for the serious disk user who works mainly in assembly language (users who work only with BASIC have no need for any DOS). At the same time the diligent computer user will be able to learn disk system principles and techniques easily.

**Documentation:** An extremely well-written 55-page manual is furnished. The instructions are thorough and

understandable, and a liberal use of examples enhances the learning process. Instructions are included for modifying FLEX-based programs to run under *Star-DOS* when those programs can be made compatible with the stock Color Computer architecture.

**Reviewer:** Ralph Tenny

**Product Name:** VICMODEM - Model 1600  
**Equip. req'd:** VIC-20 (5K or more)  
**Price:** \$109.95  
**Manufacturer:** Commodore Business Machines, Inc.  
 487 Devon Park Drive  
 Wayne, PA 19087

**Description:** The VICMODEM package lets the VIC owner join the telecommunications world. A small cartridge-like unit plugs into the VIC-20's user port and enables the VIC to communicate with other computers over telephone lines. The VICMODEM connects directly to the telephone via the plug that attaches to the handset; no acoustic coupler is required. There is a carrier detect light. The modem has both answer and originate modes to communicate with another VIC or to a time-sharing service like The Source or CompuServe. The package includes a tape with VICTERM, a comprehensive machine-language communications program. Using the menu-driven options

*(Continued on next page)*

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<b>Stack</b>	ST=7C A1 32 D5 43 D4 C1		NV-BDIZC	0000=4C
	<b>Accumulator</b>	<b>X reg.</b>	<b>Y reg.</b>	<b>Stack pointer</b>
<b>Contents</b>	A=AA	X=98	Y=25	SP=F2 PS=10110001 []=DD
			<b>Disassembly</b>	<b>Reference address</b>
<b>Next instruction</b>	FF6B-- 85 33		STA	#\$33 [#\$0033]

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## Reviews in Brief (continued)

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**Pluses:** The modem and the software are easy to use and reliable. An outstanding value.

**Minuses:** The current VICTERM software will not support a disk or a printer, nor is there any way to use the package to transmit or receive a program. The manual refers to a new terminal software package called VICTERM-40 that is being developed and should solve these shortcomings as well as provide an optional 40-character terminal display line.

**Documentation:** The 20-page booklet is well written and comprehensive.

**Skill level required:** No special skills.

**Reviewer:** David Malmberg

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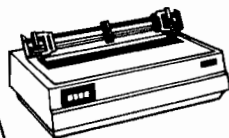
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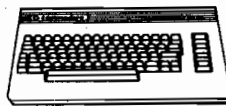
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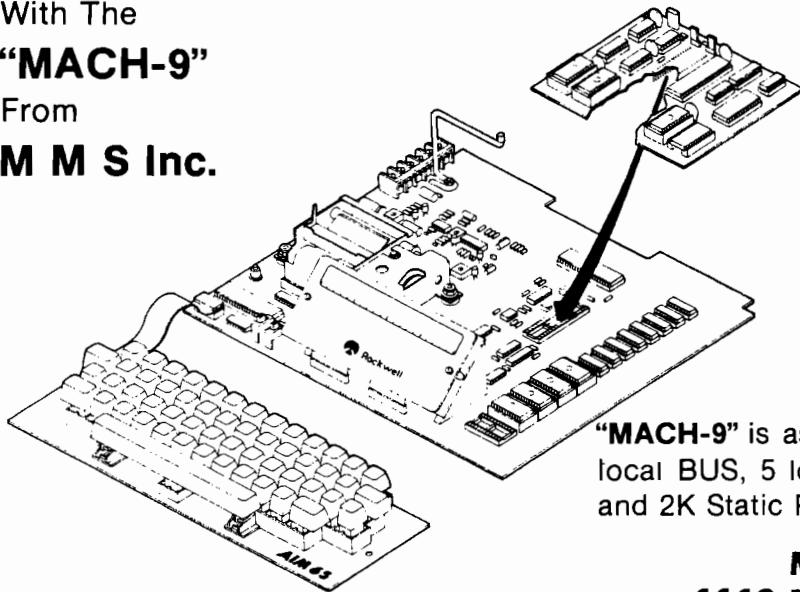
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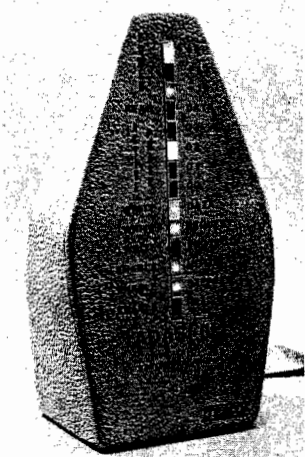


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### Apple Drive Signal Monitor

A unique programming aid for Apple computers monitors drive line status and computer power. The



Drive Signal monitor from Teaco, Inc.

ADASI units provide LED status indication of all lines

connecting the floppy drive to the computer. On system bootup, the display shows the activity with a display of flashing lights. First, it indicates the power supply voltages to assure safe operation. Then the multi-colored display shows the status of all lines, for system analysis. ADASI daisy chains between the computer and drive or can be used with the computer alone.

Three are available: The ADASI I (\$59.50), designed for internal drive connection, and the ADASI II (\$139.50) and ADASI III (149.50), for their respective drives with external connection.

Contact computer stores or Teaco, Inc., P.O. Box E, 2117 Ohio Street, Michigan City, IN 46360; (219)874-6234

### Apple Software Protected

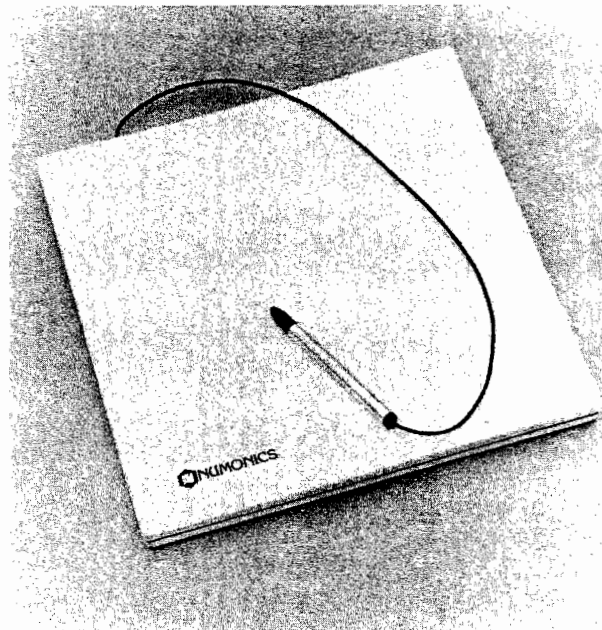
A programmable **Data Lok** for protection of Apple-compatible software allows software to be copied for normal backup. However, the software will run only on machines with Data Lok plugged into the game port socket.

Each series of keys supplied to various software companies is unique to that company. They in turn insert unique code into their software. Quantity pricing is as low as \$12. The device is available only to



authorized software companies on a controlled basis.

Available from Teaco, Inc., P.O. Box E, Michigan City, IN 46360; (219)874-6234



### 2200 Series Numonics Pad

A new **electromagnetic digitizing tablet** features user specification of output data in absolute measurement or the number of user-defined minimum increments down to 0.001" (0.025 mm). Metric or English measurements are also switch-selectable. Multiple interfaces add to its flexibility — dual RS232C, bit parallel or IEEE-488 — and can be output in either the standard serial or packed binary format. It operates in point, stream, incremental, or switch stream modes and measures up to 200 points per second. Other standard features include firmware for self-diagnostics, metric menuing, host override of switch-settable functions, and an inboard audible tone. Optional features include 1, 4, or 16 button

cursors, axis rotation and scaling.

An 12"x12" (\$675.00) and a 20"x20" (\$1275.00) version are available. Quantity prices on request.

For more information write Numonics, 418 Pierce Street, Lansdale, PA 19446 (215)923-0183

### Silence Noisy Printers

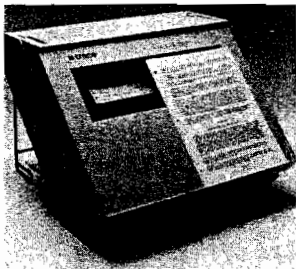
**Soundtrap** quiets printing noise to a level where a business or phone conversation can be conducted standing next to a functioning printer, according to Trace Systems, Inc. with the unit in the upright position, held by the optional stand, the accessory becomes a data holder or copy stand. Soundtrap also



provides storage for paper and simplifies paper feeding and fan folding.

This accessory accommodates most popular printers, including Epson, NEC, Okidata, IBM, and Apple.

For pricing and other information, contact Trace Systems, Inc., 1928 Old Middlefield Way, Mountain View, CA 04043; toll free (800) 24-TRACE, or in CA, call Jim Paige collect at (415) 964-3115



*Soundtrap from Trace Systems, Inc.*

### Commodore Communications

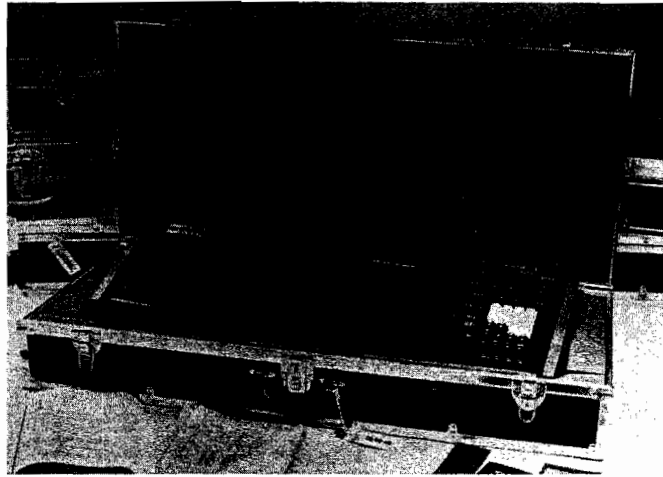
**Compack** for the Commodore 4032, 8032, 64 is an intelligent terminal communications package that turns the Commodore into a communications control center. It records data to disk, reads data from disk, and sends data to the printer. User programs control the unit to provide remote telemetry, bulletin boards, etc. Price is **\$129.95**.

For more information contact CGRS Microtech, P.O. Box 102, Langhorne, PA 19047.

### Portable 68000 Trainer

**Micro 68000** is a portable 68000 Training/Prototyping System designed for engineers and technicians. It comes with six amp switching power supply, Versabus 68000 computer board, hexadecimal keyboard, and LED display packaged in a hardwood and dark, plastic case. An optional, padded carrying case is also available.

The 16K byte memory can be any combination of RAM or ROM and includes both Pete-bug keyboard monitor and Tutor-bug providing the user with debug, assembly, disassembly, program entry, and I/O control functions. The expanded display board shows entries in both hexadecimal and binary. The computer board contains two RS-232 ports and 32 bits of parallel I/O. Micro 68000 comes with Lance Leventhal's "68000 Assembly Language Programming," Motorola's "68000 Users Manual," and CSA's "Micro 68000



*Micro 68000 from Computer Systems Associates*

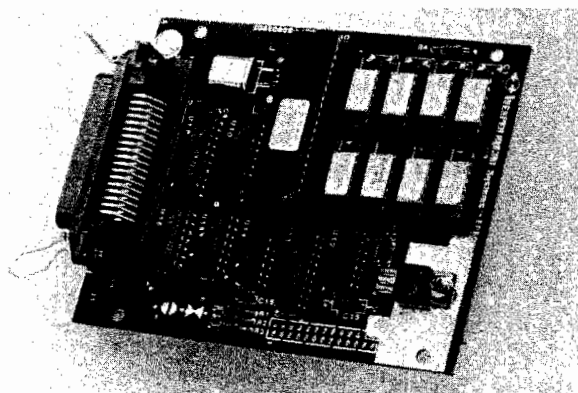
User's Manual." Price is **\$1498.00**

For more information contact Computer Systems Associates, 7562 Trade St., San Diego, CA 92121; (619)566-3911

### 64K Buffer for Epson Printers

A new printer buffer card, **Wizard-EBI Epson Buffered Interface** mounts

*Wizard-EBI Epson Buffered Interface from Wesper Microsystems*



inside all Epson MX Series Printers. It allows the computer to dump its print data into the buffer quickly freeing up the computer. The printer continues to print at its own rate of speed while the computer goes on to the next task.

The Wizard-EBI does not change the printer characteristics, so no special software or cabling is required. Delivered ready to install by a simple procedure, the buffer is available with 8K (**\$139.00**), 16K (**\$158.00**), 32K (**\$200.00**), or 64K (**\$280.00**) characters, depending on the number of RAM chips plugged into sockets provided on the card. The Wizard-EBI has a Centronics-compatible parallel interface identical to that of the Epson printer.

For more information contact Wesper Microsystems, 3188 Pullman Street, Costa Mesa, CA 92626; (800) 850-8737, or in CA (714) 850-1666.

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## Software Catalog

### Dark Crystal for the Apple

The **Dark Crystal Adventure Game** offers significant advancements in graphics, language, and programming, according to its producers. The player becomes Jen, the hero of the movie "The Dark Crystal," and controls actions by typing commands on the computer keyboard.

The plot of the game concerns a quest for a missing shard (as it did in the motion picture), which must be replaced by Jen in the broken crystal in order to save the world.

Price is **\$39.95**. Available from Sierra On-Line Inc., Sierra On-Line Building, Coarsegold, CA 93614; (209) 683-6858.

### Elementary Fun

**Rhymes and Riddles** for the Atari, IBM/PC, and Apple II Plus, contains three-letter guessing games, nursery rhymes, riddles, and famous sayings. In each game you press letters to fill in the blanks and complete the lines. Once you have correctly completed the lines you are rewarded with colorful graphics and sound.

Price is **\$29.95**. Available from Spinnaker Software Inc., 215 First St., Cambridge, MA 02142

### Help With Math

**Elements of Mathematics** for the Apple II Plus assists in the instruction of the elements of mathematical functions. Content

includes: adding fractions (common denominators); reducing fractions; adding fractions (unlike denominators). Student record-keeping is provided.

Price is **\$90.00**. Available from Electronic Courseware Systems, Inc., P.O. Box 3274, Station A, Champaign, IL 61820; (217) 359-7099.

### Stock Market on the Apple

This **Stock Market Utility Package, DOW 2000/OPTION43/BE. POINT7**, will determine price projections based on a stock's BETA coefficient or Relative Strength # and the Dow Jones Average. Projections are made as you vary

the DOW, on one stock or entire portfolio with single scan, quick scan, or variable scan of values. The option program will give you the percent of cost increase over the option months to determine which month and strike price option to buy for a given stock. BE.POINT7 will determine your break-even point for options or securities.

Price is **\$23.95** (booklet \$4.95 extra). Available from Bit'n Pieces Series, P.O. Box 7035, Erie, PA 16510-0035.

### Improve Your Typing

**Typing Package** for the VIC-20 consists of three different programs on a single tape and assists typing students. One program, WARMUP, takes the student through a series of finger exercises of increasing difficulty. The other programs give the student drill on longer blocks of text. A score is indicated for all programs. The package is a supplement to a school course or self-teaching text.

Price is **\$12.75**. Available from MFJ Electro-Enterprises, P.O. Box 13076, Kanata, Ont. K2K 1X3 Canada; (613) 592-2962.

### VIC Adventure

In **Zorlok** an adventure game for the VIC-20, you are the great, great grandson of Zorlok the wizard, and you have inherited a quest! You must enter his castle, wipe out a plague of monsters, and regain his



"The Dark Crystal" adventure game recreates scenes from the motion picture.

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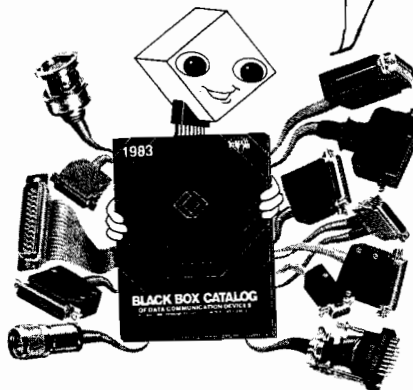
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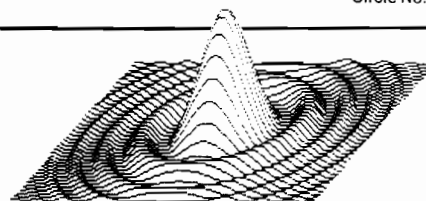
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IMAGE PRINTER starts you out on the fast track by helping you "capture" the HI-RES pictures from your favorite programs—even the copy-protected ones!

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Color fill portions of picture	X	—	—
Scroll pictures 4 ways	X	—	—
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## Software Catalog *(continued)*

treasures. Multiple skill levels are provided.

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### FILEX for PET/CBM

FILEX for PET/CBM allows you to read and write IBM "BASIC Data Exchange" diskettes. The system allows information exchange between main-frame/mini computers, and remote CBM machines. Requires 32K, PEDisk 8" floppy.

Price is **\$245.00**, which includes ROM and manual. Available from CGRS Microtech, P.O. Box 102, Langhorne, PA 19047; (215) 757-0284.

### Light Typing

MasterType™, for the Atari 400 or 800 and Apple II provides typing instruction in game format. You

must zap the enemy word by typing it correctly or the word will zap you. Eighteen lessons graduate from home letter recognition to eight-letter words, numbers, and BASIC programming words. You can create your own lesson to meet individual needs.

Price is **\$39.95**. Available from Lightning Software, Inc., P.O. Box 11725, Palo Alto, CA 94306.

### SXR Plus for the Apple II

SXR Plus produces a sorted cross reference of an Applesoft source program. Variables are always included and the user has the option to include/exclude referenced line numbers, numeric constants and or strings. All information is presented in a single alphabetized list; the user can select either a 40- or an 80-column format. A search feature is also included.

Price is **\$39.95**. Available from Prasek Computer Systems, Inc., P.O. Box 2427, Santa Clara, CA 95055; (408) 554-0420, or computer stores.

### Geography on the Color Computer

Geography Pac for the TRS-80 Color Computer, an educational program, helps you learn world or U.S. geography in an enjoyable way. You need 16K Extended BASIC machine language and a cassette tape recorder.

The **\$29.95** price includes cassette tape of U.S., Europe, Asia, Africa, and South Central America.

Available from Spectral Associates, 141 Harvard Avenue, Tacoma, WA 98466.

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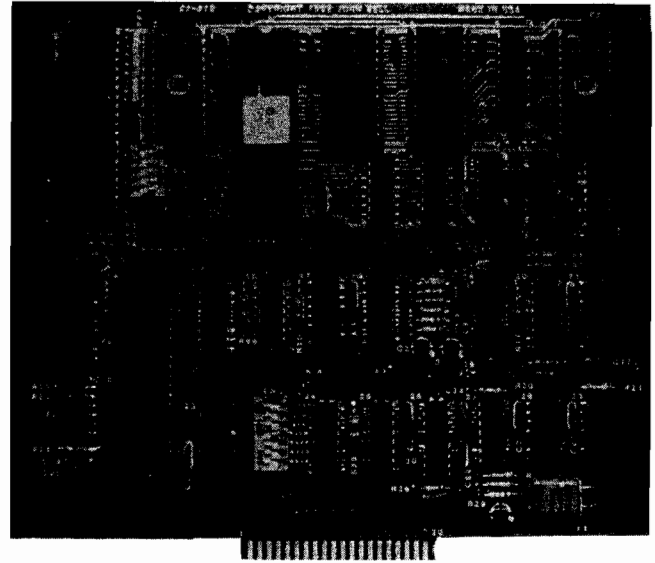
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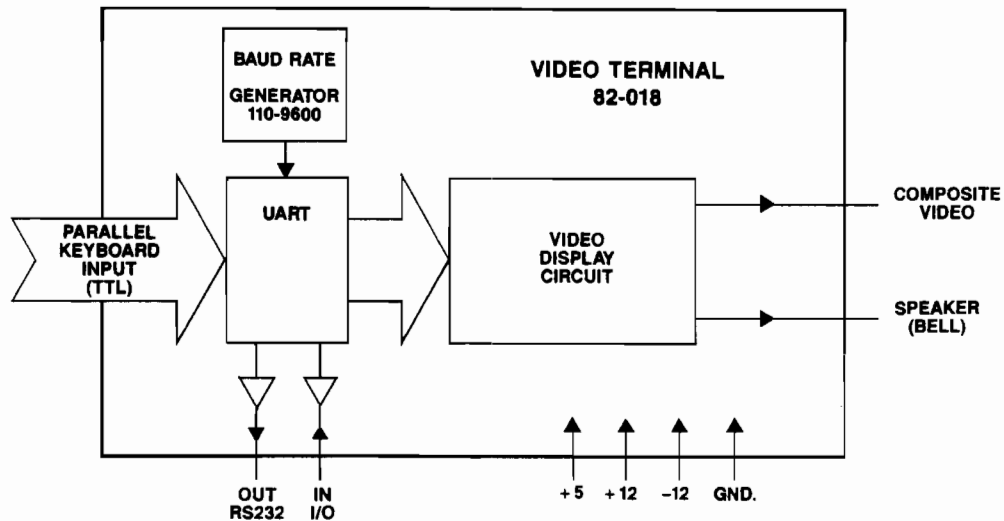


Complete source listing is included in the documentation. Both the character generator and the CRT program are in 2716 EPROMS to allow easy modification to your needs.

This board uses a 6502 Microprocessor and a 6545-1 CRT controller. The 6502 runs during the horz. and vert. blanking (45% of the time). The serial input port is interrupt driven. A 1500 character silo is used to store data until the 6502 can display it.

## Features

- 6502 Microprocessor
- 6545-1 CRT controller
- 2716 EPROM char. gen.
- 2716 EPROM program
- 4K RAM (6116)
- 2K EPROM 2716
- RS232 I/O for direct connection to computer or modem.
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- Output for speaker (bell)
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+12 50Ma.  
-12 50Ma.



This board is available assembled and tested, or bare board with the two EPROMS and crystal.

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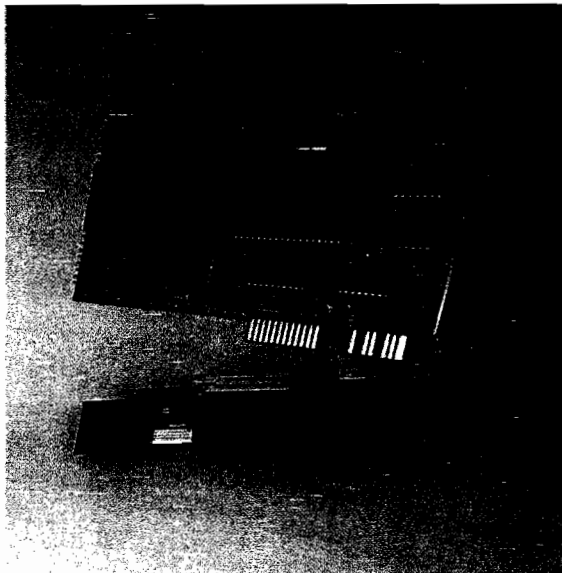
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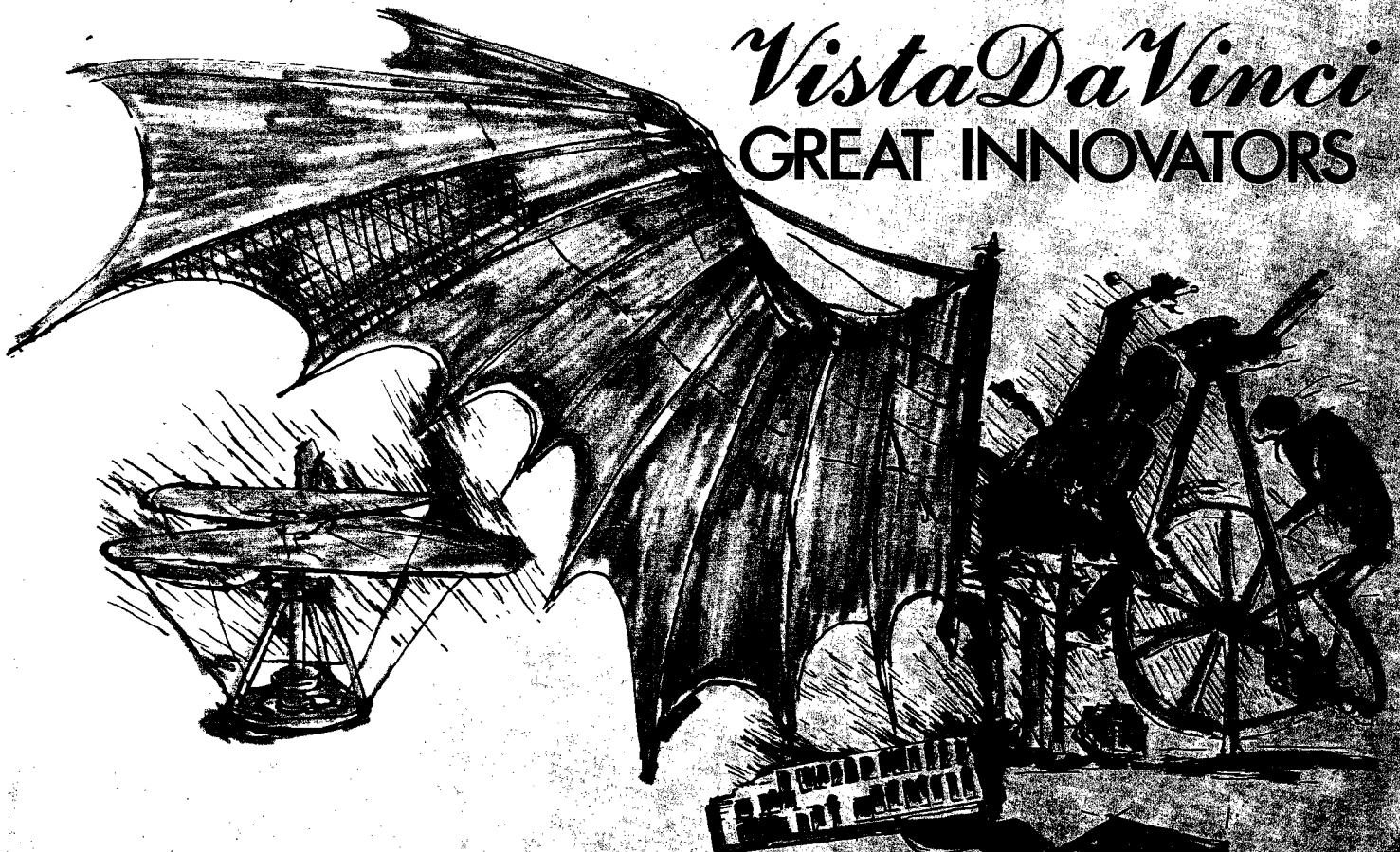
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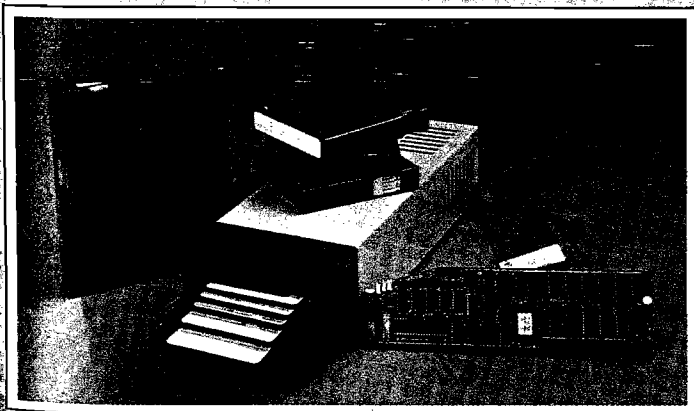
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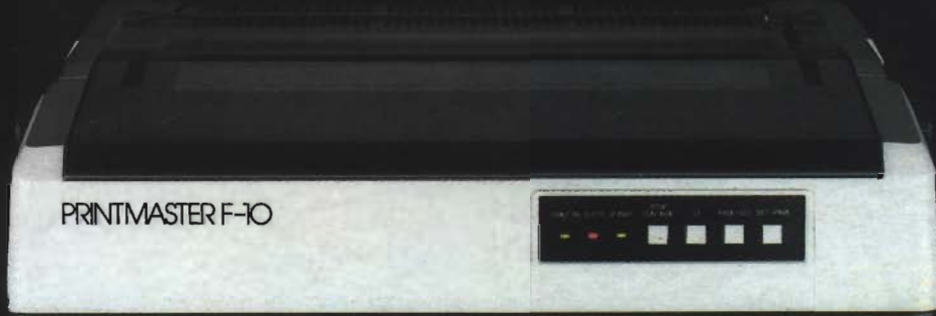
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